ANNUAL REPORT 2011-12

IUSSTF

INDO-US SCIENCE AND TECHNOLOGY FORUM

Catalyzing Indo-US Science & Technology Cooperation

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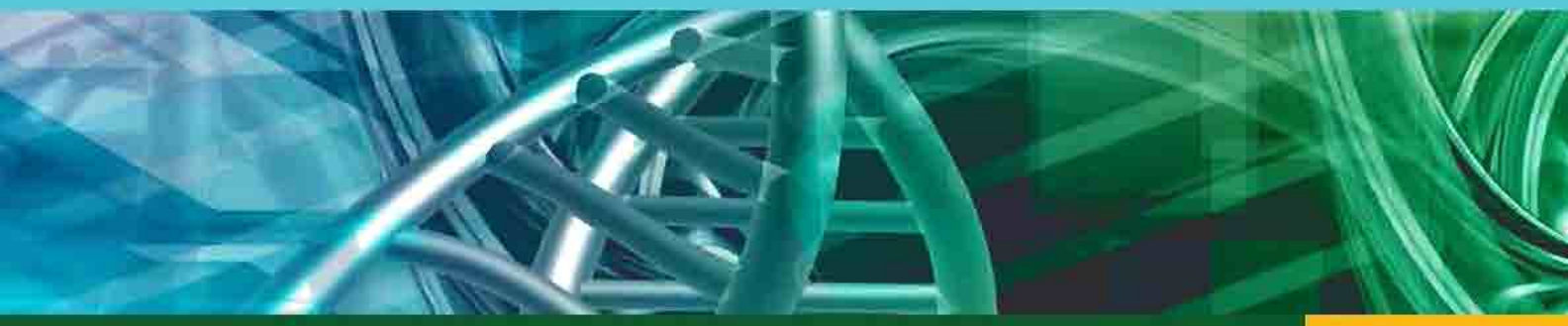

The Indo-US Science and Technology Forum (IUSSTF), established under an agreement between the Governments of India and the United States of America, is an autonomous, not for profit society in India, co-funded and co-governed by both the governments. IUSSTF promotes and catalyzes Indo-US collaborations in science, technology, engineering, biomedical research and innovation through substantive interaction among government, academia and industry.

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From the Executive Director's Desk

The Indo-US relationship has been undergoing a transformation for the last few years. The engagement between the Governments of these two great democracies has enhanced considerably over this period and this trend remains an enduring process. Science, technology and innovation (STI) has always figured prominently in the deliberations of the India-US High Technology Cooperation Group (HTCG) and the India-US Strategic Dialogue.

A report published a year ago by the Royal Society, London, highlighted that almost 35% of scientific papers published in international journals are a direct outcome of laboratory-based R&D collaborations between scientists across nations. The number of such publications with international authorship has seen a perceptible rise by 10% in the last fifteen years. This finding has reiterated the significance of the 'collaborative advantage' augured through sharing of S&T resources, infra-structure and most importantly manpower mobility which has opened up new vistas for intellectual quests through bilateral and multinational cooperation. In this context, it is relevant to mention that IUSSTF has endeavored to promote reciprocal mobility of both researchers and students through several programs that we now support. The year 2011 was a very eventful year for the Indo-US Science & Technology Forum (IUSSTF). We feel proud to bring to your notice that in 2011-12, we crossed the milestone of organizing 200 India-US bilateral workshops since the inception of IUSSTF. These workshops are aimed to disseminate information and create awareness on topical and thematic areas of interest through substantive interaction between Indian and American scientists and researchers from academia, laboratories and industry with the explicit aim to develop sustained linkages. The success of several multi-institutional Indo-U.S. Virtual Networked Centers have been amply demonstrated by joint publications, patents, reciprocal student and faculty exchanges, and

most significantly in the ability of some of the participating groups to garner national funding in their respective countries by showcasing the strength and value of such networked partnerships enabled through IUSSTF support. We also crossed the milestone of catalyzing over 10,000 linkages among US and Indian scientists, academicians, researchers and policy makers through various programmatic activities of IUSSTF.

While numbers are important, sometimes they may not reflect the whole picture. It was therefore very heartening to receive encouragement from the US and Indian governments for IUSSTF's role in promoting and catalyzing Indo-US S&T cooperation. IUSSTF was invited to participate in the First US-India Higher Education Summit held in October 2011 at Washington DC. It was encouraging to meet many of our partners and stakeholders in this Summit and learn about the activities seeded in partnership with IUSSTF that have blossomed into sustainable linkages between various Indian and US groups over the years. The Summit declaration by the US Secretary of State and the Indian Higher Education Minister **"expressed their support for the Indo-U.S. Science and Technology Forum, which provides fresh impetus to academic collaboration in the cutting-edge areas of scientific research and technology development".** Such recognition motivates us to set up higher bars for performance and excel in our endeavours to bring together the scientific community of both nations for global good.

In 2011, IUSSTF was entrusted with administering the US-India Science and Technology Endowment Fund (USI STEF) and the Joint Clean Energy Research and Development Centre (JCERDC) - two strategic programs that would radically change the way the Indian and US scientists, researchers and industry collaborate. In both these programs, Industry's contribution has been highly significant whether it is financial, technical or both. It is heartening to note that in both these programs, the response to call for proposals was tremendous. About 200 Indian and US scientists/ researchers were involved in developing 21 proposals received for JCERDC awards. On the other hand, the USI STEF calls for proposals have elicited more than 600 preliminary applications in first two calls. While processes and implementation mechanisms have been set up for these programs in 2011, the awards were granted in the year 2012. The IUSSTF team expresses sincere thanks to the expert reviewers, panel members and all the stakeholders for their help, without which it would have been a herculean task to identify the awardees.

IUSSTF has constantly strived to groom and connect the next generation of scientists and researchers which will shape the future of science and technology cooperation between India and the United States. IUSSTF has been able to successfully develop several student internship programs that would allow reciprocal visitation for science and engineering students to work in each other's country for periods up to six months. Under the Research Internship in Science and Engineering (RISE) program of IUSSTF, 12 US students were provided opportunities to undertake internships in leading academic /scientific institutions including private R&D laboratory in India. Fifteen Indian students attended an internship at the University of Wisconsin-Madison under the Khorana Program being implemented with partnership

In 2011-12, we crossed the milestone of organizing 200 India-US bilateral workshops since the inception of IUSSTF.

of UW-Madison and the Indian Department of Biotechnology. Ten Indian B.Tech/M.Tech. students were awarded internships at the Viterbi School of Engineering, University of Southern California as part of the Viterbi-India Program. The Indo-US Research Fellowships instituted in partnership with DST enabled 27 young Indian faculty members and researchers to work in premier US institutions for a period of 3 to 12 months.

IUSSTF has been effective in leveraging its unique position to bring together federal agencies, corporate houses, industry associations along with academia both from US and India on developing a program portfolio that identifies and nurtures techno-preneurship. The DBT supported Stanford-India Biodesign Program (SIB) led to the development of several proto-types of biomedical devises that have potential for affordable commercialization. The DST-Lockheed Martin India Innovation Growth Program (IIGP) is designed as an accelerated technology assessment and commercialization initiative. This program has enabled signing of several global business deals by awardees.

As our flagship program, IUSSTF also organized the 4th Indo-American Frontiers of Engineering Symposium in partnership with US National Academies of Engineering. This year symposium was hosted by the Lockheed Martin Corporation in Arlington, USA. The symposium series through its unique format provided the future leaders of engineering from both our nations to meet, interact and build bonds across disciplinary domains.

During 2011-12, we saw a considerable increase in IUSSTF activities and outreach portfolio. All of this has been made possible through the guidance of a very eminent and highly professional Governing Body and the collective efforts of a small but highly dedicated and multi-skilled team at the IUSSTF secretariat. We expect that the same trend would continue in the future as well with the continued support of our stakeholders.

We also crossed the milestone of catalyzing over 10,000 linkages among US and Indian scientists, academicians, researchers and policy makers through various programmatic activities of 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: Satellite Instructional Television Experiment (SITE)

Indo-US S&T Subcommission

1980's

Science & Technology Initiative (STI)

US-India Fund (USIF)

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 (IUSSTF)

Indo-US Science & Technology Agreement

High Technology Cooperation Group (HTCG)

Indo-US Strategic Partnership

- ICT
- Agri Knowledge Initiative (AKI)
- Space Cooperation
- Clean Energy
- Safety & Security
- Health Sciences
- Education

Joint S&T Commission

NASA-ISRO Agreement / MOES-NOAA Agreement

Indo-US Nuclear Agreement

Indo-US S&T Endowment Fund for Innovation

Joint Clean Energy Research and Development Center (JCERDC)

Structure of IUSSTF

Management

The IUSSTF functions as

- Autonomous
- Bilateral
- Nongovernmental
- Not-for-profit society

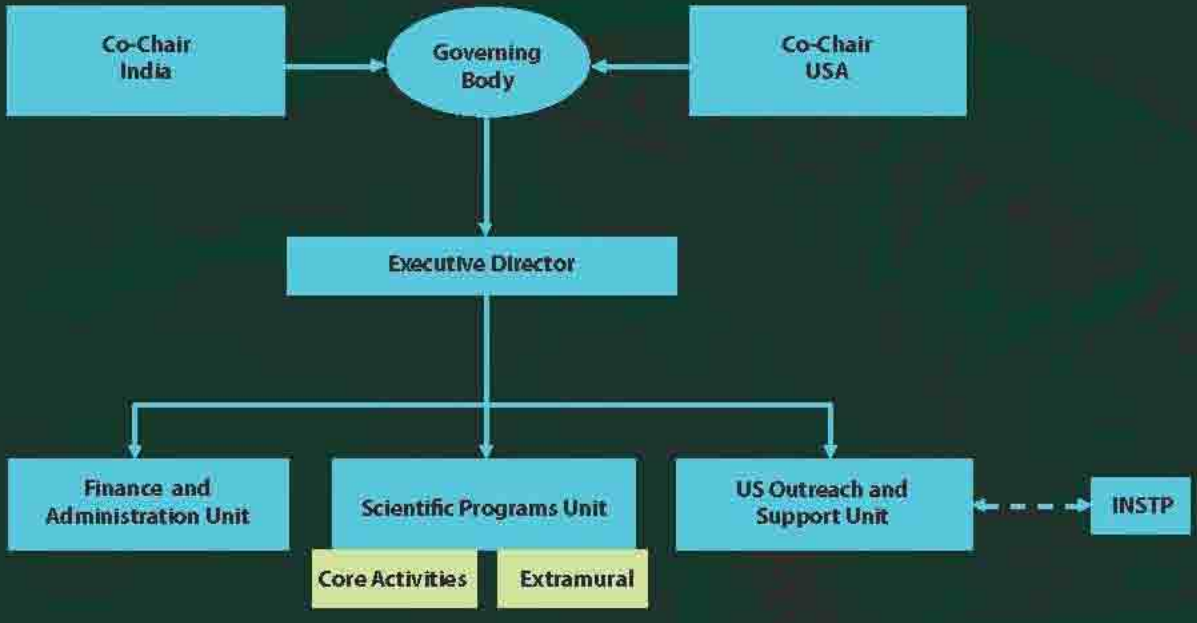
To ensure that the activities undertaken by the IUSSTF conform to the highest standards of excellence, a joint Governing Body consisting of seven Indian and seven American eminent scientists and technologists provide leadership to IUSSTF.

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.

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. As a 501(c)(3) entity, India Science & Technology Partnership (INSTP) serves to raise funds in USA to complement support for bilateral programmatic S&T activities.



Composition of the Governing Body

INDIAN CO-CHAIR

T. Ramasami
Secretary
Department of Science and Technology
Government of India

US CO-CHAIR

Norman P. Neureiter
Senior Advisor
Center for Science, Technology and Security Policy
American Association for the Advancement of Science

INDIAN MEMBERS

Maharaj K. Bhan
Secretary
Department of Biotechnology
Government of India

Samir K. Brahmachari
Director General
Council of Scientific & Industrial Research and Secretary, DSIR

Sanjay G. Dhande
Director
Indian Institute of Technology
Kanpur

Murali Sastry
Chief Scientific Officer
TATA Chemicals Ltd

R. Seshasayee
Executive Vice-chairman
Ashok Leyland India

Sheila Sangwan
Additional Secretary & Financial Adviser
Department of Science and Technology
Government of India

US MEMBERS

Michael Clegg
Foreign Secretary
National Academy of Sciences

Subra Suresh
Director
The National Science Foundation

Roderic Pettigrew
Director
National Institute of Biomedical Imaging and Engineering

Phyllis G. Yoshida
Deputy Assistant Secretary
US Department of Energy

Ray O. Johnson
Senior Vice President and Chief Technology Officer
Lockheed Martin Corporation

Venkatesh Narayanamurti
Director, Belfer Center for Science and International Affairs
John F. Kennedy School of Government
Harvard University

Objectives of IUSSTF

Catalyst to facilitate, seed and promote US-India bilateral collaboration in science, technology, engineering & biomedical research and innovation 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 partnerships 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 and technologists to develop mutual trust, leadership and fraternity in research and development.

Salient Outcome of IUSSTF Activities over the years...

"Success of IUSSTF in achieving its mandated activities should be considered as an exemplar and perhaps a benchmark for similar initiatives of S&T grant making bodies."
- NISTADS Report 2007

IUSSTF convened activities have led to the interaction of over 10,500 US and Indian scientists and technologists creating several new opportunities paving way to sustained collaborations in diverse areas of science, technology and innovation.

Inter-Institutional Agreements

IUSSTF convened events have led to collaborations through inter-institutional agreements in diverse areas like weather and climate studies (National Center for Medium Range Weather Forecast, National Center for Atmospheric Research, India Meteorological Department & National Center for Environmental Prediction); advanced computing (Center for Development of Advanced Computing & Louisiana State University); Ayurvedic research (Department of Indian Systems of Medicine and Homeopathy & National Center for Complementary and Alternative Medicine); information sciences (Mysore University & University of Pittsburgh); ecoinformatics (Ashoka Trust for Research in Environment and Ecology & University of Massachusetts); technology management internship (Technology Information Forecasting Assessment Council & National Institute of Health); Sastra Ramanujan Awards (SASTRA University & American Mathematical Society); biomedical engineering (Shree Chitra Institute of Medical Science and Technology & Penn State University); water management (Jawaharlal Nehru Technical University and University of Colorado, Boulder); air traffic management (IIT-Bombay, National Aerospace Laboratories and NASA); conservation research (JNV University and University of Arizona); optoelectronic materials and devices (Society for Applied Microwave Electronics Engineering and Research, Tata Institute of Fundamental Research and University of New Mexico); post-harvest technology (Amity University and World Food Logistics Organization for a project funded by the Bill & Melinda Gates Foundation); mathematical proteomics (University of Hyderabad and University of Minnesota); the Unique Identification Number Project (IIIT Delhi & SUNY at Buffalo); protecting senior citizens from cyber security attacks in the e-health scenario (Amrita University, IIIT Delhi & SUNY at Buffalo); cloud computing and security (Amrita University, IIIT Delhi, IIT Bhubaneswar, IIIT Allahabad, SUNY at Buffalo, Arizona State University & Kennesaw State University); state-of the art research and knowledge center for cardiovascular diseases (Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram and Oklahoma Medical Research Foundation); ecological health of rivers (Indian Statistical Institute, Kolkata and University of Illinois at Urbana Champaign); self-assembled fibrillar gels (University of Nevada-Las Vegas and JNCASR, Bangalore; IACS, Kolkata and University of Maryland; Vidyasagar University, Medinipur and Georgetown University; IIT Kharagpur and Georgetown University; and, James Madison University and Indian Institute of Science, Bangalore); new functional materials: synthesis, properties and methods (an MoU was signed between Rowan University and Jamia Milia University with reference to teaching and joint programs. One post–doctoral position at Rowan University has been created in materials under the aegis of this MoU); Biofuels: research challenges in the areas of combustion

and fuel injection (the following collaborative joint projects were identified as a result of this workshop - Combustion instability and diagnostics of biofuels; Spray: atomization and vaporization; Droplet combustion; Chemical Kinetics; Fundamental flame studies; Pollutant measurement and control including novel strategies like nanoadditives; and, Biofuel production and supply); biocomputing (a major outcome of the workshop is the International center of excellence on Biocomputing which has been set up at NIT Calicut which is organized jointly by the Department of Computer Science & Engineering and School of Biotechnology, NIT Calicut and School of Informatics, Indiana University-Purdue University Indianapolis IUPUI, USA).

Indo-US Networking and Joint R&D Projects

IUSSTF has supported 223 bilateral workshops that have had a substantive impact in generating new joint R&D projects in areas of mutual interest like agricultural biotechnology (functional genomics); traditional medicines; nanoparticle aerosol S&T; high performance computing; tissue engineering; advanced manufacturing; brain research; infectious diseases; epidemiology and environmental health; seismic studies; geological carbon dioxide sequestration; hydrogen storage materials; futuristic manufacturing; fuel cells; target detection from remotely sensed images; structures in nano-biosystems; coastal water resource management; ceramic-based biomaterials; molecular insights in digestive diseases (Christian Medical College and Tufts University School of Medicine received five NIH grants for the period 2007-2013); and, public health in India (Christian Medical College and Yale University received two NIH and one Bill and Melinda Gates Foundation funded grant for the period 2009-2015).

To enable Indian and American scientists from academia and laboratories to carry out joint research activities by leveraging already existing infrastructure, 33 **Indo-US Networked Joint Centers** have been initiated. The Joint Center (JC) on *Nanomaterials for energy* has received additional funding from Air Force Office of Scientific Research, Asian Office of Aerospace Research and Development and Defense Advanced Research Projects Agency; JC on *Climate Change and its impact on the ecosystem of the Arabian Sea* has received additional funding from NASA, NSF, and Space Application Centre; JC on *Biomaterials for Healthcare* has since been awarded 5 research projects by DRDO, DST and DBT in addition to the signing of an inter institutional MoU between IIT-Kanpur and the University of Texas at San Antonio.

Considering the outcome and achievements of the Joint Centre on *Advanced Manufacturing* (under which one patent has been filed and the further research funding was received from agencies such as NSF and DST), IUSSTF awarded the partnering institutions the **Indo-US Centre for Research Excellence in Science and Engineering (CRESE)** on *Fabrionics* in order to consolidate and continue the collaboration by intensifying academic cooperation with the active involvement of industry and entrepreneurs required to translate the R&D outcome. This CRESE has received additional funding from DST and CSIR. Also, two patents have been filed and several joint publications have been generated. Other Centers for Research Excellence in Science and Engineering established include: *Advanced Materials Research* (Partners: Jawaharlal Nehru Centre for Advanced Scientific Research, Northwestern University, Indian Institute of Science and Argonne National Laboratory); *Nanobiotechnology* (Partners: National Center for Biological Sciences, Harvard Medical School, Jawaharlal Nehru Centre for Advanced Scientific Research and Centre for Cellular and Molecular Biology); and, *Nanomaterials for Energy* (Jawaharlal Nehru Centre for Advanced Scientific Research, Purdue University and GE India Technology Centre Bangalore).

Educational Programs

By supporting over 37 Training Programs/Advanced Schools, IUSSTF has seeded the development of educational programs in nutritional epidemiology (Public Health Foundation of India, New Delhi and Emory University, Atlanta); immunology (International Centre for Genetic Engineering and Biotechnology, New Delhi and Harvard Medical School, Boston); information management sciences (Mysore University & University of Pittsburgh); green chemistry (Delhi University & Green Chemistry Institute); advanced manufacturing (IIT, Kanpur & Northwestern University); nanotechnology (SASTRA & University of Arkansas); microsurgery (All India Institute of Medical Sciences & US Association of Microsurgery); distance education in engineering

(Amrita University/ISRO & 21 US partner university and institutions); number theory (Sastra University & University of Florida) and museum science communication (National Council for Science Museums, BITS, Pilani & Smithsonian Institution); ASEE led Indo-US collaboration for engineering education; and discrete mathematical chemistry (Osmania University and University of Minnesota). The IUSSTF supported University of California Berkeley-IIT Kharagpur collaboration on energy research has catalyzed the establishment of the *PK Sinha Center for Bioenergy* at IIT-Kharagpur with a gift of $2 million from an IIT-Kharagpur alum. The Center is now well positioned to strengthen and accelerate bioenergy research between IIT Kharagpur and US Berkeley.

Major Initiatives

Some of the major initiatives catalyzed by IUSSTF includes the Indo-US civilian space cooperation; University of California-India R&D Initiative; Indo-US distance education program in engineering; Aircraft borne tropical cyclone prediction system; Biogeochemical flux monitoring network - IndoFlux; Translational Health Science and Technology Institute, India – THSTI; India's joining the US led International Partnership in Hydrogen Economy (IPHE) and the US DOE Blue Sky Carbon Sequestration Program facilitated the inclusion of knowledge-based R&D (nano, info and biotechnology) as a part of the Indo-US High Technology Cooperation Group (HTCG) dialogue.

IUSSTF maintains a close working relationship with the federal agencies, laboratories, government institutions, and the academia in U.S. and India, cutting across all disciplines. In 2011, IUSSTF has been entrusted to administer the bi-national **US-India Science & Technology Endowment Fund** and the **Indo-US Joint Clean Energy Research and Development Center (JCERDC)**.

The aim of the Endowment Fund is to strengthen and expand S&T cooperation for public good through science and technology R&D entrepreneurial activities intended to lead to the commercialization of technology that will develop sustained partnerships between US and Indian scientists and entrepreneurs for the mutual benefit of both countries. The two priority areas identified are *'Healthy Individual'* and *'Empowering Citizens'*. Under the first call of the Endowment Program, after a three-phase review process, an exciting business plan that would bring proprietary chilling technology into the market as a cold storage solution for farm produce was selected for Endowment funding. Two proposals under the Healthy Individual category were also chosen for Runners-up awards.

The JCERDC is a joint initiative of the Government of India and the US Department of Energy with the overall aim being to facilitate joint research and development on clean energy by teams of scientists, technologists and engineers from India and the United States, and related joint activities, needed to deploy clean energy technologies rapidly with the greatest impact. To achieve this objective, the Indo-US JCERDC will support multi-institutional network projects using public-private partnership model of funding. The priority areas are *Solar Energy, Second Generation Biofuels* and *Energy Efficiency of Buildings*. After completing the compliance review of the proposals received, a total of 19 proposals were accepted for further evaluation. After an intensive multi-level review and evaluation process, three consortia (one each in the three priority areas: Solar Energy, Second Generation Biofuels and Energy Efficiency of Buildings) were selected for award in April 2012. This first-of-its-kind initiative has brought together more than 90 institutional partners to work jointly in the space of clean energy research. This program is currently in its first year of implementation and the selected consortia are in the process of launching their research work. The fund commitment towards this effort by each Government is $5 million per year for five years.

Road maps of cooperation

Road maps and contours of Indo-US cooperation were chartered through IUSSTF convened events on civilian space cooperation (ISRO & NASA); microlight air vehicle development (National Aeronautical Laboratory & University of Maryland); primate national action plan (Primate Research Council & US Wildlife and Fisheries Agency); Indo-flux program (DOES); linear collider for high energy physics (DST & DOE labs); technopreneurship in academia (National Entrepreneurship Board); GLP on medical devices. In 2008, IUSSTF had supported an Indo-US workshop on *low-cost diagnostic and*

therapeutic medical technologies. As a result of this workshop, the National Institute of Biomedical Imaging and Bioengineering (NIBIB) and Department of Biotechnology (DBT), Govt. of India, are initiating jointly funded initiatives that capitalize on the expertise and resources of the two nations. On June 24th 2010, at the U.S.-India Science and Technology Joint Commission Meeting in Washington, D.C., NIBIB and DBT announced the availability of supplemental funding for eligible NIBIB-supported research grants to facilitate collaborative work among researchers in the US and India. The grants will be used to develop low-cost diagnostic and therapeutic medical technologies that can be used in underserved communities worldwide.

Indo-US Frontiers of Science (FOS) & Frontiers of Engineering (FOE)

IUSSTF has also initiated the *Indo-US Frontiers of Science (FOS) and Frontiers of Engineering (FOE)* symposium in partnership with the US National Academy of Sciences and National Academy of Engineering. This has provided a unique platform to the best and brightest young minds from India and US to interact and discuss cutting edge scientific pursuits. The series has helped to establish trans-disciplinary research activities and build contacts between the next generation scientists through IUSSTF seed awards. As a spin-off, the annual national frontiers meeting in India has been initiated by the Indian Academies.

Industry supported activities

IUSSTF has promoted techno-entrepreneurship through the *DST-Lockheed Martin Innovation Growth Program* in partnership with UT-Austin, FICCI and IUSSTF has led to the signing of 69 business deals worth Rs 200 crores/$ 43m; *Stanford-India Biodesign program* in partnership with IUSSTF has generated eight prototypes of biomedical devises for commercialization; and the *DST-Intel India Innovation Pioneers Challenge* in partnership with IUSSTF have showcased several student led innovation which have won international awards and have commercialization potential. IUSSTF also partners with IBM to conduct the *IBM-IUSSTF Visiting Fellowships in Nanotechnology*. IUSSTF also supported the *Young Engineers Visitation Program* in partnership with Lockheed Martin Corporation. Several industry funded projects in academia were initiated following IUSSTF seeded activities in areas like cyber security; microwave technology; RFID and wireless sensors; design engineering; nano-coatings; rapid prototyping; nanofabrication for solar cells; lithium-ion based Nan batteries (joint Indo-US business venture); telecom switching; design of aerospace alloys, as examples of academia-industry partnerships.

S&T capacity building

Addressing the need for human S&T capacity building, IUSSTF has instituted the *Indo-US Research Fellowship* in partnership with DST. Reciprocal student exchange programs aimed to groom and connect the next generation of scientists have been launched, which includes the *Research Internships in Science and Engineering* for PhD students; *Viterbi-India Program* (with the University of Southern California); *UC Berkeley–IIT Kharagpur exchange program*; *MIT-IUSSTF internship program*; *Experimental Learning in International Agriculture exchange program* (Cornell Univ. and 4 Indian State Agriculture Universities); *Visitation programs* with the American Physical Society and the American Society for Microbiology. It is also heartening to note the success of the *Khorana Program for Scholars* (in partnership with DBT and the University of Wisconsin-Madison). Keeping in view the success of the program, DBT approved both the extension and the expansion of the program to allow more students and more U.S. Universities to be part of this program. In 2012, 30 Indian students were placed across 9 mid-western U.S. 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). Expansion to other leading U.S. Universities is also envisioned as the program moves forward. Although in principle agreed upon in 2009; the *Technology-transfer course* (in partnership with DBT and the University of Wisconsin-Madison) came into being in 2012. This course has been specially designed as an intensive program aimed to provide participants with significant insight into managing technology in its journey from the laboratory to the marketplace.

India Science and Technology Partnership

The India Science and Technology Partnership (INSTP) based out of the American Association for the Advancement of Science (AAAS) in Washington D.C. is the US partner of the Indo-US Science and Technology Forum.

INSTP complements the activities of IUSSTF by:

- Conducting outreach among US government technical and scientific agencies;
- Increasing and expanding contacts with the US academia, business community, professional and trade associations toward fostering new bilateral S&T programs;
- Developing a closer relationship with legislative and executive branch offices interested in and supportive of closer bilateral relations with India and
- Representing IUSSTF at conferences, seminars, and other events in the United States.

INSTP also manages the US peer review process for the IUSSTF's grants program and maintains communications with US members of the IUSSTF Governing Body.

INSTP has been confirmed by the US Internal Revenue Service as a public charity, exempt from Federal income tax under Section 501(c)(3) of the Internal Revenue Code. Charitable contributions to INSTP are tax deductible under Section 170 of the code. In addition to corporate and individual contributions, INSTP has enjoyed financial support of the Richard F. Lounsbery Foundation, the US Department of State, the Office of Naval Research, the US Department of Agriculture, and the Director, Defense Research and Engineering. INSTP also enjoys significant in-kind contributions from the Smithsonian Institution, The National Academies, and AAAS.

Michael J. Cheetham serves as the Director of INSTP

13th Governing Body Meeting

The 13th annual meeting of the joint Governing Board of the Indo-US Science and Technology Forum (IUSSTF) was held at New Delhi on December 6, 2011 under the co-chairmanship of T. Ramasami, Secretary, Department of Science and Technology, Govt. of India and Norman Neureiter, Advisor, American Association for the Advancement of Science.

As IUSSTF completed eleven years of existence, the Governing Board members deliberated and provided their views on the accomplishments and also the future vision and role for IUSSTF in promoting its mandate. T. Ramasami, Indian Co-Chair, in his opening remarks welcomed the new leadership at the helm of IUSSTF. He also highlighted that IUSSTF has gained good visibility and its work was widely appreciated in India and opinioned that similar anchoring on US side should be provided by the IUSSTF Representative Office in the US. Ray Johnson, Sr. VP and CTO, Lockheed Martin, spoke about the positive feedback received from the students selected for the Young Engineers Visitation Program wherein they visited the Lockheed Martin Center for Innovation and were exposed to various systems approaches. He felt that it was imperative to engage young creative minds and challenge them with problems that are of interest to both countries. Phyllis G. Yoshida, Deputy Assistant Secretary, US Department of Energy, appreciated the role played by IUSSTF in implementing the Indo-US Joint Clean Energy Research & Development Centre, which she defined as a novel concept of bilateral cooperation that will be enabled through a true public-private bilateral partnership. Samir Brahmachari, DG, Council for Scientific and Industrial Research remarked that IUSSTF has served extremely well by meeting the needs and aspirations of its stakeholders and congratulated the organization for its achievements. Sanjay Dhande, Director, IIT-Kanpur, emphasized the need to map the indicators in science, technology,

research and education which will be the key markers to the knowledge based economy and development in both the countries.

The Governing Board complimented Dr. Mitra, the first Executive Director of IUSSTF for his ability to reach across S&T systems in India and looked forward to Dr. Rajiv Sharma, new Executive Director to continue the good work. Dr. Rajiv Sharma made a presentation to the Board outlining the programmatic activities of IUSSTF, activities supported by IUSSTF since the last GB meeting, salient outcome and accomplishments, new initiatives and future vision, status of strategic initiatives administered by IUSSTF and financial indicators. The GB expressed its appreciation of the role of IUSSTF in forging and catalyzing individual as well as institutional linkages through its programmatic activities in India and US.

Program Portfolio

IUSSTF promotes Indo-US Science and Technology partnerships by responding to the needs of its stakeholders in adopting a dynamic program portfolio largely conceived and driven by the scientific communities of both nations.

- **Symposia, Workshops, Conferences** on topical and thematic areas of interest
- **Special initiatives** on bilateral strategic partnerships
- **Visitation program** through fellowships and internships
- **Industry – Academia connect programs**
- **Innovation programs** to promote technoentrepreneurship
- **Training programs and Advanced Schools** towards human resource development
- **Public-Private Networked Centers** to foster pre-commercial R&D
- **R&D Knowledge Networked Centers** for promoting thematic research
- **Centers of Research Excellence**
- **Travel Grants**
- **Flagship Initiatives** for young scientists and technologists in partnership with US National Academies
  - Indo-US Frontiers of Science Symposium
  - Indo-American Frontiers of Engineering Symposium

Annual Report
Indo-US Science & Technology Forum

Programmatic Activities

ANNUAL REPORT 2011-12

FLAGSHIP PROGRAM

Fourth Indo-American Frontiers of Engineering Symposium

1-3 March 2012, Arlington, Virginia, USA

Organizing Co-Chairs:
Upadrasta Ramamurty
Indian Institute of Science, Bangalore
E-mail: ramu@materials.iisc.ernet.in

Lisa Alvarez-Cohen
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The fourth Indo-American Frontiers of Engineering (IAFOE) 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 Engineering (NAE) at the Hyatt Regency Crystal City in Arlington, Virginia. The event was hosted by Lockheed Martin Corporation. About 60 outstanding engineers under the age of 45 met for an intensive two-and-a-half day symposium to discuss cutting-edge developments in four focal areas. The event was intended to facilitate international and cross-disciplinary research collaboration, promote the transfer of new techniques and approaches across disparate engineering fields, and encourage

the creation of a transatlantic network of world-class engineers.

The symposium began with inaugural addresses by Charles M. Vest (President, National Academy of Engineering), Ray Johnson (Senior Vice President and Chief Technology Officer, Lockheed Martin) and Rajiv Sharma (Executive Director, Indo-US Science and Technology Forum). Welcome and opening remarks were then delivered by the Co-Chairs of the IAFOE - Lisa Alvarez-Cohen (University of California, Berkeley) and Upadrasta Ramamurty (Indian Institute of Science, Bangalore).

The four focal areas consisted of the following talks:

- ***Intelligent transportation systems:*** United States connected vehicles research program; Wireless communications applications in surface transportation; Data collection and modeling for APTS and ATIS under Indian condition; and, Design and evaluation of an adaptive traffic control system for heterogeneous flow conditions.
- ***Engineering at the interface of science:*** Soft modes and related phenomena in materials: a first-principles theory; Programming cellular behavior with RNA controllers; Protein nanocapsules for therapeutic applications; and, Engineering the microstructure of semicrystalline polymers.
- ***Technology enablers for advances in aerospace materials:*** Integrated computational materials engineering; Trends in joining of aerospace materials; Challenges in developing new coatings to improve performance; and, Advancements in qualifying new materials for aerospace systems.
- ***Engineering large infrastructure for disaster/ hazards:*** Engineering of nuclear power plants in India: present and future; Performance- and risk-based design approaches for seismic safety; Challenges in disaster mitigation of large infrastructure by engineering design; and, Hazard assessment methods for large and critical infrastructure.

STRATEGIC PROGRAMS

Indo-US Joint Clean Energy Research and Development Center (JCERDC)

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The **Indo-US Joint Clean Energy Research and Development Center (JCERDC)** is a joint initiative of the Government of India and the US Department of Energy (DOE). The overall aim of the JCERDC is to facilitate joint research and development on clean energy by consortia of scientists, technologists and engineers from Indian and the US academic/ research institutes and industry, needed to deploy clean energy technologies rapidly with the greatest impact. To achieve this objective, the Indo-US JCERDC will support multi-institutional network projects using public-private partnership model of funding.

The fund commitment towards this effort by each Government is USD 5 million per year for five years. The project funding model is Public-Private Consortia mode (1:1 contribution). The Program is being administered in India by the Indo-US S&T Forum (IUSSTF) and in the US by the Department of Energy. The three priority areas identified for joint collaboration under the aegis of the JCERDC are: *Solar energy, Second-generation biofuels, and Energy efficiency of buildings.*

On October 22nd, 2010, a Pre-Stakeholder meeting was held in New Delhi to provide potential applicants with an overview on the JCERDC and also engage the stakeholders in an open-house discussion and Q&A session. A draft Funding Opportunity Announcement (FOA) was posted online in February 2011 to garner queries/suggestions/comments from potential applicants. The final FOA was posted online on 16th May 2011 and the call for proposals (with a submission deadline of 16th August 2011) was advertised widely. IUSSTF and DOE received a total of 21 applications. After completing the compliance review of the applications, a total of 19 proposals were accepted (Solar Energy: 3; Second generation Biofuels: 9; Energy Efficiency of Buildings: 7). Three Joint Merit Review Panels (JMRP; one for each priority area) each consisting of three US and three Indian merit reviewers evaluated applications in accordance with the criteria identified in the

Joint Funding Opportunity Announcement (FOA) and ranked the top proposals in each category. Subsequent to this, the JMRP provided their recommendations and scores to the Joint Appraisal Committee (JAC). The Government of India members of the JAC consisted of senior representatives from the Department of Science and Technology, Department of Biotechnology and the Ministry of Power. The DOE members of the JAC comprised of senior representatives from the Office of Policy and International Affairs, the Office of Science, and the Office of Energy Efficiency and Renewable Energy. The Joint Appraisal Committee met in February 2012 to discuss the recommendations of the JMRP's.

Based on the deliberations of the Joint Appraisal Committee taking into consideration the evaluation of the Joint Merit Review Panels; the following consortia were selected for award in each of the three priority areas:

Solar Energy: *'The Solar Energy Research Institute for India and the United States' (SERIIUS)* (Lead Institutions: Indian Institute of Science, India and National Renewable Energy Laboratory, USA).

Second Generation Biofuels: *'US-India consortium for development of sustainable advanced lignocellulosic biofuel systems'* (Lead Institutions: Indian Institute of Chemical Technology, India and University of Florida, USA).

Energy Efficiency of Buildings: *'United States-India Joint Center for Building Energy Research and Development' (CBERD)* (Lead Institutions: Center for Environmental Planning and Technology University, India and Lawrence Berkeley National Laboratory, USA).

Details of the three winning consortia are as follows:

Solar Energy	
Solar Energy Research Institute for India and US (SERIIUS) **Theme / Focus :** Sustainable photovoltaics, multiscale concentrated solar power, and solar energy integration	
Indian Consortium Partners	**US Consortium Partners**
Lead Institution: Indian Institute of Science-Bangalore **Lead PI:** Dr. Kamanio Chattopadhyay	**Lead Institution:** National Renewable Energy Laboratory, Golden, CO **Lead PI:** Dr. Lawrence L. Kazmerski
Other Academic Partners: Indian Institute of Technology – Bombay; Center for the Study of Science, Technology and Policy; International Advanced Research Centre for Powder Metallurgy and New Materials; Solar Energy Centre; Indian Institute of Technology-Madras; Indian Association for the Cultivation of Science **Industry Partners:** S Clique Developments Ltd.; Hindustan Petroleum Corporation Ltd.; Moser Baer India Ltd.; Thermax Ltd.; TurboTech Precision Engineering Ltd.; and Wipro Ltd.	**Other Academic Partners:** RAND Corporation; 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 in St. Louis **Industry partners:** Rand Corporation; Corning Incorporated; General Electric Company;MEMC Corporation; and Solarmer Energy Inc., Cookson Electronics.

Second Generation Biofuels	
US-India Consortium for development of Sustainable Advanced Lignocellulosic Biofuel Systems **Theme / Focus :** Development of sustainable advanced lignocellulosic biofuel systems	
Indian Consortium Partners	**US Consortium Partners**
Lead Institution: Indian Institute of Chemical Technology-Hyderabad **Lead PI:** Dr. Ahmed Kamal	**Lead Institution:** University of Florida **Lead PI:** Dr. Pratap Pullammanappallil
Other Academic 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; Centre for Economic and Social Studies; Indian Institute of Technology-Delhi; Indian Institute of Technology-Chennai; **Industry Partners:** Abellon Clean Energy	**Other Academic Partners:** University of Missouri; Virginia Tech; Montclair State University; Texas A&M University **Industry Partners:** Show Me Energy; and Green Technologies

Energy Efficiency of Buildings	
United States-India Joint Center for Building Energy Research and Development **Theme / Focus :** Integration of information technology with building controls and physical systems for commercial and high-rise residential buildings	
Indian Consortium Partners	**US Consortium Partners**
Lead Institution: CEPT University-Ahmedabad **Lead PI:** Dr. N. K. Bansal	**Lead Institution:** Lawrence Berkeley National Laboratory, Berkeley **Lead PI:** Dr. Ashok Gadgil
Other Academic 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/ Confederation of Indian Industries; Indian Society of Heating Refrigeration and Air Conditioning Engineers; Rajasthan Electronics and Instruments Limited; Indian Society of Lighting Engineers **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 Academic Partners:** Oak Ridge National Laboratory; University of California Berkeley; Carnegie Mellon University; Rensselaer Polytechnic Institute **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

United States - India Science and Technology Endowment Fund

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The Governments of the United States of America and India have established the **United States - India Science and Technology Endowment Fund** for promotion of joint research and development leading to innovation, entrepreneurial and commercialization activities in Science & Technology.

The objectives of the Endowment program are to strengthen and expand S&T cooperation with focus on applied R&D; encourage entrepreneurial activities that have significant potential towards commercialization of joint technology; and, promote sustained partnerships in innovation between scientists, technologists & entrepreneurs towards economic development and public good of both countries. The stakeholders for this program cut across Academia, National Laboratories, Non-Governmental R&D Institutions, and, Start-up & Private Companies.

For the first call placed in 2011, there were two priority areas identified:

Healthy individual: With a focus on affordable diagnostic / preventive / curative measures to improve health of citizens (excludes pharmaceutical development), or food and nutrition products; and,

Empowering citizens: With a focus on reducing the digital divide and could include information and communication technologies with a societal impact

in areas such as water, agriculture financial indusion, and education.

This program is co-ordinated and administered through the binational Indo-US Science and Technology Forum (IUSSTF). IUSSTF received an overwhelming response to the first call and the evaluation was carried out based on the uniqueness of the technology and solution; extent of validation of technology; relevance of the solution to major problems, particularly those affecting "Bottom of Pyramid" at a global level; ability to scale and deploy; ability to be financially viable, and fundable by VCs or PEs in the future; quality of the team involved; and most importantly the potential for collaborations between India and the US.

After a three-phase review process, top applicants were invited to make an in-person presentation to the US-India Endowment Board. At the end, an exciting business plan that would bring proprietary chilling technology into the market as a cold storage solution for farm produce was selected for Endowment funding:

- **A fair price for healthy fruits & vegetables: Helping farmers access cold-storage technology**

Rustom Irani (Icelings Chirag Ice Factory Pvt. Ltd., India) and **Sorin Grama** (Promethean Power Systems, Inc, USA)

Nearly $10 billion of agricultural produce is lost in India every year due to inadequate cold storage. Promethean Power Systems and Icelings were awarded a grant to develop a solar-powered refrigerated storage container using a phase-change material in place of the usual refrigeration compressors, that will empower rural families by ensuring a fair price for the fruits of their labor while offering Indian consumers fresh and healthy produce throughout the year. This off-grid refrigerated container, which will be installed on small farms and remote villages throughout India, will increase the farmers' incomes by eliminating costly spoilage while allowing them to sell the produce at a fair price independent of harvest timing.

In addition, two proposals were also chosen for runners-up awards to recognize the potential of the ideas expressed:

- **Point-of-care, multiplexed newborn screening platform for Congenital Hypothyroidism (CH), Congenital Adrenal Hyperplasia (CAH), Phenylketonuria (PKU), Galactosemia (GALT), and Glucose-6-Phosphate Dehydrogenase deficiency (G6PD)**

Rohit Cariappa (NeoGen Labs, India) and **Vamsee Krishna Pamula** (Advanced Liquid Logic Inc., USA)

Newborn screening (NBS) for many disorders is a mandated public health program in many countries,

while India is yet to institute such programs. The health policies typically targeted mortality and infectious morbidities but not disabilities. This proposal aimed at adaptation of digital microfluidics technology to perform point of care NBS near the birth-site in a cost-effective manner on a simple disposable cartridge mounted on a portable instrument. The task of follow-up is also simplified when NBS is performed at the point of birth so that identified patients are not "lost". The overall goal is to develop a cartridge that performs multiplex testing on <75µL blood obtained from a heel stick from a newborn and reports the results in less than 15 minutes.

- **PDShoe: Step synchronized vibrators to improve walking of patients with Parkinson Disease**

Madhuri Behari (All India Institute of Medical Sciences, India) and **Sunil K. Agrawal** (University of Delaware, USA)

Parkinson's disease (PD) is the second most common degenerative neurological disorder for the elderly population. This group has designed a novel shoe with vibrators, named the PDShoe. The vibration in the shoe is synchronized to the heel strike and toe-off of the subject wearing it. This shoe is aimed at helping people with Parkinson's disease (PD) walk more steadily through vibration and tactile feedback. The goals of this collaborative research project are technological development of the PDShoe, and, evaluation of the PDShoe on PD patients with different symptoms and stage of the disease.

PUBLIC-PRIVATE PARTNERSHIP PROGRAMS

DST-Lockheed Martin India Innovation Growth Program

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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 jointly funded by the Department of Science and Technology, Government of India and the Lockheed Martin Corporation, USA, a premier systems integrator and global security enterprise principally engaged in the research, design, development, manufacture, integration and sustainability of advanced technology systems, products and services. The IIGP is implemented by IC² Institute, University of Texas - Austin, the Federation of Indian Chambers of Commerce and Industries (FICCI) and IUSSTF.

The aim of this public-private initiative is to identify, award, mentor and hence accelerate innovative Indian technologies into new markets in India, United States and around the world. The unique feature of the IIGP is its focus on mentoring through professional business development engagement and applying world-class commercialization strategies to bright ideas that have potential towards market realization by a quick look commercialization analysis at IC² Institute and FICCI.

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 awardees of the DST-Lockheed Martin India Innovation Growth Program 2011-12 were:

Technology Name: **Portable Unmanned Ground Vehicle**
Innovator: **Akash Sinha** (Omnipresent Robot Technologies Pvt. Ltd.)
Technology Description: The technology is a robotic, remotely-operated vehicle designed for use in the Indian armed forces and para-military services for military surveillance, reconnaissance and explosive disposal.

Technology Name: **Recycled Tungsten Carbide Alloy Powders**
Innovator: **A Jayakannan** (AEYEES Tungsten)
Technology Description: The technology is a method for recycling tungsten carbide by using thermo-mechanical techniques to breakdown the tungsten from drill bits and machine parts, and produces a high grade powder that can be readily used in manufacturing.

Technology Name: **HyCator Cavitation Reactor**
Innovator: **Anjan Mukherjee** (HyCa Technologies Pvt. Ltd.)
Technology Description: The HyCator cavitation reactor is a device that creates and uses cavitation bubbles to destroy microbes in applications ranging from water cooling towers to water treatment and biofouling prevention in an environmentally friendly and cost-effective way.

Technology Name: **Plastic BioChip based disposable Electrochemical Immunosensor**
Innovator: **Priyanka** (Institute of Microbial Technology)
Technology Description: The technology is a biochip that can detect pesticides and can be performed in laboratory or field conditions with a high degree of accuracy and provide near real time results.

Technology Name: **Solar Photo Voltaic Water Pumping**
Innovator: **Praveen Jambholkar**
Technology Description: The technology is a pumping control system used to manage solar powered water pumping systems intended to be used for irrigation and portable water systems.

Technology Name: **Drug Discovery / Drug-Target Identification Technology**
Innovator: **Chaitanya Saxena** (Shantani Proteome Analytics Pvt. Ltd.)
Technology Description: This technology assists in the identification of drug targets, which are the locations in tissues and cells in the body where medicines act. This technology claims to reduce 50 – 70% of the cost and time involved with the current technologies.

Technology Name: **ViTranSP – Virtual Transaction Service Provider**
Innovator: **Ramesh Baswa** (Basix Sub-K iTransactions Ltd.)

Technology Description: The technology is an integrated financial services platform known as the Virtual Transactions Service Platform (ViTransSP) created to deliver cost-effective financial services to un-served and under-served Indian rural and semi-rural banking customers.

Technology Name: **Coconut Eriophyid Mite Control**
Innovator: **P.S. Mukherjee** (IMMT Bhubaneswar)
Technology Description: The technology involves a novel formulation of biopesticides (biocides) which can easily be applied in coconut plantations to control the eriophyid mite.

Technology Name: **User Wearable Portable Communication Device**
Innovator: **Rajendra P. Sadhu** (Vyzin Electronics Pvt. Ltd.)
Technology Description: The Vesag watch is a personal emergency response system (PERS) designed for the purpose of patient tracking, providing pre-emptive medical care and avoiding emergencies. The medical watch includes tracking features and collects health index parameter of the patient such as pulse, ECG, body weight, blood sugar and blood pressure monitors. All accumulated data is wirelessly transmitted to the web portal for monitoring by a medical call center.

Technology Name: **Safety Medical Device**
Innovator: **Manoj Kumar Maan** (Mecmaan)
Technology Description: The MecSafe Safety I.V. Cannula was constructed to safe-guard medical professionals from needle stick injuries (NSI) and blood borne infections during needle withdrawal and disposal. The MecSafe Cannula uses a manual retraction system to withdraw the needle into the chamber and is designed so that after withdrawal, the needle is locked inside a safety chamber so the user does not come into contact with the needle or is in any danger of accidental injury.

Technology Name: **Lifestyle Wellness Garments Process**
Innovator: **Rajiv Rai Sachdev** (Advantage Organic Naturals Technologies)
Technology Description: The subject technology is a fabric treatment and dying process that produces clothing that is free of toxins, synthetic dyes or chemicals. The process utilizes a formulation of more than 200 herbal ingredients and is based on Ayurvastra- the ancient science of clothing.

Technology Name: **Screening Tool for Detection of DNA Damaging Agents**
Innovator: **Sunilkumar Sukumaran** (Anthem Biosciences Pvt. Ltd.)

Technology Description: Anthem's proprietary genotox platform involves a simple human cell based tool that provides vital information that is critical to human health care. Anthem has successfully designed, established and validated a simple, high-throughput-compatible Human cell-based genotox platform. The screen can drastically reduce time associated with screening for genotoxins, reduce or completely remove animal testing and provide consistent data critical to human health.

Technology Name: **File Format for Security**
Innovator: **Prakash Baskaran** (Pawaa Software)
Technology Description: pawaaFILE is Information Rights Management software technology that reduces the complexity of key management, improving data leak protection and providing an audit trail for compliance.

Technology Name: **Lead ECG**
Innovator: **Ravi Mehrotra** (National Physical Laboratory)
Technology Description: This technology provides low-cost ECG recordings which can be viewed on a PC and printed on a standard A4 sized printer.

Technology Name: **Remote Controlled System for Power Tiller**
Innovator: **Prajwal V. Kumar** (Mangalore Robautonics)
Technology Description: This remote controlled power tiller allows farmers to operate their tillers from a distance just by pressing a button on a hand held remote control unit. There is no need to walk along the machine as it moves in the field.

Technology Name: **Rainrunner**
Innovator: **Karan Randhawa** (Roof for Two)
Technology Description: This technology is a shield for motorcyles which protects riders from rain, blocks out direct sun rays, and protects them from cold wind. It fits onto any sub 150-cc motorcycle and features an instant deployment system from its portable form.

Technology Name: **Branchless Banking Technology Solution**
Innovator: **Seema Prem** (MINT-Today)
Technology Description: This technology consists of software, firmware, and hardware that allows for real-time access and interaction with a core banking system from satellite locations in retail outlets. The technology greatly reduces the cost to the banks eliminating the paperwork associated with the account and transactions.

Technology Name: **Development of Bioplastics from Agricultural Waste**
Innovator: **M.S. Shankara Prasad** (SPC Biotech Pvt. Ltd.)

Technology Description: This technology is an innovative manufacturing process for the production of polylactic acid-based bioplastics from agricultural waste such as the inedible parts of plants (seeds, husks bagasse, grasses, etc.)

Technology Name: **Energy Efficient Compressor**
Innovator: **Vijay Jain** (Partnership Concern)
Technology Description: This technology is designed for a reciprocating compressor, used in air-conditioning units specially installed in high temperature loads and continuous running, to improve energy efficiency which enables operating cost reduction.

Technology Name: **Low-Cost Photo-Bioreactor System**
Innovator: **Srinivas Gogineni** (Green Cell Biotech Pvt. Ltd.)
Technology Description: This technology is a fully automated, low-power and very low-cost photo-bioreactor for the cultivation of microalgae.

Technology Name: **Eco Pots**
Innovator: **Vijayan** (Neuecotechs)
Technology Description: This technology is a device and method to convert organic waste into compost that will feed and grow plants within the same container.

Technology Name: **Metal Casting Solidification**
Innovator: **B. Ravi** (IIT Bombay)
Technology Description: AutoCAST-X is a metal casting solidification software designed to improve the quality and yield of metal casts. The application is a web-based system that links to a manufacturer's Computer Aided Design (CAD) software to simulate a part before it has been cast.

Technology Name: **Ear, Nose and Throat Multiscope and Recorder**
Innovator: **Sapna Behar** (Icarus Design Pvt. Ltd.)
Technology Description: The technology is a low cost battery-operated portable ENT endoscope for smaller clinics. The portable ENT endoscope device will provide better visual access to the problem area in the ear, nose and throat versus the traditional rudimentary diagnostic tools. At an estimated sales price of $1000-$1500, the device is less expensive than a traditional endoscope.

Technology Name: **Additive Manufacturing Machine/3D Part Printer**
Innovator: **Jeldi Bala Anand** (JB Design Technologies)
Technology Description: The technology helps in realization of new designs at a click of a button. The design in 3D cad format is to be given as an input file to the machine software and once the material is chosen, within couple of hours, the

functional parts are ready to use either in metal or plastic.

Technology Name: **Hydrogen-Fueled Engine**
Innovator: **Lalit Mohan Das** (Indian Institute of Technology, Delhi)
Technology Description: The technology is a hydrogen-powered internal combustion engine designed for use on small urban transport vehicles such as auto-rickshaws with the primary objective to significantly reduce or eliminate the pollution associated with 3-wheelers.

Technology Name: **KM Technology Price Forecasting**
Innovator: **V.S.K Murthy Balijepalli** (Indian Institute of Technology Bombay)
Technology Description: The Energy Demand Advanced Forecast System (EDAFS) is a software system that uses complex algorithms to predict electricity demand for energy suppliers and regulators.

Technology Name: **Zed Sun-zyme Foliar Spray**
Innovator: **Chandrasekhar Hariharan** (Biodiversity Conservation India Pvt. Ltd.)
Technology Description: This technology is a foliar spray which enhances plant growth by boosting the synthesis of enzymes and the process of photosynthesis.

Technology Name: **Motorcycle Operated Multipurpose Farm Implement**
Innovator: **Meenakshi Deogam** (National Innovation Foundation)
Technology Description: The technology is an innovative farming machine that is much smaller than the tillers and tractors but stronger than the bullocks and other farming animals and is useful for performing numerous agricultural operations. The product is essentially a mechanical system that can easily be attached to the rear of a motorcycle by replacing the rear wheel.

Technology Name: **Milking Machine**
Innovator: **Meenakshi Deogam** (National Innovation Foundation)
Technology Description: The Milk Master technology is a cattle milking machine targeted at smaller farmers across India. The biggest advantage of this machine is that it gives the same quality of performance (accurate pulsating effect) as larger and costlier versions in the market while being small enough to be affordable for smaller farmer

Technology Name: **Defluoridation of Water and Removal of Arsenic from Groundwater**
Innovator: **S.R. Wate** (Water Technology and Management Division-NEERI)
Technology Description: The technology is a drinking water treatment plant which operates on the basis of electricity as well as solar power and aims at removing the fluoride contamination along with other impurities like bacteria and possibly arsenic present in the drinking water.

We are proud to announce that **3nethra**, an portable ophthalmologic device from Forus Health in India and a medalist in the 2011 DST – Lockheed Martin India Innovation Growth Program, recently received $5M in venture funding. 3nethra is a portable, low cost, non-mydriatic, non-invasive pre-screening ophthalmology solution, can detect cataract, glaucoma, diabetic retina, refraction and cornea problems – diseases that contribute to 90% of avoidable blindness in India. More details can be accessed at:
http://yourstory.in/2012/04/forus-health-raises-5-million-from-idg-ventures-and-accel-partners/

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 28 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 was formally launched in August 2007 by T. Ramasami, Secretary-DST and Co-Chair, IUSSTF, and is implemented with funding support from the Science and Engineering Research Council (SERC) 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. Researchers from academia and laboratories chosen for the 2012 awards are:

Abid Hamid Dar, Indian Institute of Integrative Medicine, Jammu
US Host: Hasan Mukhtar, School of Medicine, University of Wisconsin-Madison
Subject area: Cancer biology and target-based drug discovery

Achchhe Lal, Sardar Vallabhbhai National Institute of Technology, Surat
US Host: Rakesh Kumar Kapania, Virginia Polytechnic Institute and State University
Subject area: Probabilistic structural mechanics

Achintesh Narayan Biswas, Siliguri College, University of North Bengal
US Host: Lawrence Que, Jr., University of Minnesota
Subject area: Bioinorganic chemistry

Aditi Bhadra, North Eastern Regional Institute of Science and Technology, Arunachal Pradesh
US Host: Roger C Bales., University of California, Merced
Subject area: Hydrological modeling for snow and glacier covered area under climate change scenario

Amarendra Kumar Sarma, Indian Institute of Technology-Guwahati
US Host: Demetrios Christodoulides, University of Central Florida
Subject area: Photonics and optics

Arnab Sarkar, Bhabha Atomic Research Centre, Mumbai
US Host: Richard E. Russo, Lawrence Berkeley National Laboratory, Berkeley
Subject area: Studies on the advancing laser ablation and laser plasma spectroscopy for characterization of elemental impurities, including isotope ratios in nuclear fuels

Arup Kumar Pathak, Bhabha Atomic Research Centre, Mumbai
US Host: J. A. McCammon, University of California, San Diego
Subject area: Theoretical and computational biophysical chemistry

Ashutosh Kumar Shukla, Central Institute of Medicinal and Aromatic Plants, Lucknow
US Host: Toni M. Kutchan, Donald Danforth Plant Science Center, St. Louis, Missouri
Subject area: Identification and characterization of candidate genes towards filling in the gaps present in the biosynthetic pathways of therapeutically useful plant alkaloids

Ashutosh Srivastava, PDPM-Indian Institute of Information Technology, Design and Manufacturing, Jabalpur
US Host: T.P. Ma, Yale University, New Haven
Subject area: Nano-electronics/ nano scale FET's

Dambarudhar Mohanta, Tezpur University, Assam
US Host: David A. Weitz, Harvard University
Subject area: Soft matter physics and nanotechnology

Debdeep Mukhopadhyay, Indian Institute of Technology-Kharagpur
US Host: Ramesh Karri, New York University
Subject area: Cryptographic implementations and side channel analysis

Gowda Rudraswami Narappa, National Institute of Oceanography Goa
US Host: Rhian Jones, University of New Mexico
Subject area: Isotopes and trace element studies of micrometeorites and meteorites

Ibram Ganesh, International Advanced Research Centre for Powder Metallurgy and New Materials, Hyderabad
US Host: Craig L. Hill, Emory University
Subject area: Conversion of CO2 to methanol using solar energy (i.e. artificial photosynthesis)

Jatin Bhatt, Visvesvaraya National Institute of Technology, Nagpur
US Host: Matthew J. Kramer, U.S. Department of Energy, Ames Laboratory, Iowa State University.
Subject area: Metallic glasses

Koneni Venkata Sashidhara, Central Drug Research Institute, Lucknow
US Host: William Fenical, University of California, San Diego
Subject area: Marine drug discovery

P. Muthukumar, Gandhigram Rural Institute Deemed University
US Host: Frank L. Lewis, University of Texas at Arlington
Subject area: Mathematical aspects of approximate dynamic programming in optimal control

Rajesh K. Pandey, PDPM-Indian Institute of Information Technology, Design and Manufacturing, Jabalpur
US Host: Om Prakash Agrawal, Southern Illinois University Carbondale
Subject area: Fractional derivatives and their applications

Rajesh Sundaresan, Indian Institute of Science Bangalore
US Host: Promod Vishwanath, University of Illinois, Urbana Champaign
Subject area: Information flows over random networks, resource sharing in such networks for information transmission and aggregation, and decentralized algorithms

Ritu Tiwari, ABV-Indian Institute of Information Technology and Management, Gwalior
US Host: Mo Jamshidi, University of Texas at San Antonio
Subject area: Multi robot path planning and area exploration

S R Prabagaran, Bharathiar University
US Host: Chad W. Saltkov, University of California Santa Cruz
Subject area: Heavy metal metabolism–arsenic/anaerobic

Sandeep Goel, Centre for Cellular and Molecular Biology, Hyderabad
US Host: Martin Dym, Georgetown University School of Medicine, Washington, DC
Subject area: Isolation, characterization and culture of human male germline stem cells

Satendra Kumar Mangrauthia, Directorate of Rice Research, Hyderabad
US Host: Jian-Kang Zhu, Purdue University
Subject area: MicroRNA expression and regulation in rice during heat stress

Sheikh Tasduq Abdullah, Indian Institute of Integrative Medicine, Jammu
US Host: Fatih M. Uckun, University of Southern California, Los Angeles
Subject area: Translational research aimed at identifying new molecular targets of radio resistance in cancer

Sukumar Kundu, Bengal Engineering and Science University, Shibpur
US Host: David Olson and Prof. Brajendra Mishra, Colorado School of Mines
Subject area: Advanced joining technique

Sumit Kumar Mishra, National Physical Laboratory, New Delhi
US Host: V. Ramanathan, University of California, San Diego
Subject area: Optical and radiative properties of ambient aerosol

Suresh Babu Pitchuka, International Advanced Research Centre for Powder Metallurgy and New Materials, Hyderabad
US Host: Arvind Agarwal, Florida International University, Miami
Subject area: Development of novel coatings by cold spray and plasma spray techniques and performance evaluation

Vinay Gupta, National Physical Laboratory New Delhi
US Host: Alan J. Heeger, University of California, Santa Barbara
Subject area: Organic photovoltaics

Debayan Sarkar, National Institute of Technology, Rourkela
US Host: Barry M. Trost, Stanford University, California
Subject area: Organic Synthesis

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 Indian 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 is 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 work with other young innovators with a combination of engineering, medical and industry backgrounds. The team examines 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 are also mentored by "real-world" experts from the biomedical technology, legal and venture capital industries both in the United States and India. The program partnering also includes exchange of faculty between the academic institutions.

In March 2012, SIB have executed an **exclusive worldwide license to commercialize the FI technology between Biotech Consortium India Limited** (the Indian Department of Biotechnology's technology transfer organization) and **Consure Medical Private Limited.** The license will serve as a template for future products emanating from the SIB collaboration. **Consure is founded on a device that was invented in the first year of the SIB program.**

2009 SIB fellow Darshan Nayak co-founded a company in December 2011 that is developing a new device for needle-free anemia testing. In August 2011 Asokan Thondiyath, SIB Fellow 2009 and faculty member IIT Chennai, introduced the "Medical Device Innovation" course as an elective course for biodesign students at the Indian Institute of Technology in Chennai.

Four outstanding individuals were selected for the 2012 SIB Fellowship:

Jagdish Chaturvedi, with a background in Otolarynology

Jonathan D. Pillai, with a background in Drug delivery

Siddhartha Joshi, with a background in Gastrointestinal Design

Siraj Bagwan, with a background in Product Design and Engineering Medical Device Development

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

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Under an arrangement between IUSSTF and the 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 an 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 2011-12:

Elankumaran Subbiah, Assistant Professor at the Virginia-Maryland Regional College of Veterinary Medicine, Virginia Tech, Blacksburg, was awarded a Teaching Professorship to implement a one-month course titled *Novel approaches to vectored viral vaccines for animal diseases* in collaboration, with host Prabakaran Rajamanickam at the Tamil Nadu Veterinary and Animal Sciences University, Chennai.

Radhajeyalakshmi Raju, Assistant Professor at the Tamil Nadu Agricultural University, Coimbatore visited Jeanmarie Verchot-Lubicz at the Oklahoma State University in Stillwater for a period of 5 months to pursue research on *Production of virus-free canna bulbs through in vitro micropropagation and 'virus-free' certification for five major viruses.*

Srikanth Mutnuri, Assistant Professor at Birla Institute of Technology and Science, Goa, visited Max Haggblom at Rutgers, The State University of New Jersey, New Brunswick for two months to undertake a research project on *Microbial diversity in hydrocarbon contaminated sites as well as in an anaerobic digestor.*

IUSSTF-American Physical Society (APS) Fellowships

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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.

The recipients of the **2011 Indo-US Professorship Awards** in Physics are:

Bruce Mellado, University of Wisconsin-Madison
Host: Harish Chandra Research Institute (HRI), Allahabad
Subject area: Training academic lectures on "Experimental particle physics"

Corey S. O'Hern, Yale University, New Haven
Host: Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore
Subject area: Lecture series on "Theoretical and computational studies of granular materials"

David Scott Citrin, Georgia Institute of Technology, Atlanta
Host: Indian Institute of Science, Bangalore
Subject area: Taught module on "Nanophotonics"

Dibyendu Das, IIT-Bombay, Mumbai
Host: Colorado State University
Subject area: Lecture series on "Study of stochastic processes in certain physical and biological systems".

James P. Vary, Iowa State University, Ames
Host: Indian Institute of Technology-Roorkee
Subject area: Lectures on "Ab-initio methods in nuclear structure theory"

Ratnamala Chatterjee, Indian Institute of Technology Delhi
Host: Massachusetts Institute of Technology, Boston
Subject area: Topological insulators

S. Mani Tripathi, University of California, Davis
Host: Indian Institute of Science, Bangalore
Subject area: Lecture series on "Experimental searches for dark matter"

Shobhana Narasimhan, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore
Host: Louisiana Alliance for Simulation-Guided Materials Applications
Subject area: Lectures on "Density functional theory"

William Ratcliff, II, National Institute of Standards and Technology, Gaithersburg
Host: Bhabha Atomic Research Centre, Mumbai
Subject area: Lectures on "Single crystal and powder diffraction studies for solving magnetic structures"

The recipients of the **2011 Indo-US Physics Students Visitation** program are:

Lusaka Bhattacharya, Saha Institute of Nuclear Physics, Kolkata
Host: Michael Strickland, Gettysburg College

Gaurav Goswami, Inter-University Centre for Astronomy and Astrophysics, Pune
Host: Institute for Gravitation and the Cosmos, Pennsylvania State University

Hunter King, University of Massachusetts, Amherst
Host: Shankar Ghosh, Tata Institute of Fundamental Research, Mumbai
Subject area: Measuring the interactions between objects adsorbed to fluid interfaces

Kathleen Foote, North Carolina State University, Raleigh
Host: Pratibha Jolly, Miranda House, University of Delhi
Subject area: Physics education

Lakshmi Pradeep Chitta, Indian Institute of Astrophysics, Bangalore
Host: National Solar Observatory, New Mexico
Subject area: Investigation of the negative phase relation in the intensity oscillations at the sites of small scale magnetic fields in the solar atmosphere

Laura Green, University of California, Riverside
Host: Swara Ravindranath, Inter-University Centre for Astronomy and Astrophysics, Pune
Subject area: Multi-wavelength study of dust obscured galaxies at high redshifts

Sujoy Kumar Modak, S.N. Bose National Centre for Basic Sciences, Kolkata
Host: Singleton, California State University (CSU), Fresno
Subject area: Effect of Hawking radiation on black holes

Research Internships in Science and Engineering

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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 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.

The following **14 students** were selected under the RISE Program in 2011-12:





Abhik Seal, Indiana University, Bloomington, Indiana
Mentor: D.Sriram, BITS Pilani - Hyderabad Campus
Subject Area: Chemical Informatics

Abhishek Gupta, University of Illinois at Urbana-Champaign, Illinois
Mentor: Vivek S. Borkar, Indian Institute of Technology Bombay
Subject Area: Aerospace Engineering, Applied Mathematics

Anoushka Nadeem Syed, University of Wisconsin – Madison, Wisconsin
Mentor: Pooja Murada & Lalit Sharma, Institute of Rural Research and Development, Gurgaon
Subject Area: Water Sanitation Systems

Athavi Jeevananthan, University of Wisconsin – Madison, Wisconsin
Mentor: D. Balasubramanian, L. V. Prasad Eye Institute, Hyderabad
Subject Area: Biochemistry

Corey Michael Nemec, University of Wisconsin – Madison, Wisconsin
Mentor: Jyotsna Dhawan, National Center for Biological Sciences, Bangalore
Subject Area: Biochemistry

Gokul Pathikonda, University of Illinois at Urbana-Champaign, Illinois
Mentor: Roddam Narasimha, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore
Subject Area: Aerospace Engineering (Fluid Dynamics)

Graham Scott Erwin, University of Wisconsin-Madison, Wisconsin
Mentor: K VijayRaghavan, National Center for Biological Sciences, Bangalore
Subject Area: Biochemistry

Hannah Grace Cherian, University of Michigan, Farmington Hills, Michigan
Mentor: T.S. Sridhar, St. John's Research Institute, Bangalore
Subject Area: Biomedical Engineering

Hema Santhi Aluri, Virginia Commonwealth University, Richmond, Virginia
Mentor: Rashna Bhandari, Centre for DNA Fingerprinting and Diagnostics, Hyderabad
Subject Area: Mitochondrial Biology, Cardiology and Internal Medicine

Joshua B Sperling, University of Colorado, Denver, Colorado
Mentor: Siddharth Agarwal, Urban Health Resource Centre, New Delhi
Subject Area: Civil & Environmental Engineering

Kyle Christopher Kloepping, University of Iowa, Iowa City, Iowa
Mentor: Baljinder Singh, Post Graduate Institute of Medical Education and Research, Chandigarh
Subject Area: Free Radical and Radiation Biology

Mayank Garg, Ira A. Fulton Schools of Engineering, Arizona State University, Tempe, Arizona
Mentor: G. Bhuvneshwari, Indian Institute of Technology, Delhi
Subject Area: Power and Energy Systems, Electrical Engineering

Pritish Jetley, University of Illinois at Urbana-Champaign, Illinois
Mentor: Upinder S. Bhalla, National Center for Biological Sciences, Bangalore
Subject Area: Computational Science and Parallel Programming

Sohan Sudhir Kale, University of Illinois at Urbana-Champaign, Illinois
Mentor: K. Ramesh, Indian Institute of Technology Madras
Subject Area: Mechanical Engineering

Khorana Program for Scholars

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The **Khorana Program for Scholars** is a tripartite arrangement between the University of Wisconsin-Madison, the Department of Biotechnology, Govt. of India and the Indo-US Science and Technology Forum in order to enrich the scientific community of both nations. 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) to undertake a research internship at UW 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. This exchange program is aimed to foster and expand interaction between the Indian and U.S. scientific communities and prove to be transformative for both American and Indian students.

In 2011, the following 15 students attended a 10-week internship at UW-Madison:

Alokananda Ray, National Institute of Science Education and Research, Bhubaneswar
Advisor: Thomas Martin
Subject area: Studying the effects of mutations in the Munc homology domain of Calcium Activated Protein for Secretion (CAPS) on the activity of CAPS

Amrit Praharaj, National Institute of Technology, Rourkela
Advisor: Robert Nowak
Subject area: Efficient structure learning of gene network

Bhuvan Molparia, Indian Institute of Technology, Delhi
Advisor: Julie Mitchell
Subject area: Studying the effect of RMSD values on prediction of protein flexibility

Bikas Kumar Arya, Indian Institute of Technology, Kharagpur
Advisor: Meyer Jackson
Subject area: Cable analysis of superior colliculus neurons and its morphological characterization

Devika Salim, National Institute of Technology, Calicut
Advisor: Aseem Ansari
Subject area: Deciphering the 'CTD code' via chemical genomics

Ipshita Zutshi, Birla Institute of Technology & Science, Pilani
Advisor: Ronald. E. Kalil
Subject area: Nestin expressing cells in the third ventricle of the adult rat brain

Komal Soni, Delhi Technological University
Advisor: John Markley
Subject area: Investigating interactions of bacterial CyaY with other macromolecules in biogenesis of Fe-S cluster

Rishi Raj Trivedi, Indian Institute of Science Education and Research, Mohali
Advisor: Baron Chanda
Subject area: Characterization of hydrophobic residue substitution in the voltage gated K+ ion channels using voltage clamp technique

Shreya Goel, Indian Institute of Technology, Roorkee
Advisor: Weibo Cai
Subject area: Development of novel PET tracers based on graphene and TRC105 antibody

Shreyas Rangan, Indian Institute of Technology, Madras
Advisor: Richard Vierstra
Subject area: Determining the role of the BTB E3 ubiquitin ligase family in Arabidopsis thaliana

Smruthi Vijayaraghavan, Anna University, Chennai
Advisor: Norman Drinkwater
Subject area: Identification of the Chr 17 liver cancer susceptibility modifier in C57BR/cdJ mice

Swati Venkat, Indian Institute of Science Education and Research, Pune
Advisor: Robert Striker
Subject area: The effect of the C-terminal domain of Hepatitis-C virus non-structural protein NS5A, on viral life cycle.

Uma Maheswari Selvaraj, Indian Institute of Technology, Madras
Advisor: Laura Kiessling
Subject area: Scaffold based approach for neural differentiation of human embryonic stem cells

Umair Wajid Khan, Institute of Bioinformatics and Biotechnology, University of Pune
Advisor: Michael Cox
Subject area: The role of SSB in homologous recombination catalyzed by RecA in Deinococcus radiodurans

Vivek Dwivedi, Indian Institute of Technology, Delhi
Advisor: Jennifer Reed
Subject area: Incorporating thermodynamics into an existing model of the metabolic pathways in E. coli

The students visited UW Madison from 18th May 2011 to 31st July 2011. The Khorana Scholars also got to present their work at the Student Symposium held at UW on 30th July 2011.

Khorana Program: Technology Transfer Course

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The Department of Biotechnology (DBT), Govt. of India, University of Wisconsin-Madison (UW) and the Indo-US Science and Technology Forum (IUSSTF) are partnering 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.

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.

The Viterbi-India Program is envisaged to provide an opportunity to the best and brightest Indian students to gain exposure and access to world class research facilities in the Viterbi School; promote research and capacity building in frontline areas of engineering and technology; encourage outstanding students to take up research as a career; and, pave the way for the next generation engineers from India to interact with American peers, thus help building long-term R&D linkages and collaborations. The summer internship program is for Indian students currently enrolled in B.Tech. and M.Tech. programs in Electrical Engineering and Computer Sciences.

The following ten outstanding students have been selected for the program year 2011:

Abhishek Roy, Indian Institute of Technology-Kharagpur
Advisor: Urbashi Mitra
Subject area: Wireless communications

Nikhil Sudhir Upadhyay, BITS-Hyderabad
Advisor: Mike Shuo-Wei Chen
Subject area: Electrical engineering

Prachi Jain, Indraprastha Institute of Information Technology (IIIT)-Delhi
Advisor: Kristina Lerman
Subject area: Information security

Roney Michael, BITS-Pilani
Advisor: Yan Liu
Subject area: Machine vision, Bioinformatics

Sachin Gupta, Indian Institute of Technology (IIT)-Kanpur
Advisor: Rahul Jain
Subject area: Game theory

Shruti Tripathi, Indian Institute of Technology (IIT)-Ropar
Advisor: Maja Mataric
Subject area: CSCI

Swapnil Dineshchandra Haria, BITS-Pilani
Advisor: Viktor Prasanna
Subject area: Field-programmable gate array, System on chip

Swarnabha, Indian Institute of Technology (IIT)-Kharagpur
Advisor: Anupam Madhukar
Subject area: Electrical engineering

Udbhav Kumar Singh, Indian Institute of Technology (IIT)-Kanpur
Advisor: Murali Annavaram
Subject area: Computer architecture

Vaidehi Chajjer, International Institute of Information Technology (IIIT)-Hyderabad
Advisor: Gerard Medioni
Subject area: Machine vision

Young Engineers Visitation Program

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Lockheed Martin Corporation and the Indo-US Science and Technology Forum (IUSSTF) are committed to the common goal of developing an ecosystem that encourages innovation and entrepreneurship. Lockheed Martin Corporation and IUSSTF have been working together in the *DST-Lockheed Martin India Innovation Growth Program* in partnership with FICCI & IC2 Institute at University of Texas, Austin since 2008. Lockheed Martin employs more than 70,000 engineers and scientists creating innovative solutions for the global security challenges of today and tomorrow. Technology development, engineering, and innovation are instrumental to the Corporation's Aerospace and Defense core markets, as well as to emerging markets such as cyber security, health care, and energy and climate change. The Center for Innovation in Suffolk, VA., has a world class collaborative environment that provides a unique proving ground to demonstrate and understand how new technology concepts will perform in the real world. The Corporation works to continually enhance capacity of scientific and technical community to drive innovation through communication and collaboration between its engineers and scientists.

The **Young Engineers Visitation Program** is envisaged to create sustainable, long-term networks for mutual good. The objective of the joint program was to create, nurture and support techno-entrepreneurial ecosystems. The objective of this initiative was to allow young engineers to gain insight to the process of commercialization as technology moves from the lab to the marketplace through a visitation program at the *Lockheed Martin Center for Innovation*, Suffolk, VA. The Center for Innovation is a powerful net-centric experimentation and analysis laboratory and serves as a focal point for resourceful thinking and revolutionary technology.

For the year 2011, 34 *young engineers* from six reputable institutions across India (Indian Institute of Technology, Bombay; Indian Institute of Technology, Madras; Indian School of Mines, Dhanbad; Madras Institute of Technology, Anna University, Chennai; Thapar Institute of Technology, Patiala; and, Malaviya *National Institute of Technology, Jaipur)* were selected to participate in the one-week program. The students were divided into small groups of 5 each and were given specific projects in two areas – *Lego robotics* and *Virtual world.* At the end of the week, the students made a presentation of their projects to a panel of judges that included Jennifer Byrne (Vice President, Technology Strategy, Lockheed Martin Corporation), Debapriya Dutta (Counselor S&T, Embassy of India, Washington DC), Michael Cheetham (IUSSTF), Jyotsna Iyer, Kate McNamara, Steve Falatko, Krish Narasimhan, and Prakash Sesha from Lockheed Martin. The students also got the opportunity to tour the world-class laboratories for collaborative experimentation and analysis at the Centre for Innovation.

Experiential Learning in International Agriculture

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To provide students with an exposure to the multi-dimensional issues affecting agriculture and agribusiness, Cornell University has collaborated with leading Indian State agricultural universities (Tamil Nadu Agricultural University, Coimbatore; Acharya N.G. Ranga Agricultural University, Hyderabad; University of Agricultural Sciences, Dharwad; and, Govind Ballabh Pant University of Agricultural Technology, Pantnagar) and IUSSTF to jointly conduct a course on Experiential Learning in International Agriculture. Through the exchange program modules, students experience agriculture and rural development issues in upstate New York followed by field experience in India and finally present a group project paper. The course covers activities in the classroom and library, field visits and hands-on laboratory work.

The program consisted of a Communication Module at Tamil Nadu Agricultural University, Coimbatore in the form of a workshop on communication skills designed to prepare the students for better communication during the course. The Indian students then visited Cornell University in the month of August 2011 to participate in the experiential field visits to farms and laboratories. The students then traveled to India in January 2012 and visited the states of Tamil Nadu, Kerala and Andhra Pradesh. Based on the interests of the scholars, they were divided into three thematic groups – Agricultural Systems, Rural Infrastructure and Value Addition.

The following 12 students (6 from India and 6 from the US) participated in the IARD program in 2011:

Devika Subash
Thematic group: Value addition
Project title: Post-harvest losses and their effects on Indian food supply

Jehiel Oliver
Thematic group: Rural infrastructure
Project title: Agroforestry as a method for improving rural livelihoods in India

Julien Wilson
Thematic group: Rural infrastructure
Project title: Population growth control policies in India

Philomin Juliana
Thematic group: Agricultural systems
Project title: Moringa – the nutritional powerhouse to battle against malnutrition in India

Praghadeesh Manivannan
Thematic group: Value addition
Project title: Project Report on 'Impact of Operation Flood' on Dairy Industry Supply Chain in India

Sara Cullen
Thematic group: Rural infrastructure
Project title: Biofortification: investing in information communication technology for development – confronting India's 21st century challenges

Saurabh Gautam
Thematic group: Rural infrastructure
Project title: Rural Development in India

Sean Callahan
Thematic group: Rural infrastructure
Project title: Agroforestry as a method for improving rural livelihoods in India

Simone Passarelli
Thematic group: Rural infrastructure
Project title: Population growth control policies in India

Sowkya Jayaraman
Thematic group: Value addition
Project title: Biofortification – a novel tool to reduce malnutrition

T. P. Parthiban
Thematic group: Agricultural systems
Project Title: Miracle millets - food solution to the future world

Wade Simmons
Thematic group: Agricultural systems
Project Title: Population growth control policies in India

IUSSTF-PHFI Research Fellowships for Indian Public Health Researchers

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A Memorandum of Understanding (MOU) was signed on 21 March 2012 between Public Health Foundation of India and Indo-US Science and Technology Forum for the launch of the ***IUSSTF-PHFI Research Fellowships for Indian Researchers.*** The objective of the IUSSTF-PHFI Research Fellowship Program for Indian Public Health Researchers is to promote research and capacity building in the crucial area of public health. It is envisaged these fellowships will help strengthen and expand the knowledge base of Indian Public health research and education.

These fellowships will provide an excellent opportunity for the Indian Public health scientists to gain exposure and access to world class facilities and training in the latest research techniques. It will enable young Indian researchers to carry out a clearly defined research project at a place of their choice in USA upto a period of 12 months. These fellowships will encourage young and mid-career scientists in Indian Public health enterprise to interact with the international public health community to build long-term sustainable linkages. A total of 5 fellowships will be awarded per year. The Department of Science and Technology, Government of India will provide funds to Indo-US Science and Technology Forum (IUSSTF) to administer these fellowships.

BILATERAL WORKSHOPS

Indo-US Frontiers in Medicinal Chemistry and Drug Discovery

20-22 April 2011, Mysore, India

Principal Investigators:
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With the revolution in biomedical sciences in the past few decades, the field of medicinal chemistry has evolved from the chemistry of bioactive compounds to works at the interface of chemistry and biology. For most of the 20th century, the majority of drugs were discovered either by identifying the active ingredient in traditional natural remedies, by rational drug design, or by serendipity. However, with the advancement in medicinal chemistry during the past several decades; chemists are not only synthesizing new compounds, but also contributing to understanding the molecular basis of a disease and its control, identifying bio-molecular targets implicated as disease-causing, and ultimately inventing specific compounds that block the bio-molecules from progressing to an illness, or control a disease.

The Indo-US workshop on **Frontiers in medicinal chemistry and drug discovery** brought together outstanding scientists and researchers from India and the US, not only to discuss exciting advances and opportunities in their own fields, but also to learn and discuss about research at the cutting edge of other disciplines, while building new ties between future leaders of both the nations scientific enterprises.

New Functional Materials: Synthesis, Properties and Methods

2-7 June 2011, Manali, India

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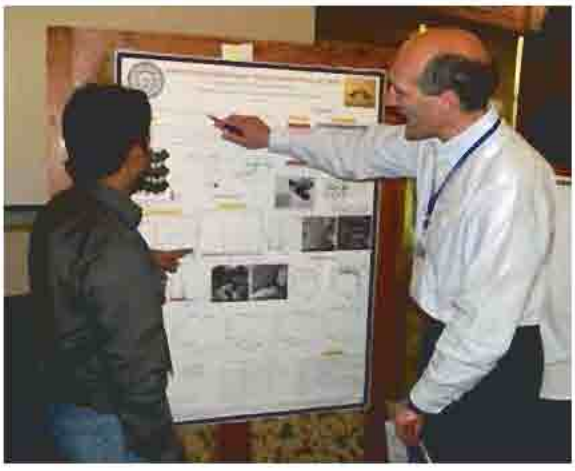
Functional materials are of intense interest to leading experimental and theoretical researchers world-wide. These materials are important for understanding fundamentally important phenomena including metal-insulator transition, charge density wave, spin density wave, magnetoresitance, magnetic ordering, and superconductivity. Understanding the structure-properties affecting these important phenomena is required for the control and design of materials properties for technological applications.

An Indo-US workshop on **New functional materials: synthesis, properties and methods** was organized in order to bring together world leaders, active in the field, both experimentally and theoretically, in the area of functional materials, to exchange ideas, develop collaborations and advance this

important multidisciplinary field. The technical program of the meeting consisted of 2 plenary lectures, 25 invited lectures, 10 oral presentations, 22 poster presentation and 4 presentations by poster awardees. The plenary and invited talks were focused on fundamental and applied research including properties and application of grapheme; superconductors; electronic instabilities (e.g., metal-to-insulator transition, charge density wave (CDW) and spin density wave (SDW) states, and electronic phase separation); magnetic and charge ordering; and, multiferroics.

Several new developments were presented at the event, such as graphene based materials and their inorganic analogues; novel magnetic devices/ switches based on grapheme; confinement of 2D electrons in specifically designed thin multilayers; importance of lower-valent nickel oxides and their properties; development of new oxypnictide and related superconductors with high critical fields; non-toxic inorganic chromophores and their structures; etc.

As an outcome of this workshop, an MoU was signed between Rowan University and Jamia Milia University



with reference to teaching and joint programs. One post–doctoral position at Rowan University has been created in materials under the aegis of this MoU. The first student to receive a fellowship under this has also been identified. Also, the following two joint publications have been generated:

- Sarkar S, Dasgupta I, Greenblatt M and Saha-Dasgupta T (2011) *Electronic and magnetic structure of bi-layer, La3Ni2O6 and tri-layer, La4Ni3O8 nickelates*. Phys. Rev. B84, 180411/1-4, (R).
- Ahmed J, Saha S, Govind, Trinh P, Mugweru AM, Ramanujachary KV, Lofland SE and Ganguli AK (2011) *Enhanced electrocatalytic activity of copper – cobalt nanostructures*. J. Phys. Chem. C, 115, 14526.

Biofuels: Research Challenges in the Areas of Combustion and Fuel Injection

22-23 June 2011, Bangalore, India

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Aviation turbine fuel, or jet fuel, is produced exclusively from crude petroleum feedstock that is processed in a refinery to make many useful products including gasoline, diesel, petrochemicals, and asphalt components. Kerosene jet fuel is a hydrocarbon fuel composed almost entirely of hydrogen and carbon elements. The hydrocarbon composition consists mainly of paraffins, cycloparaffins, and aromatics. Aviation fuels, such as Jet-A, developed over many years of application, have a relatively high energy density per unit weight and volume. The main issues with petroleum-based aviation fuels are availability and sustainability; environmental pollution; and energy security. Carbon neutral renewable liquid fuels are needed to replace the petroleum-derived transport fuels. Many critical technical and economic challenges need to be surmounted before economically viable and environmentally sound bio-jet fuels can be produced for partial or complete replacement of the petroleum-based jet fuels. The Indo-US workshop on **Biofuels: research challenges in the areas of combustion and fuel injection** focused on two major aspects/challenges in biofuel research - combustion dynamics and atomization and vaporization of biofuel.

The workshop brought together eminent scholars from universities and industries in India and USA that are major players in alternative energy research. The workshop involved panel discussions, keynote speeches and posters, and covered the following topics: combustion stability, emission characteristics of biofuel, biofuel reaction kinetics, biofuel certification and portability to industries, fuel injection, mixing and vaporization of biofuel blends, droplet combustion, operational testing in gas turbines and engines, numerical work in droplet combustion, and, general state of biofuel research and possible research directions. It was agreed that both Indian and US researchers have considerable expertise in complimentary areas and can collaborate to tackle mutliscale, multi-level problems in the above mentioned research areas.

As a result of the workshop the following collaborative joint projects were identified: *Combustion instability and diagnostics of biofuels* (IIT-M, IISc, Gatech, UCONN, Purdue); *Spray: atomization and vaporization* (IIT-M, IISc, JU, IIT-D, Cornell, UCF, Sandia, Purdue); *Droplet combustion* (IIT-M, IISC, UCF, Cornell, Sandia); *Chemical Kinetics* (Texas A & M, UCONN, IIT-M); *Fundamental flame studies* (IIT-D, IISc, JU, Texas A&M, UConn, UMICH); *Pollutant measurement and control including novel strategies like nanoadditives* (IIT-M, Texas, IISc, UCF, Cornell); and, *Biofuel production and supply* (Sandia, UMICH).

Synergy and Diversity of Molecular Medicine – Scope for Collaborative Research and Better Healthcare

27-28 June 2011, Coimbatore, India

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Molecular medicine strengthened particularly by the advances in molecular biology and –omics, has brought personalized medicine closer to reality than ever before. In addition, it has ramifications in public health, and drug development as well. Hence, molecular medicine has all the potentials for being the major driver of health-care and economics. A strong molecular medicine base in a country helps one to understand the dynamics of populations, agent-host interactions and to initiate important scientifically informed decisions.

The primary objective of the Indo-US workshop on **Synergy and diversity of molecular medicine – scope for collaborative research and better healthcare** was to facilitate an international level collaborative approach for individual and inter-institutional R&D work in the area of molecular medicine. The major technological advances pertaining to this field were presented and discussed at the workshop. The major topics covered included HIV and molecular mechanisms of T-lymphocyte activation; molecular mechanisms of lung cancer, cardiac repair, and lung repair; experimental therapeutic of breast cancer, molecular oncology in resource-limited settings; differences in molecular medicine at population levels; clinical practice of molecular medicine in resource-limited settings; molecular advances in neurological diseases; role of genetic epidemiology in practice of molecular medicine; and, ethics of molecular medicine research and clinical practice.

Highlights of the scientific deliberations included- regulatory and control mechanisms at molecular level in cancer biology; discovery and development paradigms of drugs in cancer; practice of molecular oncology and clinical genetics in resource poor settings; ethics governing research with special reference to molecular research; evolutionary and population genetics; and, genetics of drug-metabolizing enzymes.

Cognitive Neuroscience

5-14 July 2011, Bangalore, India

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Cognitive neuroscience research and training in India is at a key point in its evolution, which presents an extremely important concern for Indian faculty and students: the establishment and maintenance of connections with the international community. Such connections provide access to the latest research findings, offer opportunities for international collaborative research, and lead to greater international awareness of discoveries made by Indian neuroscientists.

In recognition of this need, the Indo-US workshop on **Cognitive neuroscience** paved the way for new collaborations and mutual exchange of students and ideas. The workshop accommodated 40 students recruited from neuroscience communities throughout India, with admission based upon merit and need. The workshop faculty consisted of 14 distinguished neuroscientists from the United States of America and a similarly distinguished group of 14 neuroscientists from India. The workshop itself had three basic educational components: lectures, lab practicum, and discussion groups. These components were interleaved with other group activities that were largely social in nature and intended to promote discussion and informal interactions between students and faculty.

Astronomy with Adaptive Optics on Moderate-sized Telescopes

22-25 August 2011, Pune, India

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Adaptive optics (AO) counteracts the severe blurring effect ("seeing") introduced by the Earth's turbulent atmosphere, when celestial objects are observed using telescopes. AO techniques have been successfully employed in astronomy for more than three decades now. However, large overheads and low efficiency still limit the applicability of AO on large telescopes for which operational costs per unit time are high. On the other hand, small and medium sized telescopes are many more in number and their operational costs are substantially lower. A reasonably powerful AO system, which works with minimal overheads and provides good sky coverage, will greatly enhance the scientific capabilities of small and medium sized telescopes by opening up the possibility of hitherto unavailable observational approaches. Caltech and IUCAA have entered into an equal partnership to develop an automated, affordable and efficient AO system suitable for use on 1-3m class telescopes.

The Indo-US workshop on **Astronomy with adaptive optics on moderate-sized telescopes** initiated the process of forging collaborations between astronomers in India and the USA, for taking up novel and unique scientific explorations exploiting Robo-AO. Wide dissemination of the results from these studies would transform Robo-AO to an archetype for a new class of AO system for small and medium sized telescopes. In addition to exploring problems of mutual interest, the workshop helped identify new synergies in the resource pools and expertise available in the two countries so as to forge new initiatives in astronomical research and development.

Biocomputing

1-3 November 2011, Kolkata, India

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Bioinformatics is an area that entails many scientific and technological advances, realizable only through a concentrated global collaborative effort. The primary objective of the Indo-US workshop on **Biocomputing** was to provide a common platform for exchanging ideas/hypotheses and to initiate and catalyze dialogues for developing long-term research and educational strategies in the field of bioinformatics for the two countries. The workshop brought together domain experts from India and the US to create a forum which would act as a focal point for engineers, scientists and academics, to exchange views, develop curricula and improve the quality of research in the area of bioinformatics for the benefit of both countries. The workshop focused on the following aspects: gaining exposure to research developments and research problems in the field through expert talks and discussions by eminent researchers and academicians; identification of important research issues of common interest with scope for collaborative research; formulation of strategies for curriculum development incorporating latest advances in the area of bioinformatics for engineering students and scholars; drafting policy suggestions for the Indian and US governments to achieve closer bilateral collaboration in the field of bioinformatics; and, catalyzing the exchange of scholars and transfer of bioinformatics technologies between institutes/ universities of both nations.

The workshop consisted of thirteen expert lectures by eminent researchers both from India and USA on various aspects of Biocomputing such as computer aided drug discovery, role of bioinformatics in designing therapeutic peptides, computational tools for genome sequencing and analysis, disordered proteins, biomarker discovery, systems biology and literature mining.

The major outcome of the workshop is the International center of excellence on Biocomputing which has been set up at NIT Calicut. This center is organized jointly by the Department of Computer Science & Engineering and School of Biotechnology, NIT Calicut and School of Informatics, Indiana University-Purdue University Indianapolis IUPUI, USA.

As a result of the interactions during the workshop, the following joint projects were identified among the participating institutions: *computational modeling and analysis of biological processes* (NIT Calicut and National Center for Biotechnology Information, USA); *protein disorder in the indegenic regions* (Symbiosis International University, Pune, Madurai Kamaraj University and Indiana University School of Medicine); *E-cell development and text mining* (Symbiosis International University, Pune and IUPUI, USA); *text mining across text lines* (Bharathiyar University and IUPUI, USA); *cyanobacteria* (IIT Bombay and IUPUI); *molecular informatics- developing chemical dictionary* (NCL, Pune and IUPUI); *miRNA interaction with protein disordered region* (Indian Statistical Institute, Calcutta and IUPUI); *WNT -signalling* (Indian Statistical Institute and IUPUI); *structural and functional analysis of VPG in intrinsically disordered protein* (Madurai Kamraj University and IUPUI); *evolutionary aspects of disordered protein* (Bose Institute and IUPUI); *binding prediction of disordered protein* (Bharathidasan University and IUPUI); *drug designing based on protein-protein interactions* (Nizam College and IUPUI); and, *prokaryotic linear motif discovery* (Madurai Kamraj University and IUPUI).

Women in Science

12 September 2011, New Delhi, India

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The US and India have a strong history of scientific collaboration, and both countries have produced many preeminent women scientists and science policy makers. Yet, despite these achievements, women in both countries still face significant socio-cultural and institutional challenges to achieving their full potential in science-related careers. To address these issues, the one-day US-India workshop on **Women in Science** followed by a US-India roundtable meeting on *Women in Science Issues* with experts from both countries, enabled a dialogue on the topic of empowering women in science and generated concrete suggestions to improve opportunities in the workshop's three key focus areas – science education for girls, success stories by women achievers, and promoting access to technology and interest in science education for women in rural areas. This conference addressed three major areas of the strategic US-India relationship: Science and Technology, Education, and Women's Empowerment. The workshop brought together approximately 200 participants from the US and Indian governments, industry, research institutions, NGOs, and academia.

Blair Hall (Minister-Counselor for Economic, Environment, Science and Technology Affairs, US Embassy) opened the inaugural session discussing the importance of science and technology and noted that the challenges women in India face are global challenges. T. Ramasami (Secretary, Department of Science and Technology, Govt. of India) discussed the competing priorities women have of home-making and nation building. He looked to the critical role government can play in promoting women in science through a sound policy framework. Shirley Malcom (Head, Education and Human Resources, American Association for the Advancement of Sciences) discussed the challenge of finding local solutions that link science and technology to the issue women face daily such as health, water, and food security.

Vinita Sharma (Advisor, Department of Science & Technology, Govt. of India) discussed the progress the government of India has made in promoting women in science, and praised the increasing numbers and success of women in the private sector science-based industries including the areas

of pharmaceutics, software development, and biotechnology.

At the US-India roundtable meeting, Blair Hall and Arabinda Mitra (Head, International Division, Department of Science & Technology) convened the discussion of key action items from the workshop deliberations and US-India bilateral collaborative opportunities on women in science issues. The roundtable participants suggested various areas for joint programs between the two countries. Participants suggested training programs on quality systems and leadership, and mentorship workshops on topics such as writing good research proposal practices. Some participants suggested collaboration of universities and colleges on both sides to ensure international exposure of students in respective countries, and facilitate visits of women scientists from both countries. Others expressed interest in joint programs on solution-oriented science in the areas of water, health, energy, and indoor air pollution.

Development and Use of Molecular Markers for Crop Improvement

29-31 October 2011, New Delhi, India

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DNA marker technology is changing at a very fast pace. A shift from PCR/gel/capillary based system to sequencing based systems is already underway. The use of molecular markers in genomics and genetic studies has been common for the last 2-3 decades but their use in crop improvement especially in cultivar development has been slow to come especially in the public sector.

The Indo-US workshop on **Development and use of molecular markers for crop improvement** was precisely designed to (i) share the experience of the scientists from the two countries, (ii) explore possibilities of future collaboration for harnessing the benefits of the emerging technologies for crop improvement, and, (iii) provide an opportunity to younger scientists and students to learn about the current and emerging technologies in the area of the symposium.

Nanomedicine: Prospects and Challenges

14-15 November 2011, Mumbai, India

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"Nanomedicine" or the exploration of medical applications of nanotechnology, is evolving from laboratory research to clinical applications, particularly in the areas of imaging, diagnostics, drug delivery, and monitoring the response of therapy and disease progression. Nanotechnology is expected to dramatically change the way disease is detected and treated, with implications for personalizing management strategies in clinical practice, patient-physician communication, and outcomes measurement.

The purpose of the Indo-US symposium on **Nanomedicine: Prospects and Challenges** was to bring together experts in the field of nano-drug delivery, nanomedicine, nanobiotechnology and allied areas on a common platform for intense deliberation on nanomedicine. Nanomedicine for cancer, infectious diseases and targeting to the brain, including the relevant biology and drug delivery approaches scale up and nanotoxicity issues were discussed. The myriad applications of nanomedicine and the means to surpass challenges were also deliberated. A poster session on nanomedicine showcased research in this important field being carried out in India. Senior, eminent scientists and research students representing Indian industry, institutes and universities working in nanomedicine across the country participated in the symposium.

Space Weather Studies

28 November - 1 December 2011, Goa, India

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Extremely Low Frequency (ELF, 30-3000 Hz) and Very Low Frequency (VLF, 3-30 kHz) waves are powerful tools for remote sensing of dynamic processes in the ionosphere and magnetosphere. ELF-VLF waves have their origin in a wide variety of both natural (eg. lightning discharges) and man-made (eg. VLF transmitters) sources. For the past several decades, satellite and ground-based observations of whistlers and VLF emissions all over the globe has been used as an important diagnostic tool to understand the process in the complex ionosphere and magnetosphere. Advancing VLF science through the Global Atmospheric Weather Electromagnetic System for Observation, Modeling, and Education (AWESOME) network concentrates on some of the key issues involved in space weather studies through observations of VLF waves across the global AWESOME VLF sites.

The Indo-US workshop on **Space weather studies** focused on a wide variety of VLF-related phenomena, induding lightning, solar flares, gamma rays, electron precipitation, and earthquakes. The workshop also addressed innovative methodologies for analysing VLF data and extending local VLF studies to global initiatives. The sessions gave researchers an opportunity to develop collaborative research initiatives with other VLF scientists. Detailed tutorial sessions were also held, with the end goal being scientific publications. The scientific sessions during the workshop was broadly categorized into four categories related to results on (i) lightning discharge and related ionospheric perturbation (ii) broadband magnetospheric VLF phenomena (iii) narrowband VLF phenomena, and (iv) space weather.

Frontiers in Liquid Atomization and Spray Systems

10-12 December 2011, Chennai, India

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The Indo-US workshop on **Frontiers in liquid atomization and spray systems** was an effort to spark joint research in liquid spray systems and atomization using a bilateral technical conference as the seed. Spray and atomization systems are the basis for several engineering activities including power generation, aviation, ground transportation, painting/coating, pharma/medicine, materials processing, and agriculture. While research and development in both academia and industry in the US is at an advanced stage, the same is not true for India. This conference helped rectify that deficit by identifying several avenues for collaborative research that will advance the scientific knowledge and technology bases for spray-related industries in India. An important feature of this conference was the participation of industry R&D personnel. The United States is by far the world's biggest commercial producer and consumer of spray and atomization systems. The presence of industrial personnel at this conference facilitated the exchange of ideas with academic researchers so as to allow all participants to tailor their future research towards industry-specific solutions.

The technical presentations were representations of the state-of-the-art as well as outlining current research results. Some highlights of the novel research results included the following : a novel CFD methodology for modeling primary atomization, research into applications of vegetable oils in IC engines, and, application of rigorous multiphase modeling approaches to sprays. Discussions at the event were focused on three areas – gas turbine applications, IC engine sprays and fundamentals of liquid atomization.

A book of abstracts has been generated from the abstracts submitted to the conference. The workshop was also archived in the form of videotapes which is available in the public domain, as appropriate. **In addition, several joint publications are also expected which will outline the state-of-the-art in the respective areas and will be included in a set of special issues of the International Journal of Spray and Combustion Dynamics.**

Nanoparticle Assembly: From Fundamentals to Applications

15-19 December 2011, New Delhi, India

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The last decade has seen a rapid expansion of synthetic methodologies for controlled production of nanoparticles with specific size, shape and functionalities. While intermolecular forces, such as dispersion, short-range repulsion, electrostatic, bonding and solvophobic forces are reasonably well-understood on the atomic scale; extrapolation of these forces to the nanoscale is not always trivial. Moreover, many applications depend upon creating appropriate two- and three-dimensional assemblies of nanoparticles. The synthesis of such nanostructured materials in amounts necessary for technological applications requires some variants of self-assembly, under either equilibrium or non-equilibrium conditions, and possibly directed by external fields or substrate templates.

The Indo-US workshop on **Nanoparticle assembly: from fundamentals to applications** focussed on new advances in the production of nanoparticles with controlled surface chemistries, the development of novel methods for characterizing the multiscale structure (and dynamics) of the assemblies, and related theory and simulations. The workshop brought together experiments, theory and simulations centered on the theme of nanoparticle assembly, hoping to catalyze the development of novel, globally relevant technologies particularly germane to the Indian subcontinent, i.e., energy, environment and sustainability industries. These applications are of particular relevance to emerging nations, such as India, due to their relatively large needs in these areas, especially those that can be developed with the smallest possible environmental footprint. The meeting highlighted interdisciplinary perspectives from engineering, chemistry, physics and biology were on synthesis, characterisation, simulations and theoretical approaches focusing directed and self-assembly in organic (e.g. liposomes, peptide-based structures), hybrid inorganic-organic (e.g. gold-DNA etc, gold-thiol, semiconductor-ligand) and polymer nanocomposite materials. A number of interesting applications were illustrated, including the oil emulsification and detection of surface defects.

Application of Molecular Marker Technology for Rapid Development and Delivery of New Crop Varieties for Enhancing Food and Nutritional Security in India

3-9 December 2011, New Delhi and Jalna, India

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Enhancing agricultural productivity on a sustainable basis is a key priority of the Governments of India and the United States for ensuring long-term food security and economic growth. With the intensification of agricultural systems during the past five decades, and the key emerging issues such as dimate change, depleting soils, biodiversity and water resources, the world is faced with a challenge of stagnating and declining yields and agricultural productivity of staple crops threatening long-term food and nutritional security. An exciting new wave of modern biotechnology tools such as molecular marker technology offers a great opportunity for enhancing the agricultural productivity through rapid and efficient crop improvement programs. Molecular plant breeding offers a unique opportunity to speed up the development and delivery of new and improved crop varieties that can address the multitude of biotic and abiotic stresses faced in the agricultural sector such as drought, salinity, heat and cold tolerance and pests and diseases. Unlike the products of genetic engineering, molecular marker technology is not controversial, less expensive and is utilized by both the public and private sector.

Building on more than 20 years of experiences in biotechnology capacity building, Michigan State University and The Energy & Resources Institute (TERI) came together with IUSSTF support to organize an Indo-US workshop on **Application of molecular marker technology for rapid development and delivery of new crop varieties for enhancing food and nutritional security in India.** Around 40 participants from various public and private sector institutions in USA and India participated in this workshop to share and exchange information, tools and research experiences in the application of molecular marker technology in plant breeding and crop improvement programs for food security and high value crops. The workshop also provided hands-on experience in the application of cutting-edge molecular marker technology and tools for the improvement and rapid breeding of field, fruit and vegetable crops of mutual interest. A highlight of the workshop was for the participants to observe plant breeding in action at both the *Rasi Seeds Company* as well as at the *Bejo Sheetal Seeds* Company in Jalna.

Given the importance of improving the efficiency of plant breeding programs, participants of the workshop wanted to develop a strong network amongst themselves to further enhance the research and teaching in the area of molecular plant breeding.

Virtual Institutes for Computational and Data-enabled Science & Engineering

21-22 December 2011, Bangalore, India

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Data-intensive and date-centric computing will be at the fore-front of research in this decade. The objective of the Indo-US workshop on **Virtual institutes for computational and data-enabled science & engineering** was to explore opportunities for synergy and collaboration in the area of Computational and Data-Enabled Science and Engineering (CDS&E). The longer term goal was to establish a virtual institute that will provide a hub of excellence in CDS&E and catalyze new thinking, paradigms, and practices in STEM research and education. Leading researchers and industrial leaders from the US and India participated in the event. There were presentations and panel sessions on the main research directions in three major areas, namely *computational mathematics & statistics, data-intensive computing & astrophysics,* and *cyberinfrastructure,* by researchers from the universities, national labs and industrial labs in US and India.



The major recommendations of the event included a proposal to produce a whitepaper (concept paper) on cyberinfrastructure which could be used a base for a proposal on a *Virtual Institute for Cyberinfrastructure;* a proposal to organize a set of summer schools and virtual meetings on HPC system administration, software managements, sharing of best-practices and expertise; and evolving a proper roadmap for the VI-MSS (Mathematics and Statistics) programme once a joint Indo-US Steering Committee is in place.


Large-scale Data Analytics and Intelligent Services

18-20 December 2011, Bangalore, India

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The Indo-US workshop on **Large-scale data analytics and intelligent services** was intended to bring together major software analytic and service providers from India and the US, together with their customer firms and users of their technologies, and leading researchers from universities in the US and India. The major theme was to focus on analytic methods and machine learning, including those bundled with intelligent services and data/text mining and information retrieval and extraction. This was in the context of application areas such as business analytics and services, healthcare, educational technologies, e-governance, homeland security, energy analytics, and others. The intent was to review the state of the art research-based technologies and define new needs and directions that require cutting edge research.

The overall scope of the workshop was to define the key analytic techniques and methods in this area, in the context of several verticals (business and financial services; healthcare; computational biology; search and advertising; energy, oil and gas; IT and data centers; homeland security; software engineering; IP and law; intelligent transportation; smart cities; smart structures and smart environments; and educational technologies). The intersection points are many, between the very many horizontals (machine learning, including dynamic mechanisms with learning; large-scale data mining with massive data sets; data, text, image, video, multimedia analytics; statistical natural language processing; semantic mining, analytics, and search, incorporating concepts, entities, relations; information retrieval and extraction, summarization including cross-language IR; opinion mining and sentiment analysis; dynamic bayesian recommender systems and social networks; and, large-scale computing, storage infrastructure and cloud analytic) and the equally large number of verticals, and define research topic areas which the centers can pursue. Consequently, during the workshop, indicative subsets of these were covered. The intent was to learn about industry needs, mutual interest, and then develop a collaborative agenda to address the open spaces and gaps.

Cellular and Molecular Medicine: Cancer, Stem Cells, and Inflammation

5-7 January 2012, Vellore, India

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We are now at a watershed in molecular medicine where the rapid advances in cellular and molecular biology of the last few decades can be linked to an unprecedented amount of sequence information from human disease subjects obtained from powerful next generation sequencing approaches. Communication and collaboration between investigators in the US and India in the context of this exciting era was the goal of this symposium on **Cellular and molecular medicine: cancer, stem cells, and inflammation.** The four goals of this event were: a) To make available to a broader Indian audience of basic science investigators, biomedical investigators, health care professionals, graduate students and medical students, research findings from leading laboratories in India, the US and elsewhere; b) To foster discussion and collaboration between investigators in India and investigators in the US, and also provide broader insights about the close links between basic science and translational research; c) To communicate basic knowledge about basic science and molecular medicine to medical and graduate students in a one-day primer linked to the symposium; and, d) Make science accessible to the general public in India and this was accomplished by two open plenary lectures by Nobel laureates.

Two major recommendations that stemmed out of this event were: (i) To create a *train-the-trainers* type of event where a structured kind of teaching is imparted to medical college basic science teachers to enhance the quality of teaching in our medical colleges; and (ii) To accelerate efforts to create MD-PhD programs in the country in order to create a cadre of physician-scientists. As an outcome of this event two joint projects were identified: one involving the University of Washington (Seattle) and CMC Vellore to generate a clinical trial, based on research findings at Seattle, to shorten the duration of treatment for patients with pulmonary tuberculosis; and another one to develop biomarkers to identify intestinal inflammation in early childhood as a predictor of long term growth and cognition between CMC Vellore and Tufts University (Boston, USA).

Looking Within: Interdisciplinary Approaches to Consciousness

5-7 January 2012, Bangalore, India

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Consciousness studies is an important scientific discipline that is emerging as one of the most significant areas of cutting edge research and would have a revolutionary impact on many fundamental concepts that we have today in brain sciences and physics. The Indo-US conference titled **Looking within: interdisciplinary approaches to consciousness** discussed merging areas of research in the country that included brain sciences, cognitive neuroscience, quantum neuro-physics, and neuropsychiatry. The conference educated students and researchers on the current debates in the field and helped identify new problems of research interest. The conference focused on three themes and dedicated one day each for the three focal areas: neurophysics, quantum mechanics, artificial intelligence; animal consciousness and cognitive neuroscience; and self in neuropsychiatry, neurophenemenology and neurophilosophy.

Nanophotonics and Nanoplasmonics

9-12 January 2012, Bangalore, India

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Nanophotonics and nanoplasmonics have recently emerged as exciting and promising areas of research with the potential to provide solutions to various challenges in energy, communication and IT in the near future. Research in this area is beginning to gather momentum and has developed very rapidly in the US and India. As a result, collaborative research between scientists from these two countries can be mutually beneficial and keeping this in mind an Indo-US workshop on **Nanophotonics and nanoplasmonics** was organized. This event brought together top scientists from the United States and India to interact and exchange ideas on the present status and future prospects in the field. The conference addressed recent technological advances in these fields of that are of great importance to both countries, such as energy, communication and information technology, and bio-medical technology.

As an outcome of the workshop, the following three joint projects were formulated: *Ultrafast plasmon-semiconductor coupling in copolymer environments* (Jaydeep Basu, IISc and Gary Wiederrecht, Argonne National Laboratory); *Electric field enhancements and other properties of metallic dimers* (George Thomas, IISER Thiruvananthapuram and Stephen Gray, Argonne National Laboratory); and, *Photoluminescence of quantum dot/metal nanoparticle systems* (Jaydeep Basu, IISc Bangalore, Stephen Gray, Argonne National Laboratory, and Alexander Govorov, Ohio University).

Integrated Vehicle Health Management (IVHM) and Aviation Safety

9-10 January 2012, Bangalore, India

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Current generation aircrafts are complex systems and the next generation aircraft designs promise to be even more advanced. They will be equipped with the technologies to predict in real time, the onset of a fault, facilitate isolation and diagnosis of the fault, minimize the false alarms and enable prognosis of the subsystem/system life while accurately indicating the mission life at any instance continuing with the onboard faults, if any. Integrated Vehicle Health Management (IVHM) is an interdisciplinary area being pioneered by NASA involving academia, industry and researchers. It deals with the ever increasing complexity in aircraft system on one hand and a compulsion to have cost-effective maintenance on the other by incorporating the health management philosophies right at the design process. This facilitates an integrated maintenance and logistics system that supports the equipment throughout its life time.

The Indo-US workshop on Integrated vehicle health management (IVHM) and aviation safety was an important step to take the S&T cooperation to a newer level by networking the researchers, academia and industry of both the countries on a focused and extremely vital domain. The theme of the workshop was the development of IVHM methodologies, architectures, and technologies for aerospace applications. This addressed both sensors and diagnostic & prognostic algorithms development.

The two major recommendations of the event were: (i) Formation of a core group of IVHM professionals in the country by drawing strengths from various organizations (comprising academia, R&D and manufacturing etc.,) and creation of an IVHM Center that will cater not only to aerospace but also to other domains, e.g., industrial and automotive health; and (ii) Analysis of legacy flight data from various airlines and predict the future anomalies that affect flight operations.

Frontiers of Excellence in Photovoltaic Science and Technologies

15-17 January 2012, Mumbai, India

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The Government of India is committed to increasing power generation from renewable sources, especially solar photovoltaic (PV) technologies. This commitment has been clearly spelt out in its national action plan and the national solar mission statement. Similarly, the US has been giving tangible support and encouragement for solar PV development and deployment. In view of the critical importance of this area of research and development, an Indo-US workshop on **Frontiers of excellence in photovoltaic science and technologies** was organized. The workshop brought together researchers, scientists and technical experts from academia and industry, from India and the United States. The event helped benefit research, development and deployment of solar PV technologies in the immediate future in both the countries.

As part of the plenary talks, Prof. Anil Kakodkar emphasized the importance of harnessing solar energy and suggested that concentrated solar cell technology should also be looked at as a viable option; Prof. A.K. Barua gave an example of successful industrial implementation of amorphous silicon solar technology in the Indian context; and, Dr. Minh Le shared the perspective of the Department of Energy of the USA on solar and key problems they would like to get resolved for the deployment of PV technologies.

The following recommendations were made at the end of the workshop: silicon based PV technology continues to have lots of room for innovation; encourage use of earth abundant material for PV fabrication for long term viability and sustainability; use of low-cost (including atmospheric) processing techniques that may be particularly relevant to Indian conditions; use of nanostructures as an important route for increased solar cell efficiency and stability; and, efficient tackling of stability issues in organic solar cells for them to find commercial applications and innovations continue to increase the cell efficiency.

Intraplate Seismicity

16-18 January 2012, Gandhinagar, India

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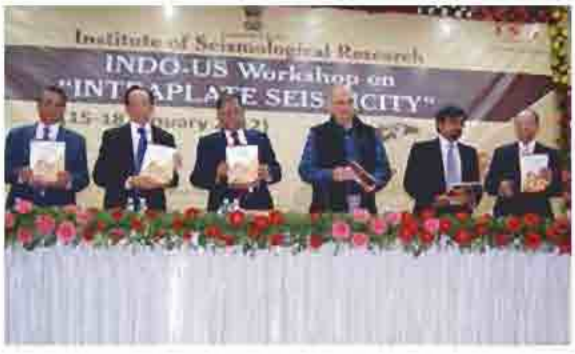

The scientific issues associated with the earthquakes that strike away from active plate boundaries are of paramount importance for understanding earthquake hazard in both India and the United States. The Indo-US workshop on Intraplate seismicity included lectures on **intraplate seismicity**, seismic hazard, and tectonic models, with emphasis on key recent theoretical and observational advances, as well as identification of key data sets that could be collected and/or made available to address outstanding issues. The workshop aimed to take stock of Intraplate seismicity studies in the US and India and come out with future directions to better understand key remaining questions, including: faulting and seismicity in continental intraplate regions; recent intraplate earthquakes: source parameters and effects; long term behaviour of faults and earthquake hazards in intraplate continental regions; paleoseismology and archeoseismology; crustal structure and processes; the new Madrid and Kachchh seismic zones; and, strain accumulation inside continents.

During the workshop, participants discussed potential collaborative projects to further investigate key remaining questions about intraplate earthquakes, including which regions are most at risk of damaging earthquakes, the average long-term rate of large earthquakes in different regions, and the overall scientific framework to explain why intraplate earthquakes occur. Specific targets for collaborations were identified, including projects to better understand the geological setting of the Kachchh region; the on-going deformation of the crust in Kachchh and elsewhere in India; the rates of past earthquakes as revealed by geological investigations; and the space-time distributions of aftershocks and other activity in Gujarat.

Nanoscience and Technology

20-23 January 2012, Hyderabad, India

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Nanoscience and technology has captured the imagination of the research fraternity worldwide as no other discipline has in the past. Consequently, the field has witnessed extremely rapid growth in recent times with an accompanying spurt in the pace at which new research findings are being reported.

Due to its interdisciplinary nature, nanoscience and technology attracts the attention of chemists, physicists, biologists, materials scientists and engineers alike. Consequently, significant nano-related research is already on-going worldwide and expert groups with immense competence in niche areas have emerged in both India and the US. However, it is abundantly clear that judicious establishment of cross-continent teams to meet identified targeted objectives that are accorded a high priority by both sides has considerable potential to not only hasten progress towards accomplishing the set goals but also result in saving of resources through sharing of infrastructure and expertise to achieve a common aim. The Indo-US discussion meeting on **Nanoscience and technology** was organized to explore recent technology advancements in the field in the two countries that are of either immediate commercial interest or have promising future prospects in the industry.

The meeting clearly brought out the overwhelming feeling on both sides that there was considerable potential for Indo-US collaboration to derive synergy from complementary individual strengths in diverse areas related to nanotechnology. In particular, areas including energy systems, environmental systems, information systems and biomedical systems were considered to be attractive areas in which joint activities could be pursued. The participants also identified a number of issues that should ideally be considered to promote bilateral interactions.

Thermoelectrics – Theory, Materials and Applications

30 January - 1 February 2012, Mumbai, India

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Thermoelectric energy conversion is a process that facilitates utilization of waste heat and converting it into useful form of energy, such as electricity. Though this phenomenon has been known for several decades, this topic has recently received significant interest worldwide because 'Sustainability and Resources Conservation' have become issues of utmost importance. The energy conversion efficiency of the thermoelectric devices is at the heart of large-scale utilization of this phenomenon. Hence, the main objective of this workshop was to discuss various issues related to efficiency improvement vis-à-vis the current developments in materials for thermoelectric energy conversion including the role of nanoscience and technology.

The Indo-US workshop on **Thermoelectrics – theory, materials and applications** aimed to sensitize various organizations and the research community at large. The workshop was a first-of-its-kind in the area of thermoelectrics in India and the speakers included theoreticians, researchers from university and federal laboratories and industry participants who are involved in materials development for different applications. Several new approaches for synthesizing thermoelectric materials such as creating new type of crystals (ferecrystals), solution phase synthesis, controlled devitrification, alloy engineering and utilizing 'nano' features, all to realize high figure of merit were discussed during the course of the workshop.

The Evolving Role of Solid-state Chemistry in Pharmaceutical Science

2-4 February 2012, Gurgaon, India

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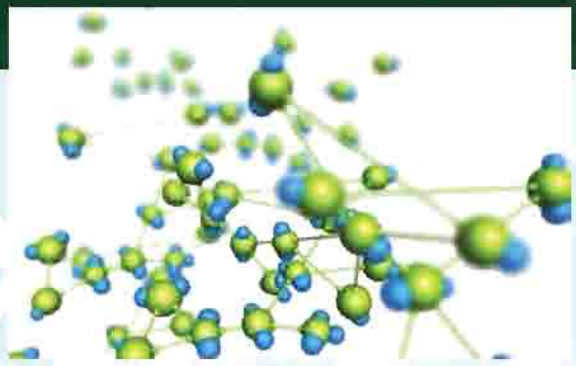
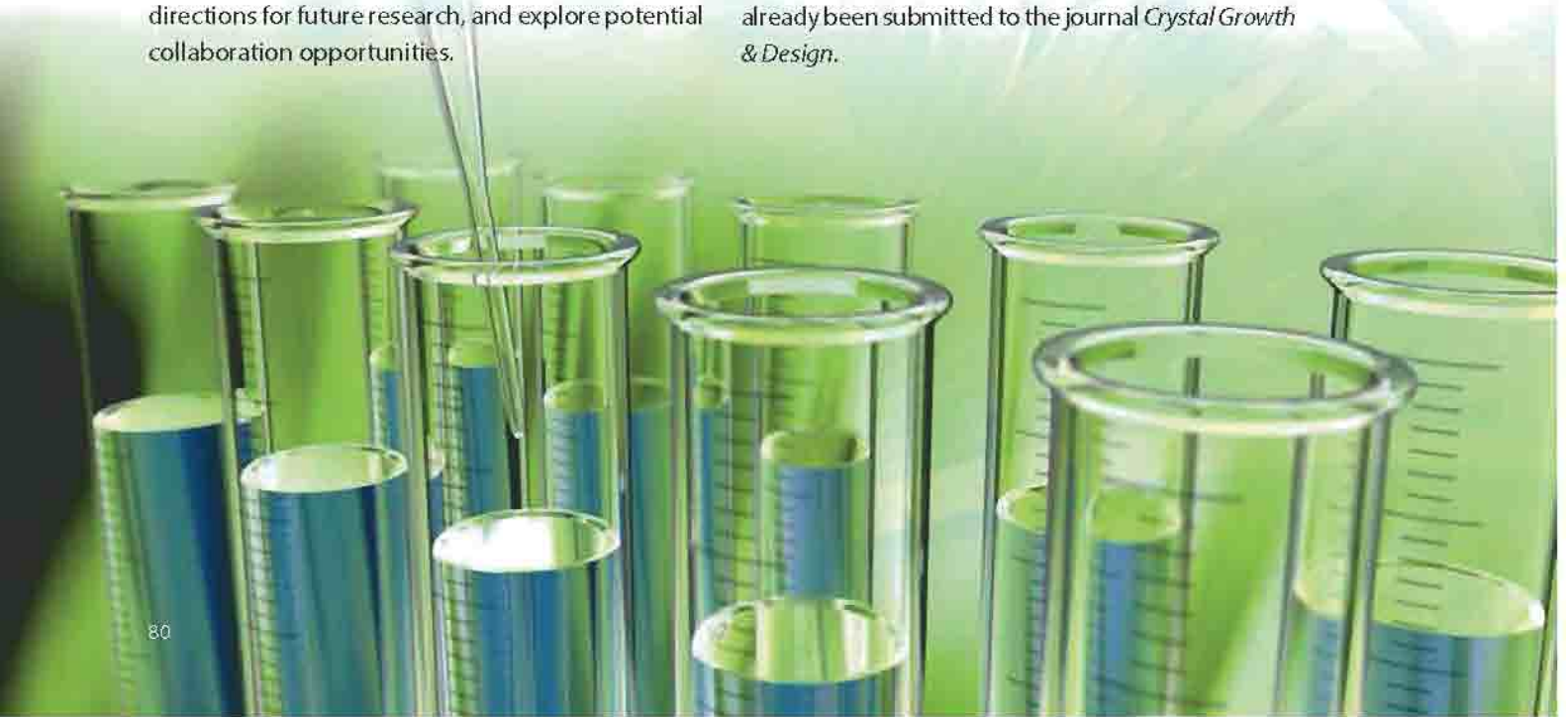


Differentiating a co-crystal from a salt, scaling up of active pharmaceutical ingredient co-crystals, stabilizing meta stable polymorphs, predicting polymorphs for a given active pharmaceutical ingredient from its molecular structure, predicting the solubility of co-crystals, and developing robust scalable crystallization processes to minimize batch-to-batch variations are some of the major challenges faced by researchers world-wide. There are a significant number of researchers in both India and the US who are working on the above mentioned facets of solid-state chemistry research.

The purpose of the workshop on **The evolving role of solid-state chemistry in pharmaceutical science** was to bring together the researchers from academic institutions as well as pharmaceutical R&D in India and the US to share their expertise on crystal design, crystal nucleation, crystallization and crystal growth and other facets of solid-state chemistry to set directions for future research, and explore potential collaboration opportunities.

The December 2011 release of a draft Food and Drug Administration (FDA) guidance concerning regulatory classification of pharmaceutical co-crystals of active pharmaceutical ingredients (APIs) addressed two matters of topical interest to the crystal engineering and pharmaceutical science communities. An entire session at the workshop was devoted to the FDA guidance and it generated strong consensus on the need to define co-crystals more broadly. It was also concluded that the diversity of API crystal forms makes it difficult to classify solid forms into three categories that are mutually exclusive. An article detailing this perspective has already been submitted to the journal *Crystal Growth & Design*.



Ataxia Telangiectasia

7 February 2012, New Delhi, India

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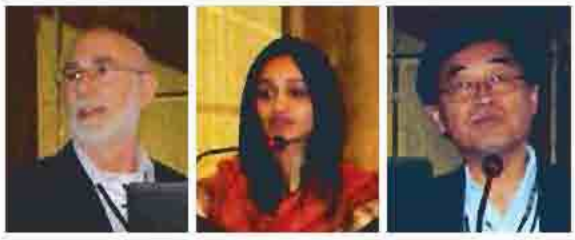
Ataxia telangiectasia is a rare, genetic immunodeficiency disease that affects multiple organ systems and is characterized by neurodegeneration and cancer predisposition. The objective of the symposium on **Ataxia telangiectasia** was to bring together basic and clinical researchers working on various aspects of the clinical and cellular phenotypes of ataxia telangiectasia mutated gene to understand its role in neural differentiation and neurodegenerative disorders, NA damage response and genomic instability as well as cancer, in a comprehensive and stimulating atmosphere to promote scientific interactions, discussions and cross-disciplinary



research collaborations. The symposium also allowed for young scientists like students, post-doctoral fellows and young clinical researchers to gain exposure to the current status of knowledge in this field and also provided them the opportunity to present their work.

Cardiovascular Research Convergence

17-18 February 2012, New Delhi, India

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The conference on **Cardiovascular research convergence** was aimed at providing a common platform for clinicians, scientists and researchers from both USA and India to acquire knowledge, exchange ideas and form fruitful collaborations for undertaking translational research in cardiovascular sciences. The conference provided the opportunity for a comprehensive overview of the latest research developments in cardiovascular therapeutics; heart failure; rheumatic heart disease; atherosclerosis and coronary artery disease; experimental cardiology; stem cell research; proteomics; cardiovascular epidemiology; and, research methodologies for interdisciplinary and translational approach.

The conference began with a Presidential address by Prof. James T. Willerson on "Update on adult stem cell treatment of coronary heart disease and severe heart failure in humans". This was followed by fifteen sessions with specific themes and speakers presenting their work and new ideas. The new developments presented at the event included an update on stem cell therapy; panel discussion on cardiac transplantation; and, ethical concerns in research, proteomics and genomics of cardiovascular diseases.

Global Challenges: Climate Change, Water, Environment and Society

5-6 March 2012, Gurgaon, India

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In recent years the global issue of climate change and its impact on the environment, glaciers melt, spatial and temporal change of precipitation both on global and regional scale has become more visible. Globally, a changing climate will present challenges for some sectors, and opportunities for other sectors. The problem of water and environment are intertwined and these problems will continue to grow globally. An Indo-US workshop on **Global challenges: climate change, water, environment and society** was organized to bring together educators, researchers, social scientists, practitioners, planners, managers, administrators and policy makers to discuss the problems related to the sustainable management of water resources in light of population increases, climate change, land use change, and increasing water withdrawals.

The workshop was interdisciplinary in nature and discussed the challenges related to water and environment for the 21st century with the following specific objectives: water and environment problems and their solutions; current state of understanding of watershed technologies and water resources; interdisciplinary problems, approaches and solutions through theoretical frameworks and models; social issues related to water and environment problems; and, research directions for a sustainable future.

The delegates noted that there was a need to investigate the causes of change in sunshine hours and their regional perspective to delineate the comparative impact of climate change as well as of anthropogenic aerosols that are being generated locally and /or regionally at different rates by the changed land-use pattern and increased polluting mechanism, such as socio-economic change, industrial growth and ill-planned development processes. They also opined that the lack of observed data for the various parameters to model the physical processes is limiting models from providing robust projections of the water potential of river basins in response to climate change. There were also expressions of concern regarding the impact of climate change on glacier-fed water systems, agricultural yields, and freshwater ecosystems.

Modelling Electrical Activity in Physiological Systems

5-10 March 2012, Agra, India

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The Indo-US workshop on **Modelling electrical activity in physiological systems** was aimed at introducing participants to the techniques and concepts of mathematical and computational modelling of the electrical events underlying neuron and endocrine cell activity. The events are important for the proper functioning of brain and endocrine cells, and thus to physiological processes controlled by the brain and by hormones released from endocrine cells. Speakers at the event included both theoretical and experimental scientists from the United States and India. The aim was to facilitate scientific interactions that would yield collaborative programmes between India and the US in the area of electrical processes underlying neural, endocrine, and neuroendocrine systems.

A mixture of mathematical and experimental developments was presented at the workshop. One important new mathematical development was the use of linear algebra techniques to greatly reduce the complexity of a neural model. Another was the development of a mathematical model for insulin-secreting cells and a novel technique for analysing the behaviour of the model. New techniques for analysing models of bursting behaviour, as well as experimental measurements of bursting behaviour, were also discussed. An interesting model that can describe the evolution of uterine oscillations before childbirth was presented. From the experimental side, recent developments used in studying the vast communication that goes on within and between hormone-secreting pituitary cells were presented, as well as some novel approaches to testing hypothesis about rhythm generation in pancreatic islets. Imaging of electrical activities in brain using three-dimensional Magnetic Resonance Imaging techniques with improved analytical methods was also discussed. Development of collaborative strategies between theorists and experimental biologists were illustrated at several points throughout the workshop.

Biosecurity and Public Health Challenges in Veterinary Hospitals in India – Bridging the Gap Between Human and Animal Health

5-8 March 2012, Hyderabad, India

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Biosecurity and infection control strategies in veterinary hospitals play a significant role in providing a safe environment to veterinary patients and in reducing the spread of nosocomial infections to animals as well as humans. Nosocomial infections or "hospital-acquired infections" are infections that are a result of treatment in a veterinary hospital or clinic. Nosocomial infections in veterinary hospitals are not solely a concern for patient-care, but the spread of infectious agents can also significantly affect normal hospital operations, revenue, client confidence, public image, and the morale of hospital personnel. There is a critical need to evaluate biosecurity and infection control practices in veterinary hospitals and to establish programs for carrying out the activities related to disease control. With this in mind, an Indo-US workshop on **Biosecurity and public health challenges in veterinary hospitals in India – bridging the gap between human and animal health** was organized to bring together experts from the US with Indian veterinarians and public health officials to collaborate on this important issue and raise the level of animal and human health for India.

The major recommendations of the event were as follows: (i) there is a need for periodical microbial surveillance in veterinary hospitals to get baseline data; (ii) measures to manage risks through infection control committees are recommended to monitor the physical standards; (iii) there is a need for training of staff to build awareness on "Biosecurity" in teaching hospitals and infection control methods on regular basis; and, (iv) need for continuous education on biosecurity measures and monitoring employee's health.

Preventing Road Crash Injury through Vehicle Safety Design

6-7 March 2012, Bangalore, India

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Fatalities and injuries caused by vehicle-related crashes are assuming menacing proportions in India. In USA, the total number of annual fatalities has stagnated in recent years after being reduced substantially from higher levels a number of years ago through the introduction of a range of safety measures including improving the passive safety features of vehicles.

The Indo-US workshop on **Preventing road crash injury through vehicle safety design** was aimed at addressing the challenging crucial issue of reducing and preventing fatalities primarily through sustainable and innovative vehicle passive and active safety design by bringing together experts from USA and India. Some of the topics of relevance covered at the symposium included statistical analysis of accident data and epidemiology of injuries; vehicle platform and system level crash safety design; crash safety design of vehicles; impact biomechanics and injury prediction; crash safety design optimization with multi-disciplinary constraints; design methodologies and algorithms; innovation in vehicle safety design; and, impact of road infrastructure, enforcement of safe driving practices, and driver education on road safety.

Green Chemistry for Environment and Sustainable Development

11-13 March 2012, Dehradun, India

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Green chemistry is the utilization of a set of principles that reduces or eliminates the use or generation of hazardous substances in the design, manufacture and application of chemical products. The Indo-US workshop on **Green chemistry for environment and sustainable development** presented the latest trends in the field of green chemistry. The workshop was a combination of lectures, discussions, and demonstrations. During the lecture sessions, speakers addressed the challenges and opportunities in green chemistry education. The participants deliberated upon strategies for designing, adapting and incorporating new green methods of synthesis.





Shale Gas

19-20 March 2012, New Delhi, India

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Shale gas belongs to the category of unconventional natural gases, which also includes coal bed methane, gas from tight sandstones and gas hydrates. Shale is a sedimentary rock formation which contains clay, quartz and other minerals. Much of the oil or gas formed in the shale which is known as source rock, being the source of the hydrocarbons migrates to porous and permeable beds.

The Indo-US workshop on **Shale gas** was aimed to provide a platform to use the experience of US to understand and exploit shale gas plays in India. The workshop participants deliberated upon the inherent reservoir rock properties for stable hole conditions; lateral and vertical communication resulting from the frac jobs; quality water required for Hydro fracturing and for multi stimulation jobs; well design and primary cement bond in old wells, surface facilities, fields under improved recovery processes, sophisticated equipment with knowledgeable skilled personnel; shale gas policies etc.

Both US and Indian representatives felt that consortia need to be formed to understand shale gas plays in India. Pandit Deendayal Petroleum University has also resolved to set up a Shale Gas Excellence Centre at their campus in Gandhinagar.

2nd US-India Network-enabled Research Collaboration Workshop

22-23 March 2012, Washington DC, USA

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The aim of the **2nd US-India network-enabled research collaboration workshop** was to drive network-enabled collaboration between research groups in India and the United States through innovative applications using advanced cyber infrastructure involving the national research and education networks in India (ERNET, NKN) and the US (Internet2, ESNet, NLR), the international circuits connecting the two countries (TransPac3 and TAJ), and other nation-wide cyber infrastructure facilities in India and the US.

The major recommendations of the event included the following: (i) evaluation of network infrastructure and advanced communications services; (ii) raise awareness on network-enabled access to and hosting of global research facilities and datastores; (iii) pay greater attention to the changing science architecture, explosion of availability of science data and making network-enabled collaboration intuitive to the user: and, (iv) raise awareness of the potential for Indo-US network-enabled collaboration.

TRAINING PROGRAMS

Advanced Training Course on Nutritional Epidemiology

5-9 November 2011, New Delhi, India

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The discipline of nutritional epidemiology involves methodological approaches to determine the association between dietary factors and the occurrence of human health-related outcomes which is a challenging task. Therefore, a multidisciplinary approach is needed to assess any relation between diet or lifestyle and disease occurrence. Nutrition epidemiology in India is at a very nascent stage and needs capacity and skill building. Limited evidence in the field of nutrition, health, diet and disease is resulting in improper implementation of policies and programs. To reduce this knowledge gap and its implementation through policies, nutrition research is needed so as to define measures to apply epidemiologic methods to nutrition including designing epidemiological studies, data collection, statistical analysis, interpretation of results and evaluation. With this in mind, an **Advanced training course on Nutritional Epidemiology** was organized

in New Delhi. The specific objectives of the program were to understand and define the domains of nutritional epidemiology; to apply and assess epidemiological methods in nutritional research; to differentiate and evaluate various study designs utilized in nutrition research; to critically appraise published research and policies in nutrition; and to develop policy recommendations based on critically reviewed evidence.

Major recommendations of the event included the following: need for addressing co-existence of dual burden of malnutrition in India through a strong nutrition policy and interdisciplinary partnerships; requirement for capacity building in areas of nutrition research methods, nutrition epidemiology and policy; need for greater investments in training a public health nutrition cadre; and, necessity for short term initiatives, collaborations, faculty exchange programs, trainings to contribute to effective policy decisions.

Winter School of Immunology

10-15 January, Jodhpur, India

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Developing countries like India have an obvious and serious need for improved vaccines against a variety of infections (such as malaria and tuberculosis). Cancer also remains a major health problem, and the limited access to chemotherapy and radiation emphasizes the importance of developing other approaches, such as immunotherapy. The rationale for the **Winter School of Immunology** was that Indians should be involved in solving the problems of India, and education has to be the foundation for building research and interest in any field, including biology and medicine.

The course provided an intense and thorough exposure to basic immunology, infectious disease immunology and cancer immunology. The major components of the course were didactic lectures, open discussions (including discussions of new

technologies), and clinical case discussions, over a period of 6 days. Prior to arrival at the course, the trainees were sent course schedule and were given copies of the presentation as a binder. A variety of interactive teaching strategies were employed within each day to enhance learning, such as lectures, round table discussions, individual meetings with the faculty members, problem-based learning tutorials and research seminars. The content in each session was designed to be integrated and to build upon a sound knowledge base in immunology. It was especially important to cover some of the basic aspects of immunology before focusing on infectious disease immunology, tumor immunology and biology, because many of the students did not have a good exposure or background in immunology. The major topics included antigen presentation, immune regulation, tolerance, T cell differentiation, infectious diseases immunology, cancer immunity, and vaccination. The participants received about 30 hours of direct classroom instruction, 6 hours of self-study, and 10 hours of individual contact time with the faculty members.

CENTERS FOR RESEARCH EXCELLENCE IN SCIENCE & ENGINEERING

Indo-US Centre for Research Excellence in Science and Engineering (CRESE) on Fabrionics

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University of Illinois, Chicago
University of Missouri, Columbia
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Central Mechanical Engineering Research Institute, Durgapur

With the emerging capabilities and rapid progress in the fields of molecular engineering, micro and nano-system technology, material science and computer engineering, the ability to manufacture micro- and nano- sized devices and autonomous machines will bring unprecedented changes in human society. The challenges are primarily a result of the current trend for miniaturization, development of new exotic nonmetallic materials and the lessons our scientists and engineers are learning from nature. Having identified and recognized this emerging new branch of technology through deliberations at the Indo-US Workshop on *Futuristic Shaping Technology at Meso, Micro and Nano Scales* held at IIT Kanpur in 2007, the participants coined the term "Fabrionics" to connote this multi-disciplinary facet of engineering sciences.

Based on the collaborative research and development work achieved under the umbrella of the earlier IUSSTF supported *Indo-US Joint Centre for Advanced and Futuristic Manufacturing*, a consortium was formed through the signing of an MoU by the five collaborating universities - IIT Kanpur; and IIT-Kharagpur from India along with the University of Illinois-Urbana Champaign; University of California-Irvine; and the Northwestern University-Evanston from USA. Considering the outcome and achievements of the Joint Centre on Advanced Manufacturing, IUSSTF awarded the *Indo-US CRESE on Fabrionics* in order to consolidate and continue the collaboration for by intensifying the academic cooperation through enlarging the participating group by inducting new institutions to bring in a multi-disciplinary expertise along with the active involvement of industry and entrepreneurs required to translate the R&D outcome. Each year, two workshops are organized – one in the US and one in India. Besides this, two lecture series for students have also been arranged that will result in books published by Springer. New smart materials for micro actuator, processes for micro forming and machining, different types of biosensors and some advanced nano- structured materials have already been developed.

The primary areas chosen for R&D project based work by the CRESE in Fabrionics include:

- New strategies/approaches for Fabrionics and shape generation through material manipulation at meso, micro and nanoscales;

- Fabrication at small scale using exotic materials-soft materials, bio materials, polymers, gels, composites etc;
- Fabrication and use of carbon Nanoelectromechanical systems (NEMS)/ Microelectromechanical systems (MEMS);
- Generative manufacturing processes-direct metal deposit techniques for micro sized parts;
- Shape generation by self assembly technique and self patterning;
- Micro fluidic-based micro devices;
- AFM based technology for mRNA isolation and protein sequencing;
- Smart material actuated micromechanism and micro devices;
- Protein motors for actuating autonomous nano robots and manipulators;
- Micro machine tools and micro factories;
- Hybrid multi-scale process development; and
- Developing the curriculum for joint teaching programs on "Fabrionics".

Research projects awarded

Consequent to the institution of the IUSSTF supported joint center has led to the following research projects getting funded to the respective partnering groups:

(i) *Characterization of μ-EDM* (PI: J. Ramkumar, IIT, Kanpur) funded by Department of Science and Technology, Govt. of India

(ii) *Development of multi-purpose micromachine tools for milling and EDM* (PI: Naga Hanumaiah, CMERI) funded by the Council of Scientific and Industrial Research, Govt. of India

(iii) *Magnetic field-assisted material removal in micro electric discharge machining process* (PI: S.G. Kapoor in collaboration with IIT, Kanpur and CMERI) funded by NSF for 3 years (2010-2013; $375,000.00)

(iv) *Laser-induced plasma micro-machining* (PI: K.F. Ehmann in collaboration with CMERI and IIT, Kapur) funded by NSF for 3 years (2010 - 2013; $411,808.00)

Patents filed

(i) Ghubade A., Mandal S., Chaudhury R., Singh R.K., Singh D., Gurunath R. and Bhattacharya S. Title of the invention: *Integrated di-electrophoresis based concentration of pathogenic bacteria and quantization using ImageJ.*

(ii) Singh R.K., Basu B. and Bhattacharya S. Title of the invention: *A novel 2/3-Dimensional Soft-lithography technique to formulate micro-channels and evaluation of various associated mechanical and biological phenomena.*

As an outcome of the Centre activities the following **research publications** have been already generated:

(i) Sharma C.S., Sharma A. and Madou M. (2010) *Multiscale carbon structures fabricated by direct micro-patterning of electrospun mats of SU-8 photoresist nanofibers.* Langmuir 26: 2218–2222

(ii) Ghubade A., Mandal S., Chaudhury R., Singh R.K. and Bhattacharya S. (2010) *Dielectrophoresis assisted concentration of micro-particles and their rapid quantitation based on optical means.* Biomedical Microdevices DOI: 10.1007/s10544-009-9316-6

(iii) Bhattacharya S., Singh R.K., Mandal S., Ghosh A., Korampally V., Bok S., Gangopadhyay K. and Gangopadhyay S. (2010) *Plasma modification of polymer surfaces and their utility in building Biomedical Microdevices.* Journal of Adhesion Science and Technology 1-32

(iv) Ray M., Basu T. S., Jana A., Bandyopadhyay N. R., Hossain S. M., Pramanick A. K. and Klie R. F. (2010) *Luminescent core-shell nanostructures of silicon and silicon oxide: nanodots and nanorods.* Journal of Applied Physics, 107: 064311

Indo-US Centre for Research Excellence in Science and Engineering (CRESE) on Advanced Materials Research

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With a continued push for miniaturization and the impending roadblock of fundamental physics constraints on the current silicon technology paradigm, there is an urgent need to diversify and enhance the back-bone technologies for the 21st century. This would require not only innovation in electronics but also in information storage, transfer and display to create science-enabled sustainable growth of a globally viable "eco-system" for developed and developing economies. Innovations in quantum materials/phenomena are critical to replace and/or complement existing architecture.

The Center for **Advanced Materials Research** (CAMR) has been anchored by the respective institutions' leadership in materials research, leveraged by established grass-root collaborations and cross-institutional bridge-building. The areas of collaboration being carried out cover broad emerging materials critical for advancing next generation information technology and include nanomaterials, soft matter, molecular electronics, structure- property relationships and computational modeling. The areas being studied are timely and have considerable potential for both advances in fundamental research as well as technological applications.

The objectives of the CRESE include the establishment of grass-root collaborations and cross institutional bridge – building initiatives as well as out-of-the box cyber enabled global education, training and outreach Programs. The centre also promotes the exchange of graduate students, post doctoral fellows and faculty members between partnering institutions.




The project period witnessed enhanced joint activities between JNCASR (and IISc) and Northwestern University with ANL representation. These activities have positioned the Joint Center for tangible output and scholarly initiatives. In addition to students and faculty exchanges, this project period included a vibrant and interactive joint workshop between Indian and US counterparts with representation from five major institutions from Israel as a part of India-US-Israel workshop that was held during March 23-25, 2011. The final details of access to ANL APS and ORNL SNS facilities for Indian scientists are being finalized and this would indude access to unique synchrotron (APS) and neutron (SNS) sources and associated tools/techniques to Indian scientists facilitated by the joint Center.

Research publications generated in 2011-12

(i) Dattatray J.L., Liu B., Ramakrishna Matte H.S.S., Rao C. N. R. and Dravid V.P. (2012) *Rapid characterization of ultra-thin layers of chalcogenides on SiO2/Si substrate.* Advanced Functional Materials, 22: 1894-1905.

(ii) Dattatray J.L., Liu B., Ramakrishna Matte H.S.S., Dravid V.P. and Rao C.N.R. (2012) *Hysteresis in single-layer MoS2 field effect transistors.* ACS Nano, DOI: 10.1021/nn301572c.

(iii) Dattatray J.L., Liu B., Liu J., Yan A., Matte H.S.S.R., Grayson M., Rao C.N.R. and Dravid V.P. (2012) *GaS and GaSe ultrathin layer transistors.* Advanced Materials, DOI: adma. 201201361.

(iv) Rao M., Ortiz R.P., Facchetti A., Marks T.J. and Narayan K.S. (2010) *Studies of photogenerated charge carriers from donor-acceptor interfaces in organic field effect transistors: Implications for organic solar cell.* The Journal of Physical Chemistry C, 114: 20609

(v) Gopalakrishnan K., Joshi H.M., Kumar P., Panchakarla L.S. and Rao C.N.R. (2011) *Selectivity in the photocatalytic properties of the composites of TiO2 nanoparticles with B- and N-doped graphenes.* Chemical Physics Letters, doi:10.1016/j.cplett.2011.06.033.

As part of the visitations under the CRESE, ten scientists from India visited their collaborators in the US and one US scientist visited their Indian counterpart institutions.

Indo-US Centre for Research Excellence in Science and Engineering (CRESE) on Nanobiotechnology

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Other Partners:
Harvard-MIT Division of Health Science Technology, Cambridge, Massachusetts

InStem, Bangalore

Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore

Two emerging areas that will dramatically impact medical sciences in the future are stem cell biology and nanotechnology. Although, these two areas are already intersecting, the interface between these areas offers an untapped niche for scientific exploration and inventions that will revolutionize translational medicine. This Centre for Research Excellence in Science and Engineering on nanobiotechnology brings together the strengths of groups at the National Centre for Biological Sciences (NCBS), Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) and InStem and the core expertise of Harvard-MIT Division of Health Sciences and Technology in material sciences and nanotechnology.

The Joint Centre has three major goals:

(i) Development of a strong research program elucidating the role of nanostructures in stem cell biology in the vascular context;
(ii) Development of a strong training component and exchange program; and
(iii) Aggressive pursuit of translation of technology developed by promoting an entrepreneurial culture and partnerships with the industry.

Specifically as the research component, the focus is on the mechanistics underlying the recruitment and differentiation of stems cells into vascular structures, and the development of novel nanostructures that can perturb this process. This will enable the understanding of the process of vasculogenesis, which holds the key for regenerative medicine critical for the management of conditions such as ischaemic heart diseases, peripheral artery diseases and diabetic sores. Furthermore, nanostructures that promote the process can be engineered as scaffolds that can be harnessed as therapeutics in the above conditions. In contrast, nanostructures that are engineered to inhibit the process could evolve as potential therapy for pathological conditions characterized by overt neovascularization, including cancer, diabetic retinopathy and rheumatoid arthritis.

The collaboration between the partners brings together scientists from a multidisciplinary background, where chemical engineers, polymer chemists, material scientists, and nanotechnologists work closely with molecular and cell biologists. It is anticipated that this exchange of knowledge would enable the development of expertise on both continents. Furthermore, annual training programs would be conducted at NCBS on tools and technologies in the area of bio-nanotechnology, which would be open to scientists across India.

Three active research projects have already been initiated by the binational team are:

(i) *Heparan Sulfate Glycosaminoglycans (HSGAGs) in human ES cell differentiation into cardiovascular lineages* (Shiladitya Sengupta, Harvard-MIT and Maneesha Inamdar, JNCASR); and

(ii) *Mechano-biology of the stem cell niche and the control of quiescence* (Jeff Karp, Harvard-MIT and Jyotsna Dhawan, InStem)

(iii) *Harnessing the human mesenchymal stem cell (hmsc) secretome for cardiovascular regeneration using bioengineering strategies* (Sudhir H. Ranganath, JNCASR, Maneesha Inamdar, JNCASR and Jeffrey M. Karp, Harvard-MIT).

As part of the CRESE activities, several exchange visits have been undertaken. Jeff Karp visited NCBS/InStem in November 2010 and in March 2011 and participated in scientific discussions. Shiladitya Sengupta visited NCBS/InStem in March 2011. R.A. Mashelkar visited Shiladitya Sengupta's laboratory in October 2010.

Abhijit Majumdar was recruited in the joint project between the Dhawan and Karp labs in 2010 and has made substantial progress on generating micro-patterned surfaces for growth and induction of quiescence of mesenchymal stem cells. Sudhir Ranganath was recruited in the joint projects between the Karp and Inamdar labs in August 2010 and has made substantial progress in establishing conditions for study of the hMSC secretome.

Also as part of the CRESE activities, the second meeting of the *Boston-Bangalore Bioengineering Initiative* was held from 07-08 November 2010 at Bangalore to spearhead a discussion between engineers, physicists, chemists, materials science experts and biologists.

Research publications generated:

(i) Sinha Roy R., Soni S., Harfouche R., Vasudevan P.R., Holmes O., de Jonge H., Rowe A., Paraskar A., Hentschel D.M., Chirgadze D., Blundell T.L., Gherardi E., Mashelkar R.A. and Sengupta S (August 2010) Coupling growth-factor engineering with nanotechnology for therapeutic angiogenesis. Proceedings of the National Academy of Sciences USA, 107(31):13608-13

(ii) Paraskar A.S., Soni S., Chin K.T., Chaudhuri P., Muto K.W., Berkowitz J., Handlogten M.W., Alves N.J., Bilgicer B., Dinulescu D.M., Mashelkar R.A. and Sengupta S. (July 2010) Harnessing structure-activity relationship to engineer a cisplatin nanoparticle for enhanced antitumor efficacy. Proceedings of the National Academy of Sciences USA, 107(28):12435-40.

Patents granted/filed:

(i) Paraskar A., Soni S., Basu S., Sengupta P. and Sengupta S. Platinum nanoparticles and methods of use thereof. PCT/US10/23217. Currently being licensed to Invictus Oncology, New Delhi by BWH.

(ii) Sinha-Roy R., Soni S., Harfouche R. and Sengupta S. 1K1 nanoparticles for angiogenesis. PCT filed by BWH. This patent has been licensed to Vyome Biosciences, New Delhi.

Indo-US Center for Research Excellence in Science and Engineering (CRESE) on Nanomaterials for Energy

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The India-US Center for Research Excellence in Science and Engineering (CRESE) on **Nanomaterials for energy** is a collaborative effort between the Jawaharlal Nehru Center for Advanced Scientific Research (JNCASR, Bangalore, India) and Purdue's Birck Nanotechnology Center (West Lafayette, IN USA) with General Electric's John F. Welch India Technology Center (Bangalore, India). To begin with, a Joint Networked Center on Nanomaterials was developed through an IUSSTF-sponsored bi-lateral workshop in Bangalore during August 2008 (http://www.nanohub.org/resources/5514) and draws from the synergistic expertise in physics and chemistry of materials at JNCASR with that of nanofabrication and engineering at Purdue. The Center seeks to find new ways of exploiting the unique properties and characteristics of nanomaterials in a broad range of energy-related applications.

The establishment of this center enables new synergies among the partners, leading to many tangible outcomes, including:

(i) A new cohort of globally engaged researchers in nanotechnology and energy with appreciation for diverse professional and international cultures.

(ii) Creation of joint research programs of both academic-academic and industry-academic types leading to new discoveries at the interface between nanotechnology and energy.

(iii) Enhancement of collaborative use of cyber infrastructure research and educational resources such as nanoHUB.org and thermalHUB.org. These resources will support global collaborations through the use of web-based computational tools, online lectures/tutorials, collaborative user/project groups, and material databases.

(iv) Organization and hosting of summer schools and related tutorial materials offered annually to attract strong participation from industrial and academic participants.

(v) Strengthening of links between academics and global technology companies with R&D centers in the US and India.

Topics of collaborative research include:

(i) *Metal-semiconductor superlattice thermoelectrics*
Faculty Participants: Umesh Waghmare (International Centre for Materials Science ICMS, JNCASR), T. Sands (Purdue)

(ii) *Exfoliated graphite/graphene materials for enhanced interfacial transport*
Faculty Participants: C. Narayana (ICMS, JNCASR), Timothy Fisher (Purdue)

(iii) *Liquid nanosolder for electrical contacts and thermal interfaces*
Faculty Participants: G.U. Kulkarni (ICMS, JNCASR), Timothy Fisher (Purdue)

(iv) *Integration of carbon nanotubes for solar, thermal and lighting applications*
Faculty Participants: C.N.R. Rao (ICMS, JNCASR), Timothy Fisher (Purdue)

(v) *Solid-state hydrogen storage*
Faculty Participants: M. Alam (JNCASR), U.V. Waghmare (ICMS, JNCASR), Timothy Fisher (Purdue)

(vi) *Behavior of attolitre water droplets*
Faculty Participants: G.U. Kulkarni (JNCASR), Scott (Purdue)

(vii) *Au nanoparticle-PDMS composites*
Faculty Participants: G.U. Kulkarni (JNCASR), Scott (Purdue)

(viii) *Electronic structure, vibrational spectrum, and thermal properties of yttrium nitride: A first-principles study*
Faculty participants: Timothy Sands (Purdue), Umesh Waghmare (JNCASR)

(ix) *First-principles analysis of ZrN/ScN metal/semiconductor superlattices for thermoelectric energy conversion*
Faculty participants: Timothy Sands (Purdue), Umesh Waghmare (JNCASR)

(x) *Interaction of butene with metal/metal oxide clusters*
Faculty participants: Timothy Fisher (Purdue), Pat Erwin (GE) and Umesh Waghmare (JNCASR)

(xi) *Quantum transport through nanostructures*
Faculty participants: N.S. Vidhyadhiraja (JNCASR), Timothy Fisher (Purdue)

(xii) *Thermal hysteresis and avalanches across the inhomogeneous Mott transition*
Faculty Participants: N.S. Vidhyadhiraja (JNCASR), Erica Carlson (Purdue), Karin Dahmen (University of Illinois at Urbana Champagne)

(xiii) *Properties of B-C-N nano structures*
Faculty participants: U.V. Waghmare (JNCASR), Timothy Fisher (Purdue), Ronald Reifenberger (Purdue)

(xiv) *Graphite petals: growth mechanism, structural and surface features*
Faculty participants: Timothy Fisher (Purdue), Ronald Reifenberger (Purdue)

(xv) *Atomic force microscope based electrical characterization of mesoscopic graphitic islands and graphene films*
Faculty participants: Timothy Fisher (Purdue), G.U. Kulkarni (JNCASR), Ronald G Reifenberger (Purdue)

(xvi) *Carbon nanotube Pd thiolate composites - thermal and electrically improved properties*
Faculty participants: G.U. Kulkarni (JNCASR), Timothy Fisher (Purdue)

The Joint Centre has led to extended interactions with other institutions with and outside of India such as University College London (UCL), Vellore Institute of Technology (VIT), Tribhuvan University - The University of Nepal, USAF, Res Lab, Thermal Sci & Mat Branch USA, Indian Institutes of Science Education and Research, Trivandrum, Georgia Institute of Technology, USA.

Research projects awarded

Consequent to the institution of the IUSSTF supported joint center has led to the following research projects getting funded to the respective partnering groups:

(i) *First-principles modeling and simulations of thermal properties of hexagonal nanomaterials* (PI: U.V. Waghmare ; Co PI: Timothy Fisher and A. Voevodin) funded by Air Force Office of Scientific Research (AFOSR)/ Asian Office of Aerospace Research and Development (AOARD)

(ii) *Nano thermal interface material development* (PI: Timothy Fisher) funded by Defense Advanced Research Projects Agency (DARPA)

Research publications generated in 2011-12

(i) Kurra N., Prakash G., Basavaraja S., Fisher T.S., Kulkarni G.U. and Reifenberger R.G. (2011) *Charge storage in mesoscopic graphitic islands fabricated using AFM bias lithography.* Nanotechnology, 22: 245302

(ii) Hodson S.L., Bhuvana T., Cola B.A., Xu X.F., Kulkarni G.U. and Fisher T.S. (2011) *Palladium thiolate bonding of carbon nanotube thermal interfaces.* Journal of Electronic Packaging 133(2): 020907

(iii) Smith K.C., Fisher T.S. and Alam M. (2011) *Isostaticity of constraints in amorphous jammed systems of soft frictionless platonic solids.* Physical Review E 84(3) Article Number: 030301

(iv) Saha B., Sands T.D. and Waghmare U.V. (2011) *First-principles analysis of ZrN/ScN metal/ semiconductor superlattices for thermoelectric energy conversion.* Journal of Applied Physics 109(8) Article Number: 083717

(v) Saha B., Sands T.D. and Waghmare U.V. (2011) *Electronic structure, vibrational spectrum, and thermal properties of yttrium nitride: A first-principles study.* Journal of Applied Physics 109(7) Article Number: 073720

(vi) Rout C.S., Kumar A., Kumar N., Sundaresan A. and Fisher T.S. (2011) *Room-temperature ferromagnetism in graphitic petal arrays.* Nanoscale 3(3): 900-903.

JOINT NETWORKED CENTERS

Indo-US Networked Center on Dynamics of Dislocations in Solid 4He and its Role in Supersolid Behavior

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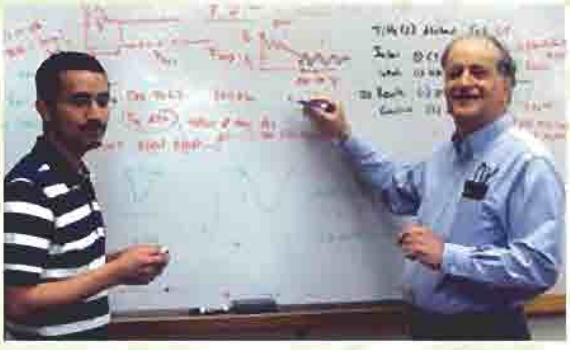

The **Indo-US Networked Center on Dynamics of dislocations in solid 4He and its role in supersolid behavior** is a collaborative effort involving partners at the University of Minnesota, the Indian Institute of Science, the University of Oregon, and the Indian Association for the Cultivation of Science, to promote and enhance theoretical physics research in the area of supersolid phenomena.

The aim of the Joint Center is to create an India-US expert group to study whether the experimentally observed behavior in "supersolid" 4He is due to the occurrence of superfluidity near the cores of dislocation lines that form a random network. To do so, the Center will investigate the dynamics of such dislocations, both in pure 4He and in the presence of 3He impurities.

With reference to the specific objectives outlined by the Joint Center, the results obtained thus far are as follows:

- Analytic and numerical studies of the phase transition in an Ising model defined on the links of a random network show that the transition temperature of the "annealed" model in which the lengths of the links are allowed to fluctuate in time is very close to the transition temperature of the corresponding "quenched" model in which the lengths of the links are held fixed.

- A computer code for simulating superfluid ordering in the DGT model, using a coarse-grained description of defects in terms of a plasticity field, has been developed.
- A computer code for simulating the equilibrium behavior of a realistic network of dislocation lines has been developed. This code is being used to generate dislocation networks with different densities of dislocation lines.
- Numerical simulations of the equilibrium and dynamical properties of the DGT model of defect-induced supersolid behavior, using a realistic description of the dynamics of a network of dislocation lines will start in the near future.

Research project awarded

- J.C. Bose Fellowship awarded to C. Dasgupta by the Department of Science and Technology, Govt. of India (Rs.68,00,000 for a period of 5 years)

As part of the visitations associated with the Joint Center, Chandan Dasgupta travelled to the University of Minnesota and Abdul Naseer Malmi Kakkada travelled to the Indian Institute of Science.

Indo-US Networked Center on Intelligent Transportation Systems Technologies

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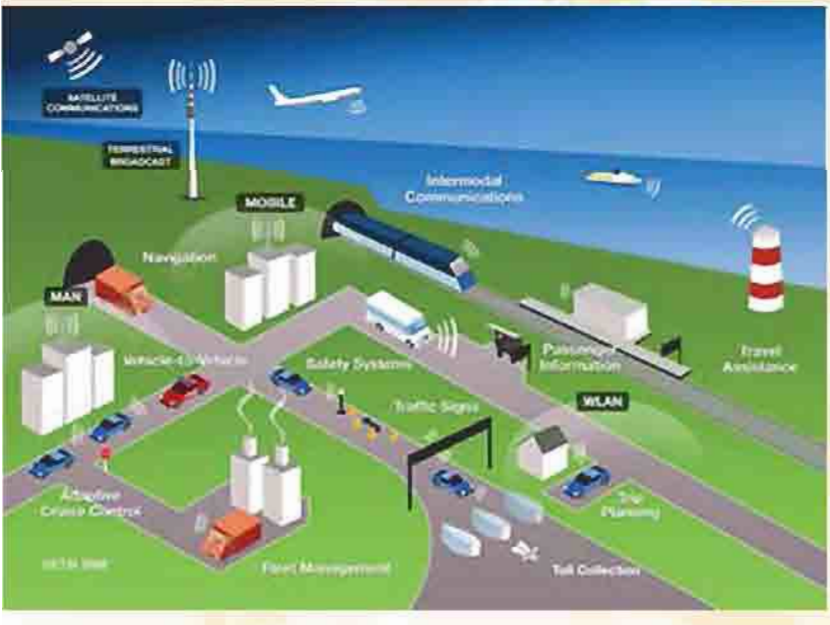

Intelligent Transportation Systems (ITS) are a popular and viable means of reducing and mitigating the effects of increased transportation demand on existing infrastructure without resorting to building new roadways, widening existing roads, etc.

Because ITS relies heavily on advanced Information Technologies both India and the United States (US) are ideally suited for adopting these systems. India, as one of the leading countries in the information technology area, has the human resources and technology required to implement ITS. Also, various Indian ministries have begun to recognize the potential of ITS as a cost effective solution for traffic-related problems. The US has been using ITS as a means of improving traffic management since the late eighties and is one of the leading countries in ITS related research and implementation. Given

the complementary nature of ITS development in both countries, collaboration between the leading research institutions in this area will be beneficial to both India and the US.

The **Indo-US Joint Centre on Intelligent Transportation Systems Technologies** was set up with a vision to become an internationally recognized center of excellence by using advanced technologies to address safety and congestion issues related to increasing demand for transportation in both India and US.

The objectives of the Joint Centre include the follwing:

- To focus on the areas of evaluation of automated traffic data collection techniques (sensors, loops, video, cell phones, etc.) that will work for traffic conditions with heterogeneity and lack of lane discipline, data monitoring and archiving and traffic modeling using these data for various ITS applications
- To increase the number of students, faculty, and staff who are attracted to and involved in the undergraduate, graduate, and professional programs of the IUJC_ITST consortium members
- To increase the quality and quantity of the transportation workforce by providing international educational opportunities in ITS to Indian and US students
- To be judged by the experts in the field to have advanced significantly the body of knowledge related to Intelligent Transportation systems
- To disseminate the Joint Center research results to both Indian and US transportation agencies in a form that can be easily implemented, utilized, and applied.

The specific activities for collaboration include:

- Test bed identification and selection of data collection technologies
- Evaluation of data collection technologies
- Data quality control and archiving
- Traffic modeling for ITS applications
- System integration
- Evaluation of ITS systems
- Dissemination of findings

Research projects awarded

The institution of the IUSSTF-supported Joint Center has led to the following research projects being funded to the partnering groups:

- *Centre of Excellence in Urban Transport at IIT* Madras funded by Ministry of Urban Development (Rs. 8.4 crore)
- *ATIS for Indian Cities* funded by Ministry of Information Technology (Rs. 3.85 crore)
- *Region 7 University Transportation Center* funded by United States DOT ($3.5 million)
- *Region 5 University Transportation Center* funded by United States DOT ($3.5 million)
- *Safety Research at Nebraska Transportation Center's* Midwest Roadside Safety Facility funded by United States DOT ($3.3 million)

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

Indo-US Networked Center on Multiwavelength Study of Solar Eruptive Phenomena and their Interplanetary Responses

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It is now widely accepted that eruptive phenomena such as coronal mass ejections (CMEs) and flares occurring on the sun are responsible for disturbances in the interplanetary medium. CME interactions with the earth's magnetosphere cause severe geo-magnetic storms. CME-driven shocks accelerate energetic particles that can be hazardous to human technology in space. These advancements in our knowledge on the solar eruptions and their relation to space weather are mainly due to the current availability of a vast array of space and ground-based observatories. However, greater understanding is needed to accurately predict the impact of the solar eruptions on the earth's space environment. The aim of the **Indo-US Networked Center on Multiwavelength study of solar eruptive phenomena and their interplanetary responses** is to exploit the availability of the space and ground-based data towards a better understanding of the origin, interplanetary propagation, and geospace impact of the eruptive phenomena.

The major scientific objectives of the Joint Center are to:

- Analyze novel multi-wavelength observations of solar transients during the solar activity from advanced space and ground based observations.
- Determine the role of magnetic field and coupling of various solar atmospheric levels above active regions to understand the dynamics of solar eruptive phenomena at the Sun
- Identify the multi-wavelength study of energy build-up and energy release processes in the flare and CME, as well as induced large-amplitude MHD oscillations in the active regions

- Detect and analyze these quasi-periodic pulsations in solar flares and their plasma diagnostics
- Analyze multi-wavelength signatures and model the large-scale transients (e.g., flares, CMEs) to understand their energy buildup and triggering mechanisms. Study the very crucial role of magnetic field and active region dynamics which produce instabilities and eruptions related with flare and CMEs
- Characterize the interplanetary responses of solar space weather events using various in situ and remote-sensing observations
- Obtain the helicity properties of solar active regions from vector magnetograms, so the helicity in the interplanetary CMEs can be predicted
- Characterize magnetic properties of active regions to predict the CME and flare occurrence probabilities.

In order to achieve the objectives of the project, the team assembled a catalog of the solar eruptive events from 2010 to 2012 observed with solar space missions such as Solar Dynamics Observatory (SDO), Solar and Heliospheric Observatory (SOHO), and STEREO, which are associated with type II radio bursts, shock waves and CMEs. They also prepared a catalog of H-alpha flares observed at ARIES, Nainital, India, during the above period. Discussions meetings with US and Indian collaborators were organized from January 4-22, 2012 at ARIES, Nainital and RAC, NCRA-TIFR Ooty, India to plan the analysis of the events from the catalog. The team watched the movies of the eruptive events one by one to see their development, shock waves, and oscillations and also cross checked the signatures with available ground based observations i.e. H-alpha, Radio, IPS, magnetometer data. During the discussion several flare events for case studies and data sets for statistical studies were identified.

Indo-US Networked Center on Gravitational - Wave Physics and Astronomy

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Gravitational waves (GWs) are freely propagating oscillations in the geometry of spacetime, produced by rapid variations in its mass-energy content. GWs are produced by a number of violent astrophysical phenomena, such as the collapse of massive stellar cores and the coalescence of compact binary stars. Although these are some of the most energetic events in the Universe, the coupling of GWs to matter is very weak, which makes the direct detection of GWs an enormous challenge.

This also means that GWs arrive at an observer nearly unaffected by any intervening matter. In that sense, GWs carry 'uncorrupted' information about their sources. GW science holds the potential to address some of the key questions in fundamental physics, astrophysics and cosmology. These include the correctness of the theory of General Relativity and constraining its validity under strong gravity conditions, properties of GWs and the nature of black holes, equation of state of neutron stars, abundance of stellar-mass black holes and the existence of intermediate-mass black holes, merger history of galaxies and supermassive black holes, the central engine of gamma ray bursts, internal processes of supernovae, nature of dark energy, and phase transitions in the early Universe.

The aims and objectives of the **Joint Centre on Gravitational - wave physics and astronomy** are to:

- Initiate cutting-edge research in experimental gravitational-wave (GW) physics and observational GW astronomy in collaboration with the international community.
- Facilitate theoretical studies investigating the science potential of upcoming advanced GW detector network. Facilitate the groundwork of building a GW observatory in the Asia-Pacific region (possibly in India).
- Training Indian students and young scientists in the emerging research frontier of GW physics and astronomy, with two major goals: 1) develop experimental expertise for building an advanced GW observatory in the Asia-Pacific region (possibly India) 2) develop an active GW-observer community who would be the potential subscribers of the data of advanced GW detectors.

With reference to the objectives of the Joint Center; the following progress has been made:

- The Indian Initiative in GW Observations (IndIGO) consortium has been accepted as a member group of the LIGO Scientific Collaboration (LSC). LSC is an international collaboration of scientists working on gravitational-wave-observation program, and is responsible for analyzing the data collected by the LIGO observatories in the US and the GEO 600 observatory in Germany. IndIGO is currently contributing to the LSC working groups searching for GW signals from compact binary coalescences, and stochastic GW sources. This involvement has been facilitated by the joint center.
- The LIGO-India project is now under active consideration by the science funding agencies in India and USA. The center has facilitated the visits of some key members of the LIGO laboratory to India for the evaluation and planning of the project.
- The construction of the 3-meter interferometer prototype would be completed in 2012.
- A theoretical study is in progress, which evaluates the scope of measuring the cosmological expansion in the local universe (the Hubble parameter) from GW observations of binary black holes using the advanced GW detector network. The visits sponsored by the joint center has directly contributed to the development of a software package (multidet) that can compute the projected errors in estimating the parameters of binary black holes using GW observations of arbitrary networks of GW detectors. The software will be made openly available to the community after completion of the ongoing project.

- The participating members have been involved in the organization of one school and one workshop on GW astronomy (December 2011, IUCAA, Pune). The joint center visits have contributed to these programs.

Research publications generated

- Unnikrishnan C.S. and Gillies G.T. (2011) *Universality in the gravitational stretching of clocks, waves and quantum states.* International Journal of Modern Physics D 20: 2853
- Talukder D., Mitra S. and Bose S. (2011) *Multibaseline gravitational wave radiometry.* Physical Review D 83: 063002
- Gopakumar and Schafer g. (2011) *Gravitational wave phasing for spinning compact binaries in inspiraling eccentric orbits.* Physical Review D, 84(12): 124007

Indo-US Networked Center on Tuberculosis India-Bay Area Initiative

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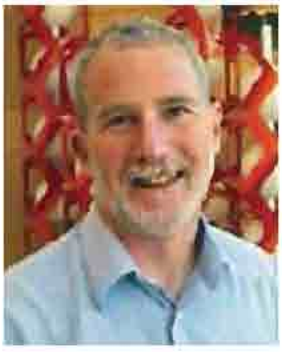
Mycobacterium tuberculosis (Mtb) has infected humans for thousands of years, and it remains a major health challenge throughout the world. Each year, 9 million people suffer from active TB, with one-third of the global disease burden borne by India. Although antibiotic treatments are effective against the disease, it is estimated that more than 5 percent of new TB cases are drug resistant. This has made the



development of new drugs and diagnostics a public health priority.

The major challenges in TB research to be addressed by the Indo-US Networked Center on Tuberculosis India-Bay Area Initiative are as follows:

- Conduct large-scale, cutting edge science that cannot be done by any single lab, but has the potential to accelerate TB drug discovery and vaccine development
- Leverage the vast but decentralized expertise and human resources in India for the large-scale experiments outlined above, by providing centralized coordination and networking opportunities
- Transfer expertise in methods development and high-throughput facilities design to Indian collaborators
- Transfer expertise in TB host-pathogen research to US collaborators, and promote the study of clinically relevant strains by US researchers
- Promote reciprocal use of research resources and facilities by participating US and Indian investigators

Indo-US Networked Center on Environmental Lung Diseases

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Environmental lung diseases remain a global public health challenge for both the developed as well as the developing world. Chronic obstructive pulmonary disease (COPD) characterized by chronic bronchitis and emphysema of lungs remains a major public health challenge with poor effective therapy. In addition, lower respiratory tract infection (LRTI) and asthma precipitated by increased exposure to environmental pollutants increase the complexity of COPD. For prevention and intervention, it is important to identify individuals who are at risk of developing this disease. It is also critical to develop novel protective strategies that can help prevent the development or progression of the disease. Secondary preventive strategies are important in those who have already developed COPD and to

help reduce their symptoms, improve quality of life, reduce exacerbations, and reduce mortality. Unlike the effects of cigarette smoke, our knowledge of these diseases in non-smokers is yet to emerge. The critical gap in India on clinical and translational research on COPD and environmental lung diseases has been a major impediment in developing prevention and intervention strategies. The **Indo-US Networked Center on Environmental Lung Diseases** acts as a catalyst for student and faculty exchange in the USA and India to facilitate the research on environmental lung diseases, which will have a great impact in improving our current knowledge on the effect of biomass fuel on respiratory health.

The Joint Center focuses on a multifaceted approach to address the following critical questions:

- Understanding phenotype of non-smoking COPD, including biomass, second hand smoke and how it is different from smoker related COPD
- Epidemiological assessment of biomass as a risk for COPD and mortality.
- Innate immune response as a result of biomass exposure, LRT infection.
- Neonatal early hit hypothesis: Does exposure of neonates to biomass indoor air pollution leads to increased susceptibility to development of COPD or lung function decline in adult life without cigarette smoking?
- Does exposure to biomass pollution predisposes to lung cancer in non-smokers? What is the level of carcinogens in the biomass indoor air particles to which the household is exposed?
- Other environmental factors that may contribute to development of COPD in non-smokers: Pesticide and metals
- Gene- environment interactions that can contribute to susceptibility.
- Impact on other cardiopulmonary diseases in the non-smoker rural population exposed to biomass indoor air pollution such as cardiovascular diseases and pulmonary hypertension.

- Epigenetic changes during antenatal and postnatal life as a result of exposure to biomass indoor air pollution
- Prevention and chemo-protection strategies in addition to decreasing exposure to pollutants
- Assessing the nutritional status and determining the antioxidant and Nrf2 inducers in the diet, enriching the diet with these components.

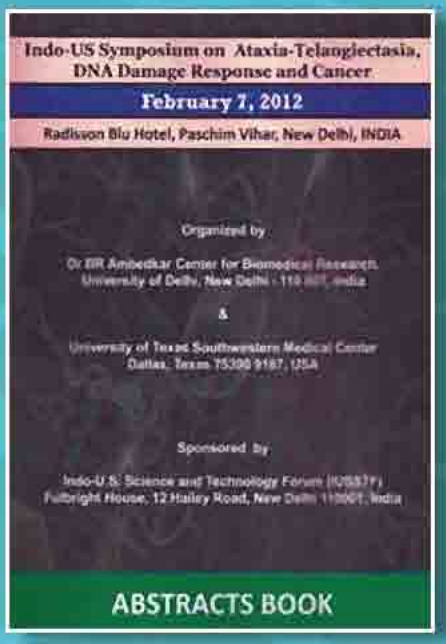
The Joint Center studies found that indoor air particulate matter collected from rural Indian homes that use biomass as cooking fuel causes potent neutrophilic inflammation that is mediated through Toll-like receptor signaling. They observed that cow dung particulate matter elicits a greater pulmonary response than wood particulate matter. This study would have substantial public health implications for establishing guidelines that could improve the health of billions of individuals who are exposed daily to biomass smoke.

Research projects awarded

Consequent to the institution of the IUSSTF-supported Joint Center has led to the following research projects being funded to the partnering groups:

- *Pulmonary effects of biomass fuel indoor PM from rural India* funded by National Institutes of Health Fogarty International Center (JHU:$21,533; India: $68,897)
- *Improved cook-stove intervention to improve markers of respiratory health* funded by Johns Hopkins Center for Global Health ($50,000)

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


Indo-US Symposium on Ataxia-Telangiectasia, DNA Damage Response and Cancer
February 7, 2012
Radisson Blu Hotel, Paschim Vihar, New Delhi, INDIA
Organized by
Dr BR Ambedkar Center for Biomedical Research,
University of Delhi, New Delhi - 110 007, India
&
University of Texas Southwestern Medical Center
Dallas, Texas 75390-9187, USA
Sponsored by
Indo-U.S. Science and Technology Forum (IUSSTF)
Fulbright House, 12 Hailey Road, New Delhi 110001, India
ABSTRACTS BOOK


Indo-US Bilateral Workshop
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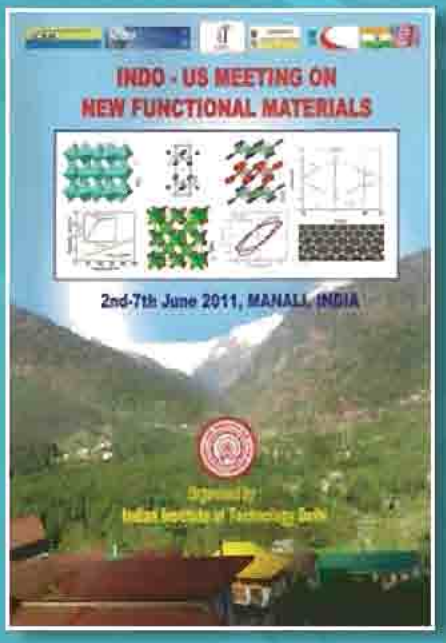
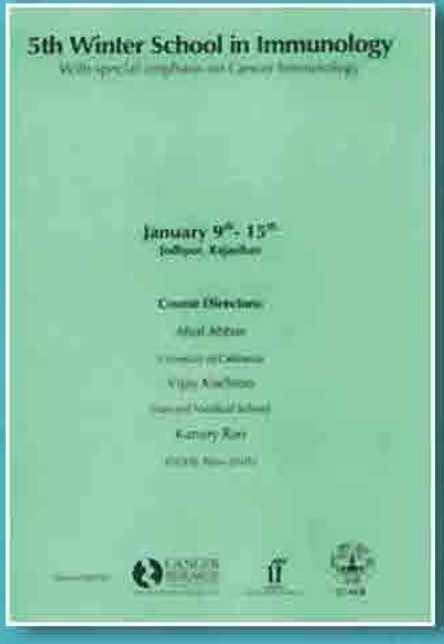
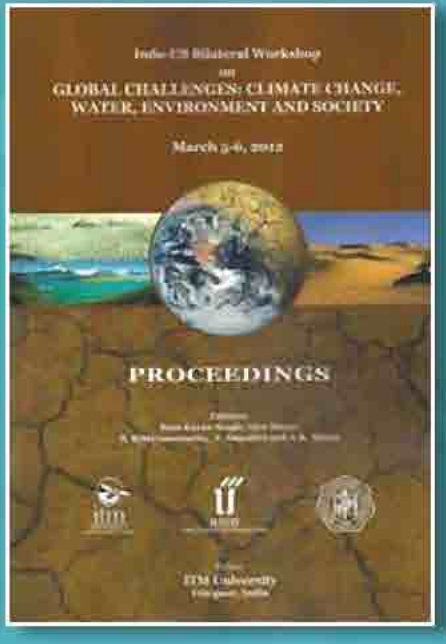
GLOBAL CHALLENGES - CLIMATE CHANGE, WATER, ENVIRONMENT AND SOCIETY
Sponsored by
March 5-6, 2012
ITM UNIVERSITY


INDO - US MEETING ON
NEW FUNCTIONAL MATERIALS
2nd-7th June 2011, MANALI, INDIA


SOUVENIR
INDO-US WORKSHOP
On
GREEN CHEMISTRY FOR ENVIRONMENTS
&
SUSTAINABLE DEVELOPMENT
11th – 13th March, 2012


5th Winter School in Immunology
January 9th - 15th
Jodhpur, Rajasthan
Course Directors:
Kanury Rao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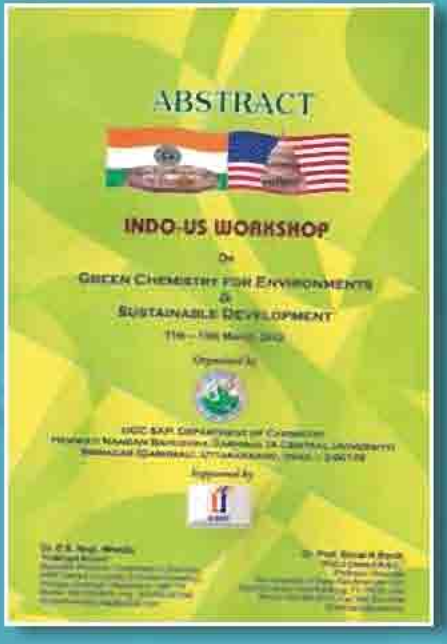
PROCEEDINGS
ITM University


ABSTRACT
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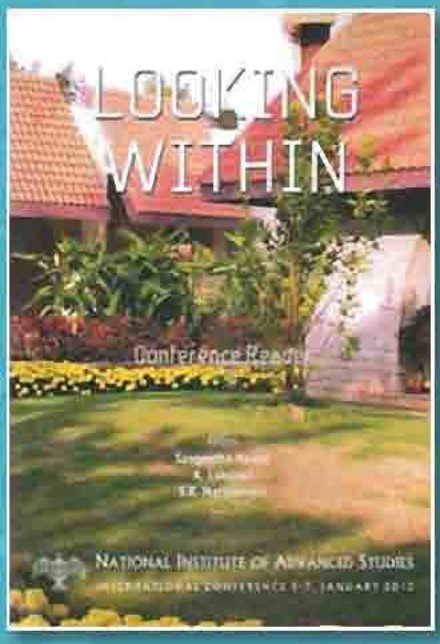
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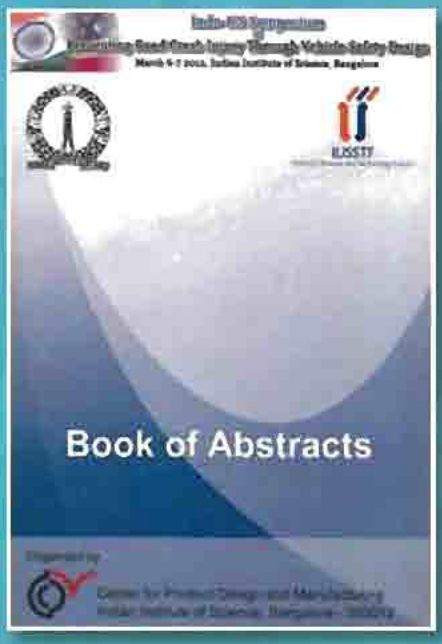
Indo-US Bilateral Workshop on
Nanoparticle Assembly: From Fundamentals to Applications
December 12-14, 2011
Organized by
Indian Institute of Technology Delhi
Information and Abstract Book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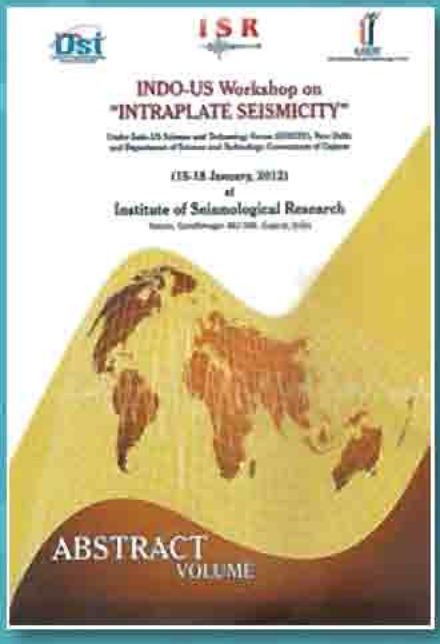
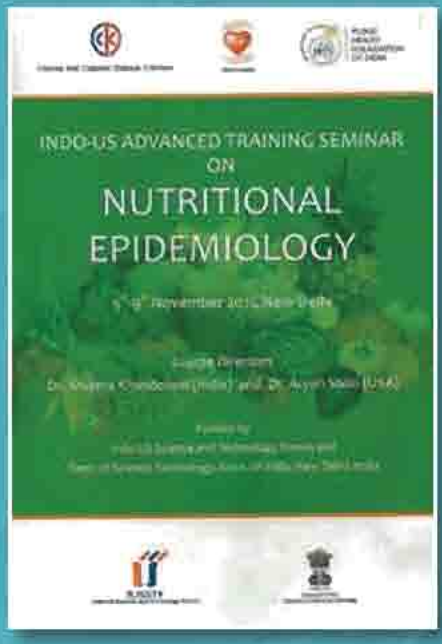
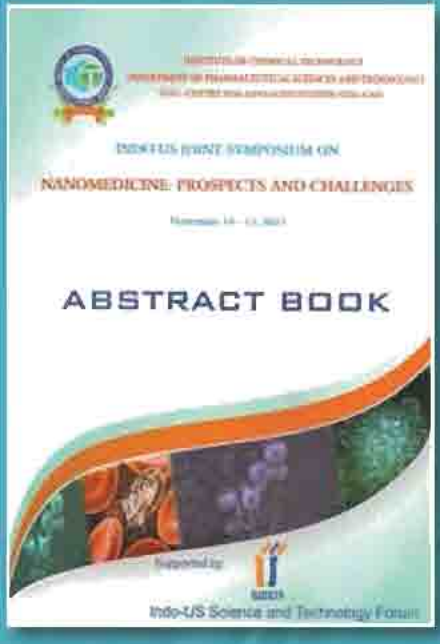
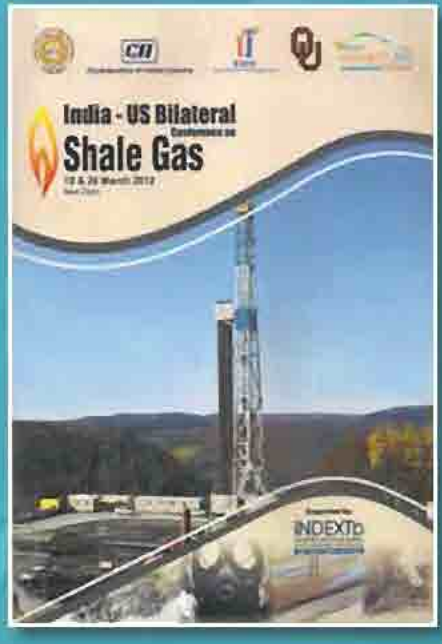

INDO-US Workshop on
"INTRAPLATE SEISMICITY"
(15-18 January, 2012)
at
Institute of Seismological Research
ABSTRACT VOLUME


INDO-US ADVANCED TRAINING SEMINAR ON
NUTRITIONAL EPIDEMIOLOGY


INDO-US JOINT SYMPOSIUM ON
NANOMEDICINE: PROSPECTS AND CHALLENGES
ABSTRACT BOOK
Indo-US Science and Technology Forum


India - US Bilateral Conference on
Shale Gas

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