

Patilka

Newsletter of the Indian Academy of Sciences

2008 Mid-Year Meeting

The 19th Mid-Year Meeting (MYM) of the Academy was held on 4-5 July 2008 at the Indian Institute of Science, Bangalore. Close to 200 outstation Fellows and Associates, about 30 invited teachers, and a large number of Fellows in Bangalore, attended this meeting. On 3rd July 2008, the day prior to the MYM, a special day-long programme involving the Teacher invitees was arranged, and in addition, the Science Education Panel including representatives from INSA and NASI held its annual meeting.

The MYM included two Special Lectures, one Public Lecture and twenty one brief twenty minute presentations by newly elected Fellows and Associates. In his Special Lecture titled 'The joy of exploring the rich repertoire of carbohydrate motifs and their shapely lectin receptors', A. Surolia described the diverse biological functions of lectins mainly involving cellular recognition. He also dwelt on their being coded for by multiple linked genes. The other Special Lecture titled 'Structural transitions: Discrete versus continuous' by



A Surolia



Srikumar Banerjee

Srikumar Banerjee dealt with chosen alloys to illustrate significant variations in phase transitions. The alloys discussed are of the Ni-Mo and Zr-Al types, and the transition processes could be by discrete nucleation and growth, or by amplification of a concentration fluctuation. The dynamics of the transition



Anil Kakodkar

processes can be followed using electron diffraction patterns and high resolution electron microscopy, and the sequence of symmetry changes can be followed.

The very largely attended Public Lecture by Anil Kakodkar on 'Evolving Indian nuclear programme: Rationale and perspectives' covered in depth a currently very important issue of great public interest. The speaker

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New Delhi	
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EDITOR

N. Mukunda

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Bangalore 560 080, India
Phone: (080) 2361 2546, 2361 4592
email: office@ias.ernet.in

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Newsletter, please write to the
Executive Secretary of the Academy
(chandra@ias.ernet.in)

Forthcoming Events – 2008

Refresher Courses

Experimental Physics

Madurai	:	22 December 2008 to 7 January 2009
Trichi	:	19 January to 3 February 2009
Karaikudi	:	02 May to 17 May 2009
Mangalore	:	01 June to 16 June 2009

Lecture Workshops

Material science and nanotechnology
Dept. of Chemistry, Bangalore University,
Bangalore (30 – 31 October 2008)

Current trends and challenges in life
sciences
St. Xavier's College, Mumbai
(26 – 27 November 2008)

Evolutionary biology
Abasaheb Garware College, Pune
(12 – 14 February 2009)

outlined the important aspects of India's three-phase nuclear power programme: uranium-based pressurised heavy water reactors, plutonium-based fast breeder reactors and thorium-based reactors. This strategy and sequence are determined by India's available resources on the one hand, and the neutron irradiation properties of the relevant isotopes on the other. The long term focus of the entire programme, and the energy needs and projections up to about 2050, were clearly brought out in the presentation. The discussion after the lecture was wide-ranging and lively.

The short presentations covered as always an astonishing range of areas: high speed aircraft air intake; the Sun and the ionosphere; the Indian monsoon over the past four centuries; communication complexity; magnetism in neutron stars; dramatic improvements in leather tanning; and the monitoring of wild life populations.

The tradition of stimulating and packed Mid-Year and Annual Meetings continues.

74th ANNUAL MEETING IIT, NEW DELHI

31 October – 2 November 2008

Programme

31 October 2008 (Friday)

0930 – 1100	Inauguration and presidential address D Balasubramanian , LV Prasad Eye Institute, Hyderabad The human eye lens: A tissue that age does wither, custom does stale
1100	Tea break
1140 – 1220	Special Lecture A K Sood , Indian Institute of Science, Bangalore Fascinating dynamics of soft matter
1220 – 1300	Lectures by Fellows/Associates
1220	K George Thomas , NIIST, Thiruvananthapuram Optical properties of hybrid nanomaterials
1240	Usha Vijayraghavan , IISc, Bangalore The making of a flowering stem: Lessons from molecular genetic analysis of flowering in model plants

1300	V Suresh , University of Hyderabad, Hyderabad Isotropy of quadratic forms	1140	Ganesh Subramanian , JNCASR, Bangalore The role of inertia in micro-scale transport processes
1320 – 1450	Lunch Break		
1450 – 1700	Symposium : Complexity and computation in the natural sciences (Convener: Rahul Pandit) An overview of the symposium	1200	Symposium : Women in Science (Convener: Rohini Godbole, Indian Institute of Science, Bangalore) Panel discussion Vineeta Bal Raghavendra Gadagkar Saman Habib Sujatha Ramdorai Indira Nath Shanti Prasanna
1455	M Barma , TIFR, Mumbai Complexity in stochastic processes and statistical physics		
1525	Somdatta Sinha , CCMB, Hyderabad A simple approach to study designs in complex biochemical pathways	1330 – 1430	Lunch break
1555	B N Goswami , IITM, Pune Computing grand challenge of projecting Indian monsoon in a changing climate	1430 – 1530	Lectures by Fellows/Associates
1625	Rahul Pandit , IISc, Bangalore Complexity in turbulence	1430	P K Das , IISc, Bangalore Chemical applications of second harmonic Rayleigh scattering
1700	Tea break	1450	Anil Kumar , NGRI, Hyderabad Kimberlites: As probes of the Earth's mantle
1800 – 1900	Business Meeting of Fellows	1510	U S Bhalla , NCBS, Bangalore How mammals discriminate odorant identity and location
1900 – 2000	Public Lecture Narayani Gupta , Jamia Millia Islamia, New Delhi Delhi – The city of many gates	1530 – 1600	Tea break
		1600 – 1715	Symposium : Energy (Convener: S Sivaram, National Chemical Laboratory, Pune) G Rajeswaran , Moser Baer Photovoltaic Limited, New Delhi Silicon-based photovoltaic technologies
1 November 2008 (Saturday)			
0930 – 1200	Lectures by Fellows/Associates		R Rajaraman , JNU, New Delhi Nuclear power – Present status and future prospects
0930	Mammen Chandy , CMC, Vellore Research on haematology at Vellore: From bedside to bench		Pushpito K Ghosh , CSMCRI, Bhavnagar CSMCRI's engagement in energy from bio-resources
0950	K Krishna Kumar , IITM, Pune Impact of climate change on India's monsoonal climate: Present status and some outstanding issues		Public Lecture C Rangarajan , Member, Rajya Sabha The state of Indian economy – Achievements and challenges
1010	Banibrata Mukhopadhyay , IISc, Bangalore Measuring spin of black holes in the universe	1730 – 1830	Cultural programme
1030 – 1100	Tea break		
1100	Dulal Panda , IIT, Mumbai Microtubule dynamics, mitosis and cancer chemotherapy	1830 – 2000	
1120	Ashwini Nangia , University of Hyderabad Crystal engineering: Polymorphs, cocrystals and network solids		
			Special Lecture K Muralidhar , University of Delhi Mammalian prolactin – an ancient but still a mysterious hormone
			2 November 2008 (Sunday)

- 1010 – 1240 **Lectures by Fellows/Associates**
- 1010 **A B Pandit**, University of Mumbai
Cavitationally induced transformations:
An emerging technology
- 1030 **S K Apte**, BARC, Mumbai
Living dangerously: The deinococcus
way
- 1050 – 1120 Tea break
- 1120 **S M Sharma**, BARC, Mumbai
High pressure investigations of some
exotic materials
- 1140 **K Somasundaram**, IISc, Bangalore
Genomic and proteomic approaches
in cancer classification and treatment
- 1200 **U V Waghmare**, JNCASR, Bangalore
Soft modes in hard materials
- 1220 **Imran Siddiqi**, CCMB, Hyderabad
Gamete formation without meiosis in
plants

ASSOCIATES – 2008



Anand, Venkataramanarao Govindan
Indian Institute of Science Education &
Research, Pune
Bio-inorganic chemistry; pi-conjugated
macromolecules and supramolecular
chemistry



Dixit, Narendra Madhukar
Indian Institute of Science, Bangalore,
Theoretical and computational biology



Karthikeyan, Thangaraj
Indira Gandhi Centre for Atomic Research,
Kalpakkam
Physical metallurgy and materials
characterization



Mahajan, Nomit
Physical Research Laboratory,
Ahmedabad
Theoretical high energy physics



Maulik, Krishanu
Indian Statistical Institute,
Kolkata
Stochastic modelling

Mitra, Abhijit

Indian Institute of Technology, Guwahati
Signal processing; wireless communication
and communication networks



Pal, Bipul

Indian Institute of Science Education and
Research, Kolkata
Semiconductor physics; laser spectroscopy
and quantum information processing



Parthasarathi, Ramakrishnan

Central Leather Research Institute, Chennai
Theoretical and computational chemistry



Sandeep, Kunnath

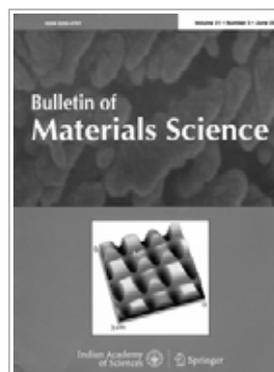
TIFR Centre for Applicable Mathematics,
Bangalore,
Elliptic PDE, nonlinear analysis and calculus
of variation



SPECIAL ISSUES OF JOURNALS

Nanoscience and nanotechnology

Guest Editors : G Sundararajan, T Narasinga Rao
Bulletin of Materials Science, Vol. 31, No. 3,
June 2008, pp. 199–584



Over the past decade, there has been unprecedented global excitement in various aspects of nanoscience and technology both of which are intimately intertwined if the immense possibilities afforded by the nanoscales are to be realized. Nanotechnology is an interdisciplinary field and thus provides tremendous scope for related technology development in a wide range of areas including electronics, biotechnology, and materials engineering. Nanotechnology has the potential to transform the current state-of-art in low-cost solar cells and sensors, faster computers with more memory capacity, filters for cleaning contaminated water, cancer killing drug molecules and more.

The Nanoscience and Technology Initiative (NSTI) was launched in October 2001 to strengthen the overall research and development in nanoscience and technology. Under this initiative, about 100 research

projects dealing with the synthesis and assembly of nanoparticles, nanotubes, nanowires, nanoporous solids and nanostructured alloys have been supported until March 2007. NSTI has also strived to retain a focus on simultaneously granting projects aimed at developing applications, especially in areas related to structural materials, energy, health and environment. Many Indian industries are showing interest in evaluating and adopting nanotechnology, thereby raising the vision of India becoming a globally significant player in the field by translating the research excitement into products of commercial or strategic significance.

A National Review and Coordination Meeting on Nanoscience and Nanotechnology was held in Hyderabad in 2007 to provide a forum for bringing together all major research groups working in nanoscience and nanotechnology, those funded under the NSTI programme as well as others, to facilitate strong interaction and provide abundant prospects for networking. The following areas were addressed at the meeting: Synthesis and characterization of nanomaterials, nanocoatings, nanocomposites, nanobiomaterials and nanofunctional materials. Among the many manuscripts submitted, 55 were accepted for publication after peer review and these are included in this volume. The editors hope that this will serve as an archival collection of papers in the rapidly expanding field of nanoscience and nanotechnology.

Statistical physics

Guest Editors: S B Santra, S S Manna

Pramana, Vol. 71, No. 2, August 2008, pp. 193–438

Statistical physics is a fundamental branch of physics, like classical or quantum physics. Phenomena in many different disciplines of science are described and understood in terms of the established laws and principles of statistical physics. Over the last several decades, statistical physics is being applied to topics that usually do not come under the purview of the conventional statistical physics such as biology, soft matters, networks, economics, besides physics of materials. These branches of research are commonly referred as multidisciplinary topics of statistical physics. An International Workshop and Conference on Statistical Physics Approaches to Multidisciplinary Problems (Guwahati, January 2008) was targeted to discuss these problems in particular. The objective of this workshop and conference was to bring together scientists working in multidisciplinary topics of statistical physics and provide a platform for interaction as well as share their knowledge and experiences with colleagues and students. This volume contains texts of twenty-four presentations made at the conference.

Aerosols, gases and radiation budget

Guest Editor: K Krishna Moorthy

J. Earth Syst. Sci., Vol. 117, July 2008, pp. 241–428

Characterizing the optical, physical, and chemical properties of atmospheric aerosols, and the spatio-temporal heterogeneities in these caused by the distributed nature of the sources and sinks, the meso-scale and synoptic scale dynamics of the atmosphere, and long-range 'trans-boundary' transport at different altitude levels, with specific focus on the Indian mainland and the surrounding oceans is of great importance in assessing the radiative impacts and the consequent regional climate implications. Such efforts call for a comprehensive approach, such as making campaign mode observations using a variety of instruments over multiple platforms over the land, the ocean and in the atmosphere (including space). To accomplish these objectives, an exhaustive field experiment, an Integrated



Campaign for Aerosols, Gases and Radiation Budget (ICARB), was conceived and successfully accomplished by the Indian Space Research Organization under its Geosphere Biosphere Programme (ISRO-GBP), during March – May 2006. This unique and most exhaustive national endeavour had the participation of more than 120 atmospheric scientists from various institutions in India, and deployed a variety of instruments. A network of 14 aerosol observatories over the Indian mainland and two islands (one each in the Arabian Sea and the Bay of Bengal), a fully dedicated, carefully instrumented cruise of the research vessel *Sagar Kanya* for a period of 64 days, and an instrumented aircraft making 26 sorties from 5 bases, were all executed in tandem to collect exhaustive scientific information on aerosols and the state of the atmosphere around the Indian region and adjoining oceans. An experiment of this magnitude was conducted for the first time, not only in Asia but perhaps, over the entire globe as well.

After the completion of the experimental phase of ICARB in May 2006, the voluminous data were examined by scientists to understand the various aspects of aerosols and gases, in line with the project objective. This special issue is a compendium of 18 scientific papers from various groups describing and discussing their findings.

Friction, fretting and wear

Guest Editors: KRY Simha, Satish V Kailas, TS Srivatsan

Sadhana, Vol. 33, No. 3, June 2008, pp. 175–356

Engineering design and analysis symbolizing artistic imagination and scientific intelligence are the drivers of modern technology. Extremely stringent specifications pertaining to dimensional accuracy and surface texture have provided tremendous impetus for the application and appreciation of surface science and contact mechanics. Reducing friction and wear between moving parts is a major aspect of fuel efficient design while at the same time ensuring safety and integrity of contacting components vulnerable to fretting wear, erosion, galling, scuffing and damage. Though these issues have been discussed and analysed extensively for well over two centuries, clear design guidelines to combat friction, fatigue and wear of metals, alloys and polymers continue to challenge scientists and engineers.

Friction, fracture and fatigue control the state of matter in the universe and therefore life. Although the origin and need for life to evolve on our planet remain unclear, the dominating role of friction, fracture and fatigue for creating, controlling and sustaining geological, biological and technological diversity is abundantly and ubiquitously evident around us. Geologically, the origin of continents, islands and volcanoes is attributed to the fracture and fragmentation of terrestrial crust; biological diversity is displayed by geckos darting across smooth walls and high ceilings while intelligent humans continue to slip and fall on rough floors; and, finally, marvellous technological diversity of emerging materials in the new millennium demonstrates exciting advances in micro/nanoengineering. The diversity of applications ranging from pharmaceuticals, dental implants, mining, transportation, space and nuclear medicine underlines the success of rigorous science and engineering education that prevailed almost until the beginning of the new millennium.

The enigma of friction has occupied human thought since the early dawn of civilization. The saga of ancient scientists, engineers and artisans to control and conquer friction in moving parts continues to this day with components shrinking in size but delivering more power. Along with fracture and fatigue the problem becomes even more enigmatic inasmuch as a comprehensive understanding of irreversible dissipative phenomena like friction, fracture, fatigue and turbulence requires fusing together irreconcilably complex concepts of classical

and statistical thermodynamics. At this juncture, it is interesting to witness a delightful interaction and interplay of precepts and concepts underpinning seismology and tribology. Modelling friction in triggering tectonic events remains hugely challenging in spite of extensive field observations and numerical effort. Asperities hold the key to opening the doors into the mysterious phenomena of stick and slip between sliding blocks ranging from the submicroscopic to the tectonic scale spanning hundreds of kilometers. Depending upon the hardness and heterogeneity of asperities, the sliding blocks tangle, jerk, slide and rub their way like a pair of sumo wrestlers. In a dizzy little earthquake paperback stirring up a cocktail of fact, myth, grapevine and anecdote, Hough writes: Friction is another notorious geophysical hedgehog (probably inspired by Lewis Carroll). It is quite plausible that sliding blocks that are temporarily locked by asperities begin to move when they are deasperated.

Bridging classical and statistical concepts involves integrating over ten orders of magnitude in time and space in order to capture the rich diversity of fundamental effects entailing electronic transition, acoustic emission, dislocation dynamics and lattice vibration to mention a few. The role of phonons and electrons in reducing friction in monolayers appears as esoteric as the emission of electrons and photons in fracturing rocks while the role of fatigue and cavitation in weakening our bones through osteoporosis is simply taken for granted. Fractoemission (FE) of electrons accompanying brittle fracture of rocks became a sensational topic attracting diverse opinion among earthquake experts for a couple of decades culminating in the publication of an entire volume in the journal *Geophysical Research Letters* in 1966. The seemingly impenetrable interface between materials science and mechanics has driven away theoreticians to seek their fortune in experiment and simulation. The range of products, instruments and techniques to probe into the finer states of matter to achieve near-zero temperature, vacuum and atomic scale resolution is indeed devastating. There are exciting developments in molecular models to engineer MEMS and NEMS devices. While there is no doubt that science is turning nano, solids and structures continue to succumb to creep, corrosion and cavitation aggravated by heat, vibration and radiation. These issues have been recently addressed and compiled in a gigantic 10 volume, 130 chapter, 5000 page handbook edited by Ritchie & Murrakami entitled *Comprehensive structural integrity* cobbling together the ideas of 193 aerospace,

biomechanical, chemical, civil, electrical, mechanical, metallurgical engineers and scientists from universities and industries drawn from 21 countries.

This special issue is an outcome of the editors' desire to promote students and young researchers working in the areas of friction, wear, emergent materials, fretting, AE and allied topics. The Internet era has vastly expanded the scope for acquiring new knowledge leaving little time for students to discover the joy of learning by integrating and interpreting conflicting results. Intelligence, interest and integrity of great scientists and engineers inspired the establishment of schools, colleges, universities and societies for promoting texts and student-friendly journals. Scientific and technical publications appear to be increasingly becoming monotonous owing to the excessive use of jargon and technological acronyms unfamiliar to students and junior researchers. Fortunately, the number of young and interested researchers actively engaged in experimental, theoretical and numerical modelling of the mechanical behaviour of solids subjected to erosion, abrasion, fretting, fatigue, impact and wear caused by mechanical, electrical, thermal and magnetic stimuli is steadily growing in recent years. Although we have come a long way in our journey towards designing that ever-elusive ideal material immune to the insidious effects of friction, fracture, fatigue, creep corrosion and cavitation under the action of thermal, magnetic and nuclear radiation, there is plenty of room for exciting innovation for future generation of research students and budding inventors. This collection contains peer reviewed but unpublished articles, research theses and new concepts for characterizing surface texture. It attempts to capture the challenges faced in advancing our understanding of friction, fatigue and fracture in the context of emerging materials and technologies focussing on micro-structure, mechanical characterization, mathematical analysis, failure analysis and technological solutions.

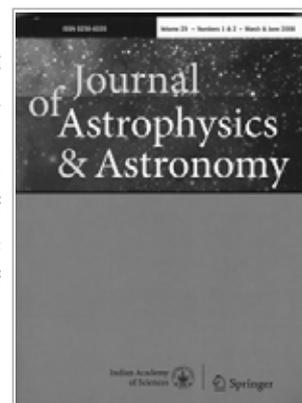
Solar cycle – 24

Guest Editors : Rajmal Jain, P Venkatakrishnan,
Judith T Karpen

J. Astrophys. Astr., Vol. 29, Nos. 1/2, March/June 2008, pp. 1–362

The Physical Research Laboratory (PRL) was founded in 1947 by Vikram A. Sarabhai, initially at his residence with research on cosmic rays. The laboratory was formally established on 11 November 1947 at the

M. G. Science College, Ahmedabad, with support from the Karmkshetra Educational Foundation and the Ahmedabad Education Society. The initial focus of research was on cosmic rays and the properties of the upper atmosphere. Research in theoretical physics and radio physics



was later added with grants from the Atomic Energy Commission. The history of solar research at PRL began with the founding of the Udaipur Solar Observatory in the middle of Fateh Sagar lake in Udaipur in 1975 and the subsequent taking over by the Department of Space in 1981.

PRL celebrated its Diamond Jubilee during 2006-07. An international conference on Challenges for Solar Cycle – 24 was organized during January 2007 as a part of this celebration. The conference was attended by more than 140 participants including 40 delegates from outside India. The conference was conceived to address key science issues such as: What would the behaviour and magnitude of the next solar cycle be? What are the major questions to be addressed by the international programmes, viz., IHY, Space-Weather, CAWSES and Sun-Earth connection? Three thematic topics viz magnetic fields, energetics, and instrumentation were decided. For each theme, several sub-topics were chosen by the scientific organizing committee. The topic 'magnetic fields' covered many important subjects such as evolution of magnetic fields, dynamo, helioseismology, helicity, magneto-convection, and coronal magnetic fields. The second topic 'energetics' dealt with sub-topics such as solar irradiance, coronal heating, flares, coronal mass ejections, particle acceleration, IP shocks, solar energetic particles (SEPs), space-weather and Sun-Earth connection, and IHY and CAWSES programmes. The 'instrumentation' theme covered ground-based high-resolution observations, active and adaptive optics, next generation instrumentation, current space missions, and future space instruments.

The scientific programme included plenary, invited and contributory talks. This volume presents 46 of the papers presented at the conference and accepted after the due process of refereeing.

DISCUSSION MEETINGS

Mechanisms of pattern formation

Orange County, Coorg

6–9 December 2007

Convener : Somdatta Sinha

Pattern formation is a multidisciplinary area of enquiry that braces physical, life and engineering sciences. While a biologist may look at generation of complex organizations of cell fates in space and time, a physicist or an engineer may be interested in studying the evolution of patterns in space and time in flow of fluids, microstructures of materials, snowflakes, or geological formations.

The goal of the meeting was to connect a group of experimentalists and theoretical scientists from diverse research fields such as physics, biology, chemical engineering, and mathematics, to discuss the critical issues that confront the description of pattern at the systemic level in biology and identify the core mechanisms that direct patterning in functional multi-cellular structures. In all 24 participants (largely national and few international) working on pattern formation came together to find out the commonalities and differences among the systems and methods.

The emergence of understanding about the similarity in fundamental mechanisms of the pattern formation in biological, chemical and physical systems makes the study of pattern formation a truly interdisciplinary science. Although pattern specification is genetically controlled in living systems, it is seemingly clear that non-genetic mechanisms such as stochasticity in gene expression, biophysical properties (such as adhesion) and their heterogeneity, matrix-mediated interactions, and environmental perturbations can be strong determinants of the final pattern. Different concepts and modelling methodologies from statistical physics and nonlinear dynamical systems used to describe pattern-forming processes have also been applied with fair success on biological systems. This amalgamation points towards a fruitful dialogue among diverse researchers in the field of pattern formation.

In her introductory presentation, Somdatta Sinha highlighted the ubiquitous presence of spatial, temporal, and spatiotemporal patterns, and their functional roles in biological and natural physical systems. The programme consisted of nine overview talks by experimentalists and theorists reviewing

specifics of pattern-forming systems and experimental and theoretical methodologies.

The meeting was a successful attempt to reach a merger between researchers from two different cultures through extensive discussions by trying to understand each others' vocabulary and restructuring the definitions. Several participants observed that such meetings could bring about possibilities of collaborative research and that more such discussion fora are needed.

Harmonic analysis and operator theory

Indian Institute of Science, Bangalore

28 December 2007 – 1 January 2008

Convener: G. Misra

The meeting held at Bangalore was attended by 100 participants from India and abroad. G. Pisier delivered a series of lectures on Operators spaces, Grothendieck's theorem and non-commutative spaces. These talks started with the description of the original Grothendieck's theorem, its connection to isometric embeddings of Hilbert space into L spaces via Gaussian random variables and the subsequent C^* algebra versions proved by Haagerup and Pisier. Recent interesting results due to Kashin and Szarek were also discussed. Pisier's lectures ended with a discussion on very recent work by Haagerup and Musat related to these topics. There were also several invited talks covering a variety of topics in harmonic analysis and operator theory. The participants also discussed on possible new collaborations and reviving the old ones.

Non-commutative geometry and operator algebras

Orange County, Coorg

25 February – 1 March 2008

Convener : K B Sinha

This meeting was aimed at discussing recent developments and problems of current interest in the field. Basics of operator algebra theory was assumed and therefore this meeting was held at an advanced level. It was attended by twenty participants including two from France, one from UK and six doctoral students. There were only two lectures every day so as to devote more time for discussions.

The subject of Operator Algebras began with the pioneering work of von Neumann and Murray in a series

of papers in the 1930s. There has since been a large body of research in this area, often driven by mathematical physicists. Along with Gelfand and others, it was noted early that operator algebras can be considered as non-commutative analogues of the algebra of functions on a set/space. This basic idea led to far-reaching generalization of classical concepts/ results, creating non-commutative or quantum versions of various fields of mathematics. While C^* algebras can be thought of as non-commutative topological spaces, von Neumann algebras can be regarded as non-commutative measure space. With this in mind, along with some possible applications in physics, Alain Connes created non-commutative geometry. It is a young, but active field with notable contributions from a small Indian group. Similarly, over the last 25 years, there have been major developments in non-commutative probability, many of it from India. This meeting discussed recent developments in operator algebras, with emphasis on non-commutative geometry.

REFRESHER COURSES

Jointly sponsored by IASc (Bangalore), INSA (New Delhi) and NASI (Allahabad)

Experimental physics

Bharathiar University, Coimbatore

16–31 May 2008



No. of participants : 22 teachers and 13 students from Bharathiar University and affiliated colleges.

Course Director: R Srinivasan (Bangalore)

Course Coordinator : D Mangalaraj (Bharathiar University, Coimbatore)

Resource Persons : K R S Priolkar and S M Sadique (Goa University, Goa), Efrem D'Sa (Carmel College, Goa), S B Gudennavar (Christ College, Bangalore),

S B Syamala (M G College, Thiruvananthapuram), Manohar L Naik (GVM's H. S. School, Goa).

Unlike previous all-India Refresher Courses this Course was meant exclusively for teachers and students of Bharathiar University and its affiliated Colleges in Coimbatore.

The following experiments were covered in the Course: Constant current source circuit; I-V characteristics; temperature coefficient of resistance and band gap of a semi conductor; signal generator circuit; capacitance measuring circuit; Stefan's constant; thermal and electrical conductivity of copper; dielectric constant of benzene and dipole moment of acetone; AC experiments; AC bridges; calibration of lock-in-amplifier and measurement of low resistance; measurement of mutual inductance with lock-in-amplifier; AC bridge circuit; lock-in-amplifier circuit; measurement of relaxation time of a serial light bulb; thermal diffusivity of brass.

Experimental Kits

As part of the activities of the Science Education Panel, the Academy has been organizing two-week Refresher Courses in Experimental Physics for the benefit of teachers since 2001. So far ten such courses have been held in Goa, Kalpakkam, Rajkot, Bhavnagar, Mysore, Guwahati, Chennai, Thiruvananthapuram, Coimbatore and Pondicherry. These courses are meant for improving the laboratory programmes at the B.Sc and M.Sc physics levels. R. Srinivasan, along with K R Rao, has been instrumental in running this programme. In order to run these courses, R. Srinivasan has conceived and developed several user friendly experiments to illustrate the principles of physics. The experiments use analogue circuits and all the circuits and set-ups required were initially assembled with the assistance of a group in the physics department from Goa University consisting of K R Priolkar, D'Sa and Sadique. The kit consists of



Experimental Kits

1. A stabilized power supply giving 30 V (max) 2 A (max).
 2. An on-off temperature controller with Pt 100 sensor.
 3. A tubular furnace of 2 cm going up to 300 C with two inserts.
 4. Two constant current sources. Each source has two ranges: Low current range: 1 μ A to 20 mA. High current range 20 μ A to 500mA (continuous operation). The source can provide currents up to 1A for intermittent operation.
 5. Two DC differential amplifiers. Each can accommodate three inputs. Amplification 10 or 100. Off set adjustment and reversal switch are provided. Useful for measuring thermo-emfs.
 6. Two signal generators: Sine, square or triangular output 30 Hz to 50 kilo-Hz in four ranges. Panel meter indicates frequency up to 7 V rms (peak to peak amplitude 20 V).
 7. AC bridge circuit: can realize Maxwell's, DeSauty's and Anderson's bridges.
 8. A power amplifier capable of delivering a power of 10 W in the frequency range 30 to 30,000 Hz.
 9. Capacitance circuit. Measures up to 200 pfd. DC output proportional to capacitance. Useful for measuring dielectric constants of liquids.
 10. Thermal relaxation time measurement circuit Measures the relaxation time of a serial light bulb and verifies the Debye relaxation formula.
 11. Lock-in-amplifier. Measure rms AC voltage from 20 microV to 500 microV. 500 microV AC gives a maximum DC output of about 2.5 V. Leads are taken from various points to illustrate the principle of phase-sensitive detection.
 12. An insert in the furnace to measure the thermo-emf of a Cu-constantan thermocouple as function of temperature in the range of 30 to 150 C and to measure the forward voltage of a Sidiode as a function of temperature for constant forward current. Both can be used as temperature sensors.
 13. An insert to the furnace to measure the temperature coefficient of resistance of copper and the energy band gap of a semiconductor.
 14. A set up for verifying Stefan's law of radiation and measuring Stefan's constant.
 15. A set up for measuring the thermal conductivity and electrical conductivity of copper and finding the Lorentz number.
 16. A set up for measuring thermal diffusivity of brass.
 17. A capacitor box to verify the law of addition of capacitances in series or in parallel.
 18. A cylindrical capacitor for measuring the dielectric constant of benzene and the dipole moment of acetone.
 19. A R-L-C box for AC experiments.
 20. A primary and secondary coil of 10 to 20 micro-Henries mutual inductance.
 21. A low resistance box for measuring resistance of about 0.1 ohm.
 22. A box for studying load regulation of the constant current source.
 23. A calibration box for differential amplifier.
- Using this kit, the following experiments can be done.**
1. Load regulation of the constant current source.
 2. Temperature variation of thermo-emf of a Cu-Constantan thermocouple.
 3. Si diode as temperature sensor.
 4. Temperature coefficient of electrical resistivity of copper.
 5. Activation energy for conductivity of a doped semiconductor.
 6. Verification of Stefan's law of radiation.
 7. Measurement of thermal and electrical conductivity of copper.
 8. Measurement of thermal diffusivity of brass.
 9. Verification of the law of addition of capacitances in series and parallel.
 10. Measurement of dielectric constant of benzene and dipole moment of acetone.
 11. Verification of Debye's relaxation formula.
 12. Variation of impedance of a coil with frequency and measurement of inductance.
 13. Measurement of the variation of the phase angle of the voltage across a coil relative to current as a function of frequency.
 14. Variation of impedance of a capacitance with frequency and measurement of capacitance.
 15. Series resonant circuit.

16. Parallel resonant circuit.
17. Maxwell's Bridge: Comparison of inductances.
18. DeSauty's Bridge: Comparison of capacitances.
19. Anderson's bridges: Measurement of L/C ratio.
20. Study of operation of a phase sensitive detector and calibration of the lock-in-amplifier.
21. Study of mutual inductance with a lock-in-amplifier to show that
 - (i) the phase of the emf of secondary coil is 90 with respect to the primary current.
 - (ii) mutual inductance is proportional to the frequency of the primary current.
 - (iii) The secondary emf is proportional to the primary current.

R. Srinivasan had a few months ago identified a company in Bangalore (Ajay Sensors and Instruments) who have now been given the licence to manufacture these kits and sell them to colleges on payment. Each kit will cost approximately Rs. 50,000/- excluding taxes, packing and freight charges. Each kit will come with a CD of the manual for the experiments. These kits will be used in the Refresher Courses to be conducted in future.

Already a few Universities in the South have accepted to introduce these experiments in their B.Sc and M.Sc curricula in colleges.

One kit was formally presented to the University of Mysore at a brief function on 9 September 2008.

LECTURE WORKSHOPS

Jointly sponsored by IASc (Bangalore), INSA (New Delhi) and NASI (Allahabad)

Concepts in chemistry II

Krishnath College, Berhampore, West Bengal
1–3 February 2008

Convener: BM Deb, IISER, Kolkata

Co-ordinator: Somes Ray (Krishnath College, Berhampur)

Speakers: SP Bhattacharyya and DS Ray (IACS, Kolkata), R. Biswa, S Dattagupta and BM Deb (SNBNCBS, Kolkata).

Participants: 165 students and teachers from 6 colleges in Berhampore.

Topics covered: Bonding structure and reactivity; spectroscopy; materials magnets and memory; the hydrogen atom; thermodynamics.

Foundations of chemistry

VYT PG Autonomous College, Durg, Chhattisgarh
7–9 March 2008

Convener: PK Chattaraj, IIT, Kharagpur

Co-ordinator: Ajai Kumar Pillai (VYT College, Durg)

Speakers: PK Chattaraj, Amit Basak (IIT, Kharagpur), S Bhattacharaya (Jadavpur University, Kolkata), R Biswas (SN Bose Centre, Kolkata), P Chakrabarti (Bose Institute, Kolkata).

Participants: 149 students and staff from colleges from Durg, Rajnandgaon, Vaishali Nagar and Bhilai.

Topics covered: Physical chemistry; electron spin resonance; organic chemistry; reaction dynamics and spectroscopy; aspects of biochemistry and drug design.

Mathematics

Department of Mathematics, Pondicherry University
3–5 April 2008

Convener: K M Tamizhmani, Pondicherry University

Co-ordinator: V Muruganandam, Pondicherry University

Speakers: N M Bujurke (Karnatak University), S Kumaresan (University of Hyderabad), M Lakshmanan (Bharathidasan University), Gadadhar Misra and S Thangavelu (IISc, Bangalore).

Participants: 110 students and teachers.

Topics covered: Computational mathematics; calculus and geometry; mechanics; linear algebra and infinite dimensional geometry; analysis.

Current topics in chemistry

St. Thomas College, Palai
10–11 April 2008

Convener: K L Sebastian, Indian Institute of Science, Bangalore

Co-ordinator: G D Gem Mathew, St. Thomas College, Palai

Speakers: KL Sebastian, Uday Maitra, G Mugesh (IISc, Bangalore); Suresh Das (NIIST, Thiruvananthapuram).



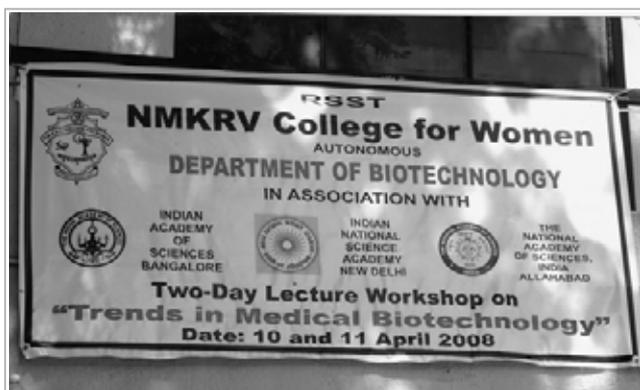
A view of the audience at St. Thomas College, Palai

Participants: 150 Students and teachers from Colleges in and around Palai.

Topics covered: quantum mechanics; molecular motors; IR and NMR spectroscopy; photoresponsive liquid crystals; photochemistry of vision; bioinorganic chemistry–metalloproteins; biomedical inorganic chemistry; chemistry education software; improving the quality of chemistry education.

Trends in medical biotechnology

NMKRV College for Women, Bangalore
10–11 April 2008



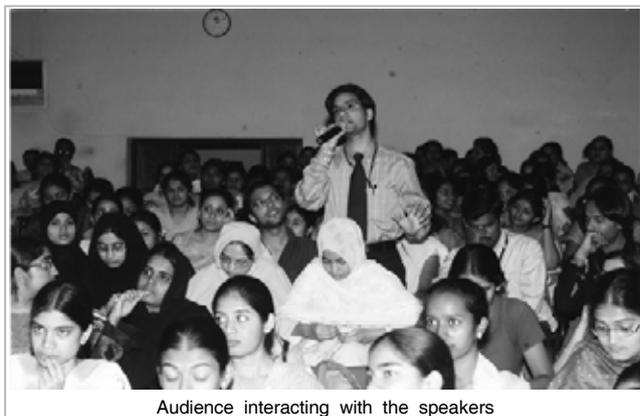
Convener: V Nagaraja, Indian Institute of Science, Bangalore.

Co-ordinator: Suman Prasad, NMKRV College.

Speakers: G Padmanaban, P N Rangarajan, K Somasundaram, P B Sheshagiri, M S Shaila, K N Balaji, and V Nagaraja (IISc, Bangalore); Hema Balaram and Ranga Udaykumar (JNCASR, Bangalore).

Participants: 250 students and teachers from 17 colleges in Bangalore.

Topics covered: Molecular medicine; vaccine development; cancer diagnosis and treatment; embryonic stem cell biology; gene therapy; modern approaches to counter malaria; HIV – the enigmatic Houdini; new therapeutic approaches to counter



Audience interacting with the speakers

resurgent tuberculosis; apoptosis – friend or foe; conventional vaccines to edible vaccines.

Molecular biology

Mangalore University, Cauvery Campus, Madikeri
11–12 April 2008



Convener: K Muniyappa, Indian Institute of Science, Bangalore

Co-ordinator: Chandrashekar G. Joshi, Post Graduate Centre, Mangalore University, Madikeri

Speakers: K Muniyappa, C Durga Rao, Ram Rajasekharan, P.N. Rangarajan, K Sekar (IISc, Bangalore).

Participants: 125 students and faculty from colleges in Madikeri, Sullia, Ujre, Puttur, Mangalore and Bangalore.

Topics covered: Metabolism; the RNA world; regulation of gene expression; the changing portrait of genetic material; gene expression; biomolecules; lipid biosynthesis; telomeres; vaccines; internet servers for bioinformatics.

Frontiers in natural resource management

College of Forestry, Kerala Agricultural University, Thrissur

25–26 June 2008



Convener: B Mohan Kumar, College of Forestry, Thrissur

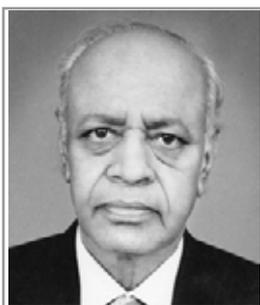
Co-ordinator: L N Santhakumaran, Institute of Wood Science and Technology, Bangalore

Speakers: K V Peter, B Mohan Kumar, P A Nazeem, C T Abraham, E V Anoop (Kerala Agricultural University); S Sankar (Kerala Forest Research Institute), L N Santhakumaran (Institute of Wood Science and Technology, Bangalore).

Participants : 69 students and teachers from institutions in Thrissur.

Topics covered : Horticulture; climate change and biodiversity; biotechnology in agriculture and medicine; environmental impact assessment; marine wood biodeterioration; bioinvasion and invasive species in the tropics; dendrochronology to assess climate change.

OBITUARIES



Arkalgud Gopalakrishna

(elected 1974) was born on 20 October 1922 in Chamarajanager in Mysore. After his matriculation in 1937 and intermediate in 1939 from Bangalore he did his B.Sc (Hons) in Zoology in 1942 securing a first rank from the

University of Mysore. He joined the Intermediate College in Bangalore working as a Lecturer in Zoology in 1946 for a few months and then shifted to Nagpur to join the College of Science as a Lecturer in Zoology (1946-54). For two years thereafter he worked at the Rockefeller Institute in New York as a visiting Fellow of the Population Council (1955-57). Returning to India in 1957 he completed his DSc from University of Mysore in 1958 specializing in the embryology and reproductive physiology of mammals. After working as a Lecturer in Zoology in Vidarbha College, Amravati for two years (1957-59) he rejoined the College of Science in Nagpur as Lecturer (1959-62). For three years (1962-65) he worked at the Government College, Aurangabad as Professor and Head of Zoology Department, before once again joining the College of Science, this time as Professor of Zoology (1965-67). In 1967 he joined the Institute of Science, Nagpur, first as Research Professor of Zoology (1967-69) and then as Director (1969-81).

Gopalakrishna specialized in reproductive physiology, embryology, cytochemistry, histochemistry, cytology and endocrinology. After studying the development of foetal membranes and placentation in all Indian and a few foreign families of bats, he formulated a new scheme of taxonomy and inter-relationship of bats. He discovered a portal vessel between the ovary and the ipsilateral uterine cornu through which progesterone is directly supplied to the uterine cornu eliciting a localized progesterational reaction near the cranial end of the uterine cornu. The persistence of a large corpus luteum up to early gestation of the following cycle brings about a regular physiological alternation of the two sides of the female genitalia in successive cycles in some monotonous bats. His studies showed a preferential male mortality during the growth period resulting in an abnormal female-dominant sex ratio in the adult stage in all bats. Extensive banding studies revealed that most colonial species migrate long distances during the breeding season and return to the original roost with young ones.

Gopalakrishna built one of the foremost schools of research in the field of Chiropteran reproduction and embryology in the world and trained or guided a large number of students.

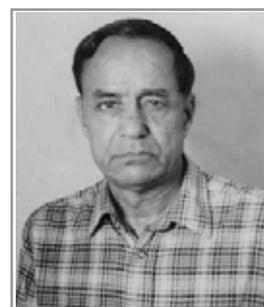
Gopalakrishna was elected to the National Academy of Sciences and received the Maharashtra State Government award for outstanding contribution in the field of education and social work.

He passed away in Nagpur on 20 September 2008 and is survived by his wife Venkamma, four sons and a daughter.

Devi Datt Pant

(elected 1970) was born on 14 August 1919 at Deorari in the Pithoragarh District of UP, now in Uttarakhand. He completed his BSc in 1940, MSc in 1942 and DSc in 1949, all from the Banaras Hindu University at Varanasi.

He started his academic career at the Indian Institute of Science, Bangalore working with C. V. Raman from 1942 to 1944. He then moved over to the Agra College in Agra as Professor of Physics (1944 – 47), the RBS College in Agra (1947 – 52) and the DSB College in Nainital (1952 – 71) where he also became its Principal. In 1971 he was appointed as Director of Education in UP (1971 – 72). He moved back to teaching by joining the SBSH Pantnagar



University as Dean of Science (1973 – 74). In 1974 he was appointed Vice-Chancellor of the Kumaun University in Nainital (1974 – 78). After retirement, he continued his research as the UGC Retired Teacher (1978 – 79) and Professor Emeritus in the Physics Department of Roorkee University from 1979.

Pant specialized in molecular spectroscopy, luminescence and non-radiative processes. His initial training was in CV Raman's laboratory in Bangalore and his first investigations dealt with photoconductivity of diamond and luminescence spectra and vibrations in crystal lattices. Later he undertook an intensive study of the spectra of uranyl salts. He was the first to suggest that in fluorescence the excited uranyl ion loses all its vibrational energy and emits only from the zero vibrational state of the excited vibrational states. This was an important contribution which led to a correct analysis of a large number of uranyl spectra. Another of Pant's important contribution is to the radiationless transfer of energy. He was the first to postulate that radiationless transfer, under certain conditions, particularly in crystals, takes place in multiple phonons. This was since proved in several other cases in solid state spectra. Pant was one of our best researchers on problems of luminescence, and related topics like life-times of excited species and transfer of energy.

Pant published over 100 research papers and 19 students worked under his supervision for their Ph.D. He visited several institutions abroad, for instance as Fulbright Scholar (Florida State University in 1961), USAID Science Improvement Programme (1968), and the National Research Council in Ottawa as a Visiting Scientist (1960).

Pant was an extremely modest individual and detested opulence. He was the recipient of the Raman Centenary and the Asundi Centenary awards.

Pant passed away in Nainital on 11 June 2008 leaving behind his wife Pushpa, four daughters and two sons.



Alladi Ramakrishnan (elected 1955), considered the father of theoretical physics research in Madras and much of South India, passed away on 8 June 2008, while visiting his son, Krishnaswamy Alladi, in Florida, USA.

Alladi was born on 9 August 1923. His father was Sir Alladi Krishnaswamy Iyer, the lawyer of legendary fame who, as a member of the Constituent Assembly, helped to draft the Constitution of India. After his early education in P. S. High School, he went to the Presidency College, Madras and graduated from there with the B.Sc. (Hons) degree in physics from the University of Madras in 1943. He seemed destined, after he passed the Law degree with a gold medal, to follow his father's footsteps. But his fascination with mathematical physics stood in the way. After meeting Homi J. Bhabha, Alladi joined him at the newly started Tata Institute of Fundamental Research in Bombay. Cosmic ray physics was the centre of attention at the Institute at that time, and Alladi became deeply involved, with Bhabha, in formulating a theory for the development of cosmic ray showers as a stochastic process. The important new concept of product densities that he introduced, and the mathematical formalism based on it, made possible the eventual solution of the fluctuation problem of cosmic ray cascades in all its ramifications. From Bombay, Alladi moved on to Manchester where his work with M. S. Bartlett strengthened his involvement with applications of stochastic theory, in particular, applications of the regeneration point method of Bellmann and Harris to a variety of physical problems. He was awarded the Ph.D. degree of the University of Manchester in 1951.

On returning from England, Alladi joined the University of Madras in March 1952 as a Reader in the Department of Physics which was then in the process of being set up. Alladi began a course of lectures in methods of mathematical physics which attracted serious students, and he soon had a band of bright young students working with him. Thus began the flowering of theoretical physics research in Madras, which was soon to gain high reputation all over the world. His visit to Yukawa Hall in Japan and attendance at the High Energy Physics Conference at Rochester in 1956, followed by a one-year stay as a Visiting member at the Institute of Advanced Study in Princeton influenced him greatly, resulting in the switching of his research interests to high energy physics. He came back with a strong desire to create an institute at Madras on the lines of the Princeton Institute.

Alladi was promoted as Professor in 1959, and posted to the newly created Extension Centre of Madras University in Madurai (which was to become the nucleus of the present Madurai-Kamaraj University).

He made frequent visits to Madras to give lectures to the Theoretical Seminar, an informal group of research scholars and M.Sc. students. They were challenged to identify and work on research problems of current interest in a variety of areas of nuclear physics and elementary particle physics, and they rose to the challenge. Many renowned physicists (including Gell-Mann, Glaser, Abdus Salam, and Niels Bohr who were or were to become, Nobel Laureates) visited, lectured to, and inspired this group, impressed by Alladi's energetic pursuit of his vision of a strong programme of research in these broad areas. Their appreciation played a key role in convincing the then Prime Minister Jawaharlal Nehru and the Tamil Nadu Education Minister C. Subramaniam of the merits of setting up a new Institute of Mathematical Sciences (MATSCIENCE), which was started in Madras in 1962 with Alladi as the Founder-Director. It has since become the leading centre for research in many areas of theoretical physics, mathematics, computer science, etc. in south India, and stands as a monument to the vision and determination of Alladi Ramakrishnan. However it must be said that he was not given due credit for his own outstanding research contributions and for his role in the development of strong research centres in theoretical physics in South India.

Of the 150 or more research papers of Alladi, those on the theory and applications of stochastic processes were the most influential, bringing him recognition as a brilliant scientist, though he also had numerous publications in elementary particle theory, matrix theory, and the special theory of relativity. His article on probability and stochastic processes in *Handbuch der Physik* (1958) provided an insightful treatment of these subjects, and stimulated several applications in diverse fields of physical, biological and other sciences. He authored several books: *Elementary particles and cosmic rays* (Pergamon 1962), *L-matrix theory or the grammar of Dirac matrices* (Tata McGraw-Hill, 1972) and *Special relativity* (East-West Books). These lectures delivered at Matscience were published by Plenum Press as Symposia on Theoretical Physics and Mathematics in 10 volumes, edited by Alladi.

He guided about 30 research students to their Ph.D. degrees, and influenced the careers of a number of others. The Tamilnadu Academy of Sciences which started functioning in 1976 had him as one of its founder Fellows, and he became its President in 1983.

Alladi's zeal for attracting young students to serious scientific pursuits never waned, and many are the

occasions when he accomplished his aim through fascinating lectures delivered in colleges and schools. He also continued to revel, till the end, in discovering new ways of understanding and presenting the essence of even seemingly-familiar subjects like relativity.



Sarukkai Krishnamachary Rangarajan (elected 1974), called SKR by his students and friends, passed away on 29 April 2008 at Bangalore, following a massive heart attack. To say that he was an outstanding electrochemist is simply inadequate to describe

the genius he was and the breadth of his polymathic talents and interests. He was eclectic with penetrating insights into issues in mathematics, science, society, literature, philosophy and administration. More than that he was a great human being with an unusual warmth and affection for fellow human beings.

SKR was born on 9 September 1932 in a lower middle class family. He obtained a B.A. (Hons.) in mathematics from Madras Christian College (MCC) in 1953. After his first job as a film critic for a Tamil art magazine he took a tutorship at MCC and later joined the postal department. In 1955 he was offered an assistant professorship at the Alagappa College of Engineering, Karaikudi. Along with teaching he actively pursued research in mathematics. Special functions in mathematics attracted him early in his career, and he published 17 papers and continued his interest in this field till his last days.

KSG Doss, then Director of Central Electrochemical Research Institute (CECRI) at Karaikudi, heard of SKR's mathematical ability and approached him for help to develop a theory for the phenomena of faradaic rectification that he had discovered. Instead of the one year that Doss was willing to grant, SKR solved the problem in a couple of days. Impressed by this Doss persuaded the young undergraduate mathematics teacher to join CECRI and start a research career in electrochemistry. Thus began SKR's long and productive association with electrochemistry.

Impressed by SKR's work Academician Frumkin, a giant in the field of electrochemistry in former Soviet Union, invited him as a distinguished visitor to the USSR Academy of Sciences thus starting a long

USSR-Indian relationship in electrochemistry. SKR remained at CECRI till 1970.

The next few years he spent as Homi Bhabha Fellow at National Aeronautical Laboratory. In 1975, he joined the Indian Institute of Science as Senior Professor in the Department of Inorganic and Physical Chemistry. During this period, he was also a visiting professor at Georgetown University and the University of Newcastle upon Tyne. He spent a sabbatical year visiting the IBM Thomas J. Watson Labs in US where he was a frequent visitor since then. He also travelled widely to other countries attending conferences, giving invited lectures and collaborating with scientists. During 1988 – 92, on deputation from IISc, he joined as the Director of CECRI. SKR was later invited by the Institute of Mathematical Sciences at Chennai to join as a Senior Professor, where he served for 3 years, till his superannuation, following which he was associated with the Raman Research Institute and then his old department at the Indian Institute of Science. A week before his death, he came to the IPC Department and excitedly told them that he was planning to give a series of lectures on stochastic problems in chemical sciences.

SKR's science spanned a wide spectrum: modelling various aspects of electrochemistry, double layer phenomena, porous electrodes, systems approach to electrochemistry, application of quantum many body theory to electron transfer reactions at the electrochemical interfaces, bio-electrochemistry, etc. In addition he was deeply interested in theoretical physics in general and believed in in-depth discussion if one wanted to do theoretical physics. In fact, he collected a group of Ph.D. students and led a regular group meeting that went in depth into some of the most current issues in theoretical physics then, such as Anderson localization phenomenon, amorphous semiconductors, renormalization group approach to statistical mechanics, etc.

When it came to modelling complex problems SKR was a master. Many engineering students at IISc get his regular help for solutions in mathematical modelling. One of his fond desires was to set up an institute for mathematical modelling. SKR's involvement in mathematics was special and long. Although he was deeply influenced by Srinivasa Ramanujan, his preoccupations with electrochemistry did not allow him to show all his results and deep insights into the world of mathematics. He had dozens of unpublished work both in mathematics and electrochemistry. In the last decade SKR was so excited

that he could trace hidden mathematical steps and reasonings behind some of Ramanujan's great conjectures and leaps. If one can complain of one defect with SKR, it was that he was not overly keen to publish all his findings and allowed many of his scientific discoveries remain unknown to the rest of the world.

SKR was also an able administrator. His term as director of CECRI transformed the place. During his stay at Matscience, Chennai, he greatly helped the Institute governance by liberally sharing his insights.

He was well recognized by the usual standards. He was elected to the Fellowship of Indian National Science Academy and TWAS. He was given the Alumni Award (1993) of IISc and the lifetime achievement award of the Chemical Research Society of India (2008), in addition to many other awards and honours. He is survived by his wife, daughter and four sons and several grand children.



Placid Rodriguez (elected 1993), renowned metallurgist, passed away in Chennai on 31 August 2008. Born in Kollam (Kerala) on 5 October 1940, Rodriguez did his M.Sc in Chemistry from University of Kerala in 1958, and BE in Metallurgical Engineering from

Indian Institute of Science (IISc) in 1960. He then had his post-graduate training in nuclear metallurgy from the BARC Training School in 1961. After an MS in metallurgical engineering from the University of Tennessee, he came back to IISc to do his Ph.D in 1976. Unusual enough, he did an MBA in human resource management from IGNOU when he was past 60.

Rodriguez started his career at the Bhabha Atomic Research Centre in 1961 as a scientific officer in Metallurgy Division. In 1974 he moved over to the Indira Gandhi Centre for Atomic Research (IGCAR) in Kalpakkam first as Head of the Metallurgy and Materials Programme and then as Director from 1992 to 2000. After his formal retirement from IGCAR he joined the DRDO organization as Chairman of the Recruitment and Assessment Centre of DRDO until 2003 when he returned to academics as a visiting professor at IIT, first at Delhi and then at Chennai.

Rodriguez made original contributions to the field of mechanical metallurgy. Starting with his earlier contributions in dislocation dynamics, polycrystal work hardening and grain size strengthening in hexagonal close packed metals zirconium, titanium and cadmium, he extended the ideas to more complex alloy systems like austenitic stainless steels and nickel-base superalloys. He made strikingly original contributions in the development of novel experimental techniques for studying dislocation dynamics. Combining Hall-Petch analysis with thermally activated strain rate analysis and designing novel experimental techniques to determine contributions of thermal and athermal components of flow stress to grain size-dependent and grain size-independent stress components, he was able to develop deeper understanding of polycrystal deformation behaviour. The decremental unloading technique he developed for studying stress relaxation and its combination with temperature cycling has been a hallmark in studies related to dislocation dynamics. He then applied acoustic emission technique and the associated detailed signal analysis to the dynamics of dislocations, their immobilization as well as cracking events during tensile deformation. This technique was also applied to the study of dynamic strain ageing (DSA).

Rodriguez also made outstanding contributions to the area of serrated yielding. In CuAu alloy, serrated yielding was shown to arise due to ordering around dislocations, by carefully planned experiments and theoretical evaluations of interaction between dislocation stress fields and strain due to tetragonal distortion accompanying ordering. His work on CuZn was equally important as he suggested a new mechanism of inhomogeneous ordering with dislocations getting locked in an atmosphere of lower degree of order, for the yield points and serrated flow. DSA studies were extended to type 316 stainless steel and Nimonic PE16 superalloy. DSA was shown to depend on grain size and the grain boundaries were found to be preferred sites for DSA effects. The role of grain boundaries and precipitates was further elucidated by a detailed study of the influence of thermal ageing to determine the size and distribution of precipitates in 316 stainless steel, on serrated flow. Certain time-temperature combinations of ageing were shown to eliminate serrated yielding thus further confirming the role of precipitates and grain boundaries in determining serrated flow.

The correlation of mechanical properties with microstructure was an important aspect of the contributions

by Rodriguez. An outstanding example of such studies is the detailed characterization of microstructures produced, in Nimonic alloy PE16, through a variety of thermo-mechanical treatments. By studying the conditions under which various types of carbides and γ' form, it was possible to arrive at an optimum heat treatment for best mechanical properties. Various deformation mechanisms and their dependence on the size and distribution of precipitates were identified and correlations developed with flow and fracture behaviour. In a later work, the characteristic AE signals from this alloy when deformation takes place by different mechanisms like Orowan looping/cutting, decohesion/fracture of carbides etc were deciphered.

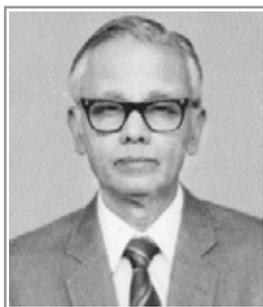
The influence of various metallurgical parameters like grain size, prior cold work and alloy chemistry in type 316 stainless steels on creep and low cycle fatigue (LCF) was investigated by Rodriguez to develop an understanding of mechanisms of deformation and fracture at elevated temperatures. Such an understanding was important in the design of high temperature alloys. An optimum grain size range for best creep properties was arrived at. His pioneering work on the influence of oxygen environment on creep of 304 SS is noteworthy and was invariably cited by all the subsequent environment-creep interaction researchers. Another major area in which he made valuable contributions is creep-fatigue interaction in austenitic steels.

Welding metallurgy is another area where Rodriguez made significant contributions. Complex microstructures developed in multipass welds and the variation in properties across weld thickness were studied and correlations developed between microstructures and properties. The importance of amount, morphology and distribution of ferrite phase in austenitic welds in determining mechanical properties was brought out by systematic studies. While it was known that transformation of ferrite to sigma phase leads to deterioration in fracture toughness and creep rupture properties, studies by his group showed that there is no direct link between low ductility creep failures and the appearance of a particular phase during high temperature exposure. The salient controlling features are the amount and morphology of the precipitates on phase boundaries and their effect on interface properties.

His scientific contributions were recognized by many professional societies. He was the recipient of the G. D. Birla Gold Medal (1987), the Keith Hartley

Lecture Medal (1986), the Honorary Fellowship of the NDT Society of India (1985), the MRSI Lecture Medal of the Materials Research Society of India (1991), and the Platinum Medal of IIM (2003). He was a Fellow of several Academies, and the Indian Institutes of Metals and Welding. He was also President of the Indian Nuclear Society (2005 – 2007).

Rodriguez is survived by his wife Blossom Valerie, a son and a daughter.



Chokkanathapuram Venkataraman Sundaram

(elected 1974) died in Chennai on 15 August 2008. Sundaram was born on 7 November 1929 at Ottapalam in Kerala. He obtained his B.Sc (Hons) in Chemistry from the Presidency College of University of

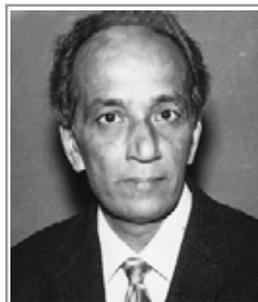
Madras in 1949 and a diploma of the Indian Institute of Science (DIISc) in metallurgy in 1952. In the same year he joined IISc as a Senior Research Assistant. Joining the Bhabha Atomic Research Centre (BARC) as a Junior Research Officer in 1956 he slowly went up the ladder as Group Leader in Extractive Metallurgy (1959 – 64), Head of the Extractive Metallurgy Section (1964 – 75) and finally Head of the Metallurgy Division (1975 – 82). In January 1982 he was appointed the Director of the Reactor Research Centre (now IGCAR) in Kalpakkam and remained there until his formal superannuation till 1989. In 1991 he took up the Homi Bhabha Visiting Professorship and spent the next ten years working at the National Institute of Advanced Studies in Bangalore.

Sundaram made outstanding contributions to the development of detailed flowsheets for the extraction of rare metals like zirconium, hafnium, titanium, thorium and beryllium. He and his group were responsible for ushering an era of production of rare reactive and refractory metals with indigenous capabilities and expertise, with important consequences to the atomic energy programme and other sectors of advanced engineering. This work led to the establishment of production plants for nuclear grade zirconium sponge metal, pure niobium and tantalum metal, and a pilot plant for the titanium sponge metal at the Nuclear Fuel Complex in Hyderabad. Another of his major contribution has been the successful development of beryllium metal for space applications. At Kalpakkam he co-ordinated the development and project activities for the successful commissioning of the liquid-sodium cooled, plutonium-fuelled fast breeder test reactor.

Earlier at BARC Sundaram specialized in the application of metallurgical thermochemistry, halide processes and high temperature vacuum technology to the extraction and refining of rare metals. In all his work he laid special emphasis on effective utilization of national resources, tailoring of special materials for industrial applications, and development of indigenous capability for fabricating sophisticated equipment and machinery.

For his contributions to rare metals research and development, Sundaram was awarded the Kamani Gold Medal of the Indian Institute of Metals (1966), the Binani Gold Medal Certificate (1968), the National Metallurgists Award (1970) and the Vasvik Award (1984), the Sanjay Gandhi Award (1985), the INSA Syed Hussain Zaheer Medal (1985 – 86) and finally the Padma Bhushan (1986). He served as President of IIM (1981 – 82) and of Indian Nuclear Society (1991 – 93) and was Chief Editor of Transactions of IIM (1972 – 80).

Sundaram remained a bachelor.



Krishna Sundaram (elected 1974) was born on 28 October 1926 in Kollen-gode, Kerala. He had his schooling in SIES School at Sion and later joined the Elphinstone College in Mumbai. He obtained his MBBS in 1949 and MD (Obstetrics & Gynaecology) from G. S.

Medical College, Mumbai in 1953 with a Prince of Wales Gold Medal. He was a recipient of JRD Tata fellowship and briefly practised as a gynaecologist but stopped it as he found it difficult to charge patients who were mostly poor.

Sundaram joined the Bhabha Atomic Research Centre (BARC) in 1957 as a Scientific Officer and started working in radiation biology. He was interested in cytology, genetics, immunology, nuclear medicine and the effects of high background radiation in Kerala. His early work related to the effects of radiation on reproductive performance of animals. During 1960 – 61 he went to the University of Rochester and returned to rejoin BARC to head the Radiation Biology and Occupational Health Section of Medical Division. His work on the etiological factors associated with toxemia of pregnancy received international recognition. It implicated mineral corticoids, later identified as aldosterone, as a causative factor in fluid retention and hypertension. He was perhaps the first in the country to apply exfoliative cytology techniques in the diagnosis

of cancer and prognosis in radiotherapy. His original work on the predisposing factors in the development of oral cancer in experimental animals highlighted the importance of nutritional deficiencies of protein and B group vitamins in its etiology. He showed, for the first time, the inter-relationship between radiation sensitivity and cancer development and that though radioprotective chemicals could reduce immediate mortality, the risk of survivors to the development of cancers was enhanced.

He became Head of the BARC Medical Division and engaged full time in research. He was sharp and easily grasped the nuances of basic sciences. In 1965 – 66, Jack Ambrose from Chester Beatty Research Institute, London who came to BARC as a visiting scientist brought with him the technique and apparatus of cell electrophoresis (migration of live cells under the influence of electric field). Sundaram along with Bal Phondk published the first paper describing electrophoretic mobilities of lymph node cells of normal and immunized rats. Several papers followed demonstrating the usefulness of the technique of cell electrophoresis to study changes in cell surface of lymphocytes brought about by immunization, malignant transformation and interactions with antibodies and lectins. These studies on two different types of antilymphocyte sera, one against normal cells and the other against immune cells led to the demonstration of immunosuppressive anti-idiotypic antibodies in the latter. With P.K. Ray and others, Sundaram co-authored many papers in cancer immunobiology, relating to the immunogenicity of cancer cells treated with an enzyme neuraminidase.

Studies on the effects of high natural background radiation always interested Sundaram. In 1975, he sent K. P. George and other associates to set up a cytogenetics laboratory in Chavara near Kollam in Kerala. This was the beginning of MSP (monazite survey project) and today the Low Level Radiation Research Laboratory stands well established for this purpose in Kollam.

In 1976 a highly cited but controversial paper was published in *Nature* by Kochupillai and others from AIIMS, New Delhi describing the prevalence of Down's Syndrome in children born in HBRA as against none in those born in normal background area. Sundaram, who also had a flair for statistical methodologies, contested these findings pointing out that since mother's age was not considered and there was no Down's cases in the NBR population

these conclusions were unacceptable. This letter was also published in *Nature*.

Another major and alarming controversy that Sundaram addressed head-on was the one arising from publications by the National Institute of Nutrition (NIN), Hyderabad which erroneously inferred that consumption of irradiated wheat resulted in increased level of chromosomal aberrations (dicentric) in mice. He insisted on double blind studies which were carried out at Mumbai and Hyderabad. These studies could not substantiate NIN's findings and a national committee with P. V. Sukhatme and P. C. Kesavan endorsed the findings of BARC and found that the extensive long-term toxicological tests conducted by BARC were valid. This paved the way for the clearance of irradiation as a method of food processing and preservation by the Ministry of Health and approval of several items for this purpose 15 – 20 years later.

This brought Sundaram into another new area of contemporary research, genetic toxicology and environmental mutagenesis. His group carried out several projects for IAEA/WHO/FAO to evaluate the genotoxic effects of a variety of chemicals using micronucleus and chromosome aberration tests. The Environmental Mutagenesis Society of India (EMSI) was born in the late 70s and so was its international counterpart. Sundaram became the founder President of EMSI and vice-president of the international society. Sundaram was elected a Fellow of INSA (1975) and was Director of Life Sciences of IAEA, Vienna for three years.

Sundaram passed away in Coimbatore on 15 May 2008 following complications from chronic obstructive pulmonary disease. He is survived by his wife Parvathy, a son and a daughter.



Joseph Thomas, a pioneer in the field of biological nitrogen fixation, passed away on 30 January 2008. Thomas was born on 20 March 1935, did his B.Sc. in 1955 from the University of Madras and M.Sc in botany in 1958 from University of Bombay. His Ph.D degree was also from Bombay in 1962 for his work in algal biology. He started his academic career in the Institute of Science, Bombay as a CSIR Senior Research Fellow (1963 – 64) before joining the Bhabha Atomic Research Centre, Bombay as a Scientific Officer

(1966 to 1987). Between 1977 and 1987 he headed the Nitrogen Fixation Laboratory in BARC. He also had brief stints abroad as a UNESCO Fellow in Institute of Microbiology, Prague (Czechoslovakia) and as a visiting scientist at the MSU/ERDA Plant Research Laboratory in Michigan State University (1974 – 76). In 1987 he left BARC to take up the Directorship of the SPIC Science Foundation and as Executive Director of SPIC (Biotech) in Chennai.

His outstanding scientific contributions are in the field of cyanobacterial (blue-green algae) nitrogen fixation. He provided the first clear evidence to show that heterocysts of cyanobacteria lack photosystem II of photosynthesis, involved in oxygen evolution and thus maintain the anaerobic milieu essential for nitrogenous activity. This was followed by additional major evidence indicating heterocysts as the site of cyanobacterial nitrogen fixation. Confirmation of this came when he pioneered the use of radioactive nitrogen in nitrogen fixation research and demonstrated that nitrogenase and glutamine synthetase (GS) are coupled in heterocysts. In a series of classical papers, Thomas and his collaborators established the pathway of nitrogen metabolism in microbes and plant cells.

His group developed facile procedures for purification of GS and provided major insights on their characteristics and modes of regulation in cyanobacteria and rice. In cyanobacteria GS was shown not to be involved in regulation of nitrogenase. Another striking

achievement is the identification and cloning of ntr and as yet unknown genes leading to the proposal of a bipromoter model for the transcriptional regulation of nitrogenase and to the development of a *Klebsiella* strain constitutive for nitrogenase.

Other discoveries of Thomas and his group at BARC were that: (a) sodium is an essential requirement for nitrogenase action; (b) sodium transport/salt tolerance is mediated by membrane electrogenesis and osmoregulation; (c) *Rhizobium* cell surface has dual binding sites for peanut lectin; and (d) legume roots secrete compounds which direct complementary rhizobia in the synthesis of specific polysaccharides involved in recognition and infection of the legume.

At SPIC Thomas established active application-oriented research teams at the Centre for Biotechnology. He organized departments for the development, commercial production and marketing of hybrid seeds, tissue culture plants, biofertilizers, botanical insect antifeedants and commercial enzymes. Over the years, the activities developed into an export-oriented multi-crore bioproduct business.

Thomas was elected as a Fellow of the Indian Academy of Sciences (1975), the Indian National Science Academy (1984) and the National Academy of Agricultural Sciences (1991). He was recipient of the FICCI award for outstanding achievements in life sciences and agriculture.

Thomas leaves behind his wife Meena and two daughters.
