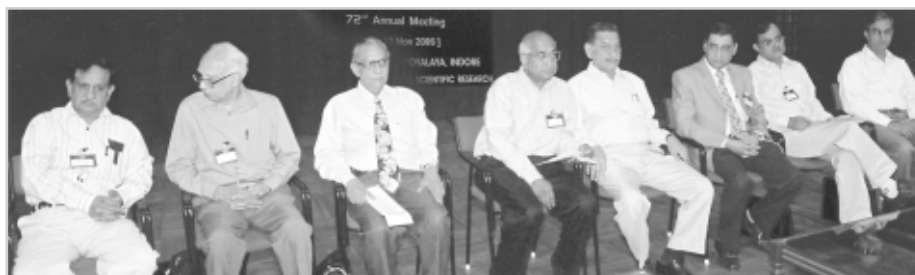


Newsletter of the Indian Academy of Sciences

2006 Annual Meeting

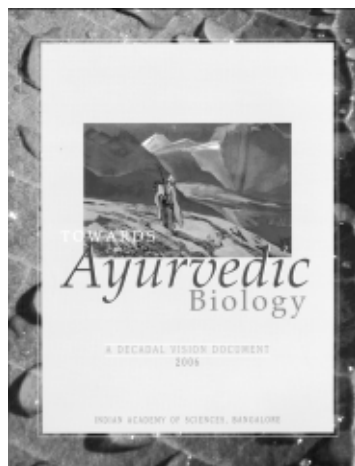
The seventy-second Annual Meeting of the Academy was held at Indore during 10–12 November 2006 co-hosted by the Devi Ahilya Vishwavidyalaya and the UGC-DAE Consortium for Scientific Research. About 200 Fellows and 30 invited teachers participated.



Some of the Academy's office bearers with the hosts at the inaugural session.

On November 9, 2006, the invited teachers had a meeting with the Science Panel conducted by S Chandrasekaran and S Mahadevan, both from IISc, Bangalore. In addition to a discussion of the various initiatives of the Panel, the collaboration with Indian National Science Academy was also mentioned. (See elsewhere in this issue for further details.)

A decadal vision document titled 'Towards Ayurvedic Biology' prepared by MS Valiathan for the Academy was released during the inaugural session. (This follows a similar document on Astronomy and Astrophysics prepared by G Srinivasan and released in 2006). The origin of Ayurveda, its golden age covering eight centuries, the works of Charaka and Susruta, and the holistic attitude of this system of health care, are all covered in this document. While releasing the document, the Academy President TV Ramakrishnan mentioned that it is an effort to place before the scientific



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

Forthcoming Events— 2007

18th Mid-Year Meeting, Bangalore
(13–14 July 2007)

73rd Annual Meeting, Regional Research
Laboratory, Thiruvananthapuram
(1–4 November 2007)

Refresher Courses

Topics in Mathematics and Physics
Ramakrishna Mission Vidyamandira,
Belur Math (Dt. Howrah)
(14–26 May 2007)

Advances in biophysics
Centre for Cellular and Molecular Biology,
Hyderabad (25 May–8 June 2007)

Experimental physics
Anna University, Chennai
(28 May–10 June 2007)

Marine geology and geophysics
National Institute of Oceanography, Goa
(22 October–2 November 2007)

Lecture Workshops

Quantum mechanics, quantum field
theory and group theory & tensors
Mar Ivanios College, Thiruvananthapuram
(1–3 August 2007)

community, especially that of India, the unique scientific opportunities that arise out of viewing Ayurveda from the perspective of contemporary science, its tools and ideas. MS Valiathan, an eminent cardiologist and medical scientist, and a profound scholar of Ayurveda, has been pioneering the idea that this is a fertile field for original scientific research at the highest level.

The presidential address by TV Ramakrishnan was on ‘Strong correlations, local constraints and gauge theories for electrons in solids’. The focus was on phenomena where explanations have emerged over the past two decades, and involving high temperature superconductors, manganites and heavy fermion systems. It is interesting that the concept of local gauge invariance, so fundamental to the studies of all basic interactions in nature, is relevant even in these complex systems.



TV Ramakrishnan



R Gadagkar



MS Valiathan



P Rama Rao



T Ramasami



Deepak Pental



MGK Menon

inadequate facilities and nonexistent research. T Ramasami outlined the plans of the Science and Technology Ministry, especially to attract talented students to science as a career.

The second symposium had five speakers touching different aspects of a sensitive subject: breeding of mustard; production of promoter modules for use in various transgenic varieties; stress-tolerant varieties; Bt cotton production and economic consequences; and the problem of eradicating the 'bollworm beast'.

MGK Menon delivered the S Ramaseshan Memorial Public Lecture on 'The changing face of science'. His tributes to Ramaseshan recalled steps taken to rejuvenate the Academy, especially its publications activities and the new appearance and role created for *Current Science*. Menon spoke of science as a part of human culture, and pointed out its explosive growth in recent decades leading to very large scale collaborations in specific areas, along with tremendously improved communication tools.

The second public lecture by Andre Beteille on 'Universities at the cross-roads' could not be delivered, but the text has since been published in *Current Science* Vol. 92, No. 4, pp. 441–449, 25 February 2007.

A very detailed report on the entire meeting appears in *Current Science* Vol. 92, No.5, pp. 574–578, 10 March 2007.

Two symposia were held as part of the programme – one on 'The state of Indian science: problems, prospects and indicators' put together by R Gadagkar; another on 'Genetically modified crops' organized by Deepak Pental. In the first symposium, the convener argued for the setting up of an institution to periodically assess the health of Indian science.

MS Valiathan described medical research in the country and especially its special position in the case of tropical diseases. Deficiencies of the current health care system, and the need for more basic research, were highlighted. P Rama Rao's presentation looked at the state of higher technical education, and some of its continuing inadequacies. There is a shortage of quality teachers,



Cultural Programme during the annual meeting

2007 ELECTIONS

Fellows

Aggarwal, Rakesh

All India Institute of Medical Sciences, New Delhi
Areas of interest: Gastroenterology; liver disease; viral hepatitis; epidemiology, health and economics



Ajayaghosh, A.

Regional Research Laboratory, Thiruvananthapuram
Organic materials; photosciences; macromolecular chemistry



Bajpai, Sunil

Indian Institute of Technology, Roorkee
Vertebrate paleontology; biostratigraphy; paleobiogeography



Balaji, V.

Chennai Mathematical Institute, Chennai
Algebraic geometry; representation theory;
topology

**Bhattacharyya, Archana**

Indian Institute of Geomagnetism, Navi
Mumbai
Ionospheric physics; geomagnetism;
space plasmas

**Dabholkar, Atish**

Tata Institute of Fundamental Research,
Mumbai
Quantum gravity; superstring theory; black
holes

**Gokhale, Rajesh Sudhir**

National Institute of Immunology, New Delhi
Chemical biology; natural product
biosynthesis; metabolic pathways

**Grover, Anil**

University of Delhi South Campus, New Delhi
Plant abiotic stress responses; plant
biotechnology; molecular biology

**Gupta, P K.**

Centre for Advanced Technology, Indore
Lasers; biomedical applications of lasers;
nonlinear optics

**Jain, Sanjay**

University of Delhi, Delhi
Mathematical modelling of complex systems;
biological and social networks; computational
and systems biology

**Jhunjunwala, Ashok**

Indian Institute of Technology, Chennai
Telecommunications; computer networks;
fibre optics

**Jog, Chanda J.**

Indian Institute of Science, Bangalore
Galactic dynamics; interacting and star burst
galaxies; interstellar molecular clouds

**Katoch, Vishwa M.**

National Jalma Institute, Agra
Taxonomy and epidemiology of
mycobacterial diseases

**Lohia, Anuradha**

Bose Institute, Kolkata
Cell cycle of protozoan parasites; molecular
genetics; regulation of gene expression

**Mittal, Sanjay**

Indian Institute of Technology, Kanpur
Unsteady aerodynamics; finite element
analysis; high performance computing

**Palit, Dipak Kumar**

Bhabha Atomic Research Centre, Mumbai
Ultrafast spectroscopy; photo & radiation
chemistry; chemical reaction dynamics in
condensed phase

**Radhakrishnan, Jaikumar**

Tata Institute of Fundamental Research,
Mumbai
Combinatorics; information theory

**Ramaswamy, Mythily**

TIFR Centre, Bangalore
Nonlinear functional analysis; elliptic partial
differential equations; control problems

**Rangarajan, P. N.**

Indian Institute of Science, Bangalore
Eukaryotic gene expression; infectious
diseases

**Sankaran, Parameswaran**

The Institute of Mathematical Sciences,
Chennai
Topology; algebraic groups

**Sarkar, Debi Prasad**

University of Delhi South Campus, New Delhi
Biochemistry; molecular virology; cell biology,
biotechnology

**Sen, Sandeep**

Indian Institute of Technology, New Delhi
Sequential and parallel algorithms;
probabilistic analysis; randomization;
computational geometry

**Shashidhara, L. S.**

Centre for Cellular & Molecular Biology,
Hyderabad
Developmental biology; evolution; genetics

**Shenoi, S Satheesh Chandra**

National Institute of Oceanography,
Dona Paula
Physical oceanography; ocean-atmosphere
interaction; satellite oceanography

**Singh, Harkesh B.**

Indian Institute of Technology, Mumbai
Main group chemistry; organochalcogen
chemistry; organometallic chemistry



ASSOCIATES 2006

Srinivasan, Narayanaswamy

Indian Institute of Science, Bangalore
Protein functions; bioinformatics in genomics; metabolism and signal transduction

Swamy, Musti J.

University of Hyderabad, Hyderabad
Protein chemistry and protein-ligand interaction; lipid phase behaviour & polymorphism; lipid-protein interaction

Tahseen, Qudsia

Aligarh Muslim University, Aligarh
Zoology; nematology

Vijayraghavan, Usha

Indian Institute of Science, Bangalore
Plant developmental genetics; microbial genetics; gene regulation

Yadav, Veejendra K.

Indian Institute of Technology, Kanpur
Synthetic organic chemistry; physical organic chemistry



Begum, Ayesha

University of Cambridge, Cambridge
Areas of interest : Radio astronomy

Bharali, Gautam

Indian Institute of Science, Bangalore
Analysis in several complex variables

Joshi, Yogesh M

Indian Institute of Technology, Kanpur
Rheology of Complex fluids, soft matter and glass transition

Kumar, Brijesh

Jawaharlal Nehru University, New Delhi
Quantum mechanism and quantum many-body physics

Sarkar, Ram rup

Centre for cellular and Molecular Biology, Hyderabad
Mathematical and stochastic modelling of biological systems, and nonlinear dynamics

Sriram, V.

National Centre for biological Sciences, Bangalore
Mitochondrial remodellings

Sunoj, Raghavan

Indian Institute of Technology, Mumbai
Computational and theoretical organic chemistry



Honorary Fellows

Gross, David J.

University of California
California, USA

Imry, Yoseph

The Weizmann Institute of Science
Rehovot, Israel

K C Nicolaou

University of California
San Diego, USA

INSA, NASI JOIN IN SCIENCE EDUCATION INITIATIVES

Both the Indian National Science Academy, New Delhi and the National Academy of Sciences of India, Allahabad, have expressed their willingness and interest in cooperating with Academy in the various activities of the Science Education Panel. Already this year's Summer Research Fellowship Programme for students and teachers is being organized jointly by all three Academies, and the number of Fellowships offered has doubled compared to 2006. Fellows of all three Academies are being requested to guide selected students and teachers.

In addition, INSA and NASI will also join Academy in organizing and conducting both Refresher Courses for teachers and Lecture Workshops for students and teachers. Three representatives each from INSA and NASI will be permanent invitees to the Academy Science Education Panel, and these programmes will be planned in a coordinated manner.

The expenses for all these activities will be shared equally by the three Academies.

SPRINGER AGREEMENT

Since the appearance of the previous issue of *Patrika*, Academy has entered into an agreement with Springer for copublication and international sales and dissemination of all its ten journals. The carefully drafted



R Gebauer and R Narasimha signing the agreement on behalf of Springer and Academy respectively.

agreement effectively safeguards the interests of the Academy, namely

- (1) Academy retains ownership, full copyright and complete responsibility for constitution of Editorial Boards.
- (2) All editorial policies, receipt, processing, refereeing of submissions, acceptance/rejection decisions, frequencies of issues, special issues, sizes of individual issues, will be in Academy's hands.
- (3) Production, pricing and distribution of the domestic editions within India will be handled solely by the Academy; this edition will continue to be available world-wide on the Academy server, with free open access to full text upon publication, including all earlier issues; there will be no page charges to authors, including for colour illustrations.
- (4) The Academy will include the Springer logo and title on the domestic editions.
- (5) The international editions will be co-published by the Academy and Springer, the on-line version will be put up on SpringerLink, based on electronic files supplied by the Academy; print versions will be produced by Academy for distribution outside India by Springer.
- (6) The international on-line editions on SpringerLink will be available at substantial discounts to all developing countries including India and as defined by HINARI, AGORA and INASP; and will be distributed elsewhere in the world by Springer on subscription basis, the rates being fixed by mutual consultation.
- (7) The international print versions will be marketed by Springer to all countries overseas. To developing countries, the subscription rates will be available at rates lower than the rest of the world.
- (8) The initial co-publication agreement between the Academy and Springer is for 3 years, 2007–2009.

It is our hope that with this arrangement, the world-wide visibility of our journals will improve substantially, and in the course of time both impact factors and quality of submissions will also improve.

RAMAN PROFESSOR

Anne McLaren, the Academy's twenty-third Raman Professor, was in India for about 4 weeks in November–December 2005 to take up the Chair (see *Patrika* 43). She again was in India for three weeks in October–November 2006 to complete her assignment.

Anne is a Principal Research Associate of The Wellcome Trust and Cancer Research Institute at the University of Cambridge in UK and is also a member of the European Molecular Biology Organization (EMBO).

On her latest visit Anne visited several institutions in Bangalore such as IISc, the Centre for Human Genetics, and the Manipal Hospital and took part in a conference on 'Genes, development and disease'. She also delivered an Academy public lecture on 'Science and ethics of stem cell research' on 28 October (for summary, see *Current Science*, Vol. 92, No.4, pp. 424-5, 25 Feb. 2007).

Anne also visited Hyderabad, Chennai, Mumbai and Delhi where she lectured at the LV Prasad Eye Institute, the Centre for Cellular and Molecular Biology, the Centre for DNA Fingerprinting and Diagnostics, Laconis Institute, Global Hospital (all at Hyderabad), Sankara Nethralaya, Vidyasagar Institute of Biomedical Technology and Science, and the Swaminathan Foundation (all at Chennai), TIFR, Mumbai and at Delhi the National Brain Research Centre, the Institute of Genomics and Integrative Biology, the Indian Council of Medical Research, the Delhi University and finally the Apollo Hospital. In her parting message Anne McLaren said that she felt deeply grateful to all concerned for enabling her "to visit many excellent institutions and meet so many interesting people".

SPECIAL ISSUES

Structural dynamics and earthquake engineering

Guest Editors: D Roy and CS Manohar
Sadhana, Vol. 31, No.4, August 2006, pp. 291–503

Sources of uncertainty in structural dynamics are traceable to modelling errors as well as inherent imperfections in structural geometry and excitations, among others. Given that the most acceptable route towards a rational description and modelling of this

uncertainty is through the use of probability theory and stochastic processes, new advances in the theory and applications to stochastic structural dynamics assume great significance. This is particularly true, for instance, in the broad field of earthquake engineering owing to the well-researched and widely appreciated stochastic models for earthquake excitations. Earthquake-resistant structures are designed to display controlled inelastic behaviour. Added to this, the need to model the nonlinear behaviour of structural systems, stochastic modelling naturally adds to the complexity of analysis posing a challenge to researchers. Indeed, for most stochastically driven nonlinear systems of engineering interest, exact analytical solutions are hardly available and the analyst has to fall back on either a clever analytical approximation or a direct numerical simulation. Approximate analytical techniques, unfortunately, have not been widely successful in accurately predicting the response of strongly nonlinear and higher dimensional systems. Therefore the research focus has, to an extent, veered round to the development and exploration of novel forms of simulation tools, e.g. Monte Carlo simulations using numerical integrations. Here again, developments of accurate schemes for stochastic numerical integrations face many more challenges than such developments in the context of deterministic systems. Even from an intuitive viewpoint, a stochastic trajectory would generally have more variations over a given length than its deterministic counterpart. In order to allow for this, such a trajectory cannot be modelled as C^∞ i.e., the modelling has to be consistent with the fact that it is differentiable only a limited number of times. In order to account for such non-smoothness, different calculi (such as Ito, Stratonovich or Malliavin calculi) have been developed. Of these, Ito calculus has been particularly useful for developing approximate analytical and numerical tools in stochastic structural dynamics. Over the last few decades, these analytical and numerical tools have been exploited to solve problems in many different areas of engineering relevance, as reflected partly in the papers published.

This special issue consists of eleven papers reflecting the progress of research in some of the broad areas on stochastic structural dynamics and applications to earthquake engineering. The topics covered include random eigenvalue problems through an asymptotic expansion of multi-dimensional integrals, Monte Carlo simulations of an ecosystem with two competing species, stochastic averaging applied to determine the PDF of strongly nonlinear dynamical systems, a study on explicit

dependence of strength reduction factors of elastic-plastic oscillators on ground motion parameters, combining stochastic finite element with the response surface method for estimating structural reliability, nonlinear dynamics of large deformations of a beam sliding on two knife-edge supports, particle filters applied to the identification of nonlinear structural dynamical systems, importance of sampling in time-varying reliability analyses, improved damage indicators through a multi-resolution analysis, and stochastic analysis of random road profiles on vehicle dynamics.

Transient phenomena on the Sun

Guest Editor: Wahab Uddin

Journal of Astrophysics and Astronomy,
Vol. 27, Nos 2/3, June/September 2006,
pp. 57–372

Transient phenomena occur on the Sun on many time-scales putting out flashes of electromagnetic radiation and material ejection superposed on the thermal radiation and solar wind. The discovery of coronal mass ejections (CMEs) in the early 1970s and their connection to the interplanetary transient phenomena observed by spaceborne instruments have dramatically improved our understanding of the Sun–Earth connected system. CMEs represent the most energetic aspects of solar eruptions that affect not only Earth’s space environment but also other planets in the solar system and ultimately the boundary of the heliosphere. The famous October–November 2003 events known as the Halloween CMEs amply demonstrated this by producing measurable effects throughout the heliosphere. CMEs are also considered to be the main contributor to the solar energetic population observed in the interplanetary medium by driving fast mode shocks that accelerate the particles. Direct impact of the CME plasma with its enhanced magnetic field is responsible for the large geomagnetic storms that have a number of consequences in geospace and on Earth’s surface. Although we understand the solar-terrestrial connection *via* the mass and photonic emissions from the Sun, we are far from understanding when the eruptions occur on the Sun and how they evolve while propagating through the interplanetary medium. For example, we understand CMEs as a magnetic phenomenon on the Sun but do not have direct measurement of magnetic fields in CMEs. We have to work mainly with photospheric magnetic field measurements. Small-scale transients such as nanoflares, on the one hand, are related to the steady emissions from the Sun *via* coronal heating and

solar wind acceleration. High speed solar wind from coronal holes interacting with neighbouring slow wind form the corotating interaction regions (CIRs), which constitute another source of geomagnetic storms. Although the CIR-related storms are of smaller magnitude, they are more frequent and related to other effects such as production of relativistic electrons in the magnetosphere.

The set of papers in this special issue grew out of the presentations at the International Solar Workshop on Transient Phenomena on the Sun held at the Aryabhata Research Institute of Observational Sciences (ARIES) during April 5–7, 2005. This Workshop was part of the Golden Jubilee celebrations of ARIES, and brought together solar-terrestrial researchers from India and abroad for a three-day deliberation on issues related to solar and solar-terrestrial physics. The importance of international collaboration in data acquisition, analyses, theory and modelling is well recognized as evident from the growth of International Space Weather and Living with a Star communities in recent years.

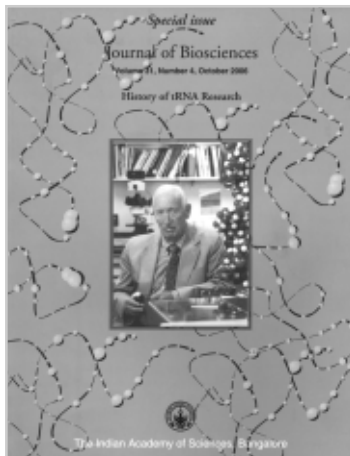
This special issue has a large concentration of papers on the origin of CMEs and flares, and their space weather consequences. The open data policy of the solar and heliospheric observatory (SOHO) mission has fuelled many of the reported studies. There are also papers on the quiet solar atmosphere and solar wind and their connection to the solar interior and the dynamo in particular. India has a long tradition of solar-terrestrial studies over the last century. Continuation of this tradition is reflected in the instrumentation papers including those discussing the extension of the observational capability to space. The papers also reflect the new openness in data policy of the international community that has promoted enhanced scientific return from various data bases constructed from ground observatories and space-based observations.

tRNA research

Guest Editor: Umesh Varshney

Journal of Biosciences, Vol. 31, No. 4, October 2006,
pp. 437–496

The history that brought it all alive: It began with an interesting conversation between Richard Giegé and Uttam L RajBhandary (Tom) that took place at the 20th International tRNA Workshop in Banz, Germany in October 2003. ‘t’ or ‘transfer’ RNAs are the central players in the transfer of the information contained in the language of genes, which are usually DNA molecules, to the

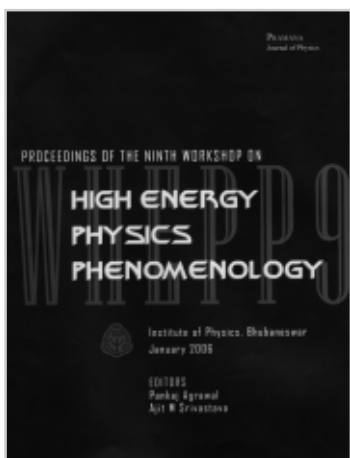


language of proteins. More correctly, tRNAs interpret the information present in messenger RNA, whose sequence is derived from that of the gene. tRNA molecules function as adaptors that bring amino acids to the protein synthesizing machine, the ribosome, in an orderly fashion and

in a way that mirrors the array of base triplets (the codons) specified on messenger RNA. Richard and Tom thought it important to bring together people who had worked on tRNA, especially in the early days, in order to exchange personal recollections about the history of the field. That discussion led to this special issue of *Journal of Biosciences* which contains six of the presentations at the Workshop which make a substantial contribution to the history of tRNA research.

WHEPP-9

Guest Editors: Pankaj Agrawal and Ajit M Srivastava
Pramana, Vol. 67, Nos. 4/5, October/November 2006, pp. 559–983



The Ninth DAE–BRNS Workshop on High Energy Physics Phenomenology (WHEPP-9) was held at the Institute of Physics in January 2006. This international workshop focussed on working group activities. One particular aspect of these workshops is the interaction between theorists and

experimentalists. This workshop also covered interdisciplinary areas and became the main conference of the Indian phenomenological community.

At the ninth Workshop, talks were presented on areas of current interest. The major activities revolved around four working groups, viz. collider physics, neutrino and

astroparticle physics, flavor physics and model building, and QCD and QGP. Activities of the working groups involved talks, intensive interaction and collaborative studies. Such activities led to numerous fruitful collaborations. On the last day of the Workshop, one coordinator from each working group presented a summary of the activities. This volume contains the proceedings of the Workshop brought out in two issues of *Pramana*.

Advanced functional materials

Guest Editors: D Bahadur and Satish Vitta
Bulletin of Materials Science, Vol. 29, No. 6, November 2006, pp. 547–647

The first Indo–Singapore Symposium on ‘Advanced functional materials’ held in February 2006 at Mumbai was organized jointly under the aegis of the Materials Research Society of India, Mumbai Chapter and IIT, Mumbai.

The main objective was to bring together leading scientists and technologists from India and Singapore to discuss various developments in materials for the 21st century and beyond. It was also expected to act as a platform for fostering scientific and technological collaborations between the scientific groups of India and Singapore. Participants were from India, Singapore, France and Myanmar. It had 4 areas as theme topics: (a) biomaterials, (b) magnetic materials, (c) electronic materials and (d) optical materials.

A total of 124 papers covering the four areas were presented which included 23 invited talks and the rest were poster presentations. Among the manuscripts that were submitted, a total of 12 contributed papers which included the best poster award papers, were selected for further reviewing and these papers appear in this special volume along with some of the invited papers.

Inorganic chemistry

Guest Editors: Ajai Kumar Singh and Ashok Kumar Ganguli
Journal of Chemical Sciences, Vol. 118, No. 6, November 2006, pp. 441–643

This special issue was based on lectures and oral presentations at the Eleventh Symposium on Modern Trends in Inorganic Chemistry (MTIC-XI) held at the Indian Institute of Technology, New Delhi in December 2005. The MTIC series of symposia (held every two years) have emerged as a primary forum for scientific fraternity

of the country to focus on the current status and future projections of research in frontier areas of inorganic chemistry, including organometallics, bio-inorganic chemistry, catalysis and materials chemistry. The wide range of topics covered in this volume reflect the current trends of research in inorganic chemistry in India and the editors hope that practitioners of inorganic chemistry will find the issue useful.

Operator theory, quantum probability and non-commutative geometry

Guest Editor: VS Sunder

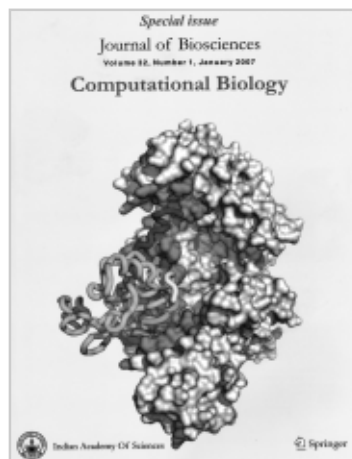
Proceedings: Mathematical Sciences, Vol. 116, No. 4, November 2006, pp. 375–551

An international conference on “Operator theory, quantum probability and non-commutative geometry” was organized in December 2004 by the Indian Statistical Institute, Kolkata. KB Sinha, a distinguished mathematician, was felicitated at the conference on his sixtieth birthday. In view of the high level of some of the talks, it was decided to bring out this special issue of the journal containing the papers presented at the conference.

Computational biology

Guest Editors: N Srinivasan, R Sowdhamini and Alok Bhattacharya

Journal of Biosciences, Vol. 32, No. 1, January 2007, pp. 1–180



The third Indo–French Bioinformatics meeting was held at the National Centre for Biological Sciences, Bangalore, in June 2005. The subject matter covered at the meeting was quite diverse and represented the rapidly changing contemporary phase of biocomputing. The idea of devoting a special

issue of *Journal of Biosciences* to the evolving field of computational biology was an offshoot of this meeting.

A number of different terms, such as ‘computational biology’, ‘bioinformatics’ and ‘*in silico* biology’ are commonly used to refer to applications of computational

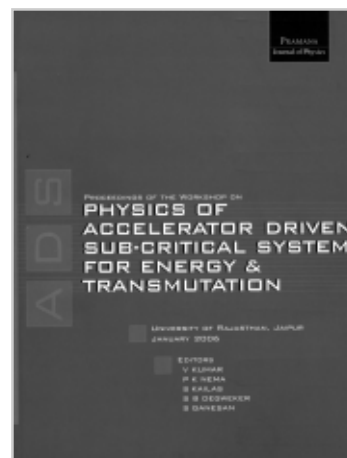
and mathematical approaches in biology. While one can debate about the meanings of these terms, the most general definition of computational biology has been adopted to include the use of computational techniques, tools, software, databases, data analyses, modelling and simulations to address biological problems. The contents of this volume cover different aspects of complexity in biological systems and consider proteins, genes, interactions, pathways, processes and cells.

The papers encompass both the technical and the scientific components of computational biology and the articles have been arranged so as to reflect an increasing level of complexity, beginning with genes and genomes and going on to cells.

Physics of ADS

Guest Editors: V Kumar, PK Nema, S Kailas, SB Degweker and S Ganesan

Pramana, Vol. 68, No. 2, February 2007, pp. 141–376



Accelerator-driven sub-critical system (ADS) is the technology of nuclear energy and incineration of the nuclear waste. Although it has a history of only a decade, many countries have drawn roadmaps of development of this technology. ADS is identified to be the forerunner of hybrid techniques of nuclear

power generation and will be more acceptable to the society from the point of safety and ecology because it is sub-critical and is capable of reducing the danger of nuclear waste. In a way, ADS will be a new kind of system of nuclear energy using a source of high energy neutrons, independent of the kind of nuclear fuel, i.e. fissile, fertile or even higher actinides, having features of incineration of nuclear waste at a fast rate. Thus, ADS being capable of using thorium as a fuel in a big way, extends the possibility of India to be self-reliant in nuclear energy because of high reserves of thorium in the country. In 2003, the Department of Atomic Energy started a programme of physics studies of ADS under its 10th plan and recently it consolidated its three-stage Indian nuclear programme to use thorium in PHWR in the second stage and APHWR+ADS in the third stage.

From the point of R&D of the technology, collection of high precision nuclear data of high energy reactions of neutrons, developing methods of shielding of high energy neutrons and study of the effects of higher order (n, xn) reactions on the fuel cycles are big tasks on one side and the challenge of developing high current (tens of milliampere) accelerator and design and modelling of spallation target on the other. In the Indian context, development of even a proton accelerator of microampere current will be treated as the first indigenous development. A Workshop on the Physics of ADS for Energy and Transmutation (WP-ADS-E&T) was planned as part of the activities of our ILTP project to exchange views, initiate collaborations, take stock of the present scientific achievements of the advanced laboratories and to plan future activities jointly. Besides two informal talks at the Workshop, 30 presentations on the six theme subjects were presented. After due review process, 23 papers were found suitable and included in this volume.

PUBLIC LECTURES

Human impact on atmospheric carbon dioxide and global climate

Jorge L. Sarmiento

Princeton University, New Jersey, USA

27 September 2006, Indian Institute of Science, Bangalore

Atmospheric carbon dioxide measurements from trapped air bubbles in Antarctic ice cores demonstrate that it is higher today than at any time in almost a million years.

Other less certain measurements suggest that the last



time the Earth saw such high levels may be more than 20 million years ago. The increased trapping of solar radiation that this is causing, in combination with other human induced changes in the Earth's radiation balance, led to a discernable heating of the Earth that will continue into the future.

The primary causes of the increased carbon dioxide are deforestation and the burning of fossil fuels. But the rate of increase is less than would be expected if all the carbon dioxide humans adding to the atmosphere stayed there. This is because of dissolution of carbon dioxide in the

ocean and the postulated uptake by land plants. For the past five decades, since Charles David Keeling initiated what has been characterized as the most important geophysical record of the century, the measurements at Mauna Loa that first demonstrated the atmospheric carbon dioxide increase beyond a shadow of doubt, scientists have developed a wide range of methods to unravel the oceanic and terrestrial contributions to the rate of increase of carbon dioxide in the atmosphere. This lecture was a progress report on that quest, documenting the remarkable and sometimes surprising developments that have occurred over the past decade, and ending with some reflections on what we need to do to get the situation back under control and what might happen if we do not.

Science and ethics of stem cell research

Anne McLaren

Gurdon Institute and Wellcome Trust, Cambridge, UK

28 October 2006, Raman Research Institute, Bangalore

Stem cells are cells with a choice: they can either divide to make more cells like themselves, or they can make specialized cells. Many tissues in our bodies depend on stem cells to replenish cells that are shed or used up, like skin, blood and gut cells. Research is now in progress to see how far these stem cells can be used to repair damage elsewhere in the patient's body, for example in the heart. As with all new medical treatments, ethical issues arise, in particular the psychological risk of raising patients' hopes unduly. For the future, there is even greater promise in pluripotent stem cell lines, which can grow indefinitely outside the body, and can be treated in such a way as to make any cell type. Such stem cell lines can perhaps be made from bone marrow and from brain cells, and certainly from early human embryos. Here the ethical concerns are greater, since the embryos (usually donated by infertile couples in IVF clinics who no longer need them for their own treatment) are used up in making the stem cell lines. Many countries (including India) now allow this, some countries also allow cloned stem lines to be made by transferring body cell nuclei into donated eggs cleared of their own genetic material (so-called therapeutic cloning). The consequences of increased understanding of serious and intractable diseases were explored by the speaker in this lecture. A summary of this lecture appears in *Current Science* (Vol. 92, No. 4, February 2007, pp. 424–425).

Crystal nucleation and ‘anti-van der Waals’ liquids

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FOM Institute for Atomic and Molecular Physics,
Amsterdam, Netherlands

25 January 2007, Indian Institute of Science, Bangalore

The first stage of crystal growth is the “nucleation” of an embryonic crystal. The nucleation of crystals has been studied for more than a century but is still not well understood. Insight into crystal nucleation comes from



an unexpected direction: the work of van der Waals. In the 1880s, when Kamerlingh Onnes started on his programme to liquefy helium, he was confident that it could be done because he was guided by van der Waals’s principle of corresponding states. However, this principle only applies to

molecules that have similar interaction potentials. For many systems, for instance protein solutions, the law of corresponding states breaks down — and this has important consequences for protein crystallization.

Living with earthquakes

Dan McKenzie

University of Cambridge, UK

23 February 2007, Indian Institute of Science, Bangalore



Most large earthquakes occur on plate boundaries. They often break an entire plate boundary in sequence, from one end to the other, as has happened in South America during the last century. In Indonesia such a sequence has just begun, with two huge earthquakes in 2004 and 2005.

The vertical movement associated with their movement produced tsunamis. Spectacular pictures, from the air and from satellites, show the uplift of the Sumatran coastline caused by these two shocks.

When the faults are on land, as they are in northern India, the vertical motions are still visible, even in cities. Many Indian cities are at risk, either from tsunamis or from

earthquakes, and a great deal can now be done to limit the damage caused by both. Tsunamis especially are often preceded by a large drop in sea level, which can give people time to escape upwards if they realize what is happening.

Memory and creativity in physics

Vinay Ambegaokar

Cornell University, Ithaca, USA

7 March 2007, Indian Institute of Science, Bangalore

A man hath sapiences thre
Memorie, engin and intellect also. . .

- Chaucer



The epigraph from the second nun’s Canterbury tale pithily distills, from Greek and Arab sources, a summary of the creative process in many human endeavours – including the “exact” sciences. Creativity in the latter context is, however, unusual in that reasonable people can agree when a mistake has

been made. An anecdotal illustration of this bracing truth was given in this lecture.

DISCUSSION MEETINGS

Inverse problems with special reference to atmospheric transport

Orange County, Coorg
23–26 November 2006

An ultra-high precision system to continuously monitor atmospheric CO₂ concentration was installed at Hanle to extract from it the spatiotemporal CO₂ fluxes by deconvolving the atmospheric transport. Since other organizations had expressed an interest in installing a similar system, it was proposed to discuss *a priori* conceived spatially distributed sites in the country where such measurements would add to the reliability of inverted flux estimates. Secondly, establishment of WMOT accredited laboratory at some appropriate institution in India for analysis of air samples collected in flasks in the country was discussed. With this in mind the discussion meeting was held. This meeting held at Orange County was attended by 18 participants from various institutions in India and France.

The first day of the meeting started with an introduction by VK Gaur (IIA, C-MMACS, Bangalore) to global carbon fluxes and their uncertainty. He mentioned the need for more stations in India for better estimates of CO₂ in the country. PK Gupta talked on outstanding issues in inverse problems and gave an overview on inverse problems. A comparative estimate of CO₂ for land and oceans from different models was given by Phillippe Bousquet.

The second day had a talk by Michel Ramonet (LSCE, France) who described the CO₂ network all over the world and suggested a few stations in India. He emphasized the necessity of an analysis unit in India. The analysis of the collected air samples need to be done using gas chromatograph or mass spectrometer. Peter Rayner (LSCE, France) spoke on different transport models in atmospheric inversions and numerical modelling schemes and advection schemes in the transcom reference frame. Phillippe Bousquet (LSCE, France) talked on source/sink attribution through inverse modelling at climate scales.

On the third day, the first talk was by Peter Rayner who talked about network design for surface CO₂ inversions. Attri (IMD, New Delhi) spoke about their work on CO₂ and related area with other organizations in India. Yogesh Tiwari (IITM, New Delhi) showed interest in taking care of a few stations in India in the effort of monitoring CO₂ stations in India among the network stations proposed by Michel Ramonet (LSCE, France). Vikram Reddy (Pondicherry University) mentioned the importance of having a station in Pondicherry for the Indian network. This was followed by a talk on methane emissions and their estimates in Europe by Phillippe Bousquet.

The last day was devoted to a talk by PS Swathi (C-MMACS, Bangalore) on the work done in C-MMACS on estimation of carbon fluxes. The meeting ended with a talk by Peter Rayner on carbon cycle data assimilation.

Mathematical finance

Orange County, Coorg
November 29–December 3, 2006

Mathematical finance has been one of the most active research areas in probability and statistics community in recent years and the main objective of this meeting was to gather together interested scientists from India and boost this activity, which has so far been rather

sporadic in our country. There were 24 participants from the finance industry and the meeting contained twelve lectures and two discussion sessions. Three main topics covered were: risk processes, interest rate models and volatility estimation.

Risk processes play a significant role in insurance and other areas. S Ramasubramanian (ISI, Bangalore) gave a series of lectures on this topic in which the basic framework of the Cramer–Lundberg model and the renewal model of insurance risk were reviewed. Ruin problem in both models was described. Renewal type equations and Pollaczek–Khinchin formula for ruin/survival probability were discussed. Exponential decay of ruin probability in small claims case, and power law decay in case of sub-exponential claim sizes were elaborated upon for the Cramer–Lundberg model. Minimizing ruin probability through investment in risky asset and/or through reinsurance was outlined in the case of Cramer–Lundberg model. Asymptotics of optimally controlled risk processes were surveyed.

K Suresh Kumar (IIT, Mumbai) gave a series of lectures on interest rate models which focused on modelling and pricing of interest rate derivatives. He gave a brief description of the basic notions like money market account, T-bond, stochastic discount factor, swaps, caps, floors, short rate etc. A substantial part of his lectures was on short rate model approach also known as the Vasicek methodology for term structure. An affine formula for the T-bond was derived using no arbitrage argument. The pricing of interest rate derivatives was obtained using the forward measure approach. The final part of his talks was devoted to the Heath–Jarrow–Morton (HJM) methodology where he showed the importance of volatility structures of forward rates in the pricing scenario. As an illustration he discussed the Hull–White model for short rate to show how the short rate modelling approach is a special case of HJM methodology in the context of derivative pricing.

A Subramanyam (IIT, Mumbai) gave a series of lectures on volatility estimation. He explained the importance of the estimation of volatility in the pricing of options and other derivatives and discussed estimating volatility interpreted as the standard deviation of the returns obtained in unit time. Various estimators based on high, low, open and close prices were described, assuming the Black–Scholes model. Subsequently he described models in which volatility is allowed to be random. The

product price model of Taylor and ARCH/GARCH models was discussed. A method of estimating volatility assuming it can take on only finitely many values was outlined. Finally he presented a model in continuous time for the returns by subordinating a Brownian motion. Estimation of 'actual volatility' using the 'realized volatility' was also discussed at the end.

Srikanth K Iyer (IISc, Bangalore) gave two lectures on credit risk in which he explained the basic problems in credit risk and elaborated upon the credit+model.

Two discussion sessions were held. The first was initiated and moderated by Vijay Phansalkar (Financial Consultant, Pune). He described a trading strategy based on the directional change in volatility of the underlying stock and mentioned that this particular strategy has been immensely successful for a certain company. The second discussion session was initiated and moderated by Sanjeevan Kapshe (SEBI, Mumbai) in which ten challenging problems in finance were described.

REFRESHER COURSES

Phylogenetic biology

University of Mysore, Manasagangotri
July 10–22, 2006

No. of participants: 32

Course Director: HA Ranganath (Bangalore University, Bangalore)

Course Co-ordinator: SR Ramesh (Univ. of Mysore, Manasagangotri)

Resource Persons: Amitabh Joshi (JNCASR, Bangalore), Amruthavalli (CIST, Mysore), KN Ganeshiah and R Uma Shaanker (UAS, Bangalore), R Geeta and John Wiens (SUNY, Stony Brook), J Nagaraju (CDFD, Hyderabad), Praveen Karanth (IISc, Bangalore) and HA Ranganath (Bangalore Univ.)

Teacher participants were from Amaravati, Bangalore, Bhimavaram, Dharwad, Ernakulam, Gorakhpur, Kolar, Mysore, Nagpur, Nanded, Orissa and Pune.

Topics of some of the lectures and laboratory exercises: Tree; parsimony analysis; character evolution; molecular evolution; Bayesian methods; langur

species phylogenetic systematics; phylip; evolution of nasuta; genome evolution; biogeography; molecular phylogeny of silkmoths; evolutionary dynamics of mariner.

Advanced topics in chemistry

Lady Doak College, Madurai
November 7–20, 2006

No. of participants: 29



Course Director: R Ramaraj (MKU, Madurai)

Course Co-ordinator: C Kalaneethy Christopher (Lady Doak College)

Resource Persons: V Krishnan (JNCASR, Bangalore), AK Shukla (CERI, Karaikudi), MV Sangaranarayanan (IIT, Chennai), M Palaniandavar (Bharathidasan University), J Gopalakrishnan and S Yashonath (IISc, Bangalore), P Ramamurthy (University of Madras), TK Chandrashekar (RRL, Thiruvananthapuram), R Ramaraj, PR Athappan, S Rajagopal, K Pitchumani and S Muthusubramanian (all of MKU, Madurai).

The course consisted of four technical sessions of 90 minute duration followed by laboratory sessions. The topics of the course included advanced topics in chemistry like solid state chemistry and materials science, nanomaterials, bio-inorganic chemistry, green chemistry, electrochemistry, molecular modelling and simulations, spectroscopic techniques like NMR, ESR, fluorescence spectroscopy. The laboratory sessions included experiments in green chemistry, absorption, emission studies, and nanoparticles. Each participant was given a copy of the books on nanotechnology, green chemistry and solid state chemistry.

The teacher participants were from institutions in Ahmednagar, Durg, Ernakulam, Koothuparamba, Madurai, Mandya, Nagpur, Perambalur, Pune, Salipur, Sambalpur, Sarugani, Sikkim, Tirunelveli, Vellore and Virudhunagar.