No. 43 Patrika March 2006

Newsletter of the Indian Academy of Sciences

2005 Annual Meeting

The seventy-first Annual Meeting of the Academy was held at Bharathidasan University, Tiruchirapalli from November 11 to 13, 2005. A good number of Fellows – about 120 – and an unusually large number of teacher invitees, many from educational institutions in and around Tiruchirappalli, were present.

Large audience at the meeting

The opening lecture by the President of the Academy, TV Ramakrishnan, was on "Transition metal oxides: Quantum many-body physics meets solid state chemistry". He surveyed a large number of currently active research areas, including perovskite oxides, colossal magnetoresistance in manganites, cuprates and their phase diagram, and some theoretical approaches to these phenomena. As he expressed it, 'chemical realities and increasing ability to make and probe things lead to unexpected new worlds'. The older familiar pictures fail in these new realms, and theorists need to puzzle over new materials and new phenomena. The talk succeeded admirably in bridging physics and chemistry in selected areas.

A special half day Symposium on 'Physics and Chemistry of Materials' under the overall convenership of CNR Rao covered unusually large ground, much

Inside…

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Published by

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This newsletter is available on the Academy website at : www.ias.ac.in/patrika/

To receive a regular copy of the Newsletter, please write to the Executive Secretary of the Academy (madhavan@ias.ernet.in)

Forthcoming Events – 2006

17th Mid-Year Meeting, Bangalore (14–15 July 2006)

72nd Annual Meeting, Devi Ahilya Vishwavidyalaya, Indore (10–12 November 2006)

Refresher Courses

Phylogenetic biology
University of Mysore (10–23 July 2006)

Tensors and their applications in engineering sciences
IISc, Bangalore (1–15 Nov. 2006)

Advanced topics in chemistry
Lady Doak College, Madurai (Nov. 2006)

Experimental physics course for Kerala teachers
Kerala University, Trivandrum (June 2006)

Lecture Workshops

Excitements in computational physical and bio-sciences
IIIT, Hyderabad (12-17 June 2006)

High energy physics, condensed matter physics and astronomy and astrophysics
Mumbai University (October 2006)

Q & A Session during CNR Rao's lecture

of it inaugurated in his own work over the decades. The five speakers, all of them close collaborators of the convener, spoke about manganites, oxide materials, nanomaterials, and open-framework structures. This symposium was capped by a public lecture titled 'Science for our future: Personal reflections on doing science in India' to a very large audience, at the beautiful and spacious BHEL auditorium, wherein Rao recalled his life-long experiences and challenges, and the impact his work has had at the international level.

The second Symposium of the meeting on 'Genomic Landscape and Structure of the People of India' was put together by Partha P Majumder. This fascinating story of the movements of human populations over a few tens of thousands of years, starting in Africa and passing through India to other parts of the world, showed how DNA and chromosome studies at the microscopic level can shed light on questions till recently examined mainly by archaeological and anthropological methods. In his opening presentation, Majumder described how female and male population movements are susceptible to separate study and one can reconstruct the entire process of peopling of India. Other speakers covered human prehistory, cultures and migrations in India from the archaeological viewpoint; genomic approaches in general and studies of haploid chromosomes in particular; and what such studies have to say about our past and what remains to be done. Readers of *Patrika* are invited to have a look at a very fine account of these research efforts in an article by Majumder and D Balasubramanian in the January 2006 issue of *Resonance*.

The second public lecture by V Shanta of the Cancer Institute, Chennai was given to another large audience at the New Auditorium of Bishop Heber College, on the topic 'Cancer causes and prevention'. The speaker, recently honoured by the Magsaysay Award, gave a very informative and lucid presentation bringing home the magnitude of the burden of cancer in India, including the continuing annual increase in incidence of various

types. Many cancers can be traced to lifestyles and the environment in the widest sense. By the same token, many of them are preventable, by such measures as reducing exposure to cancer–causing factors and changes in personal habits and hygiene.

The first special lecture on 'Volcanic poisoning and mass extinctions' by KV Subbarao dealt with events on the Indian subcontinent over 60 million years ago, the Deccan volcanic episode which caused global mass extinctions. The disappearance of dinosaurs may be due to this or, alternatively, to a meteorite impact. Apart from different technical aspects and impressive pictures of the 'canyons' in the Western Ghats, the speaker also spoke about the impact of research in India in this field, on a global scale.

RK Shyamasundar's special lecture on 'Computer science: Scientific and engineering fascinations and challenges' dealt with a subject of great current intellectual as well as technological interest. The emphasis was rightly on the basic concepts which have evolved slowly compared with applications. Ideas such as computability, robustness, universality, Turing machines and artificial intelligence have considerable subtlety and are not so easily grasped even by scientists in other fields. The speaker succeeded in conveying the essence of these ideas to a diverse audience.

Lectures by recently elected Fellows and Associates covered a wide range from 'Portal hypertensive bleeding' by SK Sarin to 'Image mining' by Subhasis Chaudhuri, and from 'Supercooled liquids' by Shankar Das to 'Human papillomavirus' by MR Pillai.

Cultural Programme as part of the Annual Meeting

Thanks to the untiring efforts of the local hosts, in particular M. Lakshmanan and M. Palaniandavar and volunteers from the university and the several educational institutions in the town, the arrangements for all aspects of the meeting were excellent.

2006 ELECTIONS

Fellows:

Banerjee, Soumitro
Indian Institute of Technology, Kharagpur
Areas of interest: Nonlinear dynamics, and electrical engineering

Basak, Amit
Indian Institute of Technology, Kharagpur
DNA-interacting agents, asymmetric synthesis, and enzymology

Basu, Joyoti
Bose Institute, Kolkata
Molecular microbiology with special reference to mycobacteria, understanding host-pathogen interactions, and membrane biology

Bhat, B. V. Rajarama
Indian Statistical Institute, Bangalore
Quantum probability, operator algebras and operator theory

Bhat, G. S.
Indian Institute of Science, Bangalore
Tropical convection, boundary layer and field studies

Bhattacharya, Samaresh
Jadavpur University, Kolkata
Inorganic chemistry, coordination chemistry, and organometallic chemistry

Bose, Arup
Indian Statistical Institute, Kolkata
Probability and statistics

Chakravarty, Charusita
Indian Institute of Technology, New Delhi
Chemical physics, and theoretical and computational chemistry

Deb, Kalyanmoy
Indian Institute of Technology, Kanpur
Optimization and design, genetic algorithms, and multiobjective optimisation

Dev, Bhupendra N.
Institute of Physics, Bhubaneswar
Surface & nanoscale physics, X-ray physics, and ion-solid interactions

Ghosh, Swarna Kanti
Tata Institute of Fundamental Research, Mumbai
Infrared astronomy, interstellar medium, and astronomical instrumentation

Guru Row, T. N.
Indian Institute of Science, Bangalore
Chemical crystallography, intermolecular interactions, and polymorphism and drug design

Hasan, Gaiti
National Centre for Biological Sciences, Bangalore
Inositol trisphosphate, and calcium signalling in neuronal physiology

Jayaraman, A.
Physical Research Laboratory, Ahmedabad
Atmospheric science, aerosols, and radiative transfer

Khurana, Jitendra P.
University of Delhi South Campus, New Delhi
Photoperception and signal transduction in plants, structural and functional genomics, and plant hormone action

Kundu, Gopal Chandra
National Centre for Cell Science, Pune
Signal transduction, cancer biology, and regulation of gene expression

Majumder, Hemanta K.
Indian Institute of Chemical Biology, Kolkata
Biochemistry, molecular biology, and parasitology

Mandal, Chitra
Indian Institute of Chemical Biology, Kolkata
Glycobiology, immunobiology, and glycoimmunology

Mandal, Nibir
Jadavpur University, Kolkata
Structural geology, and tectonics

Puri, Sanjay
Jawaharlal Nehru University, New Delhi
Statistical physics, condensed matter physics, and nonlinear dynamics

Rajasekharan, Ram
Indian Institute of Science, Bangalore
Biological sciences, lipid metabolism, and plant biotechnology

Ramakrishna, B. S.
Christian Medical College & Hospital, Vellore
Gastroenterology/medicine, transport physiology, and cell biology

Ramakrishnan, S.
Indian Institute of Science, Bangalore
Polymer synthesis, polymer folding and assembly, and hyperbranched polymers

Raychaudhuri, Amitava
Harish-Chandra Research Institute, Allahabad
Particle physics

Sengupta, Surajit
SN Bose National Centre for Basic Sciences, Kolkata
Condensed matter physics, statistical mechanics, and materials science

Sonti, Ramesh V.
Centre for Cellular & Molecular Biology, Hyderabad
Plant-microbe interactions, plant genetics, and bacterial genetics

Thelma, B. K.
University of Delhi, New Delhi
Human genetics, pharmacogenetics, and medical genomics

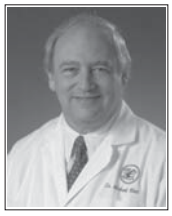
Trivedi, Sandip P.
Tata Institute of Fundamental Research, Mumbai
String theory, particle physics, and quantum field theory

Visweswariah, Sandhya S.
Indian Institute of Science, Bangalore
Cell biology, protein structure and function, and biochemistry

Honorary Fellows

Ranajit Chakraborty
University of Cincinnati
Ohio, USA

Michael L. Klein
University of Pennsylvania
Philadelphia, USA



RAMAN PROFESSOR

Prof. Anne McLaren is a Principal Research Associate of The Wellcome Trust and Cancer Research Institute at the University of Cambridge in UK as well as a Member of the European Molecular Biology Organization (EMBO). She visited India as the twenty-third Raman Professor of the Academy during the period November – December 2005. McLaren is a distinguished mammalian geneticist, an authority on early mammalian development and has made major contributions to our understanding of mammalian development, especially its genetic and epigenetic underpinnings. Her research has ranged widely over developmental biology, reproductive biology, and genetics including molecular genetics, using the laboratory mouse as a model. She was the head of the MRC Unit on mammalian development for over 25 years and received some of the world's highest scientific honours. She has been an adviser to the UK Government on policies concerning human embryo technology and stem biology. During her visit to India she was based at the Indian Institute of Science and visited and lectured at Bangalore and Hyderabad.

SPECIAL ISSUES

Asteroseismology

Guest Editor: Ram Sagar and S Seetha

Journal of Astrophysics and Astronomy, Vol. 26, Nos. 2/3, June/September 2005, pp. 117–357

Stars have been observed for ages. It is only recently that we have been able to study the interiors of the stars. Stars oscillate, exhibiting pulsations – different stars pulsating in different ways – and the study of the interiors of stars by studying these pulsations is termed 'Asteroseismology' similar to the seismology of Earth where the Earth's interior is understood by studying the oscillations during an earthquake.

There are several stars which exhibit pulsations: the classical Cepheids, the Sun, rapidly oscillating Ap stars, delta-Scuti variables, beta-Cep stars, white dwarf variables, sub-dwarf B stars, etc. For some stars, the observations and theoretical interpretations have been going hand in hand, whereas for some, theoretical explanations of observed frequencies are currently not possible, and in some others observations indicate a lack of oscillations where they are theoretically predicted. An international workshop on asteroseismology was organized by the Aryabhatta Research Institute of Observational Sciences (ARIES) at Nainital in December 2004. The workshop held to coincide with the golden jubilee of the Institute was primarily to discuss the current maturity in the field and understand as many types of stellar oscillators as possible.

This special issue comprises a collection of refereed and accepted papers based on the presentations at the workshop.

Chemical reactivity

Guest Editor: PK Chattaraj

Journal of Chemical Sciences, Vol. 117, No. 5, September 2005, pp. 359–616

Considering the importance of chemical reactivity and its strong foundations within a conceptual density functional theory (DFT) framework this special volume was brought out. Leading experts in this field from across the globe contributed papers on diverse aspects of reactivity theory.

These papers cover the whole gamut of topics within a DFT parlance encompassing different systems such as clay-type inorganic materials, boron porphyrin complexes, zeolites and hypervalent silicon compounds, as well as various concepts such as electron localization function, molecular quantum similarity, condensed atomic indices, Coulomb holes, reactant resolution, higher order energy derivatives, excitation energy, charge sensitivity, reaction force, electron propagators, separability and N-representability. There are also contributions which deal with intramolecular hydrogen shifts, cycloaddition reactions, interactions among toxins and biosystems, and electronegativity equalization. Two papers by Ralph G Pearson and Robert G Parr give a personal account of the evolution of the hardness concept. Parr in his article sets out fourteen problems in DFT.

Nanoscience and technology

Guest Editors: AK Sood, KN Ganesh, CS Sundar and AK Raychaudhuri

Pramana, Vol. 65, No. 4, October 2005, pp. 547–748

The dawn of 21st century is marked by the birth of a new science *Nanoscience* and the emanating *Nanotechnology*. Nanostructures are intermediate in size between molecular and mesoscopic structures (length scale up to ~100 nm). As a result, they are uniquely suited for detailed atomic-level engineering. Viewed as molecules, they are so large that they provide access to realms of quantum behaviour that are not otherwise accessible;

viewed as materials, they are so small that they exhibit characteristics that are not observed in larger structures. They combine small size and complex organizational patterns with the potential for very high packing densities and strong lateral interactions. Individual nanostructures involve clusters, quantum dots, nanoparticles, nanowires and nanotubes; collections of nanostructures involve arrays, assemblies and superlattices.

The uniqueness of the physics, chemistry, structural response and dynamics of the nanostructures constitutes the essential motivation for studying nanomaterials. Their electronic and magnetic characteristics are often dominated by quantum behaviour. They are emerging as key components in information technology devices with unprecedented functions. Many clear applications for nanotools and nanostructures are already evident and are targets of several emerging technology development programmes. Successful applications of nanoscience and nanotechnology require a fundamental understanding of properties of isolated individual nanostructures and ensembles, design and construction of nanoscale building blocks, interconnections to achieve new functions, bio-inspired fabrication of functional nanosystems and physics of molecular electronics.

Some of the nanotechnology products comprise of high-density information storage devices, new protective coatings for corrosion/erosion resistance, thin layers for optical filtering and thermal barriers, nanostructured polymers and catalysts, highly porous, sponge-like materials and aerogels for catalysis and energy applications, sensors for detecting pico and femtomoles of substances, self-assembled systems and lithographs etc. Development of tools and techniques for characterizing nanostructures is also a challenging area. Nanoscience and nanotechnology thus uniquely combine the concepts of engineering physics, materials chemistry and biology into making functional devices of unimaginable versatility for a variety of health, societal, and environmental applications.

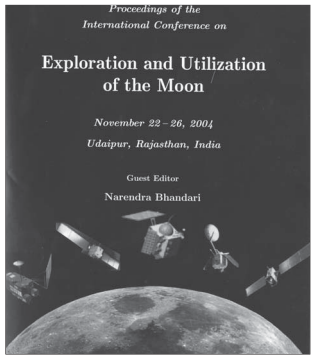
Keeping in pace with the global nanotechnology competition, the Department of Science and Technology, New Delhi launched a national programme 'Nanoscience and technology initiative' to focus on the overall research and development in this area and create advanced facilities encompassing universities, national laboratories and industry so that India can become a significant global player in this area and help bring the products of technology to the benefit of people.

This special volume which appeared in two issues of *Pramana* presents peer-reviewed contributions in the area of Nanoscience by various researchers supported by the programme during the past two years and presented at the First National Conference on Nanoscience and Technology held at NCL, Pune during March 2005.

Exploration and utilization of the Moon

Guest Editor: N Bhandari

Journal of Earth System Science, Vol. 114, No.6, December 2005, pp. 573–822



An International Conference on Exploration and Utilization of the Moon (ICEUM-6), sixth in the series, was held during November 2004 at Udaipur, Rajasthan under the aegis of the International Lunar Exploration Working Group (ILEWG). This conference was organized at a time of renewed interest in the exploration of the Moon and a large number of lunar missions were being planned. This new era started with the SMART-1 mission of European Space Agency (ESA) which attained a lunar orbit on 15 November 2004, just before the conference, exhibiting the success of the ion propulsion system. This mission is expected to be followed by Lunar-A and SELENE by Japan, Chandrayaan-1 by India, Chang'E by China and the Lunar Reconnaissance Orbiter (LRO) by USA during the next few years. There will thus be a continuous presence on the Moon till the end of this decade, and possibly a permanent presence during the next decade, offering excellent opportunities for international collaboration. The ILEWG endeavours to optimize the scientific and technical outcome of these various missions by facilitating international collaboration and by debating priorities, problems and strategies.

The main themes of the Udaipur Conference encompassed all scientific aspects of the Moon — robotics, engineering, space flight dynamics, navigation and control, lunar exploration programmes of various International Space Agencies (ESA, ISRO, Russia, NASA, JAXA and China), first results from ESA's SMART-1 mission, programmes of future lunar exploration (Lunar-A, SELENE, Chandrayaan-1 and Chang'E missions and development for lunar bases) and next generation science and technology missions to the Moon. A programme, specifically for young lunar explorers, and reviews and results from previous missions such as Clementine and Lunar Prospector were also included.

In addition, round table discussions on science questions and priorities, international collaboration and Moon–Mars roadmap and technology and resource utilization were held. The conference issued a joint declaration known as the Udaipur Declaration.

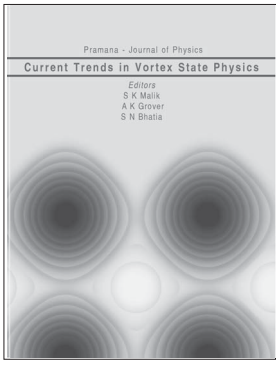
The present volume contains 29 papers accepted after a review process. These papers include topics such as

origin and early evolution of the Moon, orbital dynamics, science on the Moon, results of Clementine mission, new missions to the Moon, e.g. Lunar-A, SELENE, Chandrayaan-1, Chang'E, and Telerobotic explorations of the Moon.

International Vortex Workshop

Guest Editors: SK Malik, AK Grover and SN Bhatia

Pramana, Vol. 66, No. 1, January 2006, pp. 1–312



The idea of this special issue on vortex state studies originated when the Tenth International Vortex Workshop (IVW-10) was being planned to be held at TIFR, Mumbai during January 2005. Normally no formal proceedings of such workshops were being brought out but it was felt that it would benefit the scientific community if articles on contemporary subject in the area of vortex physics are published. There was enthusiastic response to this idea resulting in the emergence of this issue which hopefully is timely and useful to the scientific community at large, specially the young researchers.

The vortex state refers to the mixed phase of superconductors, where the magnetic field permeates and microscopically sub-divides the specimen into normal cylindrical regions surrounded by circulating supercurrents in the form of vortices. A superconductor in a magnetic field can sustain large current density without dissipation of heat only if the vortices do not move around and/or start flowing. Though the vortex state studies have been on for a long time, the discovery of high temperature superconductivity gave a fresh impetus to this field. This discovery in metallic copper oxide systems in 1987 raised the hope that these materials would transform the electrical power and the microelectronics industry. However, insurmountable difficulties in devising innovative ways to prevent the movement of vortices at boiling point of liquid nitrogen in the high temperature superconductors slowed down their development for novel applications.

The discovery of high temperature superconductivity gave an opportunity to a large section of the community of condensed matter physicists, statistical physicists, material scientists and engineers to study the vortex state in a variety of materials. The appearance of a very comprehensive and timely article in *Reviews of Modern Physics* in 1994 further attracted the attention of researchers in this area of physics, culminating in the holding of Workshops on Vortex Dynamics. The number of researchers working in this area has steadily increased as gauged by the number of prospective participants in such workshops. The Nobel prize in Physics for the year 2003 was awarded to AA Abrikosov, who pioneered the idea of vortex state in superconductors.

This special issue presents twenty six articles on a variety of areas in vortex research. It includes a review on experimental results in vortices in dilute Bose – Einstein condensates which is a new topic added to the deliberations of the tenth vortex workshop.

Metal oxides and related materials

Guest Editors: S Natarajan and TN Guru Row

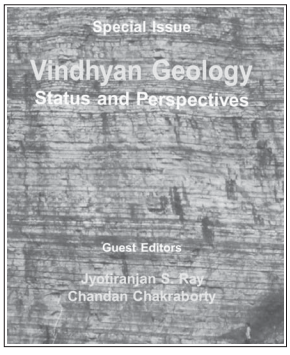
Journal of Chemical Sciences, Vol. 118, No. 1, January 2006 pp. 1–154

This special issue contains a collection of articles contributed by participants of an international conference on "Recent development in metal oxides and related materials" held in Bangalore during January 2006, jointly organized by the Solid State and Structural Chemistry Unit of IISc and the JNCASR. It contains sixteen articles on a variety of topics in chemical sciences which lie at the forefront of current international activity. The topics include: carbon nanotubes, fluorescence resonance energy transfer, nanoparticle synthesis, magnetic transport properties of rare earth manganates, lead-acid battery, density matrix renormalization group theory, ionic conduction, electronic homogeneity of ordered double perovskities, synthesis by molten salt method, layered hydroxides and its fictionalization, low–dimensional phenylarsonates, polyoxovanadates, layered vanadium phosphates and bismuth tungstates. The editors believe that the diversity and range of topics would make this volume useful to many practitioners of chemical sciences.

Vindhyan geology

Guest Editors: JS Ray and C Chakraborty

Journal of Earth System Science, Vol. 115, No. 1, February 2006 pp. 1–184



Several significant events in earth history occurred during the Proterozoic Era affecting the lithosphere, atmosphere and the biosphere. Covering almost two billion years of geologic time, the Proterozoic Era witnessed the formation of stable continents, an oxygenated atmosphere, evolution of multicellular life and extensive glaciations. India has been an integral part of the supercontinents prior to Gondwanaland, and hosts several Proterozoic sedimentary successions that contain information on ancient depositional environments and processes. The Vindhyan supergroup of central and

western India is one such major sedimentary succession. With a rock record that embraces much of geological time and space, the Vindhyans have been extensively studied over the last few decades. However, it is particularly the last few years that have seen a surge of research on these rocks, in part because of a couple of contentious fossil discoveries with profound implications.

It was therefore felt that a comprehensive volume including the recent advances in Vindhyan geology would be valuable in bringing about a better understanding of the development of this great succession and the global implications of various discoveries. This special issue contains eleven peer-reviewed research papers that cover many aspects of the Vindhyans. The main goals of this multidisciplinary research volume are to: (a) evaluate and synthesize the large quantity of data available from earlier studies; (b) present new data, ideas and methods to resolve the outstanding issues; and (c) identify the future areas for research.

The papers in this volume deal with the stratigraphy and sedimentology of the Vindhyan rocks on the paleobiology, on the new stable isotope data from the carbonate formations in the Son valley, the results of a seismic reflection study in the Vindhyans of Rajasthan, a review of the recent geochronology of the Vindhyan sequences and the petrological and geochemical aspects of kimberlitic rocks that intrude the Vindhyan supergroup.

PUBLIC LECTURES

Soap bubbles and crystals

Jean Taylor

(New York University, USA)

19 October 2005, Indian Institute of Science, Bangalore

Creating a mathematical model for soap bubble clusters required the development of a new subject, Geometric Measure Theory. It was only in 1976 that the "rules for bubbles" observed a century before were actually proved. The internal structure of metals, ceramics, and other materials is related to soap bubble clusters, but has many more features. Current research involves shrinking, slipping, sliding, and rotating crystals.

The arrow of time

Joel L Lebowitz

(The State University of New Jersey, USA)

17 November 2005, Indian Institute of Science, Bangalore

In the world about us the past is distinctly different from the future. Milk spills but doesn't unspill; eggs splatter but do not unsplatter; waves break but do not unbreak; we always grow older, never younger. These processes all move in one direction in time – they are called "time-irreversible" and define the arrow of time. It is therefore very surprising that the relevant fundamental laws of nature make no such distinction between the past and the future. This leads to a great puzzle – if the laws of nature permit all processes to be run backwards in time, why don't we observe them doing so? Why does a video of an egg splattering run backwards look ridiculous? Put another way: how can time-reversible motions of atoms and molecules, the microscopic components of material systems, give rise to the observed time-irreversible behaviour of our everyday world? The resolution of this apparent paradox was the subject of this talk.

A shock wave cosmology

Blake Temple

(University of California, USA)

23 January 2006, Indian Institute of Science, Bangalore

In this talk the speaker discussed a model of cosmology that refines the standard model of cosmology (based on the Friedmann universe) by the incorporation of a shock wave. The model explores the possibility that the explosion of the Big Bang that caused the outward motion of the galaxies, was an explosion of finite total mass, instead of the infinite mass explosion inherent in the standard model. In the shock wave model, which is based on the author's recent joint work with J. Smoller, the explosion of the Big Bang generates an outgoing, spherical, entropy satisfying shock wave that emerges from the centre of the explosion at the instant of the Big Bang, (something like the blast wave of a nuclear explosion), and the expanding galaxies correspond to the region inside the wave. One of the main consequences of this model is that when the shock wave is far enough out to be consistent with astronomical observations, (beyond one Hubble length – the distance light can travel since the Big Bang explosion), the whole explosion begins inside a (time reversed) Black Hole – a White Hole in which everything is exploding outward instead of collapsing inward. In the shock wave model, the universe eventually emerges from the Black Hole, and from then on expands like the famous Oppenheimer – Snyder solution – a finite ball of matter expanding into empty space. We are inside the explosion, but to an observer in the far field beyond the shock wave, the end stage of the explosion would look like a giant supernova. It also follows from our model that information about the shock wave

propagates inward from the shock wave, into a large shadow region of uniform expansion at the centre of the explosion – and to an observer (like us) on the inside of this shadow region, everything looks exactly like the Friedmann universe up until the time when the shock wave comes into view from the farthest field of observations. That is, in the shadow region, up until the time when the shock wave comes into view, everything looks the same as in the standard model. Other interesting consequences of the shock wave model include the unexpected emergence of the correct equation of state at the Big Bang, the breaking of the time symmetry by the entropy condition, and interesting mathematical consequences of the reversal of space and time inside the Black Hole. In this talk the speaker gave an introduction to Einstein's theory of general relativity, and then discussed this shock wave cosmology within this context. The talk began and ended with a computer visualization of our model due to Zeke Vogler.

Brighter than a million suns: the FERMI @Elettra project

Carlo Rizzuto
(University of Genova and Ellettra Laboratory, Trieste)
1 February 2006, Indian Institute of Science, Bangalore

The FERMI@Elettra international project is developing a light source, using Einstein's equivalence between mass and energy, to produce light flashes billions of times more brilliant than any present technique, spanning over all colours, and with a time structure allowing to film the behaviour of materials down to atomic levels.

The light will be generated by a "free electron laser", based on electrons travelling near the speed of light, shedding part of their mass-energy in a coherent way, when stimulated by magnetic forces. The continuous improvement in the capability of studying, understanding and designing new materials has allowed the development of new products, from metallic bearings or catalysers to microchips and medical drugs, and has been a main component of the knowledge fuelling the most impressive and durable industrial and economic growth of the last centuries.

The study and modification of materials, down to the individual atoms, requires the use of "probes" either to capture the information on how the various qualities arise, or to manipulate them. One of the most powerful probes is the light, "reading" the inside of materials or "writing" lithographies.

The development of FERMI will allow to explore and modify materials, with a time and space resolution that could not be thought of until recently and is expected to open entirely new frontiers.

Reflections on the legacy of Harish-Chandra

Robert P. Langlands
(Institute for Advanced Study, USA)
20 March 2006, Indian Institute of Science, Bangalore

This lecture was an attempt to understand Harish-Chandra's place in the mathematical firmament. Harish-Chandra made outstanding contributions to harmonic analysis on reductive groups. His research centred around the study of semi-simple Lie groups and Lie algebras and he created a theory which had implications for many domains from geometry to number theory. Harish-Chandra was a Fellow of the Academy and died in 1983 when he was sixty.

DISCUSSION MEETINGS

Instructional Workshop on Operator Theory and Operator Algebras

Indian Statistical Institute/Indian Institute of Science, Bangalore
12–17 December 2005

The workshop consisted of a short course on Lie groups and representation theory (by A Sitaram). H Upmeier presented a survey of Toeplitz operator algebras on bounded symmetric domains. There were a variety of lectures on topics from Banach space geometry, model theory, operator algebras, Hopf algebras and harmonic analysis. An interesting lecture by M Putinar on relations between positivity and decompositions of polynomials as sums of squares was also held. This workshop preceded an international conference on "Operator theory and operator algebras" which was held from December 19 to 22, 2005.

Intracellular calcium signalling

Orange County, Coorg
30 November – 4 December 2005

This international meeting held at Orange County was attended by participants from six countries, with a majority from India. The meeting was timed to coincide with recent rapid advances in the area of calcium signalling triggered by emerging post-genomic technologies. A Rao (Harvard) presented her work on the use of RNAi screening technologies to discover novel components of the cellular calcium signalling circuit. R Lewis (Stanford) spoke on the function of one such component STIM, in sensing and regulating intracellular calcium. K Rao (ICGEB, New Delhi) discussed the link between calcium and cell death

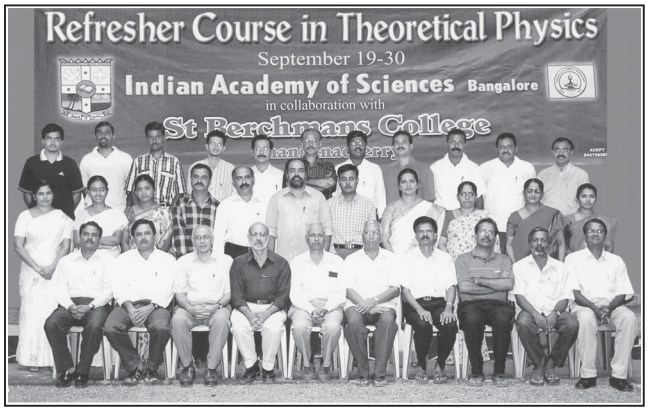
signals in the immune system followed by D Clapham (Harvard) who discussed the function of a novel calcium channel (Catsper) in regulating cell motility. Mike Berridge (Cambridge) and Ole Petersen (Liverpool) provided historical perspectives on the development of the field and their visions for its future in the light of recent developments. There were other talks on the function of calcium in physiological systems such as vision by (KW-Yau, Johns Hopkins and RC Hardie, Cambridge), insect flight (Gaiti Hasan, NCBS, Bangalore), olfaction by K Stortkuhl (Germany), A Fiala (Germany) and V Rodrigues (TIFR, Mumbai) and animal development (N Spitzer, UCSD; K Mikoshiba, Japan; A Millar, Hong Kong; T Schwarz , Harvard). Lectures on novel functional aspects of several molecules that are central to calcium signalling were delivered by CW Taylor (Cambridge), R Dolmetsch (Stanford), T Shuttleworth (Rochester), A Galione (Oxford), R Padinjat (Cambridge) and C Montell (John Hopkins). There were excellent contributions from younger scientists drawn from the participants. In conclusion the meeting drew together a number of emerging threads on the molecules that mediate the effects of calcium in cellular physiology.

REFRESHER COURSES

Theoretical Physics

SB College, Changanassery
September 19 – 30, 2005

No. of participants: 28



Course Director: S Chaturvedi (Univ. of Hyderabad)
Course Co-ordinator: C A Xavier (St. Berchmans College, Changanacherry)

Resource persons: N Mukunda (IISc, Bangalore); S Chaturvedi (Univ. of Hyderabad); R Simon and R Jagannathan (Inst. of Math. Sci., Chennai) and V Balakrishnan (IIT, Madras)

Theoretical physics is one of the toughest areas in physics, which is often ignored by students as well as teachers. A better understanding of the subject provides equal importance to both theory and experiment. Equipping the teaching community with all the aspects of theoretical physics is, therefore, very important in physics education. This course was organized keeping this in mind.

The topics of the course included: tensor analysis and relativity, group theory and applications, nonlinear dynamics, and integral transforms. The programme consisted of three 90 min lectures in the morning followed by two tutorial sessions in the afternoon. There were also common lectures of a more general nature. The participants were given course materials and books on theoretical physics.

The teacher participants represented institutions from Alappuzha, Kolkata, Changanacherry, Chennai, Delhi, Kochi, Kollam, Mumbai, Parumala, Perambalur, Puttur, Sivakasi, Solapur, and Trichy,

Probability, stochastic processes and applications

Cochin University of Science and Technology, Kochi
September 26 – October 7, 2005

No. of participants: 38

Course Director: M K Ghosh (Indian Institute of Science, Bangalore)

Course Co-ordinator: A Krishnamoorthy (CUSAT, Kochi)

Resource persons: B Rajeev and S Ramasubramanian (ISI, Bangalore); B Krishnakumar (Anna University, Chennai); RP Pakshirajan (Bangalore); MK Ghosh and Srikanth K Iyer (IISc, Bangalore); A Krishnamoorthy and MN Narayanan Namboodiri (CUSAT, Kochi).

The schedule of the course included one lecture of 90 min duration with four sessions each day. The lecture topics covered probability measure on metric spaces, stochastic models, stochastic calculus, deterministic and stochastic control, queueing theory, Toeplitz and quasi – Toeplitz matrices, probability theory, and stochastic differential equations.

Each participant received a copy of the books by B Oksendal, by SM Doss and by KL Chung and Farid Aitsahlia.