



# JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH

JAKKUR, BANGALORE - 560 064.



## ANNUAL REPORT 2004 - 2005







# **ANNUAL REPORT**

**2004-2005**



**JAWAHARLAL NEHRU CENTRE FOR  
ADVANCED SCIENTIFIC RESEARCH**

**(A Deemed University)**

Jakkur, Bangalore – 560 064.

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# The Centre

## Foreword

I have great pleasure in presenting the Annual Report of the Centre for the year 2004-2005.

The Centre has grown over the last fifteen years to become one of the leading institutions in the country for higher learning and research in frontier areas of science and engineering. During this year, significant contributions have been made from the research activities in the areas of material sciences, theoretical physics, molecular biology and genetics, evolutionary biology, chemical biology, engineering mechanics and geodynamics. Many of the contributions of our faculty colleagues and students have received national as well as international recognition. I am happy to share with you that our Founder President and Linus Pauling Research Professor C N R Rao has been awarded with the first India Science Prize and Dan David Prize of Israel for his outstanding contributions in the area of material sciences. It is also heartening to note that several of the research findings in material sciences and biology have been transformed to potential technologies which have been patented. Since the recognition of our Centre as a Deemed University by the University Grants Commission, fourteen students have obtained Ph D Degrees; three students M S (Engg.) and two students have obtained M S (Int. Ph D) degrees as on 31<sup>st</sup> March 2005. There has been a steady increase in the number of students joining the research programmes of the Centre. A new hostel building to accommodate seventy students has just been completed.

In addition to pursuing research in various contemporary areas, the Centre also has several Science Outreach Extensions and Fellowship Programmes. One such activity is the Summer Research Fellowship Programme for young students. During this year, 5185 completed applications were received and out of which 197 have been offered fellowship including 36 renewals from the previous batch. This is one of the highly acclaimed programmes in the country and the students are highly appreciative of this programme which enables them to get inspired to advance scientific research at very early stages of their education.

The POCE (Project Oriented Chemical Education) programme, which was started in 2004 has already made an impact in the student community. In its second year, this programme has attracted more attention across the country and the students going through this programme have highly appreciated the structure and the content of this training programme. A similar programme in Biology is being planned from next year. The Honorary Faculty Members of the Centre in close association with the Centre have made significant contribution to the various academic and research programmes of the Centre. Their participation in training of young students under the Summer Research Programme is highly appreciated.

The Centre continues to provide an excellent academic atmosphere for intellectual interaction and pursuit of knowledge which is the result of untiring efforts of students, the faculty and honorary faculty and other members of the Centre. I take this opportunity to thank and acknowledge the enthusiastic help that the Centre has received from its well wishers and friends. We look forward for this continued support. The Department of Science & Technology has always positively supported all the academic and development activities of the Centre which is greatly appreciated.

**MRS RAO**  
President



## INTRODUCTION

The Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bangalore, a premier research institute in the country was established in the year 1989 in the birth centenary year of Pandit Jawaharlal Nehru by the Department of Science and Technology. The objectives of the institute are to pursue and promote scientific research and training at the highest level in the frontier and interdisciplinary areas of science and engineering. The number of publications in the international journals of repute and the patent filing is steadily increasing each year. The Centre which is just fifteen years old is creating news constantly in the scientific world with its breakthrough discoveries. The Centre has global collaborations with several national and international institutions. In recognition of the achievements of the Centre, the Ministry of Human Resource Development (GOI) has accorded the status of a Deemed University to enable the Centre to train quality manpower. The faculty members of the Centre have received national and international recognition. Foremost among these being, DAN DAVID Prize (Israel) conferred on the First Asian Scientist and the first India Science Prize to Prof C N R Rao, the Honorary President of the Centre and the Chairman of the Scientific Advisory Council to the Prime Minister of India. Several faculty members of the Centre are Fellows of National and International Science and Engineering Academies.

Prof C N R Rao, the founder of the Centre, held the office of President from 1989 to 1999. Prof V Krishnan, who succeeded him, served as President of the Centre from 2000 to 2003. Prof M R S Rao is presently the President of the Centre.

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## OBJECTIVES

The objectives of the Centre are:

- To carry out front-line research in selected thrust areas of science and engineering;
- To promote collaborative research with scientists at the Indian Institute of Science and other institutions in the country;
- To provide a national and international forum for in-depth discussions on important scientific topics in areas of vital interest to scientists of the Centre and in the country at large;
- To organize periodic winter and summer schools in certain areas, where young talented scholars would be associated;
- To provide opportunities for talented young students to carry out research projects;
- To provide facilities to visiting scholars and faculty from all over India and abroad, to work for extended periods with the faculty of the Centre;
- To publish monographs and reports on frontier and futuristic areas of science as well as monographs of educational value.



## PROGRESS

The Centre has completed fifteen years with several memorable and exciting moments. The most recent being when the Dan David Prize (Israel) and the First India Science Prize conferred on Prof C N R Rao. It has acquired additional land in the recent past, built more laboratories with excellent infrastructure facilities conforming to the international standards. New Faculty appointments have been made in some research areas. The student strength has reached the projected level.

The main campus at Jakkur houses The Chemistry and Physics of Materials Unit, Educational Technology Unit, Evolutionary and Organismal Biology Unit, Engineering Mechanics Unit, Geodynamics Unit, Molecular Biology and Genetics Unit, and Theoretical Sciences Unit. A new Centre on Nanosciences has been established by the Department of Science and Technology at the Centre. The Centre has a good quality Library, excellent Computer Laboratory, Lecture Halls, a Chemical Education Laboratory, a Conference Hall, a Seminar Hall, a Poster Presentation Hall, Faculty Offices and the Administrative Office.

The Chemical Biology Unit and the Condensed Matter Theory Unit are located on the IISc Campus. On this campus, the Centre also possesses an Administrative Office with a seminar hall, a well-furnished accommodation for the academic visitors and a Visitor House for the students and the R & D assistants.

The Centre pursues excellence in research and education in frontier and interdisciplinary areas of science and engineering. It provides stimulating academic environment to the talented, motivated students to pursue scientific research. The students strength as on 31<sup>st</sup> March 2005 was 88. The research training at the Centre has led to the award of 20 Ph D degrees, 13 M S degrees, 3 M S (Engg.) degrees and one M Sc (by research) degree as on 31<sup>st</sup> March 2005.

Some of the recent research highlights at the Centre include the following: A number of inorganic nanostructures with zero-, one-, and two-dimensionalities have been synthesized and characterized; Synthesis of nanocrystalline metal films of controlled thickness grown at liquid-liquid interfaces and their electrical characterization; Spatially resolved photocurrent in organic planar structures over a wide length scales; Studied in superfluid, Mott-insulator, and mass-density-wave phases in the one- dimensional extended Bose-Hubbard Model by using a density-matrix renormalization-group method; Indian monsoon rainfall in relation with higher solar activity; Creation of faster developing *Drosophila* through laboratory selection to investigate genetic control of the timing of developmental events; Life expectancy consequences in *Drosophila melanogaster* during lack of a circadian organization; Optimization of DNA vaccines through engineering molecular adjuvants; Identification of several genes involved in blood vascular development using various *in vivo* and *in vitro* models such as embryonic stem cells, mouse embryos and *Drosophila*.

The IP Management Committee at the Centre monitors and advices on all matters relating to Intellectual Property generated at the Centre. Several meetings were held to discuss filing of various patents, licensing products, royalty receipts and sharing, etc. Technology licensing agreements have been executed for some of its products and the Centre continues to receive royalty from various Companies.

The Centre is actively pursuing interaction with academic institutions and universities globally. Honorary Faculty Members of the Centre have continued to play an important role in guiding academic and extension activities of the Centre. The campus is lively and vibrant with active support from administrative and scientific staff.

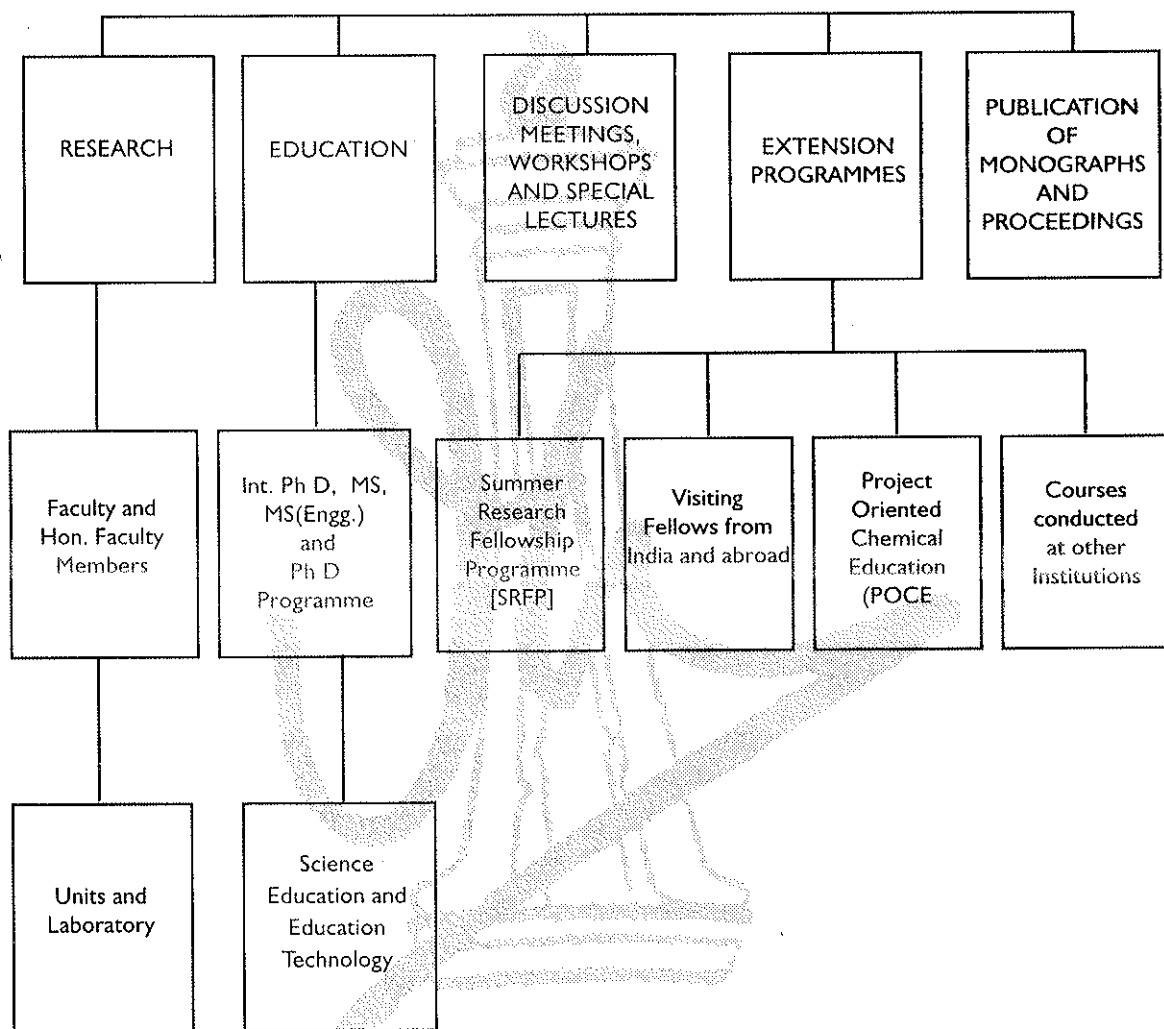
The Centre has published 15 high quality educational monographs, seven multimedia packages, several books and numerous scientific papers. Two educational monographs are at the final stages of publishing.

The Faculty members of the Centre have received a number of national and international awards and recognitions for their contribution to the advancement of science and technology.

Summer Research Fellowships, Project Oriented Chemical Education Programme, Visiting Fellowships, Extension Programmes and Academic Exchange Programmes of the Centre have attracted wide attention and were highly successful. The Centre has been entrusted with a new Postdoctoral Fellowship Programme in Nano Science and Technology funded by DST. Since April 2004, 30 Discussion Meetings/Workshops were conducted, either wholly or partially supported by the Centre. The first meeting of the TWASROCASA was successfully held in September 2004 at the Centre. In addition, about 50 seminars were also held at the Centre.

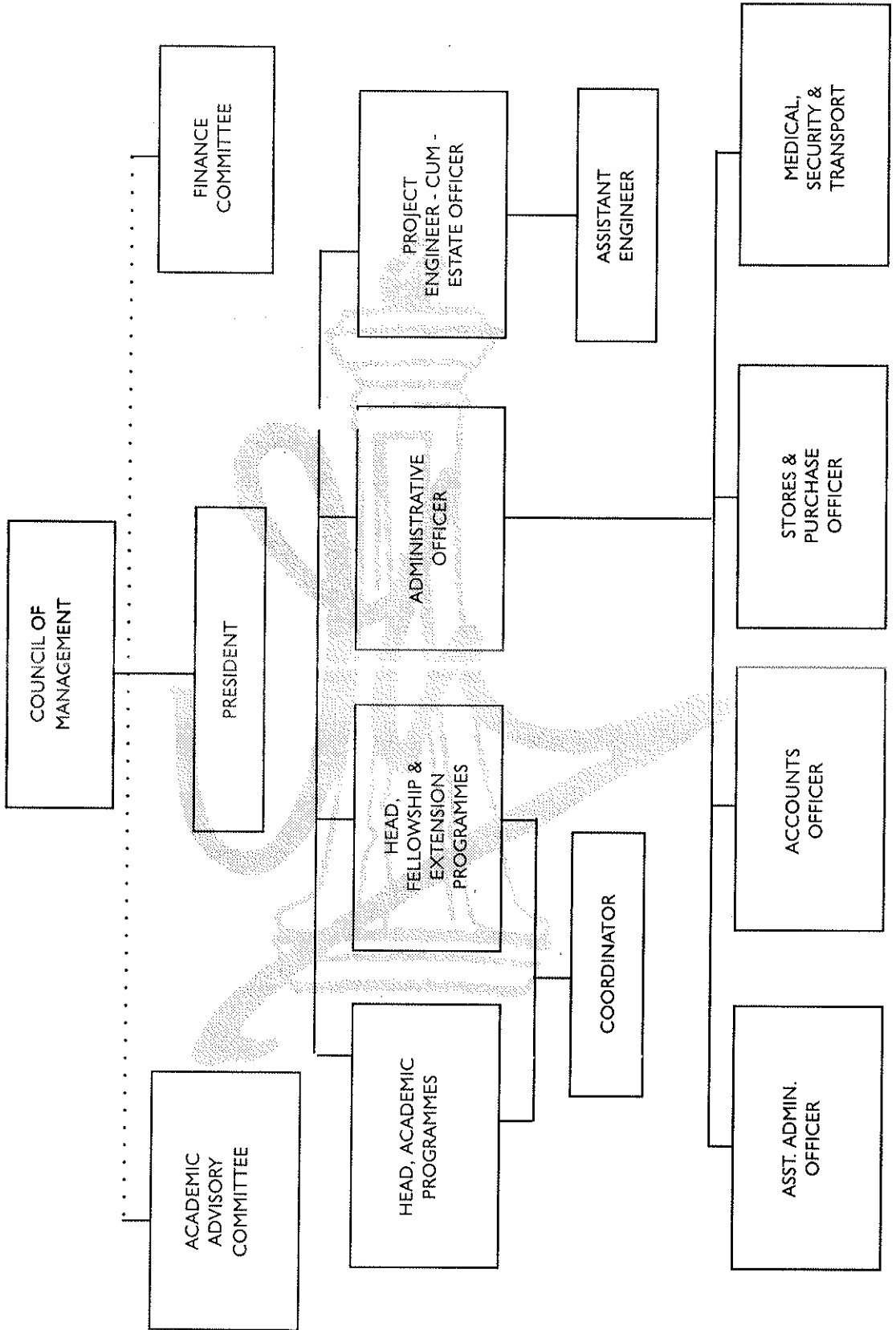
# ACTIVITIES CHART

## JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH





# ORGANISATION CHART



# THE ORGANISATION

## I. Council of Management

The administration and management of the affairs and finances of the Centre are conducted by the Council of Management. The Council of Management of the Centre meets twice a year.

The following are the members of the Council.

<b>P Rama Rao</b> ISRO Brahm Prakash Distinguished Professor, ARCI, Hyderabad	Chairman
<b>M R S Rao</b> President, JNCASR	Member
<b>V S Ramamurthy</b> Secretary Department of Science and Technology New Delhi	Member
<b>C N R Rao</b> Linus Pauling Research Professor JNCASR	Member
<b>S K Joshi</b> National Physical Laboratory New Delhi	Member
<b>Arun Sharma (upto 24.2.2005.)</b> Joint Secretary & Financial Adviser Department of Science and Technology New Delhi	Member
<b>K P Pandian (from 25.2.2005)</b> Joint Secretary & Financial Adviser Department of Science and Technology New Delhi	Member
<b>G Mehta</b> Director Indian Institute of Science, Bangalore	Member
<b>Sinha B</b> Director VECC & Saha Institute of Nuclear Physics Kolkata	Member
<b>S Chandrasekaran</b> Indian Institute of Science Bangalore	Member
<b>A N Jayachandra</b> Administrative Officer, JNCASR	Secretary



## 2. The Finance Committee

The Finance Committee of the Centre scrutinizes all financial proposals, and makes recommendations to the Council of Management.

The constitution of the Finance Committee is as follows:

<b>M R S Rao</b> President, JNCASR	Chairman
<b>C N R Rao</b> Linus Pauling Research Professor JNCASR	Member
<b>Arun Sharma</b> (upto 24.2.2005 ) Joint Secretary & Financial Adviser Department of Science and Technology New Delhi	Member
<b>K P Pandian</b> (from 25.2.2005) Joint Secretary & Financial Adviser Department of Science and Technology New Delhi	Member
<b>S Chandrasekaran</b> Indian Institute of Science Bangalore	Member
<b>R S Gururaj</b> Accounts Officer, JNCASR	Member
<b>A N Jayachandra</b> Administrative Officer, JNCASR	Secretary

### 3. The Academic Advisory Committee

The functions of the AAC include planning, execution and coordination of research and other academic activities of the Centre. It also regulates the courses of study, procedure for admission of students, examination, etc. It meets at least twice a year. The Committee makes its recommendations to the Council of Management.

The members of the Committee are:

<b>M R S Rao</b> President, JNCASR	Chairman
<b>C N R Rao</b> Linus Pauling Research Professor JNCASR	Member
<b>S Dattagupta</b> SNB NCBS, Kolkata.	Member
<b>Dipankar Chatterji</b> IISc., Bangalore.	Member
<b>N Kumar</b> Director, RRI, Bangalore.	Member
<b>P Ramachandra Rao</b> Director, Institute of Armament Technology Pune	Member
<b>S Bhattacharya</b> Director TIFR, Mumbai	Member
<b>T Ramasamy</b> Director Centre for Leather Research Institute Chennai	Member
<b>M K Chandrasekaran</b> Head, Academic, Fellowships & Extn. Programmes, JNCASR	Member
<b>K Vijay Raghavan</b> Director NCBS, Bangalore	Member
<b>A N Jayachandra</b> Administrative Officer, JNCASR	Secretary

### 4. Faculties

The faculties are involved in the academic activities of the Centre and assist the Academic Advisory Committee in discharging its functions. The last Annual Faculty Meeting was held in November 2004 which included lectures by the faculty on the advances made in various research areas. Local faculty meetings were held in August 2004 and February 2005 to review the progress and provide inputs wherever required.



## 5. Administration

### President

M R S Rao, Ph D (IISc), F A Sc, F N A, F N A Sc, F T W A S

### Head, Academic, Fellowship and Extension Programmes

M K Chandrashekar, Ph D (Madras), D Sc (MKU),  
F A Sc, F N A, F T W A S

### Administrative Officer

A N Jayachandra, B Com (Mysore), ICWA (Inter)

### Assistant Administrative Officer

G Jayaram, B Com (Bangalore)

### Coordinator

K Santhanam, Ph D (IISc)

### Warden & Student Counsellor

Hemalatha Balaram, Ph D (IISc)

### Associate Warden

S Balasubramanian, Ph D (IISc)

### Accounts Officer

R S Gururaj, B.Sc. (Mysore) M P Ed (Bangalore)

### Secretary to President

A Srinivasan, B A (Hyderabad)

### Asst. Stores & Purchase Officer

K Bhaskara Rao, M Sc (Hyderabad), M Phil  
(New Delhi)

### Project Engineer

S Chikkappa, B E (Mysore)

### Junior Engineer

Nadiger Nagaraj, DCE

### Consulting Medical Officer

B S Subba Rao, MBBS (Mysore)

### Consulting Lady Medical Officer

Kavitha Sridhar, MBBS (Bangalore)

### Honorary Medical Officers

P H Prasad, B Sc, MBBS (Karnatak), FCCP  
G R Naghabhushan, MBBS (Mysore), FCCP, FCGP,  
P G Dip in M&CH  
L Sharada, MBBS (DGO (Madras))  
R K Nivedita, MBBS (Mysore)  
C Satish Rao, MBBS (Mysore)

### Honorary Security Officer

M R Chandrasekhar, B Sc, LLB (Bangalore)

# UNITS, COMPUTER LABORATORY AND ENDOWED RESEARCH PROFESSORS

## I. Chemistry and Physics of Materials Unit

The Unit made vital contributions in the area of materials chemistry and physics during this period. Several novel ideas have been developed for the design, and synthesis of new inorganic compounds in exotic nanoscopic forms. A variety of inorganic nanostructures with zero-, one-, and two-dimensionalities have been synthesized and characterized. Typical of these are fullerenes, nanotubes and nanowalls formed by GaS and GaSe, and nanowires of ITO, MgO and GeO<sub>2</sub>. Single-molecule precursors based on urea have been developed for preparing nanowires and nanocrystals of the semiconducting nitrides, GaN, AlN, and InN. Chemically bonded ceramic coatings have been grown on carbon nanotubes and inorganic nanowires by a new method.

Several metal carboxylate open-framework structures have been synthesized and characterized. New frameworks have been designed based on oxyanions such as sulfate and selenate. More importantly, it has been demonstrated that complex three-dimensional metal carboxylate structures are formed through a progressive building up process including an increase in dimensionality.

Rare earth manganates of the general composition Ln<sub>1-x</sub>A<sub>x</sub>MnO<sub>3</sub> (Ln=rare earth, A=alkaline earth) have been investigated to understand charge ordering, and electronic phase separation in these systems.

Many new experimental investigations were undertaken which include synthesis of nanocrystalline metal films of controlled thickness grown at liquid-liquid interfaces and their electrical characterization, developing a new method of making robust electrodes and markers on Si substrates, dip-pen nanolithography with several new colloidal and molecular based inks, synthesis of pyramidal nanostructures of ZnO by pulsed laser deposition, etc. Besides, a combined study using STM and X-ray diffraction based charge density measurements was carried out on conducting toluene molecules. The Light Scattering Laboratory has been working on Brillouin Scattering studies on Manganites, Oxides, nanotubes and nanomaterials. It has also been working on high pressure Raman scattering studies on mid chain alkanes and perovskites. A new program, on the use of Raman spectroscopy to study biological systems has been initiated. We have developed indeginously a micro Raman setup which can handle samples as small as 2 microns. We have also developed the technique of surfaced enhance Raman spectroscopy in proteins and nucleotides. In collaboration with the Transcription laboratory at JNCASR, the interaction of the activator CTPB with p300 (HAT) protein using surfaced enhanced Raman spectroscopy has been investigated. CTPB attaches itself to the unstructured parts of the p300 molecule and regulates the active sites. Raman and Infrared studies on CTPB and CTB have also been carried out in order to understand the difference in hydrogen bonding in these due to the presence of a long alkyl chain in CTPB and the difference in their chemical behavior to p300. The transport properties and solvation dynamics of model 1,3-dialkylimidazolium chloride melt at 425K has been studied using molecular dynamics simulations. The structural properties of this melt has been investigated using ab initio molecular dynamics simulations, which confirms the experimental finding on the presence of a hydrogen bond between the acidic ring proton and the anion. Ethanol is widely used as a cosolvent to enhance the solvent properties of supercritical carbon dioxide. The nature of interactions between ethanol and CO<sub>2</sub> has been characterized using simulations via the Car-Parrinello molecular dynamics (CPMD) method. Atomistic molecular dynamics simulations have been performed in the isothermal-isobaric ensemble to explore the phase behavior of n-heptane. Motivated by recent high pressure spectroscopic experiments on n-heptane, this work aimed at understanding the liquid-solid and the alluded solid-solid transitions upon increasing pressure. Several parallel computers using commodity components have been built for the purpose of performing accurate molecular simulations.

Projects related to memory effects in polymer field effect transistors using optoelectronic methods were completed. Spatially resolved photocurrent in organic planar structures over a wide length scales were accomplished. Conducting Polymer (PEDOT:PSS)-Membrane Protein (bR) interfaces were studied. Electric Field driven instabilities formed on elastomeric surfaces are currently being probed. A facility to study the sensitivity of gas sensors has been setup. Nanosized powders of ZnO-Co have been synthesized using the sol-gel method for gas sensor applications. Activities in the area of organic electronics, bioelectronics and surface patterning have been carried out. A photo-polymer Field Effect Transistor (FET) for memory applications and a polymer based optical position sensor have been invented, fabricated and studied. Electric field induced pattern formation on soft elastomeric surfaces have been studied.

Photochemical transport in bacteriorhodopsin-conducting polymer systems has been explored. Fabrication of gas-phase reactor coupled with online gas chromatogram to carry out deNOx and hydrocarbon oxidation reactions is in progress. A new laboratory named *Superconductivity and Magnetism* has been established with facilities to make bulk functional oxide materials and thin films. A single phase and epitaxial thin film of  $\text{Ce}_{0.5}\text{Sr}_{0.5}\text{MnO}_3$  has been prepared by RF magnetron sputtering and characterized by x-ray, magnetic and electrical transport measurements. Bulk oxides in the  $\text{La}_{0.5-x}\text{Ce}_x\text{Ba}_{0.5}\text{MnO}_3$  system has been investigated by x-ray, magnetic and electrical transport measurements. Coexistence of superconductivity and magnetism in  $\text{RuSr}_2\text{GdCu}_2\text{O}_7$ , has been investigated in order to understand their interplay.

The following are the members of the Unit:

#### Chair

C N R Rao

Ph D, D Sc, F A Sc, F N A,  
F R S, F T W A S, Hon F R S C

#### Hon Professors

A K Sood

Ph D, F A Sc, F N A

A K Raychaudhuri

Ph D, F A Sc, F N A

#### Associate Professors

S Balasubramanian

Ph D

G U Kulkarni

Ph D

K S Narayan

Ph D

S Natarajan (upto 20.8.2004)

Ph D

A R Raju

Ph D

#### Faculty Fellows

N Chandrabhas

Ph D

M Eswaramoorthy

Ph D

A Sundaresan

Ph D

#### Technical Officers

V Sreenath

BE

S Srinivas

BE

#### Technical Assistant

Usha Govind Tumkurkar

M Sc

#### Lab Assistants

J Anil Kumar

DEE

B S Vasudev

BE

Basavraj Devaramani

DEE, BE

Alla Srinivasa Rao

DECE, BE

#### Research Associates

Manashi Nath

Suman Cherian

Vasuda Bhatia

#### R & D Assistants

Annu Thomas, Gomathi A, Hari Krishna S, Krishnan M, Manish C M, Nirmala P M, Ratnesh Kumar S, Sajini Anand, Selvi N R, Sunil Kumar S, Ujjal K Gautam, Yasar K.

## 2. Chemical Biology Unit

Novel Cationic Surfactants with Multiple Pyridinium Headgroups have been synthesized. Investigation of aggregation properties of cationic surfactants with multiple pyridinium headgroups has been performed using spectroscopic and small-angle neutron scattering studies. New class of Lipids with oxyethylene linkages have been developed and their biophysical properties after membrane formation were investigated. Evidence of enhanced reactivity of dephosphorylation and deacylation reactions in cationic gemini micellar media has been found. Using novel strategy distamycin-linked oligonucleotides with chosen sequences have been synthesized. Their duplex formation and related physical characterization has been completed.

Total synthesis of complex natural products that exhibit novel and unusual biological activity profile has been pursued. The idea is to explore these natural products as lead or 'privileged' structures for drug discovery by creating molecular diversity around them. The protocols developed for the total synthesis lend themselves to ready adaptation to generate small molecule libraries. Recently, the total syntheses of over a dozen molecules of varying degree of complexity have been accomplished. These molecules exhibit activities ranging from the inhibition of angiogenesis to promotion of apoptosis. Some of these natural products are of great contemporary interest and the activities in this area will be strengthened in the coming months.

While the hydrophobic driving force is thought to be a major contributor to protein stability, it is difficult to experimentally dissect out its contribution to the overall free energy of folding. Small substitutions of buried hydrophobic residues at positions 8 and 13 in the peptide: protein complex, RNase-S has been made and the structures characterized by X-ray crystallography. The thermodynamics of association of these mutant S-peptides with S-protein was measured in the presence of different concentrations of methanol and ethanol. The reduction in the strength of the hydrophobic driving force in the presence of these organic solvents was estimated from surface tension data as well as from the dependence of the DCp of protein: peptide binding on alcohol concentration. The data indicated a decrease in the strength of the hydrophobic driving force of about 30-40% over a 0-30% range of alcohol concentration. Large to small substitutions were observed to destabilize the protein. However, the amount of destabilization, relative to wild type, is independent of alcohol concentration over the range of alcohol concentrations studied. The data clearly indicate that decreased stability of the mutants is primarily due to loss of packing interactions rather than a reduced hydrophobic driving force, and suggest a value of the hydrophobic driving force of less than  $18 \text{ cal mol}^{-1} \text{ \AA}^2$ .

The synthesis of a rare bile acid found only in some species of pythons has been accomplished. Phosphonobile acids and cationic analogs of bile acids have been extensively investigated for their gelation and cholanochemical properties. A general strategy for the design of PET-based cation sensors has been developed, and demonstrated for the sensing of potassium ions. The structure and dynamics of a molecular hydrogel has been investigated in detail using fluorescent probes.

The following are the members of the Unit:

### Chair

Uday Maitra

Ph.D, FA Sc

### Professor

V Krishnan

Ph.D, F A Sc, F N A, F T W A S

(Hindustan Lever Research Professor)

### Hon Professors

P Balaram

Ph D, F A Sc, F N A, F T W A S

G Mehta

Ph D, F A Sc, F N A, F T W A S

### Hon Faculty

Raghavan Varadarajan

Ph D, F A Sc

Santanu Bhattacharya

Ph D, F A Sc

### Research Associate

Uday Kumar Kundu

### R & D Assistant

Suguna, P



### 3. Condensed Matter Theory Unit

The members of the Condensed Matter Theory Unit (CMTU) are engaged in theoretical research on a variety of frontier areas of Condensed Matter Physics and Chemistry. The research topics pursued which are classified into three major areas are listed below. During 2004-05, they made significant progress on several problems in each of these areas. While the details of the advances made in these areas can be gleaned from the publications, some specific accomplishments are mentioned below. While the planned research activities in the next year will continue to address problems in these areas, some newer areas are also mentioned under the appropriate heads.

#### ***Strongly Correlated Quantum Many-Body Systems***

Pursued and planned areas of research: Kinetically-driven magnetism in double perovskites and dilute magnetic semiconductors; colossal magneto resistance, and spin, charge and orbital ordering in doped manganites; metal-insulator transitions; low dimensional systems such as quantum wires and spin chains, and tunnelling in quantum dots; studies superfluid, Mott-insulator, and mass-density-wave phases in the one-dimensional extended Bose-Hubbard Model using the density-matrix renormalization-group method.

Some specific accomplishments: The critical anomaly of the sound velocity and other lattice effects near a Mott metal-insulator transition has been investigated within the compressible Hubbard model in the framework of dynamical mean-field theory. The results compare favorably to recent experiments on the layered organic conductor (BEDT-TTF)<sub>2</sub>Cu[N(CN)<sub>2</sub>]Cl. The theory for doped manganites in the orbital liquid regime developed last year has been extended to the half doped manganites which exhibit charge, orbital and antiferromagnetic order, and helps to understand several features of the doping and magnetic field induced insulator-metal transitions in these materials.

#### ***Soft Condensed Matter***

Pursued and planned areas of research: Vortex matter in type-II superconductors; semi-flexible polymers; Rheology of sheared complex fluids; charged micellar systems; porous networks and biomembranes; solvation in complex liquids; colloidal suspensions; surfactant solutions; liquid crystals; phase transitions in colloidal systems in a laser-induced periodic potential.

#### ***Nonequilibrium / Time-dependent Statistical Physics***

Pursued and planned areas of research: Stick-slip phenomena; martensitic transformations; fluid and magnetohydrodynamic turbulence; spatiotemporal chaos in excitable media; driven diffusive systems; slow dynamics near the glass transition; dynamics of evolving networks; protein folding and association; orientational relaxation dynamics in liquid crystals; dynamics of water molecules in carbon nanotubes, dynamics and rheological chaos in surfactant solutions, theory and experiments on ordered nonequilibrium steady states in agitated monolayers of granular rods, statistical hydrodynamics of self-propelled organisms, from fish to bacteria to cell-membranes coupled to motors, filaments, and ATP; the rheology of the living cell.

Some specific accomplishments: In the area of turbulence it has been shown that the decay of magnetohydrodynamic turbulence depends on the type of initial condition used. In particular, if initial energy spectra have a power-law dependence on the wavevector, then an energy cascade does not set in (for positive powers) and the total energy decays, in the absence of forcing, as a negative power of time. The study of the multiscaling of time-dependent structure functions in fluid and passive-scalar turbulence has been systematized, and it has been shown how to uncover the dynamic multiscaling of such structure functions via derivative and integral time scales and why these different time scales lead to different dynamic multiscaling exponents. In addition, a detailed numerical study (with a spatial resolution that is three orders of magnitude better than any previous study) of turbulence in the one-dimensional Burger's equation forced stochastically with a force whose spectrum scales as  $1/k$ , where  $k$  is the wavevector. The study shows that, even with such a high-resolution, it is difficult to distinguish true multiscaling of velocity structure functions from bifractal scaling corrected by subdominant terms. This has obvious implications for multiscaling in fluid

turbulence. Finally, the nature of turbulent drag reduction via polymer additives has been elucidated by studying decaying turbulence in the presence of polymers in a shell model for drag reduction. This study leads to an appealing definition of drag reduction in the context of decaying turbulence.

The following are the members of the Unit:

**Chair**

H R Krishnamurthy Ph D, F A Sc, F N A

**Hon Professors**

Biman Bagchi Ph D, F A Sc, F N A, F T W A S

Chandan Dasgupta Ph D, F A Sc, F N A

N Kumar Ph D, F A Sc, F N A, F T W A S

S Ramasesha Ph D, F A Sc.

D D Sarma Ph D, F A Sc, F N A

**Hon Faculty**

G Ananthakrishna Ph D, F A Sc

Binny J Cherayil Ph D

Diptiman Sen Ph D, F A Sc

Rahul Pandit Ph D, F A Sc, F N A

K L Sebastian Ph D, F A Sc

Sriram Ramaswamy Ph D, F A Sc

S Yashonath Ph D, F A Sc

**Research Associate**

Aniruddha Chakraborty

**R & D Assistants**

Arul Murugan, Bidisa Das, Nandan Pakhira, Pinaki Choudhury, Rajesh Karan

## 4. Education Technology Unit

The Unit under the programme of popularisation of Science (particularly amongst the school and college students), has produced and developed CD-ROMs and books in English and other Indian languages. The CD-ROM in Kannada, titled *Vignyana Kaliyona Samputa 2* consisting of two modules on Energy and Physics was completed.

The Unit has organised five Workshops on *Learning Science* and *Celebration of Chemistry* at various venues all over the country: BHU Varanasi, RRL Trivandrum, NCSC Kolkata, University of Madras, Chennai, JNCASR Bangalore. Prof C N R Rao gave the theme lecture in most of these programmes and students in thousands attended the programmes. At the Asia-Pacific Meet on Science Education, a multimedia presentation of excerpts from the CD-ROM *Learning Science* was presented by the Unit.

The Unit in collaboration with the Karnataka State Council for Science and Technology (KSCST) organized the program *Vignyana Kaliyona* for students of Kannada medium schools in Bangalore district. Many students and teachers actively participated in the programme. This was followed by a multimedia presentation of excerpts from the CD-ROM *Vignyana Kaliyona* in Kannada developed by the Unit.

A multimedia presentation from CD-ROM *Understanding Chemistry* was presented in Project Oriented Chemical Education programme of the Centre.

The Unit is presently engaged in producing four parts of Learning Science books in English. The first three volumes are printed. The first part consists of three main topics - Universe, Solar System and Earth, whereas the second part which has two main topics is titled *The World of Physics and Energy: Learning physical principles*. The third part has three topics, *The World of Chemistry: Of Molecules and Materials, Air around us and All about water*.

The following are the members of the Unit:

### **Incharge**

V Krishnan

Ph D, F A Sc, F N A, F T W A S

### **Coordinator (Hon)**

Indumati Rao

M A, M S, C E

### **Technical Officer**

Jatinder Kaur

M Sc

### **Multimedia Asst. (Hon)**

Sanjay Rao

B Sc, Cert. Multimedia

## 5. Evolutionary and Organismal Biology Unit

This Unit consists of two laboratories doing research and teaching in the following subjects: chronobiology, behavioural ecology and sociobiology, evolutionary genetics and population ecology. Our research employs *Drosophila melanogaster*, the ant *Camponotus compressus*, and the field mouse *Mus booduga*.

### Facilities:

1. Fully computerized insect activity recording systems with hundreds of channels to continuously record locomotor activity of fruitflies, ants and mice.
2. A laboratory to carry out molecular biological work with extensive facilities for RNA and protein estimation.

### Research highlights:

#### Chronobiology Laboratory

*Drosophila melanogaster*: Established mRNA of the clock genes period (per), timeless (tim), clock (clk) and cryptochrome (cry).

Lack of a circadian organization has life expectancy consequences in *Drosophila melanogaster*. This is the first unequivocal demonstration that an absence of circadian integrity can shorten life in any organism.

We demonstrated that in the ant *Camponotus compressus* only major workers (foragers) have robust circadian clocks and that minor workers (nurses) do not have circadian clocks. A first report.

We have reported 'clocks for sex'; *Camponotus compressus* queens lose their clocks after mating. We have also reported first evidence for shift work schedules in forager/worker ants.

#### Evolutionary Biology Laboratory

- a) Evolutionary Genetics: Populations of faster developing *Drosophila* have been created through laboratory selection to investigate genetic control of the timing of developmental events.
- b) Population Ecology: Experimental and theoretical studies are in progress to understand better demographic stochasticity of metapopulations. Studies on Indian species of Drosophilids are underway to examine the generality of life-history trade-offs.

The following are the members of the Unit:

#### Chair

M K Chandrashekar      Ph D, D Sc, FASc, FNA, FTWAS

#### Honorary Professors

Raghavendra Gadagkar      Ph D, F A Sc, FNA, FTWAS  
Vidyanand Nanjundiah      Ph D, F A Sc, FNA

#### Associate Professor

Amitabh Joshi      Ph D, F A Sc, F N A Sc

#### Faculty Fellow

Vijay Kumar Sharma      Ph D.

#### Research Associate

Hemavathi      Ph D.

#### Jr Scientific Assistant

A V Nagarathnamma      M Sc

#### R & D Assistants

Manjunatha S, Shaik Irfan



## 6. Engineering Mechanics Unit

The Engineering Mechanics Unit pursues research on a variety of topics where fluid and solid mechanics and heat transfer play a critical role in providing insights to various phenomena and in enhancing skills in prediction. From this point of view work done in the Unit covers not only areas of direct interest in a variety of technological applications but also phenomena encountered in nature. Faculty of the Unit have thus been involved in investigating a wide variety of problems.

### 1. Stability and Transition

An analysis of experimental data on swept wings has revealed that in the leading edge region there can sometimes be as many as six transitions back and forth between laminar and turbulent flow. The presence of several such 'transition cycles' is thought to be responsible for the anomalous scaling effect seen in the maximum lift of swept wings of modern transport aircraft. The Boeing Commercial Airplane Company sponsored the experimental part of this work, which has been carried out in collaboration with scientists at NAL.

It is shown that the statistics of turbulent spot birth can be reconstructed qualitatively knowing the macroscopic characteristics of the laminar-turbulent transition zone. A connection between turbulent spot birth and the secondary instability of the laminar boundary layer has been demonstrated.

The critical Reynolds number for linear instability of the laminar flow in a divergent pipe has been shown to be finite for any divergence, the straight pipe being a limiting case. The flow solution, obtained on Flosolver Mk 6, a new parallel machine built at NAL, showed a superlinear speed-up.

The properties of adjoint operators are exploited to obtain the solution of a partial differential equation of a certain type, by solving directly only an ordinary differential equation. This technique is used to obtain accurately the instabilities in a two-dimensional boundary layer.

Even though the instability-induced patterns and turbulence have been extensively studied in classical fluid mechanics, such studies are relatively new for multiphase (e.g. suspensions) flows. The focus of our theoretical effort is to use accurate (non-Newtonian) rheological models to predict the onset of instabilities and unveil the related nonlinear patterns in dry granular flows and suspensions. We are also using large-scale molecular-dynamics simulations to uncover patterns in such fluids.

### 2 Atmospheric Science

A project on the effect of low wind on eddy fluxes in a nearly free convection regime has been completed. The work shows a linear increase in drag with wind speed and heat flux that is independent of wind speed up to a value that depends on the densimetric Froude number. In a separate investigation it has been demonstrated that Indian monsoon rainfall is significantly higher during epochs of higher solar activity. Further work on the subject is continuing using a variety of wavelet methods of analysis.

A simple theoretical model with a closed form solution has been devised for explaining the lifted temperature minimum phenomenon.

Field experiments to study nocturnal atmospheric boundary layer: A field observation station has been established at the IISc airstrip where we can record vertical and temporal variations of temperature, humidity and air velocity to study the special atmospheric phenomenon of the formation of the Ramdas layer. When the Ramdas layer is formed, a minimum in the vertical temperature profile of the nocturnal atmospheric boundary layer occurs at a few decimetres above the ground. In our research program we study some of the issues connected with this phenomenon like radiation stabilisation of the air layer close to the ground, temperature-slip due to radiation and dependence of the phenomenon on other governing parameters.

### 3. Computational Fluid Dynamics (CFD)

The research activity includes kinetic schemes, development of novel numerical methods, grid free methods, issues of connectivity, accuracy on irregular meshes, rotationally invariant schemes, KFVS and fibre bundles, automatic mesh refinement, convergence acceleration devices such as multigrid, GMRES, dual time stepping and computation of vortex dominated flows. The CFD application activity includes flow past supersonic and hypersonic flight vehicles, control surface deflections, aero elasticity of turbine and compressor blades, multipassage and multi blade row flows, strongly rotating viscous flows.

#### 4. *Double Diffusive Instabilities and Convection*

Convection in a double diffusive system is due to instabilities generated by the diffusion of two components having different molecular diffusivities (e.g. heat and salt) with opposing contributions to the vertical density distribution in a fluid medium. Interaction of double-diffusive convection and the stratified medium is relevant in many natural phenomena and engineering applications like in oceanography, geophysics and metallurgy. At this Unit, research on double diffusive systems includes both experiments and numerical simulations to study the effect of governing parameters like Prandtl number and density stability ratio on the behaviour of the system.

#### 5. *Unsteady Aerodynamics of Insect Flight*

With many years of research, principles of steady aerodynamics (2-D aerofoils and finite wings) applicable to a fixed wing aircraft are quite well understood. In contrast, the engineering principles needed for optimum design of small mechanical objects that can use unsteady aerodynamics for their means of propulsion and lift, have not yet been established. The emphasis in our research is to have a systematic and comprehensive study of the principles of unsteady aerodynamics pertaining to the fluid dynamical problems of flapping flight. The research will help in understanding the rationale for its use in nature and will provide design guidelines to exploit unsteady aerodynamics for making small flying devices.

#### 6. *Experimental and Numerical Study of Entrainment Process in Turbulent Free Shear flows*

Turbulent free-shear flows spread in a direction normal to their primary-flow direction by incorporating irrotational ambient fluid into the turbulent jet-flow. This process is known as entrainment. In our research program, using both experimental and computational techniques we address the issue of variation in rate of entrainment due to changes in ambient viscosity, axial pressure gradient and axial acceleration.

#### 7. *Mechanics and Physics of Complex Fluids*

Complex fluids refer to fluids that have microstructures and are rheologically complex, in contrast to 'simple' fluids whose rheology is of order-one. Common examples of complex fluids are polymers (e.g. DNA), suspensions (e.g. milk, myonese, blood, paints, slurries), granular materials (e.g. powders, agricultural products, coal, sand), etc. The granular materials and suspensions are important in numerous chemical processing and pharmaceutical industries as well as in geophysical contexts (avalanche, volcanic eruption, mud flow, sand-dunes, etc.).

Our current work is focussed on understanding the rheology and the dynamical patterns in complex fluids. We carry out microscopic/particle-level (molecular dynamics) simulations, formulate rheological models, and analyse continuum models for various flow configurations using the tools of nonlinear dynamics and numerical methods (e.g. CFD). A concerted effort has been undertaken to probe the non-Newtonian rheology of particulate fluids using particle-level simulations and the kinetic theory.

The following are the members of the Unit:

##### **Chair**

R Narasimha Ph D, F A Sc, F N A, F T W A S, F R S

##### **Senior Associate**

S M Deshpande Ph D

##### **Associate Professor**

Rama Govindarajan Ph D, F N A Sc

##### **Faculty Fellows**

Meheboob Alam Ph D

K R Sreenivas Ph D

##### **Fellow**

K Sanjeev Rao Ph D

##### **R & D Assistants**

Kaushik Srinivasa, Manjunath P L, Saritha Azad, Vijaya Kumar Chikkodi, Vinod N.

## 7. Geodynamics Unit

The thrust of research endeavours is the studies on tectonic movements that have taken place in the Late Quaternary time. Mainly field-based, the investigations relate to reactivation of older faults and fissures, rapid rise of mountain ranges, drainage development including formation and disappearance of lakes in essentially riverine regimes, reshaping of landscape, and geomorphic rejuvenation of older mature topography. The neotectonic studies aim at gaining insight into the mechanism of recent movements — the quickened pace of which generates hazardous events — and obtaining information on climate changes in the past 50,000 years.

The focus of attention at present is on the Southern Sahyadri mountain and coastal terrain in Central Kerala in South Indian Shield in the south and on the Himadri – Tethys Himalaya transition zone in Central Himalaya in the north.

### Chair

K S Valdiya

Ph D, F A Sc, F N A, F N A Sc, F T W A S

## 8. Molecular Biology and Genetics Unit

The central theme of research activity of this Unit is Biology of Diseases. The different areas under this broad discipline being pursued are: (a) Infectious Diseases include Malaria and AIDS (b) Chromatin Remodelling and Transcriptional Regulations in relation to Cancer (c) Developmental Biology and Genetics in relation to Angiogenesis, Deafness and Epilepsy. The Unit during the last two years has expanded both in terms of various research activities as well as physical infrastructure like additional laboratory space and sophisticated equipments like Multiphoton Confocal Microscopy, CD Spectropolarimeter etc. Given below, is the brief outline of the work done in the Unit during the year 2004-05, along with future plan of work.

### ***Chromatin Biology Laboratory***

Global chromatin remodeling is an important event during mammalian spermatogenesis, particularly with respect to (a) genetic recombination at the pachytene interval and (b) during final stages of spermiogenesis. There are several diseases associated with spermatogenesis resulting in infertility as a consequence of defective genetic recombination as well as chromatin packaging during the final stages of sperm development.

We have been interested in both these aspects namely genetic recombination during meiotic prophase and chromatin remodeling during spermiogenesis. We have recently identified and characterized a meiotic recombination hotspot in the mouse genome and mapped the cross over region at the nucleotide resolution level. Its syntenic locus has also been identified and characterized in the human genome which has been mapped to high resolution to single nucleotide level. A freely available Web-based Database of the Human Recombination Hotspots was created. Further, several new sequence motifs associated with human recombination hotspots were identified. The mouse recombination hotspot locus also encodes a noncoding RNA which is transcribed by RNA Polymerase II. We are now addressing the biological role of this noncoding RNA.

We have shown earlier that Transition protein, TP2, which appears during later stages of spermiogenesis is a zinc finger protein having DNA condensing properties. Now confocal microscopy and localized regions of TP2 binding sites in the spermatids have been used and shown to correspond to "GC" rich sequences. By using chromatin immunoprecipitation technique, a novel highly conserved 21 nucleotide sequence which may represent the TP2 cognate binding site in the genome was identified. The various covalent modifications which TP2 undergoes and study their biological role in the chromatin remodeling process are now being addressed.

### ***Transcription and Disease Laboratory***

The mechanistic (molecular) aspects of regulation of transcription from the chromatin template with special emphasis on human diseases are areas of active research. We have established an essential role of the histone chaperones in acetylation-dependent chromatin transcription. This is being followed up by the molecular dissection of the process and in exploring the sphere of action of the histone chaperone in stress-induced gene expression. We have shown previously that the non-histone chromatin protein HMGB1 and the positive coactivator PC4 regulate p53 gene expression. The exact mode of action of PC4 to result in the enhancement of p53 DNA binding is being worked out with particular reference to DNA damage repair. Altering the established view of

PC4 as a transcriptional coactivator alone, is our observation that it also acts as a non-histone chromatin protein that is actively involved in dynamic chromatin organization. Further work in this field involves the elucidation of the effect of post-translational modifications, phosphorylation and acetylation, of PC4 on its condensing ability. In parallel, the functional genomics of this protein is being carried out to understand the signals that activate the expression of this gene.

Chromatin transcription involves a large number of modifying enzymes that control transcription through the modulation of the chromatin structure. Recent reports have highlighted the importance of these enzymes in the development of a diverse group of diseases such as cancer, cardiac hypertrophy, asthma, neurodegenerative diseases and diabetes. We are working towards the isolation of naturally occurring small molecules that would modulate the function of the different chromatin modifying enzymes, which could not only lead to the design of a new line of therapeutics, but also act as useful biological probes. In this context we have identified three inhibitors and one activator for the histone acetyltransferases. Expanding this variety, we are initiating work to identify naturally occurring, cell-permeable modulators for histone methyltransferases.



### **Molecular Parasitology and Protein Engineering Laboratory**

Malaria, a disease caused by infection with the protozoan parasite of the genus *Plasmodium*, is a major public health problem in many parts of the world. Human Malaria, caused by 4 species of *Plasmodium*, viz., *P. falciparum*, *P. vivax*, *P. malariae* and *P. ovalae*, is transmitted by the Anopheles mosquitoes. *P. falciparum* causes the most lethal form of the disease with increasing incidences of cerebral malaria. Though many potential vaccine candidates are under study, an effective vaccine/immunization against malaria is not available. The most widely used and inexpensive antimalarial is chloroquine. Clinical treatment of Malaria in many endemic areas has been complicated by the appearance of chloroquine and multi-drug resistant parasites.

Enzymes of metabolic pathways are suitable targets for drug development. This laboratory studies the enzymes of the purine salvage pathway in *Plasmodium falciparum*. With the absence of the de novo purine biosynthetic pathway, the parasite is vulnerable to inhibition of the salvage pathway. Enzymes that have been the focus of studies in this laboratory are HGPRT and ADSS. Structural basis of substrate specificity of HGPRT, the unique ability of this enzyme from the parasite to switch from active to inactive form are some of the issues that we have been pursuing. We have obtained the structure of PfADSS and have been using the structure to understand properties unique to the parasite enzyme.

Currently we have extended our studies to include *P. falciparum* ASL, IMPDH and GMP synthetase that are also involved in purine nucleotide synthesis. Another enzyme that has been the focus of our studies is silent information regulator (SIR2) of *P. falciparum*. We have also been studying the homologous human enzymes and from archae bacteria with the aim of understanding the diversity in protein structure and function across distantly related species.

This laboratory is also involved in studying *Plasmodium* biology has contributed very significantly to the understanding of protein and fatty acid biosynthetic pathways in the parasite. Efforts are on to dissect these two pathways and develop specific inhibitors for some of the essential enzymes/ proteins which alone or in combination with other antimalarials/inhibitors may be more effective.

Towards achieving this goal few inhibitors of fatty acid synthesis pathways have been designed and synthesized. This *Plasmodium* pathway was discovered at the Centre. As this pathway is taking place in an organelle the 'Plastid', it is of prokaryotic nature, intrinsically different from that operating in the eukaryotic host. Thus, the inhibitors for this pathway would be specific for the parasite. Future plans include characterization and crystallization of the enzymes of the pathway to understand structure-function relationship, which eventually would help in the design of effective inhibitors. The crystal/NMR structures of three of the enzymes of this pathway have been solved in collaboration with Prof Suguna and Dr Siddhartha of Molecular Biophysics Unit, IISc. The efficacy of combination therapy using triclosan and other antimalarials/ antibiotics/other inhibitors will be evaluated.

### **Molecular Virology Laboratory**

This is one of the few dedicated laboratories for AIDS research in India, focuses on several medically and scientifically important areas of HIV/AIDS research. The main theme of the laboratory revolves around subtype-C strains of HIV-1 that cause nearly 60% of all the infections globally and almost 99% in India. Are subtype-C viruses endowed with unique biological properties that make them successful in establishing rapidly spreading epidemics of the world? The active theme of this laboratory is thus elusive but challenging question. Various themes being pursued in the laboratory are summarized below in brief.

- *The Indian epidemics are dominated by HIV-1 subtype-C strains:* Studies on the molecular epidemiology of HIV from India have been few in number, limited in the size and restricted to a few urban cities (Delhi and Punjab, Kolkata, Mumbai, Pune and Goa). Lack of a suitable molecular technique is one reason why large scale studies have not been attempted in India. Monitoring the distribution of viral subtypes in a geographical region is important as the viral subtype distribution is a dynamic process and could change as a function of time. The standard techniques used for viral molecular subtyping, sequencing of the envelope and/or the heteroduplex mobility assay (HMA), are too cumbersome, technically difficult and expensive to apply to hundreds of samples. We developed a novel subtype-C specific PCR and applied this technique to more than 600 primary clinical samples collected from a number of rural villages, towns and urban centers spanning across all the four southern

states of India. Our study identified that nearly 99% percent of these samples (602/608) are caused by subtype-C. This study is not only the first of its kind in southern India but also with largest sampling size from India.

- *Identification of unique HIV-1 B/C recombinant viruses in India:* We identified three unique B/C recombinant viruses in India for the first time. The env sequence of one of the three recombinant strains phylogenetically associated with Thai-B viruses that are common in China and Thailand while that of the other two with subtype-B viruses of the USA and Europe. Presently it is not known if an independent epidemic is emerging in India due to B/C recombinants. The real incidence of such a possibility could be addressed only by a large scale epidemiological study. Interestingly, B/C recombinant viruses containing env sequences of subtype-B viruses of the USA and Europe have not been identified previously. Work is in progress to collect a few thousands of samples from all over the country to determine the incidence of recombinant strains in India.
- *Are subtype-C viruses endowed with unique biological properties?* We have had an opportunity to test a unique pathogenic property of HIV-1 subtype C virus. We identified a natural variation in the Tat protein of subtype-C (C-Tat). Tat, mimicking cellular chemokines, recruits activated monocytes to brain and triggers a cascade of signaling events that finally converge in neuron death and the manifestation of HIV-associated dementia. A cysteine to serine substitution at position 31 should disrupt the chemokine property of Tat in subtype-C. We experimentally demonstrated loss of chemokine property in C-Tat and hypothesized a correlation between this natural variation in Tat and low incidence of HIV-associated dementia in India. This variation, however, did not affect other properties of the viral protein. Interestingly, we identified that the variant serine in C-Tat is phosphorylated suggesting acquisition of novel signaling properties for C-Tat. We are presently generating Tat-transgenic mice to study neuropathogenesis in these mice. Additionally, human primary monocytes infected with subtype-B or -C viruses will be injected into mouse brains to study encephalitis, monocyte migration and other pathological manifestations. We are also generating isogenic full-length C-viruses that differ only in the cysteine 31 residue. The replication fitness of these viruses will be evaluated in pairwise competition experiments.
- *Optimization of DNA vaccines through engineering molecular adjuvants:* DNA vaccines offer the advantage of targeting the encoded antigens to the MHC class I pathway. However, DNA vaccines are not efficient either in eliciting strong immune responses in larger animals or augmenting humoral immune responses. One way to improve the function of DNA vaccines is to engineer molecular adjuvants into the DNA-expression vectors. Numerous attempts at vaccine development for HIV have largely been unsuccessful for various reasons. Failures with env vaccines prompted search for alternative or adjunct candidate viral proteins that may serve as better vaccines or as constituents of multi component HIV vaccine. We elected to optimize the viral antigen Tat as this protein offers several technical advantages for HIV vaccine design. For instance, immune responses to Tat antigen in a natural infection appear to be protective, but only a small fraction of HIV infected people contain immune responses to Tat, however, these people appear to be slow progressors and there is an inverse correlation between Tat immune response and disease progression. We have demonstrated enhanced immune responses to Tat by means of codon-optimization of this viral antigen, targeting Tat for rapid antigenic processing by ubiquitin-tagging and enhanced antibody generation by linking it to multiple copies of C3d. We are presently optimizing EFlá promoter as a possible alternative for the popular CMV promoter. Additionally, we are also evaluating the effect of engineering various regulatory elements into Tat-expression vectors for enhanced immunogenicity.
- *Development of immune and molecular diagnostic techniques for HIV:* For the disease management of HIV/AIDS, availability of efficient and affordable diagnostic tests is as important as access to chemotherapy. Two tests are highly important for HIV disease management, (1) the viral load assay and (2) CD4/CD8 count. Although both these tests are commercially available from several standard diagnostic laboratories in India, they are prohibitively expensive and not within the reach of the majority. Most of these available kits are manufactured by international multinational companies. Considering the importance of indigenous technology for HIV disease management, our laboratory is actively collaborating with Biotechnology companies like Microtest Innovations, Bangalore and Bharat Biotech, Hyderabad to develop such molecular diagnostic techniques.

### **Human Molecular Genetics Laboratory**

Studies on genetic basis of congenital deafness is one of the major focus of research in the human molecular genetics laboratory of the unit. Deafness is one of the most common sensory disorders in humans. Profound hearing loss occurs in one in 1000 children, most often due to genetic mutations. Hearing is a complex physiological process and so are the causes of hearing impairment. Deafness is highly heterogeneous genetic disorder with over 100 genes predicted to be associated with this disorder. We are carrying out mutational analysis of several deafness genes and whole genome-wide scanning of appropriate families to identify novel genes in the process of hearing.

In a multicentric collaborative effort, involving AYJNIHH, Mumbai, ALMPGIBMS, Chennai, MAMC, Delhi and JNCASR, Bangalore, we are collecting about 500 families with two or more members showing severe-to-profound sensorineural hearing loss. These families are being analyzed to understand genetic complexities of deafness in Indian populations. In the first phase of the work, a 3-step protocol to analyze 12 deafness genes (*Cx-26*, *Cx-30*, *Cx-43*, *TMCI*, *TMPRSS3*, *MYO6*, *MYO15*, *MYO7A*, *HAR*, *CDH23*, *CLDN14* and *PDS*) is implemented which involves direct sequencing of four of the genes and genetic linkage followed by mutational screening for the remaining ones. In 300 families analyzed so far, mutations at the *Cx-26* gene account for the maximum proportion (~25%) of deaf individuals whereas *Cx-30* and *Cx-43* make no contribution. A number of families, wherein linkages to the *TMCI*, *TMPRSS3*, *HAR* and *CDH23* genes has been found, are being analyzed for identification of pathogenic mutations. Concurrently, we are carrying out cell biological and biochemical studies on the specific novel mutations to obtain an understanding of the manner in which these mutations may be affecting the normal auditory physiology.

Towards isolation of novel deafness genes, we are conducting genome-wide two- and multi-point mapping studies on a set of multiple-affected families. In one such study involving a large multiple-affected family, a novel genetic locus on the chromosome 18 has been identified, and additional interesting observations made in another family affected with recessive, profound sensorineural deafness wherein an unusual, long-range gene regulatory mechanism seem to govern expression of an already known deafness-causing gene.

### **Vascular Biology Laboratory**

Studies on the regulation of blood vessel formation have potential implications on devising pro- and anti- angiogenic therapies for combating ischemic diseases or cancer, respectively. These studies depend on a detailed understanding of the molecular-genetic and cellular mechanisms of blood vessel formation. However, the limited knowledge of gene expression changes that occur in normal vascular development and in tumour angiogenesis has hindered the development of specific treatments and therapies. We are interested in studying the development of circulatory systems, with a focus on mouse vascular development. We have identified several genes involved in blood vascular development, using various *in vivo* and *in vitro* models such as embryonic stem cells, mouse embryos and *Drosophila*.

*The OCIA domain family: A novel family of proteins expressed in the cardiovascular system:* Using a functional genomics approach in ES cells and comparative analysis of gene expression patterns, we have identified a novel gene family that is expressed in cardiovascular development. This family comprises two novel genes that we have identified, namely, *asrij* and *padosan*. Both genes express in ES cells and the developing vascular system. Their expression patterns are largely overlapping. Proteins encoded by both genes localize to endocytic vesicles. The *asrij* and *Padosan* proteins have a novel conserved hydrophobic motif called the OCIA domain. We have shown that this domain alone is sufficient to target proteins to vesicles. Lack of the OCIA domain results in general cytoplasmic distribution of *Asrij* and *Padosan*. We have also shown that *asrij* chimeric mice have cardiovascular defects. We identified the *asrij* promoter and showed that transgenic mice carrying a lacZ reporter under the control of *asrij* express beta-galactosidase in the heart and blood vessels. We have also shown that *Drosophila asrij* is expressed in hemocytes and mutants lacking *asrij* are temperature-sensitive lethal.

*Rudhira a novel marker for ES cells and the erythroid lineage, is upregulated in tumors:* We describe a novel murine gene *rudhira* that is expressed at high levels in embryonic stem cells and is restricted to blood islands and the erythroid lineage during embryonic development. *Rudhira* is expressed in angiogenic precursors but is excluded from the differentiated endothelium. *Rudhira*-expressing cells are seen in close proximity to endothelial cells in angiogenic blood vessels. *Rudhira* encodes a predicted cytoplasmic WD40 protein that is 98% identical to human BCAS3. The gene encoding BCAS3 maps to a breakpoint of hematological neoplasms on human chromosome 17q23, but its expression and function remain to be determined. We demonstrate that mouse *Rudhira* is a novel marker for analysis of the erythroid lineage.

Since the genes we have identified are conserved in humans and already implicated in cancer, they are good candidates to study in the context of various angiogenic tumors and in neoplasms. This would give insight into human cardiovascular and hematopoietic development, aid in understanding tumor angiogenesis and facilitate therapeutic design.

The following are the members of the Unit:

**Chair**

Dipankar Chatterji Ph D, F N A Sc, F A Sc, F N A

**Professor**

M R S Rao Ph D, F A Sc, F N A, F N A Sc, F T W A S

**Honorary Professor**

H Sharat Chandra Ph D, F A Sc, F N A

**Associate Professors**

Anuranjan Anand Ph D

Hemalatha Balaram Ph D

Namita Surolia Ph D, F A Sc

Ranga Uday Kumar Ph D

Tapas Kumar Kundu Ph D

**Faculty Fellow**

Maneesha Inamdar Ph D

**Research Associates**

Mantelingu K, Shipra Agrawal

**R & D Assistants**

Aparna Jayachandran, Ashoka D, Ashok Reddy, Balasiddiah A, Brahmanaspati G Sastry, Hari Kishore, Manisha Mishra, Manjunatha M, Manjunatha Prabhu, Naga Shankar G, Prejo Philip, Radhika A Varier, Raghavendra A S, Rajan A K, Raspudin S, Roopesh Udupa, Sankar Ganesh A, Sandeep K, Satish V, Shilpa N, Srilekha Devi, Sridhar R, Suma, B S.



## 9. Theoretical Sciences Unit

We have studied various important issues in the physics of turbulence; these are described briefly below:

- (a) We have shown that the decay of magnetohydrodynamic turbulence depends on the type of initial condition used. In particular, if initial energy spectra have a power-law dependence on the wavevector, then an energy cascade does not set in (for positive powers) and the total energy decays, in the absence of forcing, as a negative power of time.
- (b) We have systematised the study of the multiscaling of time-dependent structure functions in fluid and passive-scalar turbulence. Our work shows clearly how to uncover the dynamic multiscaling of such structure functions via derivative and integral time scales and why these different time scales lead to different dynamic multiscaling exponents.
- (c) We have carried out a detailed numerical study (with a spatial resolution that is three orders of magnitude better than any previous study) of turbulence in the one-dimensional Burger's equation forced stochastically with a force whose spectrum scales as  $1/k$ , where  $k$  is the wavevector. Our study shows that, even with such a high-resolution study, it is difficult to distinguish true multiscaling of velocity structure functions from bifractal scaling corrected by subdominant terms. This has obvious implications for multiscaling in fluid turbulence.
- (d) We have elucidated the nature of turbulent drag reduction via polymer additives by studying decaying turbulence in the presence of polymers in a shell model for drag reduction. Our study leads to an appealing definition of drag reduction in the context of decaying turbulence.
- (e) We have also studied superfluid, Mott-insulator, and mass-density-wave phases in the one-dimensional extended Bose-Hubbard Model by using a density-matrix renormalization-group method. This has been motivated by the recent suggestion that a supersolid phase of Helium might well exist.

The following are the members of the Unit:

### Chair

Rahul Pandit

Ph D, F A Sc

### Associate Professors

Shobhana Narasimhan

Ph D

Srikanth Sastry

Ph D

### Faculty Fellows

Swapan K Pati

Ph D

Umesh V Waghmare

Ph D

### Fellow

N S Vidhyadhiraja

Ph D

### Research Associate

Jayati Sarkar

### R & D Assistants

Abdul Rehaman M S, Bhaskar Jyoti Borah, Moumita Maiti,

Siram S M, Saju Joseph, Viswas V.

## Computer Laboratory

Activities in the Computer Lab involve (a) regular day-to-day maintenance and repair of computers and local network across the Centre (b) keeping the presence of the centre on the web up to date and (c) help users of the central computing facility with computing, printing and other peripheral facilities and (d) maintain backups and network security measures.

In addition, new features are introduced at this laboratory to keep up with evolving changes in computing technology. The following are the highlights during this year:

- Hardware upgradation of the email server to dual Xeon machine with 2 GB memory.
- Hardware upgradation of the proxy server to a PIV machine with 2 GB memory.
- Installation of a shared memory (10 GB) high-performance computing SGI Altix machine with 4-itanium CPUs.
- Installation of a distributed memory (20 GB) high-performance computing cluster with 20-xeon cpus.
- Expression of willingness to participate in the National Grid-Garuda for high- performance computing,
- New webpage for complab released.
- Change of IP address on intranet machines to 172.16.x.x
- LAN extended to *The College* building.
- LAN extended to Pauling buiding extension.
- Shell access disabled on mail and web server.

The following are the members of the Laboratory:

### Head

Umesh V Waghmare Ph D

### R & D Assistants

Preetham, Rajesh Kanna T R, Shithal T K

## Endowed Research Professors

### D S Kothari Chair

M M Sharma FRS, F A Sc, F N A

### Hindustan Lever Chair

A Chakravorty F A Sc, F N A  
V Krishnan F A Sc, F N A, F T W A S

### Linus Pauling Research Professor

C N R Rao F A Sc, F N A, F R S, F T W A S, Hon.F R S C

### Vikram Sarabhai Research Professor

B M Deb F A Sc, F N A, F T W A S

# ACADEMIC PROGRAMMES

## I. Academic Activities

The Centre offers regular Ph D., Integrated Ph D, M S and M S (Engg.) degree programmes in Science and Engineering. The Integrated Ph D programme in CPMU is available to those with a B Sc degree. The Centre selects candidates on an all-India basis, offers course work (in collaboration with IISc) provides research facilities, administers the programme and award the degree. After 3 years of successful completion of the Integrated Ph D programme, candidates are awarded a Master's degree (M S). The Ph D degree is awarded after a period of research and acceptance of a thesis. The regular Ph D programme in science and engineering is available to post-graduates who have successfully completed GATE/UGC-CSIR-NET,JRF; ICMR JRF/JEST/equivalent examinations. Graduates in Medicine/Engineering/Technology are admitted for the M S/M S (Engg.) programme.

### (a) Research Admissions

During the year 2004-2005, 25 students (two students for the Integrated Ph D, 18 students for the Ph D programme and five students for M S(Engg.)) were admitted to work in the following areas:

#### (i) Chemistry & Physics of Materials

*Integrated Ph D*

Mohan, P J, Kumara Ramanatha Datta K

*Ph D*

Venkata Prasad Bhat, Manohar Rao N V, Vijay Kumar T, Pavan Kumar G V, Jyoti Ranjan Sahu, Vengadesh Kumara Mangalam R, Soumya Saswati Sarangi.

*M S (Engg.)*

Gomati, A

#### (ii) Evolutionary & Organismal Biology

*Ph D*

Arachana N, Satish K M, Ambika Lalit Mohan.

#### (iii) Molecular Biology & Genetics

*Ph D*

Arif, Vinay B, Gayatri G, Javaid Bhat Yousuf, Jayesh Pandya, Shrikanth Gadad, Pankaj Sharma.

#### (iv) Theoretical Science

*Ph D*

Sairam Swaroop M

#### (v) Engineering Mechanics

*M S (Engg.)*

Manikandan M S, Pinaki Bhattacharya, Rajaram Lakkaraju, Vijay Kumar Chikkadi.

**(b) Degrees awarded**

**Ph D**

- (i) Chemistry and Physics of Materials  
Th. Birendra Singh, Manoj A G, Vaidhyanathan R, Gargi Raina
- (ii) Engineering Mechanics  
Saji Varghese
- (iii) Molecular Biology & Genetics  
Jayalakshmi, R

**M S (Engg.)**

- (i) Engineering Mechanics  
Binay Kumar Dhar, Kirti Chandra Sahu
- (ii) Theoretical Sciences  
Ashwin S Sampangiraj

**M S (Int. Ph D)**

Chemistry and Physics of Materials  
Ayan Datta, Vivek Chand S R C

## **2. Discussion Meetings / Workshops**

The following discussion meetings/workshops have been held since the last report:

*The Tenth Asian Congress of Fluid Mechanics*, May 17 – 21, 2004 at Sri Lanka, Dr T S Prahlad NAL, Bangalore).

*Summer Course on Understanding Science: Introduction to History and Philosophy of Science for College Students*, June 14 – 25, 2004, Prof R Narasimha (JNCASR).

*Workshop on Unifying Concepts in Glass Physics III*, June 28 - July 1, 2004, Prof Srikanth Sastry (JNCASR) and Dr Silvio Franz (ICTP).

*IUPAP International Conference on Statistical Physics STATPHYS 22*, July 4-9, 2004, Prof T V Ramakrishnan (IISc), Prof S Dattagupta (SNBCBS) and Prof Rahul Pandit (IISc).

*Conference on Perspectives in Nonlinear Dynamics 2004*, July 12-15, 2004, Dr Neelima Gupte (IIT Chennai) and Dr Rama Ramaswamy (JNU) at IIT Chennai.

*National Symposium on Advances in Geotechnical Engineering*, July 22-23, 2004, Prof B R Srinivasa Murthy (IISc).

*Seminar on Assessment and Management of Water Resources (AMWR-2004)*, July 26, 2004, Prof B K Raghuprasad and Prof M S Mohan Kumar (IISc).

*AIDS in India: A Workshop-Symposium on Research, Trials and Treatment*, July 31 – August 7, 2004, Dr Udaykumar Ranga (JNCASR) Dr V R Prasad (AECOM) and V Ravi (NIMHANS).

*Indo-US workshop on Nanotechnology: Issues in interdisciplinary research and education*, August 11-13, 2004, Prof K Chattopadhyay (IISc).

*6<sup>th</sup> International Conference on Solvothermal Reactions*, August 24 – 28, 2004, Dr K Byrappa, (University of Mysore).  
*Consortium of Students in Management Studies (COSMAR) 2004*, September 24-25, 2004, Prof N J Rao, (IISc)

*Lecture and Panel Discussion on Nano Science and Technology*, August 26, 2004 (JNCASR and IISc) *In-house Brainstorming Meeting on Challenges to Indian Science and Scientists*, September 1, 2004 (JNCASR)

*Seminar on Science, Development and Education*, September 27-28, 2004 (TWASROCASA at JNCASR)

*Workshop for College Teachers*, November 15-17, 2004, Prof M V George (RRL, Tiruvananthapuram).

*Asia-Pacific EPR/ESR Symposium*, November 22-25, 2004, Prof S V Bhat (IISc).

*International Workshop on Risk Assessment in Site Characterization and Geotechnical Design*, November 26-27, 2004, Dept. of Civil Engg., (IISc).

*IUTAM – Symposium on Laminar Turbulent Transition-2004*, December 13-17, 2004, Prof Rama Govindarajan (JNCASR)

*Symposium on Epigenetics*, December 22-23, 2004, Prof V Nanjundiah (IISc) and Dr Maneesha S Inamdar (JNCASR).

*Inservice Training Programme for the High School Science Teachers at Dharwar*, December 23, 2004 – January 1, 2005, Prof H L Bhat (IISc)

*Mahabaleswar Seminar on Evolution of Plasticity in Developing Brains*, January 21-26, 2005, Prof Veronica Rodrigues, (TIFR, Mumbai).

*6<sup>th</sup> meeting of OP 2005 – Optical Probes of Conjugated Polymers and Biosystems*, January 4-8, 2005, Prof K S Narayan (JNCASR) and Prof S Ramesha (IISc)

*Indo-Japan Workshop on Understanding of Chromatin Structure Function*, January 20- 23, 2005, Prof Tapas Kumar Kundu (JNCASR) and Dr Masami Horikoshi, Japan.

*Recent Trends in Solid State NMR in Biological Systems*, January 24 – 26, 2005, Prof K V Ramanathan (IISc)

*Scientific Computation, Numerical Analysis and Application; Workshop I*, January 24- February-4, 2005, Prof G Rangarajan (IISc)

*Advances in Spectroscopy*, February 21-24, 2005, Prof S Umapathy and Prof E Arunan (IISc)

*Research and Development in India: Current Frontiers*, February 10 – March 3, 2005, R K Kasturirangan, IAS.

*Workshop on Convection*, March 1-2, 2005, Dr K R Sreenivas (JNCASR)

### **3. Colloquia**

#### **JNC Colloquia**

*What really drives the monomers*, Prof J Srinivasan, Indian Institute of Science, Bangalore, September 1, 2004.

*Complexity in protein folding*, Prof Jayant Udgaonkar, National Centre for Biological Sciences, Bangalore, October 1<sup>st</sup>, 2004.

*Rheology of concentrated suspensions: Latest variations on a theme by Albert Einstein*, Prof. Andreas Acrivos, Levich Institute, City College of CUNY, New York, December 22, 2004.

#### **Fluid Dynamics Colloquia**

*Coherent structures in high Rayleigh number turbulent free-convection*, Mr Baburaj A Puthenveetil, Indian Institute of Science, Bangalore, April 21, 2004.

*Measurements in a jet, chine and a shear layer*, Dr R Panchapakesan, Indian Institute of Technology, Chennai, May 5, 2004.

*Buoyancy-driven turbulence in a vertical pipe*, Mr Murali R Cholemari, Indian Institute of Science, Bangalore, August 25, 2004.

*Prediction of tropical cyclone genesis*, Dr. T N Venkatesh, National Aerospace Laboratory, Bangalore, September 8, 2004

*Solution algorithms for viscous flow: BGK and time-spectral methods*, Prof Antony Jameson, Stanford University, USA, September 20, 2004

*Vortex-shedding phenomenon in three-dimensional fluid flows*, Dr O N Ramesh, IISc, October 20, 2004.

*Oscillatory eddy structure in a cylindrical container*, Dr Kidambi Rangachari, CTFD, National Aerospace Laboratories, Bangalore, November 10, 2004.

*The Dynamics of 2D buoyancy driven convection in a horizontal rotating cylinder*, Prof Sanjib Sanghi, IIT Delhi, Delhi, November 24, 2004.

*A residue-based error estimator for compressible flows*, Prof N Balakrishnan, IISc, Banaglore, December 1<sup>st</sup>, 2004.

*Gravity currents in geophysics*, Prof Herbert Huppert, University of Cambridge, January 12, 2005.

*Working out the kink: Drop break-up with linear dynamics*, Dr. Itai Cohen, Harvard University, January 17, 2005.

*Statistical mechanics of sheared granular flows*, Prof. V. Kumaran, IISc, Bangalore, February 9, 2005.

*Inconsistent sun*, Prof S M Chitre, Lokmanya Tilak Bhavan, University of Bombay, Vidyanagari, Santacruz (E), Mumbai, March 2, 2005.

*Performance and some recent results of the earth simulator*, Prof T Kambe, University of Tokyo, Japan, March 9, 2005

*Mathematical modeling of flow near permeable interfaces: The dilemma of equations and boundary conditions*, Prof Arzhang Khalili, Max-Planck-Institute for Marine Microbiology, Germany, March 11, 2005

*Particle motion in fluids: 'Moving beyond stokes'*, Dr Ganesh Subramanian, Cornell University, USA, March 16, 2005

*Numerical simulation of sonic boom*, Prof Francois Coulouvrat, Universite Pierre et Marie Curie, Paris, March 21, 2005.

#### **4. Frontier / Special Lectures**

*Performing Arts and Social Commitment*, Mr M S Sathyu, Film and Theatre person, Bangalore, April 22, 2004.

*Measures of Progress in Science and Technology*, Dr R Chidambaram, Homi Bhabha Professor and Distinguished Alumni Chair, IISc., September 9, 2004.

*Panoramic View of the History of Medicine*, Dr Farokh E Udvardia, Breach Candy Hospital, Mumbai, October 15, 2004.

##### **Michael Faraday Lecture**

*Plastic Electronics and Optoelectronics*, Prof Alan J Heeger, Nobel Laureate, University of California, Santa Barbara, U.S.A, February 21, 2005.

#### **5. Endowment Lectures**

##### **Prof V Ramalingaswamy Memorial Lecture in Biology**

*Newer Facets of Malarial Parasite Biology of Biochemistry*, Prof G Padmanaban, Hon. Professor, Department of Biochemistry, IISc, July 16, 2004

##### **C N R Rao Oration Award Lecture**

*Uncovering patterns in the laminar-turbulent transition*, Prof Rama Govindarajan, JNCASR, August 10, 2004.

##### **DAE-Raja Ramanna Endowed Lectures in Physics,**

*C Axis Normal State Transport in Cuprates*, Prof S K Joshi, National Physical Laboratory, New Delhi, October 26, 2004.

*Phases and Fluctuations in nonequilibrium Systems*, Prof Mustansir Barma, Tata Institute of Fundamental Research, Mumbai, October 26, 2004.

##### **ISRO-Satish Dhawan Lecture**

*On Being an Indian Writer*, Dr U R Anantha Murthy, Distinguished Writer and Scholar, Bangalore, December 14, 2004.

##### **Tenth Rajiv Gandhi Science & Technology Lecture**

*Risk and Innovation in Science - A Personal History of the Journey to the Nobel Prize*, Prof Alan J Heeger, Nobel Laureate, University of California, Santa Barbara, U.S.A., February 22, 2005.

##### **A V Rama Rao Foundation Lectures in Chemistry**

*Novel C-C Bond-forming Reactions and their Applications in Organic Synthesis*, Dr G Vijay Nair, R.R.L., Trivandrum, March 23, 2005

*Iron and Copper Complexes of Varying Nuclearity, Inorganic and Bioinorganic Perspectives*, Prof R N Mukherjee, IIT, Kanpur, March 23, 2005



## 6. Lectures delivered at the Annual Faculty Meeting by Faculty/Hon. Faculty Members

Computational studies and design of materials: A first-principles approach

Dr Umesh V Waghmare

Granular Fluid

Dr Meheboob Alam

Size dependence of self diffusivity: Stokes-Einstein relation and Levitation Effect

Prof S Yashonath

Conductances of quantum wires: the effects of interactions, scattering points and junctions

Prof Diptiman Sen Rational design of temperature sensitive mutants Prof R Varadarajan

## 7. Seminars

*Self-Assembly of two dimensional molecular nanostructure*, Prof Bai Chunli, Chinese Academy of Sciences, April 6, 2004.

*Conformational polymorphism in room temperature biphenyl and dynamical orientational disorder in stilbene molecular crystals : Looking into details through computer simulation studies*, Dr N Arul Murugan, SSCU, IISc, April 21, 2004

*Holographically recorded polymer dispersed liquid crystals*, Dr Mousumi De Sarkar, IIT Kharagpur, May 18, 2004.

*Confining, manipulating and analyzing light in nanodomains*, Prof Aaron Lewis, Hebrew University of Jerusalem, Israel, June 3, 2004

*Novel calcium binding proteins of Entamoeba histolytica*, Prof Alok Bhattacharya, Jawaharlal Nehru University, New Delhi, June 17, 2004.

*Systems problems and biology*, Dr. Reuben Rabi, MIT, USA, June 18, 2004

*Studies of Protein -DNA interaction using analytical centrifuge with brief introduction to Beckman proteomics*, Dr.Ehrhardt Lutz, June 24, 2004

*Laser Raman Seminar*, M . Stan Terras, M/s. Renishaw PLC. UK, August 9, 2004.

*Mixing between two gases under acceleration*, Prof Devesh Ranjan, University of Wisconsin, August 10, 2004

*Water-mediated interactions relevant to protein structure and stability: Understanding pressure effects on proteins*, Prof Shekhar Garde, Rensselaer Polytechnic Institute, USA, August 13, 2004.

*Structure and origin of ion exchange selectivity in tunnel type silicates* , Prof A Clearfield, Texas A&M, August 23, 2004.

*Boundary element methods*, Dr Vikram Jandhyala, University of Washington, USA, August 27, 2004.

*Extracting many body correlations in glasses using local probes*, Dr Gautam I Menon, Institute for Mathematical Sciences, Chennai, September 7, 2004.

*Isomerization and dissociation of aromatic hydrocarbon*, Prof Y.T Lee, Nobel Laureate, President, Academia Sinica, Taiwan, Rep. of China, September 28, 2004.

*Kondo resonance in quasi-ballistic 2D electron systems: Emergence of many body spin effect*, Dr A Ghosh, Cambridge University, UK, October 8, 2004

*Vanadium Oxides, gel foams and nanotubes*, Dr Jacques Livage, Pierre et Marie institute, Paris, October 15, 2004.

*Genetic and epigenetic analysis of human embryonic stem cells*, Dr Sujoy Dhara, Hebrew University, Israel, November 3, 2004

*Low dimensional models for incompressible Navier-Stokes equations for the turbulent boundary layer (Tutorial – Lecture 1)*, Prof Sanjeev Sanghi, Indian Institute of Technology, Delhi, November 23, 2004.

*Flows with natural convection, where the energy is coupled with the momentum equation (Tutorials – Lecture 2)*, Prof Sanjeev Sanghi, Indian Institute of Technology, Delhi, November 24, 2004.

*Reentrant phase and vortex dynamics under crossing field in Bi2212 crystal*, Prof Tamio Endo Mie University, Japan, November 24, 2004.

*High quality high-Tc oxide superconductor thin films for future electronic devices*, Dr Kazuhiro Endo, Mie University, Japan, November 24, 2004.

*Characterization of micelles by time resolved fluorescence quenching and electron spin resonance*, Prof Radha Ranganathan, Department of Physics and the Center for Supramolecular Studies, California State University, Northridge, December 2<sup>nd</sup>, 2004.

*Tailoring properties of magnetic oxide superlattices: Oscillation exchange and multiferroism*, Dr Wilfrid Prellier, Laboratoire CRISMAT, Caen, France, December 3, 2004.

*Phase transformation behavior of mesoporous silica*, Dr Tatsuya Okubo, Department of Chemical System Engineering, The University of Tokyo, December 6, 2004.

*Novel marangoni flows and other surface-tension driven phenomena*, Prof George Homsy, University of California, Santa Barbara, USA, December 10, 2004.

*$\beta$ -ketoacyl ACP synthases and mycolic acid biosynthesis in *Mycobacterium tuberculosis* : Novel therapeutic targets against tuberculosis ?* Dr Laurent Kremer, Universite Montpellier, France, December 15, 2004

*Recent theoretical topics of nanostructures: Scanning probe microscopy and atomic contacts*, Prof Masaru Tsukada, Waseda University Nano Technology Center, December 15, 2004

*Stability of viscosity stratified flows*, Dr Satish Malik, University of the West of England, UK, December 21, 2004

*Computer simulation on multi-teraflop machines: Challenges from Chemical Physics to Chemical Biology*, Prof Michael L Klein, University of Pennsylvania, Philadelphia, December 22, 2004

*Small angle neutron scattering on the phase separation in manganites*, Dr Charles Simon Laboratoire CRISMAT, France, January 7, 2005.

*Modularity and evolution in large scale metabolic networks*, Prof Sanjay Jain, University of Delhi, January 7, 2005.

*Hydrogen bonds in solid and liquid water: Dielectric and vibrational behaviour*, Dr Manu Sharma, Dept of Chemistry, Princeton University, January 13, 2005.

*Interaction effects in quantum dots: A quantum Monte Carlo Study*, Dr Amit Ghosal, Duke University, January 13, 2005.

*Cloning and characterization of the centromeric DNA of the human fungal pathogen, *Candida albicans**, Dr Kaustuv Sanyal, University of California, USA, January 17, 2005.

*Towards understanding water: Simulations of modified water models*, Prof Ruth M Lynden-Bell, Queens's University, UK, January 18, 2005

*Transport and Dynamics of Mobile Ions in Glasses*, Dr S Murugavel, Westfälische Wilhelms-University of Muenster, January 24, 2005

*Complex flow and automatic control: An overview of research activities*, Dr M.K. Bobba, California Institute of Technology, USA, January 28, 2005.

*Application of the real-time PCR technique for molecular diagnostics and quantitation of nucleic acids*, Dr Ranga Uday Kumar, JNCASR, Bangalore, January 31, 2005

*Instabilities in half-doped manganites induced by magnetic-field and doping*, Dr Olivier Cepas, College theorique, Institut Laue Langevin, Grenoble Cedex 9, France, February 3, 2005

*Birth and Infancy of Self-Mending Plastics*, Prof Fred Wudl, Department of Chemistry and Biochemistry, University of California, Los Angeles, February 7, 2005

*DNA adduct profiling in cancer etiology and prevention*, Prof. Ramesh Gupta, Professor and Agnes Brown Duggan Chair in Oncological Research Pharm & Tox Brown Cancer Centre, University of Louisville, Louisville, February 14, 2005.

*Acoustic communication in crickets : Solos, choruses and symphonies*, Dr Rohini Balakrishnan, IISc, Bangalore, February 17, 2005.

*Superconductivity, charge order and anomalous magnetism in Na cobaltates*, Prof H Alloul, Physique des Solides, Université Paris Sud, ORSAY (France), February 18, 2005

*Diffusion and diffusion equation: The retrospective*, Prof T N Narasimhan, University of California at Berkeley, February 28, 2005

*Theoretical and computational methods in biochemistry: Applications to the interfacial properties of dipolar liquids and the dynamical behavior of acetylcholinesterase*, Dr Sanjib Senapati, University of California, San Diego, March 2<sup>nd</sup>, 2005.

*Upliftment of Himalayas*, Dr Soumyajit Mukherjee, IIT Roorkee, March 7, 2005

*Statistical analysis of complex systems: A random matrix approach*, Dr Pragma Shukla , IIT Kharagpur, March 31, 2005

# EXTENSION ACTIVITIES

## I. Summer Research Fellowships/ Department of Science Technology Fellowships/ Rajiv Gandhi Science Talent Research Fellowships

The Centre offers these fellowships for two summer months to bright undergraduate and graduate students. For the year 2005, 161 students were offered fresh fellowships and 36 renewals. Out of this, 50 students were awarded Department of Science Technology Fellowships and 15 students Rajiv Gandhi Science Talent Research Fellowships.

Faculty members/ Scientists in nearly 42 institutions across the country listed below were identified to guide these students:

All India Institute of Medical Sciences, New Delhi  
Advanced Centre for Treatment, Research and Education in Cancer, Mumbai  
Banaras Hindu University, Varanasi  
Bose Institute, Kolkata  
Central Drug Research Institute, Lucknow  
Centre for DNA Fingerprinting & Diagnostics, Hyderabad  
Dr L V Prasad Eye Institute, Hyderabad  
Gurunanak Dev University of Amritsar, Amritsar  
Indian Association for the Cultivation of Science, Kolkata  
Indian Institute of Chemical Biology, Kolkata  
Indian Institute of Chemical Technology, Hyderabad  
Indian Institute of Science, Bangalore  
Indian Institute of Technology, Chennai  
Indian Institute of Technology, Delhi  
Indian Institute of Technology, Guwahati  
Indian Institute of Technology, Kanpur  
Indian Institute of Technology, Kharagpur  
Indian Institute of Technology, Mumbai  
Indian Space Research Organization, Bangalore  
Indian Statistical Institute, Bangalore  
Indian Statistical Institute, Kolkata  
Institute of Genomics & Integrative Biology, Delhi  
Institute of Genomics & Integrative Biology, Kolkata  
Institute of Mathematical Sciences, Chennai  
Inter-University Centre for Astronomy and Astrophysics, Pune  
Jawaharlal Nehru University, New Delhi  
Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore  
National Aerospace Laboratory, Bangalore  
National Brain Research Centre, Haryana  
National Centre for Cell Science, Pune  
National Centre for Biological Sciences, Bangalore  
National Chemical Laboratory, Pune  
National Institute of Immunology, New Delhi  
National Institute of Nutrition, Hyderabad  
Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram  
Raman Research Institute, Bangalore  
Regional Research Laboratory, Thiruvananthapuram  
Satellite Application Centre (ISRO), Ahmedabad  
Tata Institute of Fundamental Research, Mumbai  
University of Delhi, South Campus, Delhi  
University of Hyderabad, Hyderabad  
University of Pune, Pune.

## 2. Academic Exchange Programme

As part of the academic exchange programme, the following scientists/scholars carried out collaborative work with scientists of the Centre and the Indian Institute of Science for varying periods during the year under report.

### Visiting Scientists

- Dr Birgit Schwenzer  
University of California, USA.
- Dr Takeshi Nishimatsu  
Tohoku University, Japan
- Dr M Padmanabhan  
Mahatma Gandhi University Kottayam, Kerala

### Visiting Scholars

- Mr Gregory Cottureau  
Ecole Polytechnique de l'Universe de Nantes France
- Mr Leejun Kim  
Kyun Kwan University South Korea

## 3. Visiting Fellowship Programme

The Centre offers Visiting Fellowships to research scientists in educational institutions and R&D laboratories, for a duration of 2-3 months, to work with the faculty of the Centre.

The following were offered Visiting Fellowships during 2004 - 2005 to work at the institutions as indicated below:

Name and address of the visitors	Collaborating with
Dr More Pravin Dnyaneshwar V Y College of Arts and Science Lecturer Peth Vedgaon , Kolhapur	Prof C N R Rao Prof A R Raju CPMU, JNCASR
Dr S Stephen Rajkumar Inbanathan Lecturer Dept of Physics, American College Madurai	Dr Umesh V Waghmare TSU, JNCASR
Dr S Shishupala Reader Dept. of Microbiology, Kuvempu University Davangere	Prof P Balaram Molecular Biophysics Unit Indian Institute of Science Bangalore.
Dr D.Muralidhara Rao Teaching Faculty Dept of Biotechnology Srikrishnadevaraya University Anantapur.	Prof K N Ganeshaiah University of Agricultural Scs. GKVK, Bangalore.
Dr Basavaraj A Kore Lecturer Yeshwantrao Chavan Institute of Science, Satara.	Prof Raghavendra Gadagkar Centre for Ecological Scs. Indian Institute of Science Bangalore.
Dr Priyanshu M Sarma Research Associate The Energy Research Institute New Delhi	Prof Dipankar Chatterji Molecular Biophysics Unit Indian Institute of Science Bangalore.

#### 4. Project Oriented Chemical Education (POCE)

A new programme, Project Oriented Chemical Education (POCE) was initiated in 2004 to give an opportunity to young bright undergraduate students to discover their potential and to develop scientific temper. The programme meant for students studying in first year B Sc is planned in such a way that after attending three consecutive summer programmes of 6-8 weeks (each year) they will be better equipped to take up research as their career. In this programme 10 first year B Sc students selected on all India basis are offered summer scholarship of Rs.4,000/- p.m (for 6-8 weeks).

The students of the first year attended lectures, carried out experiments and participated in seminars and discussions whereas in the second year summer programme, each one of them carried out a small project work under a faculty member in addition to attending academic lectures and giving seminars. During the third year they carry out research work under faculty members.

The good response from the students is an indication that the programme is becoming more and more popular. Participants have shown keen interest to come to JNCASR during their midsemester/winter vacation to work on small projects.

#### 5. Science Education Programme

##### National Science Day

The National Science Day was celebrated on February 28, 2005, which provided an excellent opportunity to celebrate the World Year of Physics – 2005. Albert Einstein made landmark contributions in 1905 that shaped the Physics. The excitement continues even after 100 years of these contributions. A series of lectures, demonstrations and discussions relating to Einstein's contribution (Special Theory of Relativity, Photoelectric Effect and Brownian Motion) was organized at the Centre. Students and teachers from various schools in the city have participated in this programme. They also visited laboratories and interacted with faculty and students. Active participation of the faculty, students and others made this programme a grand success.

# RESEARCH PROGRAMMES

## I. Research Areas

There are ongoing research programmes in several frontier, interdisciplinary areas of science and engineering. The main areas of research interest at present are:

- Molecular modeling of materials, Monte Carlo and molecular dynamics
- Brillouin and Raman Scattering
- Nanoscience, Molecular charge density
- Optical, electronic and magnetic phenomena in organic/polymeric/nanoparticle based materials and devices
- Inorganic framework and nanoporous solids, phosphors and related ceramics
- Thin films by chemical vapour deposition, Nanomaterials, Gas sensors and Spintronics
- Solid State & Materials Chemistry
- Experimental condensed matter physics, Nanotubes and Semiconductors
- Superconductivity and magnetism in transition metal oxides
- Thin films and superlattices of functional oxides
- Molecular dynamics simulations and kinetic theory, Fluid mechanics at micro and nanoscales
- Instability and transition to turbulence, mixing and vortex dynamics
- Fluid mechanics, Aerospace engineering, Atmospheric sciences
- Unsteady aerodynamics of insect flight, entrainment in free shear flows, geo-fluid dynamics
- Evolutionary Genetics and Population Ecology
- Chronobiology and Animal Behaviour
- Ecology and Evolution
- Developmental Biology and Evolutionary Theory
- Molecular, physiological, evolutionary and social aspects of circadian rhythms
- Neotectonics and Environmental Geology
- Human Molecular Genetics
- Protein engineering, Molecular enzymology and parasitology
- Molecular and developmental analysis of blood vessel formation in mouse
- Comparative analysis of circulatory systems in human, mouse and *Drosophila*
- Functional genomics of discovery pathways in *Plasmodium* viz. fatty acid and heme biosynthesis for antimalarial drug development
- Detailed analysis of the 'Platid' organelle
- Design and optimization of DNA vaccines
- Development of immunological and molecular diagnostic tests for HIV-1, and screening for anti-HIV agents
- Chromatin remodeling during mammalian spermatogenesis, DNA repair and cancer, Cancer Genomics
- Mechanisms of transcription regulation through chromatin in humans, with special reference to diseases
- *Ab initio* Theory, Modelling and Simulation of Materials
- Slow dynamics and Glass transition in liquids
- Liquid-Liquid phase transition in supercooled silicon
- Quantum many-body studies: Molecules to extended materials
- Condensed matter theory
- Molecular design and Supramolecular chemistry
- Mechanisms of gene delivery
- Mechanism of action of Hepatotoxins
- Bioinorganic chemistry
- Dynamical cluster approximation for strongly correlated electronic systems
- *d*-Wave superconductivity in cuprates
- Spin-wave dispersions in double perovskites
- Spin, charge and orbital ordering in manganites



## 2. Research Facilities

The Centre has the procured following research facilities during the year 2004-2005.

Turbo Vacuum Pump  
ALTIX 350 Base System - Centrifuge  
LSM 510 Meta Advance Confocal Laser Scan Microscopy System  
Facscalibur Dual Laser with built in Sorter Scanner  
PDL Picosecond Dual Laser & Laser Head with collimator  
LC/MS/MS Nitrogen Gas Generator Model NM18L  
Precision Co2 Incubator  
Eppendorf Centrifuge  
HP Color Laserjet 4650 DTN Printer  
Nikkon Inverted Microscope  
Accessories for Nikkon Inverted Microscope  
Physical Properties Measuring System - 9 Base System  
Benchtop Muffle Furnace  
Packard Cobra Model 5002 Gamma Counter  
iCycler Base Module with sample block  
Nuaire Ultraflow freezer - 86 deg.C  
LEICA CM3050 CRYOSTAT  
AGILENT 6890N Network Gas Chromatograph  
SOCOMEK SICON UPS 10 KVA  
Integrated Board for K760 Xray Generator  
MILLIPORE ELIX 3LTS. WATER PURIFICATION SYSTEM  
Ultrasonic Processor Model VS750 Vibra cell  
Scan Array GX TM MicroArray Scanner  
High Resolution Mega Plus II camera  
Beckman Coulter Model Avanti Centrifuge  
Eppendorf Injectman N12  
Nuiare Ultraflow freezer -86degC  
FRCA 920 Fraction collector system  
GEL DOC XR Documentation system  
Accessories for ZEISS LSM 510 CONFOCAL SYSTEM  
Nuaire Ultraflow freezer - 86 deg.C  
9 node clusters Sun Microsystems Servers  
Cold room - Blue Star  
24 node clusters Sun Microsystems Servers  
24 node clusters Sun Systems

### 3. Sponsored Research

Sl.No.	Investigator	Title	Funding Agency	Duration
1.	C.N.R. Rao	Materials based on transition metal oxides	DAE (BRNS)	4 years
2.	C N R Rao	Collaborative projects between JNCASR & DRDO	DRDO	4 years
3.	Namita Surolia	Fatty acid biosynthesis in Malaria Parasite <i>Plasmodium falciparum</i> as target for developing novel anti-Malarials.	DBT	3 years
4.	Maneesha S Inamdar	Functional analysis of identified gene trap clones in blood vessel formation studies on embryonic stem cells and chimeric mice.	DST	3 years
5.	Hemalatha Balaram	<i>Plasmodium falciparum</i> hypoxanthine guanine phosphoribosyltransferase and dihydrofolate synthase Synthetic : Targets for antimalarial drug development.	DBT	3 years
6.	Tapas Kumar Kundu	Screening of cancers manifesting altered histone Acetyl-transferases (HATs) & (HEACs) function & research for inhibitors of these enzymes in natural products as the therapeutic agents	DABUR, DST	3 years
7.	Tapas Kumar Kundu	Role of positive cofactor 4 (PC4) in Transcriptional Regulation diseases	DST	3 years
8.	G U Kulkarni	Investigation of properties and phenomena exhibited by Nano-materials, nano-fabrication, lithography & related aspects	DST	3 years
9.	Swapan K Pati	Prediction of new organic chromophore and biochromophore optical limiters	CSIR	3 years
10.	Rama Govindarajan	Secondary instabilities of viscosity-stratified flows	DRDO	2 years
11.	K R Sreenivas	Research infrastructure for high precision measurements in fluid mechanics	DRDO	2 years
12.	Anuranjan Anand	Deafness in India: A network mission towards understanding the genes and mutations and their clinical outcomes	DBT	3 years
13.	Namita Surolia	Purification of anti-malarial compound from Indian Herbs & Elicitation of their mode of action in <i>Plasmodium Falciparum</i>	ICMR	3 years

14.	Anuranjan Anand	Molecular genetic basis of hot water epilepsy	ICMR	3 years
15.	K S Narayan	Development of semi-conducting polymer based DAE devices for spatially resolved photocurrent	DAE	3 years
16.	S Balasubramanian	Computer simulations of aqueous protein solutions: A study on the role of biological water	DBT	3 years
17.	Swapan K Pati	Electronic transport in molecular nano-systems	DST	3 years
18.	Srikanth Sastry	Swarnajayanthi Fellowship	DST	5 years
19.	Srikanth Sastry	Understanding the landscape of glass forming systems	IFCPAR	3 years
20.	K S Narayan	Polymer based photo detectors and Development of pixilated line sensors	MIT	2 years
21.	Ranga Udaykumar	Efficacy and safety evaluation of siddha Medicines HIVS-2003 for HIV/AIDS	DST and Vedic Drugs Ltd.	2 years
22.	Prof R Narasimha	Research Programme on Flow Instabilities	DRDO	3 years
23.	K S Narayan	Interfacial processes in conducting polymer-bacteriorhodopsin structures	DRDO	2 years
24.	Umesh V Waghmare	Electroactive Polymers (EAP) and Composites – The DuPont Young Faculty Programme	DuPont	One year
25.	Co-ordinated by JNCASR	Postdoctoral Fellowship in Nano Science and Technology	DST	2 years
26.	Maneesha S Inamdar	Genome-wide transcriptional profiling and Pathway analysis in embryonic stem cells and the vasculature	DBT	3 years
27.	C N R Rao	The Science Outreach Programme	DAE/BRNS	
28.	Hemalatha Balaram	NMITLI Project on Improved Genome Annotation through a combination of Machine learning and experimental methods: <i>Plasmodium falciparum</i> as a case study	CSIR	3 years
29.	Ranga Udaykumar	Functional Analysis of the NF-kB Polymorphism in the terminal repeat of HIV-1 subtype-C viruses	DBT	3 years
30.	Hemalatha Balaram	Molecular dissection of the purine salvage Pathway in <i>Plasmodium falciparum</i> : Essentially of HGPRT, IMPDH and ADSS in purine nucleotide synthesis	CSIR	3 years
31.	Ranga Udaykumar	Immunological and molecular characterization of HIV-1 Tat and long terminal repeat (LTR)	ICMR	3 years

cloned from Indian patient with and without dementia and/or opportunistic infection

32.	Ranga Udaykumar	Developing an indigenous and cost effective CD4 and CD8 count assay for HIV/AIDS	DST/MIPL	2 years
33.	Amitabh Joshi	Towards a realistic model of insect population growth in the single and metapopulation level: <i>Drosophila</i> as a model system	DST	3 years
34.	M R S Rao	Nuclear Import Machinery of Male Haploid Germ Cells: A study with Transition proteins TPI and TP2	DBT	3 years
35.	Rama Govindarajan	An analysis of the vortical density stratified flows	NPOL	2 years
36.*	K R Sreenivas	Study of turbulent shear flows in Stratified medium	NPOL	2 years
37.	C N R Rao/ G U Kulkarni	Nanomaterials Science & Technology Initiative	DST	5 years
38.	S Balasubramanian	Simulation studies of structure, Dynamics and solute-solvent interactions in super-critical carbon dioxide.	CSIR	3 years

# PUBLICATIONS

## I. Research Publications of Units

### (i) Chemistry and Physics of Materials Unit

- 1) Rao CNR, Sampathkumaran EV, Nagarajan R, Paul G, Behera JN, Choudhury A. Synthesis, structure and unusual properties of an amine-templated iron (II) sulfate possessing the Kagome lattice. *Chem. Mater.*, 16, 1441, 2004.
- 2) Behera JN, Paul G, Choudhury A, Rao CNR. An organically templated Co (II) sulfate with the Kagome lattice. *Chem. Commun.*, 456, 2004.
- 3) Udaykumar D, Rao CNR. First-amine templated layered metal selenates. *Euro J. Inorg. Chem.*, 1733, 2004.
- 4) Behera JN, Gopalakrishnan KV, Rao CNR. Synthesis, structure and magnetic properties of amine-templated open-framework nickel (II) sulfates. *Inorg. Chem.*, 43, 2636, 2004.
- 5) Nath M, Rao CNR, Biro RP, Yaron AA, Tenne R. Nanoparticles produced by the laser ablation of HfS<sub>3</sub> in liquid medium: Inorganic fullerene-like structures of Hf<sub>2</sub>S. *Chem. Mater.*, 16, 2238 2004.
- 6) Neeraj S, Rao CNR, Cheetham AK, Open-framework zinc and cobalt phosphates synthesized by the tributylphosphate route. *J Mater Chem.*, 14, 814, 2004.
- 7) Kam K, Deepak FL, Cheetham AK, Rao CNR. In<sub>2</sub>O<sub>3</sub> nanowires, nanotrees and nanoboquets. *Chem. Phys. Lett.*, 397, 329, 2004.
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- 9) Nath M, Choudhuri A, Rao CNR. Chemical routes to GeS<sub>2</sub> and GeSe<sub>2</sub> nanowires. *Chem. Commun.*, 2698, 2004.
- 10) Tenne R, Rao CNR. Inorganic nanotubes. *Phil. Trans. Royal. Soc. (London)*, 362, 2099, 2004.
- 11) Murugavel R, Walawalkar MG, Dan M, Roesky HW, Rao CNR. Transformations of molecules and secondary building units of materials: A bottom-up approach. *Accts. Chem. Res.*, 37, 763, 2004.
- 12) Ghosh M, Rao CNR. Solvothermal synthesis of CdO and CuO nanocrystals. *Chem. Phys. Lett.*, 393, 493, 2004.
- 13) Gundiah G, John NS, Thomas PJ, Kulkarni GU, Rao CNR. Dip-pen nanolithography with magnetic Fe<sub>2</sub>O<sub>3</sub> nanocrystals. *Appl. Phys. Lett.*, 84, 5341-5343, 2004.
- 14) Vivekchand SRC, Govindaraj A, Seikh MM, Rao CNR. A new method of purification of carbon nanotubes based on hydrogen treatment. *J. Phys. Chem.*, 108, 6935, 2004.
- 15) Vivekchand SRC, Gundiah G, Govindaraj A, Rao CNR. A new method for the preparation of metal nanowires by nebulized spray pyrolysis. *Adv. Mater.* 16, 1842, 2004.
- 16) Gautam UK, Rao CNR. Controlled synthesis of crystalline tellurium nanorods, nanowires, nanobelts and related structures by a self-seeding solution process. *J. Mater. Chem.*, 14, 2530, 2004.
- 17) Deepak FL, Gundiah G, Seikh MM, Govindaraj A, Rao CNR. Crystalline silica nanowires. *J. Mater. Res.*, 19, 2216, 2004.
- 18) Gautam UK, Ghosh M, Rao CNR. A template-free chemical route to ultrathin single crystalline films of CuS and CuO employing the liquid-liquid interface. *Langmuir*, 20, 10775, 2004.
- 19) Seikh MM, Sudheendra L, Rao CNR. Magnetic properties of La<sub>0.5-x</sub>Ln<sub>x</sub>Sr<sub>0.5</sub>MnO<sub>3</sub> (Ln = Pr, Nd, Gd and Y). *J. Solid State Chem.* 177, 3633, 2004.
- 20) Kundu AK, Ramesha K, Seshadri R, Rao CNR. Magnetic and electrical properties of La<sub>0.7-x</sub>Ln<sub>x</sub>CoO<sub>3</sub>: A study in phase separation. *J. Phys. Condens. Matter.*, 16, 7955, 2004.

- 21) Kundu AK, Rao CNR. Cation size-disorder as the crucial determinant of the unusual magnetic and electronic properties of  $Gd_{0.5}Ba_{0.5}CoO_3$ . *J. Phys. Condens. Matter*, 16, 415, 2004.
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- 25) Rao CNR, Seikh MM, Chandrabhas N. Spin-state transition in  $LaCoO_3$  and related materials. *Topics in Current Chem.* 234 (II), 1, 2004.
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- 29) Kundu AK, Sampathkumaran EV, Gopalakrishnan KV, Rao CNR. Inhomogeneous magnetic behaviour of  $Pr_{0.7}Ca_{0.3}CoO_3$  and  $Nd_{0.7}Ca_{0.3}CoO_3$ . *J. Mag. Magn. Mater.* 281, 261, 2004.
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- 33) Kam K, Deepak FL, Gundiah G, Rao CNR, Cheetham AK. Properties of nanostructured GaN prepared by different methods. *Solid State Sci.* 6, 1107, 2004.
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- 51) Pal S, Sanyal MK, John NS, Kulkarni GU. Formation of a rectifier with gold nanoclusters: X-ray reflectivity and atomic force microscopy measurements. *Phys. Rev. B*, 71(12), 121404(R), 2005.
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- 2) Kulkarni GU, Thomas PJ, Rao CNR. Nanocrystals: Synthesis and mesoscale organization. In: *Dekker Encyclopedia of Nanoscience and Nanotechnology*. 2004.
- 3) Raju AR, Jens S, Hermann S, Horst H. Synthesis of hollow spheres of samarium oxide powders by Nebulized Spray Pyrolysis and Pneumatic Spray Pyrolysis. In: 7<sup>th</sup> International Conference on Nanostructured Materials. June 20-24, Wiesbaden, Germany, 2004.
- 4) Raju AR, Chandrasekhar R, Prasad MVN, Nayak MM. Gas Sensing properties of Nanocrystalline zinc oxide films on MEMS based microheaters. In: 7<sup>th</sup> International Conference on Nanostructured Materials, June 20-24, Wiesbaden, Germany, 2004.
- 5) Balu R, Raju AR, Mohan S. Ion beam sputtering deposition of SmCo permanent magnetic thin films for microsystems applications. Fourth International Conference on Smart Materials, Structures and Systems, July, IISc, Bangalore, India, 2005.

#### (ii) Chemical Biology Unit

- 1) Mehta G, Pan SC. Total synthesis of the novel, biologically active epoxyquinone dimer ( $\pm$ )-Torreyanic Acid: A biomimetic approach. *Org. Lett.*, 6, 3985, 2004.
- 2) Mehta G, Islam K. Enantioselective total synthesis of epoxyquinone natural products (-)-phyllostine, (+)-epoxydon, (+)-epiepoxydon and (-)-panepophenanthrin: Access to versatile chiral building blocks through enzymatic kinetic resolution. *Tetrahedron Lett.*, 45, 7683, 2004.
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### (iii) Condensed Matter Theory Unit

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## 2. Research Publications of Honorary Faculty/Endowed Professors

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- 84) Thangadurai P, Ramasamy S, Kundu TK, Manoharan PT. EPR study and extraction of  $\alpha$ -phase EPR spectra in Mn<sup>2+</sup> doped nanocrystalline PbF<sub>2</sub>. *Eur. Phys. J. B.*, (in press)
- 85) Chen Y, Rangarajan G, Ding M. Stability of synchronized dynamics and pattern formation in coupled systems: Review of some recent results. *Communications in Nonlinear Science and Numerical Simulation*, (in press).
- 86) Chakrabarti S, Kaur K, Komatireddy S, Acharya M, Devi KR, Mukhopadhyay A, Mandal AK, Hasnain SE, Chandrasekhar G, Thomas R, Ray K. Gln48His is the prevalent myocilin mutation in primary open angle and primary congenital glaucoma phenotypes in India. *Molecular Vision*, (in press).
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- 88) Pahari D, Ghosh P, Chattopadhyay S, Mukherjee D. Towards the development and applications of manifestly spin-free multi-reference coupled electron-pair approximation (MRCEPA) like methods: A state specific approach. *Theor. Chem. Acc* (Malrieu Special Issue), (in press).
- 89) Chakraborty K, Shivakumar P, Raghobama S, Varadarajan R. NMR structural analysis of a peptide mimic of the bridging sheet of HIV-1 gp120 in methanol and water. *Biochemical J*, (in press).

#### Articles/Chapters in Books and Papers Presented at Conferences

- 1) Agrahari M, Gadagkar R. Division of labour and its regulation in a primitively eusocial wasp. In: *Proceedings of the National Symposium on Frontier Areas of Entomological Research*, Nov. 5-7 2003. Subrahmanyam B, Ramamurthy VV, Singh VS (Eds.). Indian Agricultural Research Institute, New Delhi, 2004.
- 2) Gadagkar R. Life, Mind and consciousness. *Papers read at a Seminar held at the Ramakrishna Mission Institute of Culture, Kolkata*, India, January 2004, The Ramakrishna Mission Institute of Culture, Kolkata, 2004.
- 3) Chattopadhyay S, Pahari D, Mahapatra US, Mukherjee D. Computation of excited state potential energy surfaces via linear response theories based on state specific multi-reference coupled electron-pair approximation like methods. In: *Computational Chemistry: Reviews of Current Trends*, Vol. 9, Leszczynski J. (Ed.). World Scientific, Singapore, London, Hong Kong, New Jersey, 2005.
- 4) Pahari D, Chattopadhyay S, Das S, Mahapatra US, Mukherjee D. Size-consistent state-specific multi-reference methods: A survey of some recent developments. In: *Theory and Applications of Computational Chemistry: The First 40 Years*, Dykstra CE, Kim KS, Frenking G and Scuseria GE (Eds.), Elsevier, (in press).
- 5) Borkar VS, Jain S, Rangarajan G. Evolutionary mechanisms of organization in complex systems. In: *Modern Applied Mathematics*, Misra JC (Ed.). Narosa, New Delhi, (in press).

### 3. Books/Proceedings Authored/Edited by Faculty and Hon. Faculty Members

- 1) Rao CNR, Mueller A, Cheetham AK (Eds.). *Recent Advances in the Chemistry of Nanomaterials*. Wiley-VCH, 2004.
- 2) Valdiya KS, *Understanding Earthquakes and Landslides: Preparing for Hazards*. Department of Science and Technology, Government of India, New Delhi, 2004.
- 3) Chandrashekar MK. *Time in the Living World*. Universities Press, 2005.
- 4) Dattagupta S, Krishnamurthy HR, Pandit R, Ramakrishnan TV, Sen D (Eds.). *Proceedings of the 22nd IUPAP International Conference on Statistical Physics*. Indian Academy of Sciences, Bangalore, 2005. Nath BB. *Dawn of the Universe*. University Press, 2005.

# AWARDS/DISTINCTIONS

The following faculty and honorary faculty members of the Centre have received various distinctions and awards both at the national and international level in recognition of their significant contributions to the progress of science and technology.

## Awards & Honours

### Prof C N R Rao

India Science Prize, Government of India, 2004

Da: David Prize for Science in the Future Dimension, Israel, 2005

Chevalier de la Legion d'Honneur (Knight of the Legion of Honor) French Republic, 2005

Chemical Pioneer, The American Institute of Chemists, USA, 2005

D Sc (Honoris Causa), Bengal Engineering & Science University, 2005

D Sc (Honoris Causa), Visvesvaraya Technological University, 2005

Medal of Honor, Chemical Research Society of India, 2005

Barrett Lecture, Illinois University, 2005

Watt Lecture, University of Texas, 2005

Burstein Lecture, University of Pennsylvania, 2005

### Prof M K Chandrashekar

Har Swarup Memorial Lectureship, Indian National Science Academy, 2005

### Prof Chandan Das Gupta

Prof Rustum Choksi Award, Indian Institute of Science, 2004

### Prof Rama Govindarajan

Prof C N R Rao Oration Award, JNCASR, 2004

### Prof Tapas Kumar Kundu

National Biosciences Award for Career Development for 2004-05, DBT, Govt. of India

### Dr Umesh V Waghmare

Material Research Society of India Medal, 2005

### Prof Raghavendra Gadagkar

Vasvik Award, Vividhluxi Audyogik Samshodhan Vikas Kendra, Mumbai, 2002

Prof Rustum Choksi Award, Indian Institute of Science, 2004

### Prof Debashis Mukherjee

Sadhan Basu Memorial Lecture Award, Indian National Science Academy, 2005

### Prof S Dattagupta

Distinguished Lectureship, Materials Research Society of India, 2005-06

### Dr K N Ganesh

Silver Medal, Chemical Research Society of India, Bangalore, 2004

### Prof N K Ganguly

Life Time Achievement Award, The Indian Society of Parasitology, 2004

Norman Alpert Award, International Academy of Cardiovascular Sciences, 2004

Dr Subhas Mukherjee Memorial Oration Award, Dr Subhas Mukherjee Memorial Reproductive Biology Research Centre, 2004

Annual Award, International Spirit of Life Foundation, USA, 2004

Ramniklal Jivanlal Kinariwala Oration Award, Gujarat Cancer Society and Gujarat Cancer & Research Institute, 2005

6<sup>th</sup> Dr S K Malik Memorial Oration Award, Postgraduate Institute of Medical Education & Research, Chandigarh, 2005

Prof V Ramalingaswami Memorial Lecture, National Institute of Immunology, New Delhi, 2005

### Prof M V George

Professor K Venkataraman Memorial Lecture, NCL, Pune

**Prof R A Mashelkar**

Honorary Doctorate, Guru Nanak Dev University, Amritsar, 2005  
Honorary Doctorate, Maharishi Dayanand University, Rohtak, 2005  
Honorary Doctorate, Govind Ballabh Pant University of Agriculture & Technology, Pantnagar, 2004  
Honorary Doctorate, Narendra Deva University of Agriculture & Technology, Faizabad, 2004  
Honorary Doctorate, University of Kalyani, Kalyani (WB), 2004  
Star of Asia Award of Business Week, USA, 2005  
LakshmiPat Singhania -IIML National Leadership Award, Indian Institute of Management, Lucknow, 2004  
Life Time Achievement Award, Indian Science Congress Association, 2004

**Dr Satyajit Mayor**

Shanti Swaroop Bhatnagar Award, 2003  
Swarnajayanti Fellowship, Department of Science and Technology, 2003-2008

**Prof P T Manoharan**

Mahatma Gandhi University Decennium Award Lecture and Medal

**Prof Raghavan Varadarajan**

Darshan Ranganthan Memorial Lecture, CRSI.

**Prof M M Sharma**

Maiden Dhirubhai Ambani Memorial Oration, Indian Institute of Chemical Engineers  
Honorary Doctorate, University of Calcutta

**Dr Seyed E Hasnain**

Dr Nitya Anand Endowment Lecture for Biomedical Research, INSA, 2005  
Shri Om Prakash Bhasin Award for Science & Technology, Shri Om Prakash Bhasin  
Foundation for Science & Technology, 2004  
Goyal Award for Life Sciences, Kurukshetra University, 2004

**Prof A Surolia**

Dr B R Ambedkar Centenary Award for Excellence in Biomedical Research, 2003  
K K G Menon Memorial Lecture, Department of Chemical Technology/Hindustan Lever  
Research Centre, Mumbai, 2004

**FELLOWSHIPS****Prof C N R Rao**

Honorary Fellow, Indian Association for the Cultivation of Science, Kolkata

**Prof Rama Govindarajan**

Fellow, National Academy of Sciences India, Allahabad

**Prof Tapas Kumar Kundu**

Fellow, International Union Against Cancer

**Dr Satyajit Mayor**

Fellow, Indian National Science Academy  
Fellow, Indian Academy of Sciences

**Dr R A Mashelkar**

Fellow, Indian Association for the Cultivation of Science, Kolkata

**Prof P T Manoharan**

Fellow, Third World Academy of Sciences  
Fellow, World Innovation Foundation

**Prof M M Sharma**

Fellow, Biotech Research Society of India (BRSI)

**Prof Sriram Ramaswamy**

Fellow, Indian National Science Academy

**Dr C S Sundar**

Fellow, Indian Academy of Sciences  
Fellow, National Academy of Sciences

**Prof E D Jemmis**

Fellow, Third World Academy of Sciences

## EDITORIAL BOARDS

### **Prof C N R Rao**

Bulletin of Chem. Soc. of Japan  
J Cluster Science  
SMAL

### **Prof M K Chandrashekar**

Chief Editor, Resonance

### **Prof Amitabh Joshi**

Editor, Journal of Genetics  
Member, Resonance

### **Dr Vijay Kumar Sharma**

Member, Journal of Circadian Rhythms  
Member, Journal of Genetics

### **Dr Satyajit Mayor**

Member, Traffic.

## MEMBERSHIPS/APPOINTMENTS

### **Prof C N R Rao**

Chairman, Science Advisory Council to the Prime Minister, Govt. of India

### **Prof M K Chandrashekar**

Elected Member, Systems Biology Committee, Third World Academy of Sciences, Trieste, Italy

### **Prof Amitabh Joshi**

Member, Expert Consultative Committee for Evolving Areas for Research and Training in Behavioural/Social Sciences using Mathematical Methods, DST, Govt. of India  
Member, Sectional Committee for Animal/Plant Sciences, Indian Academy of Sciences, Bangalore  
External Member, Faculty of Science, Delhi University

### **Prof Raghavendra Gadagkar**

Member, Core Committee for SCOPE General Assembly Event, INSA, New Delhi  
Vice-Chancellor's Nominee, Faculty of Science, University of Delhi  
INSA Representative, Organizing Committee of SCOPE General Assembly, INSA, New Delhi  
Non-official Member, National Biodiversity Authority, Government of India  
Member, Advisory Committee, International Conference on Microbial Diversity  
Member, Animal Sciences and Biotechnology Research Committee, CSIR, New Delhi  
Member, Selection Committee, Dr (Mrs) Gouri Ganguly Memorial Award for Young Scientist in Animal Behaviour  
Member, Selection Committee, E K Janaki Ammal National Award, 2005-2007.  
Chairman, Two-member Committee, Sir Ratan Tata Trust, to evaluate Centre for the Study of Culture and Society work, Bangalore

### **Prof Debashis Mukherjee**

Member, International Organizing Committee, Asian-Pacific Conference on Theoretical and Computational Chemistry, Okazaki, Japan  
Honorary Professor, Department of Chemistry, Beijing University

**Dr K N Ganesh**

Visiting Professor, ETH Chemical Sciences, Zurich, 2005  
Honorary Chairman, Royal Society of Chemistry, West India Section  
Member, DST Expert Committee on Nanoscience and Technology Initiative (NSTI)  
Member, DBT Programme Advisory Committee on Resource Networking

**Prof N K Ganguly**

President, International Lancefield Society for Streptococcal Diseases  
President, International Heart Research Society (Indian Chapter)  
President, Academy of Cardiovascular Sciences (Indian Chapter)  
President, Asian Society of Diarrhoeal Disease and Nutrition

**Dr R A Mashelkar**

Foreign Associate, US National Academy of Sciences, USA  
President, Indian National Science Academy

**Prof M Vijayan**

Elected President, Asian Crystallographic Association  
Vice President, Indian National Science Academy

**Prof M M Sharma**

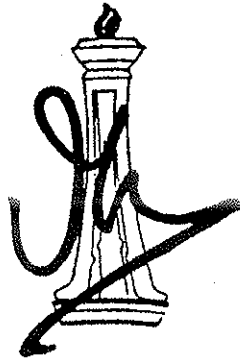
Member, Scientific Advisory Council to the Prime Minister of India

**Dr Seyed E Hasnain**

Member, Scientific Advisory Council to the Prime Minister of India  
Member, Science and Engineering Research Committee (SERC) of the DST

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# FINANCIAL STATEMENTS



**Name** : JAWAHARLAL NEHRU CENTRE FOR  
ADVANCED SCIENTIFIC RESEARCH

**Address** : JAKKUR POST, BANGALORE – 560 064

**Year Ended** : 31<sup>ST</sup> MARCH 2005

**Assessment Year** : 2005-06

## **Auditor's Report to the Members of the Governing Body of Jawaharlal Nehru Centre for Advanced Scientific Research**

We have audited the attached Balance Sheet of Jawaharlal Nehru Centre For Advanced Scientific Research as at March 31, 2005 and also the Income & Expenditure Account for the year ended on that date annexed thereto. These financial statements are the responsibility of the Management of Jawaharlal Nehru Centre For Advanced Scientific Research. Our responsibility is to express an opinion on these financial statements based on our audit.

We conducted our audit in accordance with auditing standards generally accepted in India. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by Management as well as evaluating the overall financial statements presentation. We believe that our audit provides reasonable basis for our opinion.

We report that :

1. We have obtained all the information and explanations, which to the best of our knowledge and belief were necessary for the purpose of our audit.
2. In our opinion proper books of accounts as required by law have been kept by Jawaharlal Nehru Centre for Advanced Scientific Research so far as it appears from our examination of those books.
3. The Balance Sheet and Income and Expenditure Account dealt with by this report are in agreement with the books of account.
4. The Balance Sheet and Income and Expenditure Account dealt with by this report are prepared in accordance with the Accounting Standards issued by the Institute of Chartered Accountants of India subject to :
  - (i) It is the policy of the entity to prepare its financial statements on accrual basis except in respect of interest income from investments made and income from Royalties which are recognized when received rather than when earned. Non-recognition of interest income and Royalty income on accrual basis is not in conformity with the Accounting Standards 9 (Revenue Recognition) issued by the Institute of Chartered Accountants of India. [Refer Note No. 4 and 8 of Schedule No. 24]
  - (ii) Non-Provisions of accrued liability in respect of gratuity and leave encashment which is not in conformity with the Accounting Standard 15 [Accounting for retirement benefits in the financial statements of Employers] issued by the Institute of chartered Accountants of India. [Refer Note No. 3 of Schedule No. 24]
5. In our opinion and to the best of our information and according to the explanations given to us and subject to notes on accounts and our qualifications in para 4 above, the said accounts give a true and fair view in conformity with the accounting principles generally accepted in India:
  - (a) in the case of Balance Sheet, of the state of affairs of the Jawaharlal Nehru Centre for Advanced Scientific Research as at March 31, 2005; and
  - (b) in the case of Income and Expenditure Account, of the excess of expenditure over income for the year ended on that date.

For **P. V. PRABHU & CO.,**  
Chartered Accountants

Sd/-  
**(NAGARAJA)**  
Partner

Membership No. 205345

Place : Bangalore  
Date : 21.09.2005

# JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH

## BALANCE SHEET AS AT 31<sup>ST</sup> MARCH 2005

Description	Schedule	Current year 2004-05	Previous year 2003-04
<b>LIABILITIES</b>			
Capital Fund	1	554787912.56	471042555.66
Earmarked and Endowment Funds	3	54417634.16	46970702.41
Current Liabilities and Provisions	7	29296323.35	5234673.45
Other Funds-Cluster Studies		39541.00	39541.00
Scheme Balances		41575000.92	42221206.80
<b>Total</b>		<b>680116411.99</b>	<b>565508679.32</b>
<b>ASSETS</b>			
Fixed Assets (at gross)	8	554787912.56	471042555.66
Investments-Endowment Funds	9	52150000.00	46602000.00
Investment - Others	10	54970000.00	6970000.00
Current Assets, Loans, Advances, etc.	11	13850544.05	36548712.03
Deficit as per Income & Exp. Account (Rs.4345411.63 + 12543.75)		4357955.38	4345411.63
<b>Total</b>		<b>680116411.99</b>	<b>565508679.32</b>
Significant accounting policies (Enclosed)	24		
<b>This is the Balance sheet referred to in our report of even date.</b>			

## INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31<sup>ST</sup> MARCH 2005

Description	Schedule	Current year 2004-05	Previous year 2003-04
<b>INCOME</b>			
Grants/Subsidies received	13	161433529.00	89310690.00
Less: Extent of fixed assets procured		83745356.90	28428064.00
		<b>77688172.10</b>	<b>60882626.00</b>
Income from Fees/Subscriptions, etc	16	3089168.50	1788298.70
Income earned - Interest	17	518860.00	711447.00
Other miscellaneous income	18	197535.00	143621.00
<b>Total</b>		<b>81493735.60</b>	<b>63525995.70</b>
<b>EXPENDITURE</b>			
Establishment expenses	20	34069202.00	28121430.00
Other administrative expenses	21	47437077.35	35288832.15
<b>Total</b>		<b>81506279.35</b>	<b>63410262.15</b>
Excess of income / (expenditure) carried forward		<b>(12543.75)</b>	<b>115733.55</b>
Significant accounting policies (Enclosed)	24		

**This is the Income & Expenditure Account referred to in our report of even date.**

for **P. V. Prabhu & Co.,**  
Chartered Accountants  
Sd/-  
**(Nagaraja)**  
Partner  
Membership no.205345

Sd/-  
**R.S.Gururaj**  
Accounts Officer

Sd/-  
**Prof.M.R.S.Rao**  
President

Place: Bangalore  
Date: 21.09.2005



## Schedule No. 24

### Accounting Policies and Notes on the Accounts for the Year 2004-05

1. The fixed assets are stated at cost. The Centre has identified depreciation on fixed assets, and since they are created out of Grant in Aid funds, has classified the same in the statement of affairs under Capital Fund and also under Fixed Assets schedule respectively.
2. Grants received and utilised for procurement of fixed assets has been reduced from the total grants received in the Income and Expenditure Account and the same has been included under the Capital Fund Account.
3. The Gratuity & leave encashment to the staff members is accounted as and when it is paid.
4. Investments of the Centre are stated at cost. The interest on investment is accounted as and when they are received from the concerned banks and financial institutions.
5. The foreign currency transactions are translated at the rates prevailing on the date of transaction.
6. Previous years figures have been regrouped and reclassified to read in conformity with the current year's figures.
7. The Centre has put in to operation a system whereby the accounting standards with respect to the above are brought in conformity with the mandatory accounting standards recommended by the Institute of Chartered Accountants of India.
8. Royalty income has been accounted as and when received.

For **P. V. Prabhu & Co.,**  
Chartered Accountants

Sd/-  
**R.S.Gururaj.**  
Accounts Officer.

Sd/-  
**( Nagaraja )**  
Partner  
Membership no.205345

Sd/-  
**Prof.M.R.S.Rao**  
President

Place : Bangalore  
Date : 21.09.2005

# JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH

## Schedule forming part of the accounts

Description	31.03.2005	31.03.2004
<b>Schedule 1: Capital Fund</b>		
Balance as at the beginning of the year	<b>424294516.66</b>	<b>395866452.66</b>
Carbon Nano Materials	34182430.00	34182430.00
Physics and Chemistry of Materials	9878095.00	9878095.00
Cluster Studies	2687514.00	2687514.00
	471042555.66	442614491.66
<b>Less:</b> Depreciation up to the end of previous year	116526261.59	102127871.00
	354516294.07	340486620.66
<b>Add:</b> Addition to Fixed Assets during 2004-05	83745356.90	28428064.00
	438261650.97	368914684.66
<b>Less:</b> Depreciation for the current year	20507496.41	14398390.59
	417754154.56	354516294.07
<b>Add:</b> Depreciation Reserve per contra	137033758.00	116526261.59
<b>TOTAL</b>	<b>554787912.56</b>	<b>471042555.66</b>
<b>Schedule 3: Earmarked / Endowment Funds</b>		
Opening Balance of the Funds	46970702.41	44167368.41
<b>Add: Additions :</b>		
Funds/Donations/Grants/Royalties	4984372.00	1580313.00
Funds-Income from Investments made	5193315.75	2984749.00
Funds - Other funds		91000.00
To be transferred to the Centre's account	429185.00	
	57577575.16	48823430.41
<b>Less:</b> Funds-utilisation/Expenditure incurred	3159941.00	1852728.00
<b>TOTAL</b>	<b>54417634.16</b>	<b>46970702.41</b>
<b>Schedule 7: Current Liabilities and Provisions</b>		
Sundry Creditors EMD	292203.00	524221.00
Sundry Creditors CMD	107185.00	91185.00
Sundry Creditors for equipments / others	27566102.26	4619267.45
Due to Scheme Account	1330833.09	
<b>TOTAL</b>	<b>29296323.35</b>	<b>5234673.45</b>

Sd/-  
**R.S.Gururaj**  
Accounts Officer

# JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH

## Schedule forming part of the accounts

Description	31.03.2005	31.03.2004
<b>Schedule 8: Fixed Assets</b>		
Land - Free Hold	17715351.00	17384101.00
Buildings	79658165.26	79658165.26
Plant/Machinery/Equipment	183853372.47	131875361.57
Vehicles	1083551.00	1083551.00
Furniture and fixtures	16943424.87	12256100.87
Office equipment	5222690.63	4819665.63
Computer/peripherals	13856320.00	9950033.00
Electrical installations	3118336.00	1773992.00
Library Books	7608858.21	6936743.21
Library Journals	40613344.80	34383709.80
Tubewells and water supply	200034.00	176359.00
Infrastructure facility	32328997.32	31827870.32
Hostel Building	15570835.00	15570835.00
New Lab Building - AMRL	25377072.00	25377072.00
Animal House	5425605.00	5425605.00
Staff Housing	4118031.00	4118031.00
ETU Building	2048814.00	2048814.00
The College, Biology block, Extn.AMRL etc.	26003654.00	12335090.00
Equipments Carbon & Nano Materials	34182430.00	34182430.00
Equipments Physics and Chemistry of Materials	9878095.00	9878095.00
Equipments Cluster Studies	2687514.00	2687514.00
Equipments Advance Technology Lab	20202562.00	20202562.00
Equipment Magnet	7090855.00	7090855.00
<b>TOTAL</b>	<b>554787912.56</b>	<b>471042555.66</b>
<b>Less -</b> Depreciation up to the end of previous year	116526261.59	102127871.00
Depreciation for the current year	20507496.41	14398390.59
Written down value of the assets as on 31.03.2005	417754154.56	354516294.07
<b>Add -</b> depreciation reserve per contra	137033758.00	116526261.59
<b>TOTAL</b>	<b>554787912.56</b>	<b>471042555.66</b>

Sd/-  
**R.S. Gururaj**  
Accounts Officer

# JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH

## Schedule forming part of the accounts

Description	31.03.2005	31.03.2004
<b>Schedule 9: Investments - Earmarked/Endwment Funds</b>		
<b>Long Term Deposits</b>		
ICICI	800000.00	800000.00
IDBI	3100000.00	6200000.00
HDFC	12050000.00	12050000.00
CRB CAPITAL		12000.00
CANARA BANK		18540000.00
GOVERNMENT OF INDIA 8% SAVINGS BONDS 2003 ( SHCIL )	36200000.00	9000000.00
<b>TOTAL</b>	<b>52150000.00</b>	<b>46602000.00</b>
<b>Schedule 10: Investments - Others</b>		
<b>Short Term Deposits</b>		
Fixed deposits with banks - Canara Bank	22000000.00	
Fixed deposits with banks - Canara Bank ( Schemes )	32970000.00	6970000.00
<b>TOTAL</b>	<b>54970000.00</b>	<b>6970000.00</b>
<b>Schedule 11: Current Assets, Loans, Advances etc.,</b>		
Other advances	1295275.00	646142.00
Cash in hand at Centre	67519.00	115926.00
Cash in hand with Schemes	49819.00	79972.00
Cash at bank :		
Centre - Canara Bank	3637864.13	5832078.13
Schemes - Canara Bank	2531467.79	28379288.79
Schemes - State Bank of India	6023714.13	1261112.11
Advances to staff	112885.00	205961.00
Contingent Advances	132000.00	28232.00
<b>TOTAL</b>	<b>13850544.05</b>	<b>36548712.03</b>

Sd/-  
**R.S.Gururaj**  
Accounts Officer

# JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH

## Schedule forming part of the accounts

Description	31.03.2005	31.03.2004
<b>Schedule 13: Grants/subsidies</b>		
Grants - DST	155000000.00	85000000.00
Grants - Discussion meetings/Seminars	5862642.00	4263690.00
Grants - Travel grants	570887.00	47000.00
<b>TOTAL</b>	<b>161433529.00</b>	<b>89310690.00</b>
<b>Schedule 16: Income from other sources</b>		
Income from fee, subscriptions etc.,	3089168.50	1788298.70
<b>TOTAL</b>	<b>3089168.50</b>	<b>1788298.70</b>
<b>Schedule 17: Interest earned</b>		
From Term deposits	153064.00	686878.00
From SB accounts with nationalised banks	365796.00	24569.00
<b>TOTAL</b>	<b>518860.00</b>	<b>711447.00</b>
<b>Schedule 18: Other income</b>		
Other miscellaneous income	197535.00	143624.00
<b>TOTAL</b>	<b>197535.00</b>	<b>143624.00</b>

Sd/-  
**R.S. Gururaj**  
Accounts Officer

# JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH

## Schedule forming part of the accounts

Description	31.03.2005	31.03.2004
<b>Schedule 20: Establishment expenses</b>		
Salaries & Scholarship to students	26174422.00	20939261.00
Wages	5485106.00	5294394.00
Allowances ( Medical reimbursements etc.,)	809519.00	886692.00
Bonus	155421.00	153776.00
Contribution to CPF	1178673.00	746191.00
Other expenditure like honorarium etc.	205879.00	101116.00
LTC	60182.00	
<b>TOTAL</b>	<b>34069202.00</b>	<b>28121430.00</b>
<b>Schedule 21: Other Administrative expenses</b>		
* Electricity & Power	10474948.00	7752693.00
Water charges	1598218.00	2038867.00
Insurance	253592.00	245955.00
Repairs & maintenance	2917344.00	2743726.00
Rents, rates & taxes	267266.00	197885.00
Vehicles running & maintenance	2081191.00	1914024.00
Postage, telephone & communication	3741763.50	3124861.50
Printing & stationery	1857574.00	1552284.00
Travelling and conveyance	1950003.00	1104873.00
Expenses on Seminars/workshops/discussion meetings	6445052.75	3270959.50
Subscriptions	42891.00	99691.00
Fees	106700.00	117029.00
Professional charges	1213899.00	741412.00
Canteen subsidy	7452.00	96274.00
Laboratory consumables	10389133.00	6550663.15
Advertisement & Publicity	2122303.00	1617099.00
Other miscellaneous expenses	836873.10	1355573.00
Audit Fees	22040.00	21750.00
Student Research Fellowship Programme	1108834.00	743213.00
<b>TOTAL</b>	<b>47437077.35</b>	<b>35288832.15</b>

Sd/-  
**R.S.Gururaj**  
Accounts Officer

**JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH  
CPF AND GRATUITY FUND STATEMENT AS ON 31.03.2005**

Particulars	Rs.	Rs.	Particulars	Rs.	Rs.
<b>SUBSCRIPTION</b>					
Opening Balance	8429630.00		Investments in: Government of India 8 % Bonds (SHCIL)	10500000.00	
Add :Subscriptions during the year	2281108.00		ICICI	100000.00	
Add :Interest on subscriptions	733296.00		IDBI Flexi bonds	500000.00	11100000.00
Total	11444034.00		Cash at Bank: SB A/C No.17513		
Less withdrawals	-799615.00	10643670.00	Canara Bank. IISc branch		7232202.84
Less Bank Charges	-749.00		TDS receivable		41234.00
<b>CONTRIBUTION</b>			Deficit on interest payment 2003-04		806203.16
Opening balance	5510876.00				
Add : Contribution during the year	1178673.00	7121893.00			
Add : Interest on total contributions	432344.00				
<b>Gratuity fund</b>					
Balance brought forward		1414077.00			
<b>Total</b>		<b>19179640.00</b>	<b>Total</b>		<b>19179640.00</b>

for P.V.Prabhu & Co.,  
Chartered Accountants

Sd/-  
**(Nagaraja)**  
Partner

Membership no.205345

Sd/-  
**R.S.Gururaj**  
Accounts Officer

Sd/-  
**Prof.M.R.S.Rao**  
President

Place: Bangalore  
Date: 21.03.2005







