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Annual Report

2008 – 2009

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C O N T E N T S

P R E A M B L E

The Annual report of the Raman Research Institute for the year 2008-09 is a summary of the research and academic activities of the Institute during the year.

The Annual report presents synopses of the ongoing knowledge creation activities in the different research groups, many of which have outcomes in the form of publications in refereed scientific journals. The Institute considers the transmission of knowledge an important activity; this includes the guidance of students for the confernment of PhD degrees as part of the PhD programme of the Institute, as well as the active Visiting Students Programme under which a number of students from all over the country visit the Institute for stays ranging from a few weeks to several months and participate in the many research activities of the Institute. Communications of the ongoing research and also a sharing of knowledge of current research – in professional talks given by members of the Institute in conferences and in external institutions as well as Journal Review talks at the Institute – is another aspect of our knowledge diffusion. A cultural function of a premier research institute is the upholding and promotion of academic traditions and this activity includes the conduct of specialized seminars on technical topics targetted at specialized audiences as well as colloquia in a wider range of topics that are delivered in a style that strives to make current advances assessible to a wider community. Additionally, outreach activities include writings intended for a lay and discerning audience as well as the delivery of motivational talks at educational institutions.

Included in this report are lists of publications in refereed journals, conference proceedings as well as in monographs, books and in popular periodicals, PhD degrees awarded during the period 01 April 2008 to 31 March 2009, as well as seminars and review meetings focussed on current research, which were held at the Institute. The report also lists the scientists who have visited the Institute from within India and from overseas during the period.

Bangalore
September 22, 2009

Ravi Subrahmanyan
Director

RAMAN RESEARCH INSTITUTE

Bangalore

Annual Report 2008 - 2009

INTRODUCTION

The Raman Research Institute was founded by Prof. C.V. Raman in the late forties. After his death in 1970, it was reorganised as a national institute for research in basic science. The Institute has been receiving grants from the Department of Science and Technology of the Government of India since 1972. The main fields of research have been, and continue to be, Astronomy & Astrophysics, Light & Matter Physics, Soft Condensed Matter and Theoretical Physics. The Liquid Crystals research has expanded and diversified and is today the Soft Condensed Matter research theme that includes inter-disciplinary soft condensed matter and biological physics, which has a significant overlap and interaction with the Theoretical Physics activity. In addition, Laboratories in the theme of Light and Matter Physics are making experimental studies in the emerging fields of laser cooling and trapping of atoms and molecules, light propagation in diverse media, and ultra-fast atomic processes using femtosecond (10^{-15} s) laser pulses.

1. Astronomy & Astrophysics and related signal processing, imaging, and instrumentation development

Astronomy measures phenomena in outer space, i.e., planets, stars, galaxies, clusters of galaxies and the intervening gas and dust in interstellar and intergalactic space; astrophysics develops physical models that deepen our understanding of the universe. An important aspect of modern astronomy and astrophysics is the study of the evolution of the universe and its constituents: the formation of stars and galaxies out of the primordial gas. These studies are accomplished by examining the radiation received on Earth from or through them, developing theoretical models for the observed phenomena, and simulating the physical processes in powerful computers.

The diverse objects in the Universe emit radiation across the electromagnetic spectrum: from low frequency radio waves to extremely energetic gamma ray photons. Studies of phenomena in space, or objects in the Universe, require a holistic approach if a deep understanding is to be attained. Telescopes have been built to cover all bands of the electromagnetic spectrum and in those wavelength

bands in which our atmosphere is opaque, telescopes have been launched into space in our quest for a deeper understanding of our universe and its origins.

The Raman Institute has participated in several telescope projects. It has built a Decametre wave Radio Telescope at Gauribidanur – about 80 km from Bangalore – jointly with the Indian Institute of Astrophysics. Members of the Institute use the Ooty Radio Telescope (ORT), which is operated by the Tata Institute of Fundamental Research (TIFR), Mumbai, and have also contributed by modernising its capabilities with state-of-the-art reconfigurable digital receivers that enhance its capabilities and versatility with a view to continuing to use it for contemporary research. The Radio Astronomy Lab of the Institute has in the past built receivers in the 20-cm wavelength band for the Giant Metre wave Radio Telescope (GMRT), operated by TIFR, and also built specialized pulsar receivers for GMRT. Today, members of the Institute are giving new capabilities to the GMRT: very low frequency receivers in the 30-90 MHz band were designed, built, installed on four GMRT antennas and validated in astronomical observations. Another project that was executed previously is the low-frequency (150 MHz) Mauritius Radio Telescope (MRT) built at Mauritius in collaboration with the University of Mauritius and the Indian Institute of Astrophysics; outcomes of this research in the form of images of large regions of the southern sky at 150 MHz are being placed on the world-wide-web as a resource for the astronomy community. The Raman Institute has also built a millimetre wave telescope of diameter 10.4 metres on campus and is currently engaged in refurbishing and modernising the telescope and installing receivers in the 40-50 GHz band for a dedicated spectral-line survey of star-forming regions.

The Raman Research Institute is now a full partner in an international collaboration – the Murchison Wide-field Array – to build a large low radio frequency telescope array in a remote Western Australian radio-quiet location, which is a pathfinder to the International Square Kilometer Array project. The participation includes contributing to engineering in the form of digital systems and software – which challenge and stretch our in-house capabilities in appropriate directions – and involvement in specific science goals by sharing in the development of innovative observing techniques, analysis methods, detection algorithms and parameter extraction tools. Developments during 2008-2009 include design, fabrication and testing of digital receivers and data processing electronics, which form part of the telescope. RRI members worked as part of international teams in campaign mode installing, testing and commissioning telescope systems at the remote site in Western Australia. There are now 32 antenna tiles on the ground at the site, with which prototype digital receivers built at RRI were successfully tested in observations of astronomical objects.

The year saw the fructification of a novel project developing a wide-band antenna and a multi-band receiver for simultaneous observations of celestial phenomena over a range of radio wavelengths when mounted at the focus of a large dish antenna. The project was specifically designed to be mounted at the focus of the US Green Bank telescope, which is the largest steerable dish antenna in the world. RRI members, including our PhD students, have been granted competitive telescope time to use the instrumentation for specific investigations before it would be made available to the international community as a new facility. The system has been tested on a GMRT antenna and subsequently at the Gauribidanur field station north of Bangalore.

The developmental effort towards realizing an X-ray polarimeter has taken off: the X-ray astronomy laboratory is now actively building and testing critical components and evaluating novel design configurations for the polarimeter, and designing and testing electronics and logic circuits that are essential for the detectors. A laboratory model polarimeter using a rectangular configuration has now been built and successfully tested at RRI; a cylindrical configuration polarimeter is under development; proposals have been submitted to ISRO for mission approval.

The Institute further continued its development of low-cost 12-15 metre class parabolic dish antennas. Noteworthy developmental effort during the year was the evolution in the preferred design to a *Bent-Spoke Dish*.

Members of the Astronomy & Astrophysics group are currently engaged in research into the understanding of events in the evolving universe and a variety of phenomena associated with cosmic bodies. Research on reionization and structure formation examined and pointed out the potential of observations of cosmological redshifted 21-cm line radiation both as probes of cosmological parameters and primordial magnetic fields. Studies of active galaxies examined the origins for their radio structures, and the consequences of the cessation of activity. Extragalactic research included galaxy interactions, stellar dynamics in nuclear regions of galaxies, the formation of cluster halos and galactic outflows. This report includes work done at RRI on foundational problems in the astrophysics of accretion disks and dynamo theory. Aspects of X-ray binary systems formed the centre of attention of research on compact stellar objects: the X-ray flux variations in a number of Galactic X-ray binaries have been used to expand our knowledge of these enigmatic astrophysical objects.

The telescopes and receivers developed and built in the Radio Astronomy Laboratory provide vital observational clues for this research; however, it may be noted that the windows covered by the Institute's facilities cover only a part of the electromagnetic spectrum. Additionally, a holistic investigation of space phenomena often requires observing capabilities not available in India; therefore, the astronomers of the Institute propose and successfully win the use of valuable observing time on facilities throughout the world.

2. Light and Matter Physics

Quantum optics, requiring advanced technologies related to the laser cooling and trapping of atoms in magneto-optic traps, is a very fast advancing field of research and development in the world today, particularly because of its potential applications in industry. The LAMP group has adopted a basic science research approach, as opposed to a competitive technology development approach, in keeping with the overall philosophy of the Institute.

Research work at the Institute continues to include classical optics, which was one of the key areas of research in the days of the Founder. Recent work – reported herein – includes original contributions to eigenvalue toggling of optical activity, and insightful use of the van de Hulst theorem for reflection of polarized light. Experimental work includes investigations of light transmission in mixtures of magnetite nano- and micro-sized spheres, and light emission from carbon Nanotubes.

The last several years of committed effort has brought the experimental capability to the stage where confidence has been established in the setting up of laser systems, vacuum chambers, and laser cooling and trapping of atoms in magneto-optic traps. Cold clouds of Rubidium are now routinely made in the vacuum traps. Magneto-optic traps with miniature coils have also been successfully constructed and operationalized, enabling multiple traps within the same chamber for controlled quantum interactions. Preliminary experiments on Electro-magnetically induced transparency within hyperfine transitions of cold atoms have been successful.

Research in non-linear optics included degenerate four-wave mixing to characterize samples and identify candidates for photonic device applications, z-scan experiments using white light supercontinuum source, and the recording and analysis of X-ray emission from laser-induced plasma in a planar water jet.

On the strength of the experience gained in experimental quantum optics in the laboratories at the Institute, and as a result of novel experimental ideas born in the interactions at the Institute and with visitors, the members of the group have proposed and attempted difficult experiments in overseas laboratories that have considerably more expertise. Experiments in this category include laboratory measurement of the deflection of light owing to gravity and an experiment to observe quantum walks by ultra-cold atoms in a double optical lattice.

3. Soft Condensed Matter

The Raman Research Institute has made outstanding contributions to the development of the field of liquid crystals for over three and a half decades. Liquid crystals are a thermodynamic stable phase of matter that has anisotropy of properties without the 3-dimensional order of crystal lattices. Nematic liquid crystal molecules are rod-like and tend to point in the same direction but without positional order; smectic liquid crystal molecules align themselves in layers that can flow past each other; in discotic liquid crystals disc-like molecules are stacked in parallel columns. There are many more complex forms of molecular ordering known with interesting and subtle properties; research in this field at the Raman Institute is unique in that it enjoys the interactions between chemists, electrochemists, condensed matter physicists, theoretical physicists and members with statistical physics expertise.

Liquid crystalline substances have interesting optical properties, and external perturbations can cause significant changes in their macroscopic properties; the theoretical and experimental research at the Raman Institute is towards understanding these unique effects and synthesizing new liquid crystalline materials. Novel mesogens with bent-core molecules continue to be synthesised in the liquid crystal laboratory, and uncommon and sometimes completely new phase transitions have been observed. The phase behaviour of functionalized carbon nanotubes, when dispersed in discotic monomers and polymers, were studied. Synthesis of rod-disc oligomers, ionic liquid crystalline polymers, electron-deficient discotic liquid crystals, discotic liquid crystalline symmetric donor-acceptor-donor triads and experimental studies of their mesophase behavior represent further examples of current research. Other experimental research in liquid crystaline materials included studies of non-equilibrium fluctuation theorems.

We are witness to a proliferation of liquid crystal display devices at home and beyond and industrial research has invested enormous resources into research in this field. Nevertheless, a niche area of research at the Raman Institute, which is a

significant contribution to this highly competitive field, is in the development of techniques for driving the matrix displays: using sophisticated signal processing algorithms and methods to reduce power consumption in the display drivers. International patents have been filed to protect intellectual property rights, in this area.

Research of the soft condensed matter group, which was earlier focussed on liquid crystals, has now expanded into examining physical effects, including electrical conductivity, arising from the dispersion of nanoparticles and enzymes into the bulk of liquid crystalline phases, and properties of films and monolayers formed by mesogens and complexes containing mesogens. The soft matter group has research interest in instability pattern formation in liquid crystals as well as in interfaces between Newtonian and aging non-Newtonian fluids. Experimental studies included microviscosity measurements in aging clay suspensions, and examination of the structure, dynamics and mechanical properties of copolymer solutions in which ionic surfactants have been added. The phase behaviour of amphiphilic systems at interfaces and in the form of membranes has been studied.

Consistent with the vision of the group to include a flavour or 'nano' in the soft matter research, several works reported herein involve physical effects, including magnetic susceptibility and optical limiting properties, of nanocomposites synthesized in the Institute and nanoparticle and nanosphere dispersions in liquid crystals. Development of innovative methods for preparation of thiol stabilized gold nanoparticles, mesoporous gold films and polyelectrolytes.

Experimental biological physics is an area into which the soft matter research at the Institute has taken a step. Initial experimental efforts in this research area, which are reported herein, are groundwork towards dynamical studies of cell shape and mechanical studies of Axons.

Soft matter research has in some cases used specialized investigative techniques, for example, oscillatory rheology studies and magnetic susceptibility studies, for appropriate problems. All of the investigations into the fascinating behaviours, quantitative measurements of the properties and the response to various control parameters, and the experimental elucidation of the molecular ordering in different circumstances, require sophisticated and modern equipment. The group has, in its laboratories, instruments like an atomic force microscope, scanning tunnelling microscope, polarization and confocal microscopes, and apparatus for X-ray diffraction. Upgrades to existing equipment and measuring devices, as well as the acquisition of new facilities that open new windows to the studies, are an ongoing

activity so as to maintain the relevance and to enable new dimensions and directions in the research.

4. Theoretical Physics

Theoretical physics research in the Institute is in the areas of condensed matter physics, statistical physics, physics in biology and gravitation, which includes classical and quantum gravity and gravitational radiation. Nevertheless, as might be expected in a small institute where interactions within a research community with diverse pursuits and experimental activity triggers lateral thinking, the research outcomes include analyses of fundamental questions in optics, quantum mechanics and general physics.

Recent theoretical work considered a variety of issues, including questions ranging from the dynamics of a charged particle moving on the surface of a sphere in the presence of an external uniform magnetic field, understanding quantum measure theory, to geometric and topological contributions associated with the phase in neutrino oscillation formulae, which may be akin to the Pancharatnam topological phase. In non-equilibrium statistical mechanics, research continues in the formalisms associated with heat current in open systems, the probability distribution of heat flow and the heat conduction in disordered harmonic crystals, and electron transport in mesoscopic systems. Again in this theme, studies of the evolution of flexible polymer chain as it tumbles end to end in a shear flow was a topic of recent research.

Biological physics research is attracting increasing interest among theoretical physicists as well as scientists from soft condensed matter areas of the Institute. Here again is an example of the value of having a relatively small institute with a wide range of professional research interests and scientists who are open minded and willing to move into new areas and apply their experience to related fields. Recent work continues on satistical mechanical study of stiff polymers motivated by buckling phenomena in cellular cytoskeletons.

In general relativity, research has been on precise calculations of the gravitational wave-forms expected from in-spiralling binaries. This problem is of contemporary significance because of the coming on-line of gravitational wave detectors, which need an accurate ‘template’ with which the data may be cross correlated in order to detect cosmic signals. During the year, research has moved into examining signal detection with future space based gravity-wave detectors, pointing out that LISA observation of SMBH coalescence events could potentially constrain the dark

energy equation of state. Additionally, derivations of analytic solutions of orbits in Kerr spacetime and numerical computations of the gravitational waves induced by particles on eccentric inclined orbits around Kerr black holes are reported herein.

Quantum gravity research at the Institute has continued in the Causal Set approach and Loop quantum gravity. Further development of the analogy pointed out by members of this Institute between the cosmological constant of the Universe and the surface tension of fluid membranes constitute recent research that shows the generality of the analogy beyond the Causal Set approach.

Technical summaries of the work carried in the past year at the Raman Research Institute are given in the pages that follow.

ASTRONOMY & ASTROPHYSICS

Areas of Research: Cosmology & Structure Formation
Extragalactic Astronomy
Neutron Stars, Pulsars & Transients
The Galaxy & the Interstellar Medium
Surveys
Topological Phase
Instrumentation & Signal Processing

Cosmology and Structure Formation

Primordial magnetic fields and the epoch of reionization: Red-shifted 21-cm HI line radiation is potentially observable from the epoch of reionization. The imprint of the presence of primordial magnetic fields on this cosmological signal has been investigated. In particular, the impact of ionization inhomogeneities on the 21-cm signal was analysed. The analysis revealed that the scale of the HI signal owing to primordial magnetic-field induced structure formation is smaller than the usual case and the scale of ionization inhomogeneities is about half a Mpc, almost independent of the strength of the magnetic field. The study also showed that the HI signal for a magnetic field strength of $B \cong 3 \times 10^{-9}$ G is detectable by interferometers like the MWA and LOFAR. The HI signal for the entire range of magnetic field values of interest will be potentially detectable by an SKA for integration times of less than a week. [Shiv Sethi, Kandaswamy Subramanian (IUCAA, Pune)]

Fluctuations in cosmological 21-cm HI radiation as a probe of cosmological parameters: It has been shown that the red-shifted 21-cm HI radiation from low and intermediate redshifts may be used as a discriminant between cosmological models. Its effectiveness is due to its sensitivity to the derivative of coordinate distance, which contains local information and, as a result, could be a superior method compared to CMBR, SN1a, etc. Thus, this work provides a new motivation for observations of cosmological 21-cm radiation, complementing current methods that probe the expansion history and elucidate the nature of the dark energy. [Shiv Sethi, S. Bharadwaj (IIT, KGP) and Tarun D. Saini (IISc)]

Extragalactic Astronomy

Tidal Interactions in Radio Galaxies: Giant Metrewave Radio Telescope (GMRT) observations of the interacting system Arp86 in atomic hydrogen and in

radio continuum at 240, 606 and 1394 MHz were carried out using the GMRT. These observations show a complex distribution of HI tails and bridges due to tidal interactions. The regions of highest column density appear related to be recent sites of intense star formation. HI column densities ~10^{21}/cm^2 has been detected in the tidal bridge which is bright in Spitzer images as well. We also detect HI emission from a tidal dwarf galaxy in this system. The radio continuum observations show evidence of a nonthermal bridge between NGC 7752 and NGC 7753, the two dominant galaxies of the system, and reveal a radio source in the nuclear region of NGC 7753 that is consistent with it having a LINER nucleus. [Chandreyee Sengupta (NCRA), K.S. Dwarakanath and D.J. Saikia (NCRA)]

Adiabatic Compression in a galaxy cluster: A low frequency study of the diffuse radio emission in the galaxy cluster A754 was carried out using observations at 150, 330 and 1363 MHz. Four diffuse features, of which one is new, were detected at 150 MHz using the GMRT. Integrated spectra of all the diffuse features were estimated. Model spectra obtained in the framework of the adiabatic compression model were used to fit the observed data. It is shown that the spectrum of one of the diffuse features is consistent with that of a cocoon of a radio galaxy lurking for about 9x10^7 yr; no shock compression is required. The other three diffuse emission features have steeper radio spectra and could be cocoons lurking for a longer time. Other possibilities such as shocks and turbulent reacceleration being responsible for the diffuse emission in A754 are discussed. [Ruta Kale and K.S. Dwarakanath]

Steep Spectrum Extended Sources: A new sample of steep spectrum sources which consist of extended extragalactic radio sources without obvious active galactic nuclei (AGN) in them was formed. Most of these sources appear to be dead double radio sources. These sources were identified using the 74 MHz (VLSS) and the 1400 MHz (NVSS) surveys and further imaged using the Very Large Array (VLA) and the Giant Meterwave Radio Telescope (GMRT). The radio morphologies of these sources are rather unusual in that no obvious cores and jets are detected in these sources, but a pair of extended lobes is detected in most. At their mean redshift of ~0.2, the linear extents of the sources in the current sample are 250 kpc with their spectral luminosities at 1.4 GHz in the range 2-25 x 10^{23} W/Hz. The steep spectra in these sources are a result of the cessation of AGN activity about 15 to 100 million years ago. Before the cessation of AGN activity, the radio luminosities of these galaxies were 1000 times brighter than their current luminosities and would have been comparable to those of the brightest active radio galaxies detected in the local universe. The dead radio galaxies reported here represent the tip of the iceberg and quantifying the abundance of such a population has important implications for the life cycle of AGNs. [K.S. Dwarakanath and Ruta Kale]

Galactic out flows: Standard models of thermal-pressure driven galactic outflows fail to explain some key observations of outflows in both low and high redshift sources. An alternative scenario has been worked out in which radiation pressure from massive stars in a stellar population drive a shell of gas and dust. Subsequent supernova explosions from the most massive stars in this population then drive stellar ejecta outward in a rarefied medium, making it collide with the radiation pressure driven shell. This results in the shell fragmenting under Rayleigh-Taylor instability. It has been shown that the dynamics of these shells may explain correlations observed in Lyman break galaxies between wind speed, reddening and star formation rate. [Biman Nath and Joseph Silk (Oxford University)]

Production of molecular hydrogen at high redshift: A continuation in earlier work calculating the details of molecular hydrogen production in small objects at high redshift, in the presence of primordial magnetic fields, has resulted in progress. Earlier work at RRI had shown that magnetic field dissipation can increase the molecular hydrogen abundance by more than an order of magnitude, which could potentially change the history of star formation in the universe dramatically. More detailed models are being worked out for gas collapse in these galaxies, taking into account realistic gas density profiles and its evolution with time. [Biman Nath, Shiv Sethi and Kanhaiya Lal Pandey]

GRB detection with ASTROSAT: The GRB luminosity function has been determined using the existing BATSE and afterglow data of GRBs. Improved constraints on the luminosity function have been derived in this work owing to the availability of afterglow data for more GRBs in recent years. The luminosity function is used to determine the redshift distribution of GRBs that might be detectable by the CZT instrument on board ASTROSAT. [Shiv Sethi and S. G. Bhargavi]

Large-scale structure in gas probed by giant radio galaxies: An investigation has been made of the relationships between the radio properties of a giant radio galaxy MRCB0319-454 and the surrounding galaxy distribution with the aim of examining the influence of intergalactic gas and gravity associated with the large-scale structure on the evolution in the radio morphology. A comparison is made of radio continuum observations of the radio source with the 3D galaxy distribution derived from galaxy redshift surveys. Galaxy density gradients are observed along and perpendicular to the radio axis: the large-scale structure is consistent with a model wherein the galaxies trace the ambient intergalactic gas and the evolution of the radio structures are ram-pressure limited by this associated gas. The case study presented is a demonstration that giant radio galaxies may be useful probes of the warm-hot intergalactic medium believed to be associated with moderately

over dense galaxy distributions. [V. Safouris (ANU); R. Subrahmanyan; G.V. Bicknell (ANU); L. Saripalli]

Genesis of Morphologies in extended radio sources: Relationships between the morphology in double radio sources and the radio-optical position angle offset—the relative orientation of the radio axis with respect to the major axis of the host galaxy – have been examined. The finding is that radio morphological features have dependence on the radio-optical position angle offset and on whether the source is a major- or minor-axis source. The evidence indicates an anisotropic gas environment, related to the ellipticity of the host galaxy, that causes the source linear size evolution, strength of backflow in the radio lobes, off-axis lobe distortions and the formation of wings, and X-shaped radio sources to depend on the radio-optical position angle offset. A class of X-shaped radio sources, which are either edge-darkened or lacking hotspots, are identified that appear to have inner doubles suggesting a restarting of activity. A common formation mechanism requiring backflows is proposed for these apparently FR-I X-shaped radio sources as well as the edge-brightened X-shaped sources. [Lakshmi Saripalli & Ravi Subrahmanyan]

NEUTRON STARS, PULSARS & TRANSIENTS

Discovery of an eclipsing Supergiant Fast X-ray transient with a short orbital period: An eclipsing Supergiant Fast X-ray Transient (SFXT) IGR J16479-4514 with a short orbital period of 3.32 day has been discovered using the long-term light curve obtained with Swift Burst Alert Telescope (BAT). The importance of this discovery is that IGR J16479-4514 has the shortest orbital period among the three SFXTs with measured/known orbital period. The SFXTs were believed to be long period X-ray binaries, intermediate between X-ray binaries with supergiant companions and Be-star companions. This discovery poses a new challenge in interpretation of the behaviour of the SFXTs. [C. Jain (Univ. of Delhi), B. Paul and A. Dutta (Univ. of Delhi)].

Evolution of orbital and spin periods of accretion discs: New measurement of orbital and spin period evolution of the accretion disk corona source 4U 1822-37 has been made using archival data from multiple X-ray observatories. Using a longer database the evolution time scales have been determined with greater accuracy, and this has been used to estimate the magnetic field strength of the neutron star. [C. Jain (Univ. of Delhi), B. Paul and A. Dutta (Univ. of Delhi)]

Timing and Spectral investigations of X-ray pulsars: Extensive X-ray timing and spectral investigation of the nature of two low luminosity slow X-ray pulsars

have been made using new observations using the Chandra and XMM observatories. Accurate position determination with the Chandra telescope allowed identification of the optical/near-IR counterparts. The nature of the companion stars was further investigated using infrared observations with the NTT. [Ramanpreet Kaur et al.]

Orbital eccentricity and the angle of periastron of giant stars: Using archival RXTE data of two bright persistent sources Cen X-3 and SMC X-1, the very small orbital eccentricity and the angle of periastron of these two binary systems have been measured. Measuring the rate of apsidal motion allows one to estimate the apsidal motion constant of the mass-losing companion star and hence make a direct test of the stellar structure models for these giant stars present in the HMXBs. It has been found that the small variations in the pulse profiles of these sources, rather than the intrinsic timing accuracy provided by RXTE, limit the accuracy with which the arrival times of pulses from these sources may be measured. This influences the accuracy with which measure the orbital parameters may be estimated, especially the very small eccentricity and the angle of periastron in these sources. [H. Raichur and B. Paul]

Aspidal motion of X-ray binaries: The rate of apsidal motion of 4U 0115+63 using data from PCA instrument of the RXTE satellite has been measured. This is the first such definite measurement in any X-ray binary. The complete set of orbital parameters of two other Be/X-ray binaries, namely 2S 1417-624 and V0332+53, was also obtained. Be/X-ray binary pulsars have wide eccentric orbits and hence the angle of periastron of the orbit is very well defined in these sources. The presence of an X-ray pulsar allows for accurate measurements of orbital elements. The tidal interaction between neutron star and its companion star plus the rapid rotation of the Be-star alter the mass distribution in the Be-star from the normal spherical symmetry and a measurable rate of apsidal motion is expected in these systems. [H. Raichur and B. Paul]

The Galaxy &the Interstellar Medium

Dynamo action due to turbulence in shear flows: Large-scale dynamo action due to turbulence in the presence of a linear shear flow was studied. The treatment was quasilinear but non-perturbative in the shear strength. The integro-differential equation for the evolution of the mean magnetic field was derived by systematic use of the shearing coordinate transformation and the Galilean invariance of the linear shear flow. For non-helical turbulence, the time evolution of the cross-shear components of the mean field does not depend on any other components excepting

themselves. Hence the shear-current assisted dynamo is absent in the quasilinear regime. [S. Sridhar, Kandaswamy Subramanian (IUCAA)]

Stellar dynamics in Galactic Nuclei: Counter-rotating populations of stars around super-massive black holes in galactic nuclei are prone to a dynamical instability that makes the stellar orbits eccentric. The instability is due to angular momentum transfer, facilitated by the long-range gravitational interactions between the stars. In this work, the first analytical treatment of this problem was carried out for the case of two coplanar stellar populations. The goal is to ultimately develop stellar-dynamical models for the nuclei of The Milky Way and M31. [S. Sridhar, Jihad Touma (American University of Beirut, Lebanon)]

Slow pressure modes in thin accretion discs: Thin accretion discs around massive compact objects can support slow linear pressure modes which are lopsided (m=1 azimuthal symmetry). It is demonstrated, through WKB analysis and numerical solution of the eigenvalue problem, that these modes are stable and have spatial scales comparable to the size of the disc. The eigenvalue equation was mapped into a Schrodinger-like equation, whose analysis shows that all eigenmodes have discrete spectra. The large spatial scale of the modes implies that (i) they do not suffer much damping, and (ii) can have interesting observational consequences. [S. Sridhar, Tarun Deep Saini (IISc) & Mamta Gulati]

The state of hot molecular cores: The Mopra antenna was used to detect emission lines of N2H+(1→0), HCN(1→0) and HNC(1→0) towards several star-forming clumps. Combining these measurements with other molecular data, properties such as virial and local thermodynamic equilibrium masses, rotational temperatures and chemical abundances have been derived in these star-forming clumps. These values have been compared between subsamples associated with different indicators of evolution. The greatest differences are found between clumps associated with 8.6 GHz radio emission and isolated masers (without associated radio emission), and between clumps exhibiting CH3CN emission and those without. Clumps associated with 8.6 GHz radio emission tend to be more massive and more luminous than clumps without radio emission. The gas mass to sub-mm/IR luminosity relation for the combined sample was found to be $L \propto M^{0.68}$, considerably shallower than that expected for massive main-sequence stars. This implies that the mass of the clumps is comparable to, or greater than, the mass of the stellar content. The mass of the hot core is also found to be correlated with the mass of the clump in which it is embedded. [B. Ramesh, C.R. Purcell (Univ. of Manchester, UK), S.N. Longmore, M.G. Burton, A.J. Walsh, V. Minier and M.R. Cunningham (UNSW, Australia)]

Search for Electron-Cyclotron Maser Emission: Several candidates for electron-cyclotron maser emission from cool dwarfs, selected from a sample of steep spectrum sources that were identified using the 74 MHz VLSS and 1.4 GHz NVSS surveys, were observed with GMRT at 235 MHz. The radio source VLSS 0406.1+0251 has been located to be within 0.5" near the M3 dwarf LSPM 0406+0251. We are continuing to investigate this and other objects to confirm the physical associations examining variability and other features. [B. Ramesh, Shuji Deguchi (NAOJ, Japan) and Kazutaka Koike (NAOJ, Japan)]

Surveys

A Low-brightness survey with the Australia Telescope: A radio survey – the Australia Telescope Low Brightness Survey (ATLBS) – of 8.4 square degrees sky area has been made using the Australia Telescope Compact Array in the 20-cm band, in an observing mode designed to provide wide-field images with exceptional sensitivity in surface brightness, and thereby explore a new parameter space in radio source populations. A fifth of ATLBS sources, and about a tenth of the sub-mJy population, are either doubles or triples or have more complex structure or have more than half their flux density in extended emission. The observations are consistent with FRI radio sources dominant in the extended source population at sub-mJy flux density, and a transition to hot-spot type FRII structures in the mJy population. [R. Subrahmanyan, R.D. Ekers (ATNF, Australia), L. Saripalli, E.M. Sadler (Sydney Uni.)]

An All Sky Survey at 150 MHz using the Mauritius Radio Telescope: A homography-based correction technique was applied to correct for systematics in positional errors of sources in the MRT images. The errors were, consequently, reduced to well within 10% of the beamwidth for sources with SNR above 15-σ. The corrected MRT images are available for download at http://www.rri.res.in/surveys/MRT. Positional error analysis clearly shows that MRT images are stretched in declination (about 1 part in 1000). This implies a compression of the baseline scale, in the visibility domain, pointing towards possible errors array geometry. The array geometry has been re-estimated using the principles of astrometry and the new images generated do not show measurable systematic positional errors. [N. Udaya Shankar, Arvind Nayak and Soobash Daiboo (UOM)]

Topological Phase

van de Hulst theorem re-visited: It was shown that some symmetry theorems stated by van de Hulst in the context of scattering of polarized light impose

constraints on the matrices for reflection of polarized light from surfaces of birefringent and dichroic media. These can serve as useful tools to check the consistency of derived expressions for such matrices in terms of the parameters of the medium. This has been illustrated using examples. [R. Bhandari]

A Flip-Flop for optical activity: It was shown that an SU(2) polarization element, sandwiched between two orthogonal halfwave plates at 45 degrees, is equivalent to another SU(2) element with the same eigenvectors but with the signs of the eigenvalues changed, thus acting as an eigenvalue toggle. With electrically switchable halfwave plates, it provides a simple way to switch the sign of optical activity of a medium or to rotate a waveplate through 90 deg remotely without any moving parts. [R. Bhandari]

Cancellation of Pancharatnam phases in a Michelson Interferometer: A recently proposed method to describe reverse propagation of light was used to derive the complex visibility function of a Michelson interferometer with optically anisotropic mirrors and beam splitters and with polarization transforming elements placed in each arm. To verify the prediction made in a recent paper, an experiment to demonstrate cancellation of Pancharatnam phases in a Michelson interferometer with a Faraday rotator in each arm was designed and is being implementated in collaboration with the LAMP group at RRI. [R. Bhandari]

INSTRUMENTATION & SIGNAL PROCESSING

Modernisation of ORT: A new initiative has been taken to modernize the Ooty Radio Telescope (ORT) by introducing 264 digitizers along the feed array interfaced to provide a programmable digital receiver with a view carry out a large scale sky survey. A feasibility study has been conducted with the help of a small scale industry in Bangalore. When completed, this will provide a new lease of life to the ORT and give it a unique capability for studying signatures of HI mass fluctuations at redshifts close to 3.3 through large scale surveys. Additionally, there would be an order of magnitude enhancement of its capacity for space weather watch. [C.R. Subrahmanya, P.K. Manoharan (RAC, Ooty)]

ORT Back-end Receiver: The Digital Back-end Receiver was upgraded to provide easy connectivity to computing hardware through Gigabit Ethernet ports using a higher capability FPGA platform. Software tools were developed and tested for estimating the delay and phase parameters and to form the Phased Array response of ORT modules from the voltage data received using the Digital Back-end Receiver. RFI detection and characterization schemes were developed [Prabu T.; Subrahmanya C.R.; Peeyush Prasad; Venkatesan S. (RAC, Ooty)].

PWM controller for the 3-m Submillimeterwave Telescope Prototype (3-m STeP): A new lowcost, network-ready, power efficient PWM controller and drive system for the 3-m telescope has been developed. While the commercial PWM drive systems use rectified DC input and an H-bridge, the present circuit developed accepts an AC input and drives a DC motor in both directions using PWM technique. Presently, a bi-directional half-bridge equivalent of this new circuit has been implemented and tested. Implementing and testing the full-bridge equivalent using inexpensive power transistors is in progress. [Soumya Mariam Sam, Sharath B. Raju, Sudarshan and B. Ramesh]

A 50 MHz system for GMRT: Four antennas of GMRT have been equipped by RRI with 50 MHz receivers. Initial tests revealed that the observing performance is limited by broad-band RFI and system performance limitations. To validate the receivers and explore the cause of performance limitations, a system capable of digitizing the 50 MHz RF directly at the antenna base, recording the RF signal with a bandwidth of 5.5 MHz and computing cross-correlations off-line was designed, developed, tested and integrated with the GMRT receiver system. While this showed improved performance over the GMRT hardware and software correlators (by factors of 3 and 1.5), it is still a factor ~4 worse than the thermal noise limit. Redesigns and development to attain thermal noise limited performance is in progress. [N. Udaya Shankar, B.S. Girish, R. Somashekar, Arvind Nayak, Wences Laus & K.S. Dwarakanath]

Development of Parabolic Dishes: A design study for a 15-m diameter parabolic dish was carried out. This study compared the benefits of 15-m diameter antennas with and without preloading. It has been demonstrated conclusively that there is no specific advantage in preloading a dish with regard to obtaining a lesser weight-per-unit-area of the dish. On the other hand, higher stresses into members of the dish due to preloading compel usage of higher strength materials for the spokes. The study also highlighted safety risks involved in assembling a preloaded dish on site. The preliminary design study has recommended a detailed analysis of a *Bent Spoke Dish* using aluminum with a wheel and track mount. [N. Udayashankar, R. Duraichelvan, C.M. Ateequlla and A. Krishnan]

Following photogrammetry measurements of the surface distortions of a 12-m preformed parabolic dish constructed by RRI at Gauribidanur, the panels have been realigned using modified supporting elements. The dish structure now has been biased to be nearly ideal at an elevation angle of sixty degrees. System tests have been carried out using both L-band and C-band feeds. While the system tests indicate improved system performance, a second session of photogrammetry is

planned to assess the effect of biasing. [K.B. Raghavendra Rao, H.A. Aswathappa, C.M. Ateequlla, Durai Chelvan, P.V. Rishin and N. Udaya Shankar]

The Murchison Widefield Array (MWA): MWA is an aperture synthesis telescope and being built in Western Australia as collaboration between US and Australian partners and the Raman Research Institute. A digital receiver for this array has been developed at the Institute. It is designed to operate between 80 and 300 MHz, and will be capable of high dynamic range imaging.

The digital receiver was designed for MWA in collaboration with Scientists and Engineers at ANU and was built at RRI. The digital receiver digitizes the RF signals using a set of dual 8-bit ADCs operating at 655.36 MHz. The first Nyquist zone is subdivided to 256 channels using a polyphase filter bank; the bandwidth of each filter is 1.28 MHz. Data from a selected set of 24 filter bank outputs, which corresponds to a total bandwidth of 30.72 MHz, is sent to the correlator through three optical fiber links. The hardware work at RRI involved the design and development of Virtex 5 FPGA based data aggregation and formating board (AGFO board), backplane, duplication of ADC boards (ADFB) provided by CSIRO and building a clock and synchronization signal distribution system. Firmware was designed and developed for interfacing the ADC to FPGA, implementing the features needed for observing with the digital receiver, transporting data from receiver to correlator through optical fiber and recording data using a VSIB based data acquisition system (DAS).

After the development and testing of a receiver at RAL, four prototype receivers were made. These receivers were successfully used for test observations at MWA site (Boolardy, WA) by recording data with the VSIB based DAS and software correlation. Currently the digital receiver and the hardware correlator are being interfaced through optical fiber link. A set of firmware was also developed for testing and validating the receivers during their mass production. [Anish Roshi D.; Srivani K.S.; Deepak Kumar; Gopalakrishna M.R.; Kamini P.A.; Madhavi S.; Prabu T.; Deshpande A.A.; Udaya Shankar N.]

Calibration of low-frequency radio interferometers with large field of view: Interferometer arrays such as the MWA require calibration using multiple sources and at short time intervals. A simulation using thirty sources and varying number of antennas has been carried out. The simulation demonstrated that the fractional errors gradually increase as bright sources are subtracted and fainter sources are used to estimate antenna gains. The consequences of using a larger number of array elements were revealed by the simulations. [Shiv Sethi]

10.4-m Telescope Q-band operations: From first light detection of Sun and subsequent azimuth and elevation scans, the beam properties and overall system performance were evaluated revealing that the optics arrangement at 43 GHz required re-analysis and further development. A new secondary mirror was fabricated and from tests carried out with it the beam-width of the telescope was measured to be about ~1.2-1.3 times the required beam-width. Operation of the cryogenic system with receiver was tested for continuous use by keeping the whole system on for five days, and its performance was found to be normal and stable. A new driver amplifier for the first local oscillator, and a Gunn diode based oscillator – built in-house – was installed and tested and found to be stable. A method for machining of the secondary mirror surface and design of a back-up structure for stiffening this surface was also developed [Ananthasubramanian P.G.; Ramesh B.; Mamatha T.S.; Ezhilarasi M.S.; Chandrashekara K, Dhamodaran V.; Gopal N.; Gopi G.; Puttaswamy T.; Abdul Majeed S.A.; Anand K.; Sivasakthi R., Charles Paul I.; Elumalai R.; Lakshmanan R.; Durai Chelven, Achan Kunju; Venu V.; Gokulachandran V., Ravi Sankar].

X-ray laboratory: The development of a Thomson polarimeter using rectangular detector configuration has been completed. The development includes proportional counter detectors, associated front-end electronics, event processing logic, data acquisition system, and test and calibration system. The unit has been successfully tested in the energy band of 9–23 keV and a modulation factor of ~35% has been obtained. Based on this experiment, a proposal has been submitted to ISRO for mission approval. The mechanical fabrication of detectors for a cylindrical polarimeter configuration has been completed. An FPGA based pulse processing electronics based on charge division technique is under development. For the ASTROSAT- LAXPC instrument, the control software required for the X-ray modulator based timing calibration system has been developed and tested [Rishin P.V.; Rajagopala G.; Gopalakrishna M.R.; Nagaraja H.N.; Prabu T.; Sandhya P.; Mamatha T.S.; Ezhilarasi M.S.; Chandreyee M. (PhD student); Swetha (VSP student); Narayan].

GBT – RRI Multi Band Receiver: The GBT-RRI Multi Band Receiver system was designed, developed and successfully tested. This is a self-contained receiver system, consisting of a dual-polarization feed covering a wide-span in its spectral response (100-1500 MHz), to be used at the prime focus of the Green Bank telescope. The system was motivated by the need for simultaneous high time and spectral resolution studies of pulsar emission at single-pulse level, opening possibility of tomography study of pulsar emission cone. The system caters to simultaneous sampling of dual polarization voltage signals in the 10 bands, tunable

in pre-selected (relatively) RFI-free windows, within its wide-spectral range. Each of the 10 pipelines contains an RF/IF section and a digital back-end for recording directly the raw voltage time-sequence in two polarization channels. The sampled data is transferred to 10 DAS computers, each catering to one band, connected through Gigabit Ethernet to a master computer which runs the monitoring and control (M&C) software. The M&C software controls the RF & IF attenuators, LO frequency, and data acquisition. The complete system was first tested at GMRT field station in Oct 2008 and subsequently thoroughly tested in GBD field station till April 2009, before installing it at Green Bank, WV, USA, for use with the GBT [Vinutha C.; Deshpande A.A., Raghavendra Rao K.B.; Jayanth C.; Ezhilarasi M.S.; Sujatha S.; Kasturi S.; Sandhya P.; Sarabagopalan G.; Somashekar R.; Srivani K.S.; Nagaraja H.N.; Kamini P.A.; Girish B.S.; Prabu T.; Aswathappa H.A.; Mamatha T.S.; Salna, Deepa, Harshad (VSP students); Yogesh Maan (Ph.D. student); Narayan; Wences Laus; Rajagopala G.; Chandrasekara K.].

A cosmological re-ionization telescope: A purpose-built telescope is being designed and constructed to attempt a detection of spectral features in the background sky at low radio frequencies, which arise from events in the re-ionization era. Software simulations of the characteristics of a mesh screen together with elementary antenna pair operating as a 2-element EW interferometer has been completed; the simulations have revealed the detectability of monopole components in cosmological reionization signals. The receiver design of both the receivers and digital FPGA based corrrelator is in progress. [Raghunathan A.; R. Subrahmanyan]

LIGHT AND MATTER PHYICS

Areas of Research: Bose Einstein Condensation, Laser Cooling & Trapping of Atoms
Ultracold Molecules
Light Scattering
Quantum Optics
Ultrafast & Nonlinear Optics

BEC, Laser Cooling and Trapping of Atoms

Hadamard walks by ultracold atoms and photons: By means of extensive numerical calculations, using realistic parameters and including decoherence effects, experimental signatures of a Hadamard walk in ultracold rubidium atoms in a double optical lattice were simulated. It was shown that with present day experimental capabilities, few-step and many step quantum walks can indeed be induced and measured; the former by means of population measurements among various hyperfine states, and the latter through absorption imaging. An experiment to induce and study such quantum walks by ultracold atoms in a double optical lattice has been taken up at Umea. A quantum interference experiment to observe Hadamard walk by photons in the frequency-space also was taken up, using classical optical elements. The results were somewhat ambiguous, and it has been realized that two improvements are essential. To achieve these objectives, the interferometer is being reconfigured [Hema Ramachandran, Nandan Satapathy; Anders Kastberg, H. Hagman and M. Zelan (Umea University, Sweden), Thierry Kauffmann (Ecole Polytechnique, France)].

Gravitational fall of light in a table top experiment: The deflection of a weak probe light was sought to be measured in a helium vapour cell under EIT condition, where the group velocity of light was reduced to a few kilometers per second. However as several other effects in the system dominated over the expected deflection, it was concluded that a further reduction in the group velocity is necessary for the fall to be seen. It is now planned to carry out the experiment at the Institute using paraffin coated vapour cells of Rb [N.Kumar, Hema Ramachandran, N. Andal; Fabien Bretenaker, Fabienne Goldfarb and Amie Cotton (Orsay, France)].

Localisation of light in ferrofluids under correlated disorder: Following recent reports of the field induced absence of light transmission in a mixture of magnetite nano- and micro- spheres, an investigation of this phenomenon as a possible

manifestation of light localization was taken up. After several experiments and numerical analysis, a semi-phenomenological theory has been proposed in which it is shown that chain-like structures of the microspheres that form in magnetic fields and coherent scattering of the nanospheres in the Dicke limit can enhance scattering to an extent that the Ioffe-Regel criterion for light localization is satisfied. The anisotropy in the medium further favours localization [N.Kumar, Hema Ramachandran, M. Shalini].

Light emission from carbon nanotubes: Carbon nanotubes are known to emit light on application of high electric fields, or under high power ultrashort pulse laser irradiation. However, in the experiments carried out on suspensions of carbon nanotubes in optical tweezers, bright broadband emission in the visible region of the spectrum was observed from the nanotubes even under very low irradiance of a few milliwatt of the continuous wave tweezer light in the infrared. This has been explained in terms of blackbody emission due to the localized heating resulting from the very high absorption of the carbon nanotubes in the infrared [Hema Ramachandran, D.Mathur, A.Dharmadhikari and J.Dharmadhikari (TIFR, Mumbai)].

Towards quantum logic using cold atoms: Quantum logic using cold atoms being one of the research goals of the LAMP group, several possible techniques for trapping few atoms, or for permitting individual atom addressing, or for manipulating two or more species are being examined. Towards this end, the building of a magneto-optic trap with miniaturized coils within the vacuum chamber that was started towards the end of the last year was completed and rubidium atoms cooled and trapped. This now enables us to have several traps within the same chamber, and for inducing controlled interaction between atoms in a pair of traps [Hema Ramachandran, Meena M.S., Deepak Pandey, Smitha Jose].

Progress in the development of a BEC apparatus: The reservoir of Rb metal designed and fabricated recently is now attached in the BEC chamber. After rebaking, a vacuum of ~5×10^{-9} mbar in the upper MOT and ~ 8×10^{-12} mbar in the lower chamber was obtained. New magnetic coils that provide better optical access were also built. A cold cloud of Rb atoms can now be routinely obtained. Several rack modules for the master and slave laser controls were made [Hema Ramachandran, Nandan Satapathy, M.S.Meena, D.Dhanalakshmi, Tarun Johri].

Ultra-cold Molecules

Ion Trapping and Ion-Atom Experiments: A versatile experiment has been built that has the capacity to investigate ion-atom physics at ultra-cold temperatures. The experiment is currently operational with Rubidium atoms and ions, and is to be followed with cesium. Calibration of the detectors is underway to be followed by experiments on charge exchange, sympathetic cooling, etc. [Sadiq Rangwala, K. Ravi, Seunghyun Lee, Arijit Sharma, Guenther Werth (Johannes Guttenberg University, Mainz, Germany].

Ion Trap Development: An elegant ion trap configuration has been proposed which may be scaled in 3 physical dimensions and this has been characterized. This is an important step in ion trap physics since it enables experiments in many different directions including ion clocks and precision spectroscopy, quantum information processing, few body physics studies, chaos and studies with quantum simulators [Sadiq Rangwala, Seunghyun Lee, K. Ravi, Arijit Sharma, Tridib Ray, Guenther Werth (Johannes Guttenberg University, Mainz, Germany].

Cavity Based All Optical Switch: In order to study how driven atoms interact in optical cavities, this study was initiated. It led to the development of an all-optical switch, where light of appropriate frequency with reference to the cavity modes and the transition frequencies of the enclosed atoms may be switched. Briefly, a very weak beam of light incident transverse to the cavity mode may alter the field strength in the cavity mode dramatically [Sadiq Rangwala, Arijit Sharma, Tridib Ray, K. Ravi].

Cold Molecule Trapping and Detection: The experimental system to do cold molecule trapping and detection has been designed, machined and is in the early stages of being mounted. This is a complex experimental design and has, therefore, taken a long time to build. Central to it is the ability of the system to trap atoms and molecules and/or ions simultaneously. Moreover, it may be used for atom or ion transport and detection of molecules via the all optical switching mechanism and/or other cavity based mechanisms. These features make the present experiment versatile [Sadiq Rangwala, Arijit Sharma, Tridib Ray, K. Ravi]

Effect of large electric fields on alkali vapor density in paraffin coated cells: Alkali-metal vapor cells with anti-relaxation coating (especially paraffin-coated cells) have been a central tool in optical pumping and atomic spectroscopy experiments for 50 years. A dramatic change of the alkali-metal vapor density in a paraffin-coated cell upon application of an electric field to the cell was discovered. A systematic experimental characterization of the phenomenon is carried out for

electric fields ranging in strength from 0–8 kV/cm for paraffin-coated cells containing rubidium and cells containing cesium [Sadiq Rangwala, Ravi K, Arijit Sharma, Vaibhav Prabhudesai, D. F. Jackson Kimball (California State University-East Bay, USA); D. Budker (University of California at Berkeley, USA)].

Transfer of Alignment Between Ground States Rubidium Atoms: A very high sensitivity measurement of the transfer of alignment pumped in one isotope of Rb and collisionally transferred to another isotope of Rb was attempted. The method used is time-dependent magneto-optical rotation. The present measurements put an upper limit on the cross section of the collisional transfer of alignment [Sadiq Rangwala, D. F. Jackson Kimball (California State University-East Bay, USA); D. Budker (University of California at Berkeley, Berkeley, USA; J. M. Higbie (Bucknell University, USA)].

Investigation of Anti-relaxation Coatings for Alkali-Metal Vapor Cells using Analytical Methods: Alkali atoms have been known to have about 10^4 collisions with paraffin before depolarizing. This is a property that has applications both for fundamental physics and precision technology. However, the mechanism of atom-surface interaction that allows a large number of state-preserving collisions remains poorly understood. Thus, this work concerns itself with analytical tests on the paraffin coatings used in such alkali vapor cells to facilitate the understanding of the physics behind these coatings [Sadiq Rangwala, V. V. Yaschuck, A.Hexemer (LBNL, Berkeley, USA); D. Budker (University of California at Berkeley, USA); A. Pines (University of California at Berkeley, USA); M. Balabas (S. I. Vavilov State Optical Institute, St. Petersberg, Russia)].

High sensitivity detection of chiral molecules: The idea here is to develop the technology in the direction of high sensitivity measurements. Chiral media rotate the plane of polarized light that propagates through it. The aim is to determine the smallest concentrations of such molecules in the medium which can be measured at the limit of detection. The experiments are in progress. [Sadiq Rangwala, Ghazal Sheikholeslami].

Quantum optics/mechanics, Quantum Information, Foundations of Quantum Mechanics

Quantum Optics experiments with cold atoms: A stable MOT of cold atoms was achieved and characterized. The Rubidium 85 atoms which are currently trapped in the laboratory MOT are at a temperature of around 100 micro-Kelvin. The lifetime of the cloud (when the trap beams and the magnetic field are switched OFF) is 20 milli seconds. The shape of the cloud is ellipsoidal. The shorter side length is

about 2 mm and the longer side is about 4 mm. A preliminary experiment to show Electro-magnetically Induced Transparency (EIT) within hyperfine transitions of cold atoms was successful. Close to 100% transparency of the cold cloud was achieved [Andal N, T.M. Preethi, M. Manukumar (VSP)].

Simulations of non-equilibrium effects in cold atoms: A Monte-Carlo simulation was carried out to test the validity of steady state fluctuation theorem in cold atoms. The system simulated is a double optical lattice loaded with cold atoms. Transfer of atoms between the lattices is not symmetric. Additionally, the lattices are staggered with respect to each other. This spatio-temporal asymmetry creates a steady state of uniform velocity cold atoms. This system was simulated using the Langevin equation and the validity of Steady State Fluctuation Theorem (SSFT) was verified in such systems. It was found that the time scale in which the theorem is valid is very small compared to experimental timescales. Nevertheless, it was found that this is a promising system to study non-equilibrium effects in light matter interactions [N.Andal, Shreyas Potnis (VSP)].

Building up of a microwave cavity at 3 GHz for Quantum Optics: A cylindrical micro-wave cavity at 3 GHz is being built and tested with the help of facilities at the Institute. 3 GHz is the separation between ground hyperfine levels of Rubidium 85. This is a magnetic dipole transition and is famous for the clock resonance in Rubidium clocks. The aim is to connect these levels by Microwaves and study the possibility of coherence transfer between the microwaves and the optical waves during an Electro-Magnetically Induced transparency phenomenon. The cavity was built in the workshop and is being tested [N.Andal, Anish Roshi; Sijo Joseph, Shabeeb P.K.; Umesh Mohan and Ranjit V (VSP)].

Slow light experiments with room temperature Rubidium atoms using Zeeman degenerate levels: An experiment to slow down the group velocity of a pulse of light using the steep dispersion of the group index of Rubidium Vapour under Electro-Magnetically Induced transparency conditions was undertaken. This experiment achieved the lowest possible width for our EIT signals (100 kHz) but could not measure the slowing down of the pulse. This is mainly due to the 100 kHz width of our EIT signal. A good width of EIT, for a 3 - 4 sigma measurement of slowing down (with our current available technology) will be 2 - 10 kHz. This may be achieved by coating our glass cell containing Rubidium with paraffin to avoid spin relaxation at the walls of the cell. Further work is in progress [N.Andal, Hema Ramachandran; Azhar M. (VSP)].

Ultrafast and Nonlinear Optics

Nonlinear optical studies of nanomaterials and other media: The nonlinear optical transmission in different nanomaterial systems was investigated using the open aperture z-scan experiment. Degenerate Four Wave Mixing (DFWM) was employed to characterize the third order nonlinear susceptibility of a few of the samples. Some of these materials were found to be potential candidates for optical limiting and photonic device applications [Reji Philip, Suchand Sandeep C.S., V. Lakshminarayanan; M.R. Anantharaman (CUSAT, Cochin), V.P.M. Pillai (Kerala University), V. Kumar (CMET, Thrissur), B. Karthikeyan (NIT, Trichy), A.V. Adhikari (NIT, Surathkal).

Ultrafast laser-induced plasma from planar liquid jets: An intense, ultrashort laser pulse falling on a medium will generate high density plasma. This plasma is a source of highly energetic radiation, including (but not limited to) UV rays, X-rays, and Gamma rays. X-ray emission from a planar water jet was studied and a comparison made with emission from a planar silver nanoparticle jet. Ultrashort laser pulses of 6 mJ energy and 100 fs pulsewidth (FWHM) were used for the experiment. A calibrated Si-PIN detector combined with a multi channel analyzer (MCA) was used for X-ray detection. X-rays in the range of 5 keV to 30 keV were recorded and analyzed [Reji Philip, C.S. Suchand Sandeep].

Z-scan experiment using a white light Supercontinuum: The white light supercontinuum is an intense broadband emission from suitable media which may be generated using an ultrafast laser. It has a large spectral extent ranging from UV to IR with high intensities and short time scales. Conventionally, the z-scan experiment is carried out using a monochromatic laser source. However, if white light supercontinuum is used as the source, the dispersion of nonlinear absorption over a range of wavelengths can be measured in a single experiment. An experimental set-up has been developed and a few preliminary measurements have been done. These experiments are continuing [Reji Philip, C.S. Suchand Sandeep].

SOFT CONDENSED MATTER

Areas of research: Liquid Crystals
- Synthesis
- Structure, Phase Behaviour and
- Physical Properties
- Displays

Colloids
Amphiphilic Systems
Surface Science and Nanocomposites

LIQUID CRYSTALS

Synthesis

Novel mesogens with bent-core molecules: Two new series of unsymmetrical bent-core compounds were synthesized using isomeric 3,4-disubstitued biphenyl unit. The 5-ring compounds synthesized from 3-hydroxybiphenyl 4-carboxylic acid exhibited SmAdb phase. The compounds synthesized from 4-hydroxybiphenyl 3-carboxylic acid gave SmAdPA phase. In addition, the higher homologues exhibited SmAd phase [S. Radhika and B.K. Sadashiva]

Discotic liquid crystalline symmetrical donor-acceptor-donor triads: Two series of novel triphenylene-anthraquinone-based symmetric discotic liquid crystalline trimers were prepared. These triads were prepared using microwave dielectric heating. Conventional heating under similar reaction conditions failed to produce desired products. The columnar hexagonal mesophase structure of these discotic oligomers has been elucidated with the help of polarizing optical microscopy, DSC and X-ray diffraction studies. [Satyam Kumar Gupta, V. A. Raghunathan and Sandeep Kumar]

Room-temperature electron-deficient discotic liquid crystals: Two novel series of rufigallol-based room-temperature discotic liquid crystals have been designed and synthesized using microwave dielectric heating within few minutes in good yield. Columnar hexagonal structure of the mesophase of these compounds was established with the help of X-ray diffraction studies. [Hari Krishna Bisoyi and Sandeep Kumar]

Carbon nanotubes in monomeric and polymeric discotic liquid crystals: The dispersion of functionalized single-wall carbon nanotubes in novel room temperature liquid crystalline discotic monomers and polymers was achieved. The effect of nanotubes on phase behavior of electron-rich triphenylene derivatives and electron-deficient anthraquinone derivatives has been investigated. [Hari Krishna Bisoyi and Sandeep Kumar]

Rod-disc oligomers: Microwave-promoted synthesis of novel rufigallol-based liquid crystalline oligomers, containing six rod-like cyanobiphenyl moieties connected to the rufigallol core via flexible alkyl spacers was achieved. The synthesis of the target compounds was challenging since classical reactions failed to produce these oligomers. These compounds display a nematic phase with a shorter spacer and a smectic A (SmA) phase with a longer spacer. The compound with medium alkyl spacer exhibits both nematic and SmA phases at higher temperature and a re-entrant nematic phase at lower temperature. [Santanu Kumar Pal, Sandeep Kumar and Jhumur Seth**]**

Ionic Discotic Liquid Crystalline Polymers: The photopolymerization of triphenylene-substituted 1-vinylimidazole yielded a novel ionic discotic liquid crystalline polymer. Both the monomer and polymer displayed columnar rectangular mesophase over a wide temperature range. [Santanu Kumar Pal and Sandeep Kumar]

Structure, phase behaviour and physical properties

Electrohydrodynamic instability in the nematic phase exhibited by banana shaped molecules: The instability patterns exhibited in the nematic phase of bent-core banana shaped liquid crystals have been investigated. The patterns observed have significant differences with that observed in the case of rod-like molecules. [Meenal Gupta and Arun Roy]

Experimental studies on the nonequilibrium fluctuations in liquid crystals: The validity of some nonequilibrium fluctuation theorems was studied experimentally using liquid crystals. [Soma Datta and Arun Roy]

Displays

Power dissipation of drivers in liquid crystal display: Power dissipation in drivers of LCD for several line-by-line addressing techniques was analyzed. Addressing waveforms of the techniques based on diagonal matrices and wavelets were modified to reduce power dissipation and supply voltage of the display

drivers. Power dissipation of drivers in LCD for several multi-line addressing techniques that are based on Hadamard matrices, diagonal matrices and wavelets were analyzed and compared [T.N. Ruckmongathan and Raghavasimhan Thirunarayanan]

Low supply voltage and low power for LCD: Low supply voltage and low power dissipation was achieved by combining the best features of several addressing techniques. Low supply voltage by using multi-line addressing and low hardware complexity for large number of gray shades was achieved by using successive approximation and the controller design was simplified using sparse Hadamard matrix. [A.R. Shashidhara and T.N. Ruckmongathan]

Colloids

Phase behavior and dynamics of triblock copolymer solutions: The dynamic light scattering (DLS) and rheological measurements were employed to understand the structure, dynamics and mechanical properties of the aggregates that form when ionic surfactants are added to copolymer solutions. [Harsha Mohan (MPI, Mainz, Germany), Rajib Basak, Nabaneeta Mukhopadhyay (VSP), Ranjini Bandyopadhyay]

Falling ball viscometer experiments to calculate the microviscosity of aging clay suspensions: The terminal velocities that a ball attains during its fall through laponite suspensions of various ages were estimated, and the effective viscosity of the laponite medium surrounding the falling ball (i.e. its 'microviscosity') was then calculated from the Stokes Einstein equation. These microviscosity results were compared with rheometric estimates of the zero-shear bulk viscosities of laponite suspensions of the same ages. [Ranjini Bandyopadhyay and Rema Govindarajan (JNCASR, Bangalore)]

Instability at the quasi-2D interface between a Newtonian and an aging non-Newtonian fluid: The fractal dimensions of the patterns are computed and their dependence on the age of the laponite suspension is studied. For smaller ages of the laponite suspension, the pattern resembles a Saffmann Taylor viscous fingering instability that may be decribed as a Laplacian growth process. At larger suspension ages, where elastic effects dramatically affect pattern formation, the instability resembles a crack propagation pattern. [Ranjini Bandyopadhyay and Rema Govindarajan (JNCASR, Bangalore)]

Amphiphilic Systems

Mesogenic molecule at air-water and air-solid interfaces: The kinetics of trans-cis isomerization of azobenzene dimers at air-water interface and the Langmuir monolayer of mesogenic azobenzene dimer at an air-water interface were studied. The trans to cis isomerization reaction of the molecules in the monolayer shows deviation from first order kinetics, unlike those reported on Langmuir monolayers of azobenzene molecules [Bharat Kumar and K.A. Suresh].

Structure and phase behaviour of lipid-sterol membranes: The structure and phase behaviour of lipid bilayers containing sterols, such as cholestane, 7-dehydroergosterol and 25-Hydrocholesterol, have been studied. Partial phase diagrams of these mixtures have been determined using small angle X-ray scattering. **[**Bibhu Ranjan Sarangi, V.A. Raghunathan]

Salt-induced melting of DNA-surfactant complexes: Salt-induced melting of DNA-surfactant complexes had led to the observation of some novel intermediate phases. Extensive modeling of the X-ray diffraction data has been carried out in order to establish the structures of these phases. A detailed phase diagram in the DNA - surfactant composition plane has also been determined. **[**A.V. Radhakrishnan, V.A. Raghunathan]

Probing mechanical properties of Axons: A novel fiber optics based technique is being developed to perform force spectroscopy on axons with nano-Newton resolution and simultaneous high resolution imaging. Etching techniques to produce optical fiber force transducers, testing of detection system and electronics, mounting of micro-manipulation arrangement on the microscope, and computer interface have been developed. [Francisco Melo and Dr. Roberto Bernal (University of Santiago, Chile), S. Rao and Pramod Pullarkat]

Cell shape dynamics: A microfluidic system to sustain concentration gradients has been developed. Cell viability in such conditions has been verified. Different soft gels were prepared and a technique for measuring their stiffness was developed. [VijayRaghavan (NCBS), Maneesha Inamdar (JNCASR), Renu Vishavkarma and Pramod Pullarkat]

Surface Science and Nanocomposites

Thiol stabilized gold nanoparticles: An electrochemical method of preparation of thiol-monolayer-protected gold nanoparticles has been developed. Nanoparticles

were characterized by UV-visible absorption and transmission electron microscopy (TEM) studies [D.H. Nagaraju and V. Lakshminarayanan].

Polyaniline-Porphyrin nanocomposite: Nonlinear absorption studies on the nanocomposite formed by 4,4′,4″,4‴- (Porphine-5,10,15,20-tetrayl) tetrakis (benzoic acid) (PTBA) when mixed with the conducting polymer polyaniline (PANI) were carried out using the open aperture Z-scan experiment. The nanocomposite was found to show a greater nonlinear optical limiting property compared to either of the parent compounds PTBA and PANI [R.K. Pandey, C. S. Suchand Sandeep, Reji Philip and V. Lakshminarayanan].

Electrochemically grown mesoporous gold film: Using a simple one–step electrochemical process it was shown that it is possible to form a thin networked film of gold nanoparticles on metal surfaces. The mesoporous film was characterized using AFM, SEM and XRD studies. The surface modified by nanoparticles was also shown to possess very high electrocatalytic activity for alcohol oxidation in alkaline media [D.H. Nagaraju and V. Lakshminarayanan].

Supramolecular nanocomposite: A novel hybrid organic/inorganic nanocomposite has been prepared consisting of a π electron rich discotic liquid crystal that acts an electron donor and a powerful oxidizing agent gold tetrachloride which acts as an inorganic dopant and an electron acceptor. The nanocomposite material showed enhanced d.c. and a.c. electrical conductivity by several orders of magnitude in laboratory conditions [P. Suresh Kumar, Sandeep Kumar and V. Lakshminarayanan].

Lead sensing using layer by layer assembly of polyelectrolytes: The porphyrin–Poly aniline layer–by-layer assembly has been prepared using the electrostatic interaction between the negatively charged porphyrin sulphonate and positively charged poly aniline. This film has been shown to possess excellent sensitivity towards lead [Rakesh. K. Pandey, R. Avinash and V. Lakshminarayanan].

Liquid crystal-gold nanosphere composites: Stable dispersions of gold nanospheres in smectic liquid crystals were obtained and characterized on the basis of the surface plasmon resonance (SPR) wavelength. The red-shift observed in SPR wavelength with increasing concentration of the gold nanospheres in the liquid crystal matrix has been explained using calculations based on the Maxwell Garnet effective medium theory. [R. Pratibha, Ivan Smalyukh (USA)].

Liquid crystal nanoparticle dispersions: Different preparation conditions on making a stable dispersion of ferroelectric nanoparticles in a smectogenic liquid crystal have been investigated. The physical properties have been characterized using polarized optical microscopy, X-ray diffraction, dielectric and order parameter measurement studies. [Meenal Gupta, Arun Roy and R. Pratibha].

Physical studies on nanoparticles-liquid crystal composites: Magnetic susceptibility, d.c. conductivity and small angle X-ray diffraction studies on hexanethiol covered gold nanoparticles (GNPs) in a discotic liquid crystal namely hexahexylthiotripheneylene (HHTT) were carried out. It is inferred that the smaller 1.2 nm GNPs randomly occupy positions in the liquid crystalline matrix within the columns as well as inbetween the columns. The bigger GNPs (2.6 nm and 4.6 nm) form 2D intercalated hexagonal structures with the disc molecules. [D. Vijayaraghavan and Sandeep Kumar].

THEORETICAL PHYSICS

Areas of Research: Condensed Matter and Statistical Physics
Physics in Biology
Gravitation
Optics, Quantum Mechanics & General Physics

Condensed Matter and Statistical Physics

Green-Kubo formula for open systems: An exact linear response formula of the Green-Kubo type was derived for the heat current in open systems. Hamiltonian systems connected to both stochastic as well as deterministic heat baths were considered and a general proof was given. [Anupam Kundu, Abhishek Dhar + Onuttom Narayan (University of California, Santa Cruz, USA)].

Transport in mesoscopic systems: The problem of transmission of electrons between two noninteracting leads through a region where they interact (quantum dot) was addressed. A simple model of spinless fermions was studied. In an earlier work by the authors it was shown that the Lippmann-Schwinger approach can be used to exactly solve the two-particle problem and also to perturbatively study transport in the many-particle case. Two new phenomena have now been studied using this approach, namely a two-particle resonance effect and diode-like behaviour. [Dibyendu Roy, Abhishek Dhar + Abhiram Suri (IISc) and Diptiman Sen (IISc)].

Heat conduction in disordered harmonic crystals: The system-size dependence of heat current in disordered harmonic lattices in two and three dimensions has been addressed. Analytic results have been obtained using arguments based on localization theory and kinetic theory. These results were then tested through extensive numerical calculations and simulations. This work provides the first ever numerical verification of normal diffusive heat transport in a three-dimensional system and that of a heat-insulator in two dimensions. [Abhishek Chaudhuri, Anupam Kundu, Dibyendu Roy, Abhishek Dhar + Joel Lebowitz (Rutgers University, USA) and Herbert Spohn (Technische Universitat, Germany)].

Probability of rare events and fluctuation theorems: The probability distribution of heat flowing through a system in a given time has been studied. An important question in nonequilibrium physics is whether this distribution satisfies the fluctuation theorem. A computer algorithm has been developed to access the

tails of this distribution. This requires sampling of rare events and has been acheived by using techniques based on importance sampling. Some analytic results for the distribution function have also been obtained. [Anupam Kundu, Sanjib Sabhapandit and Abhishek Dhar].

Statistics of a flexible polymer chain in shear flow: In shear flow, a polymer gets stretched as well as tumbles in an irregular fashion. A crucial quantity which describes the interesting conformational evolution of the polymer is its end-to-end vector. The probability distribution of the tumbling times as well as the distribution functions for the length and orientational angles of the end-to-end vector has been calculated analytically in the case of a Rouse polymer. [Sanjib Sabhapandit + Dibyendu Das (IIT Bombay)].

One-dimensional ballistic aggregation model: The ballistic aggregation model describes a sticky gas of N particles with random initial positions and velocities, moving deterministically, and forming aggregates when they collide. The final 'fan' state of this model in 1-D without any boundary has been investigated. A closed formula for the stationary measure of the final state has been obtained and using it some remarkable features of the final 'fan' state has been analyzed. In particular, the universal properties that are independent of the initial position and velocity distributions of the particles have been identified. The cluster distributions have been studied and exact results for extreme value statistics have been derived. The energy distribution in the final state has also been obtained. This model generates dynamically many different scales and can be viewed as one of the simplest exactly solvable model of N-body dissipative dynamics. [Sanjib Sabhapandit + Satya N. Majumdar (LPTMS, Orsay, France) and Kirone Mallick (IPhT, Saclay, France)].

Physics in Biology

Semiflexible polymers- mechanics and thermal fluctuations: The study of the statistical mechanics of semiflexible polymers was continued. In biological systems, polymers of all rigidities appear, an example being DNA. Understanding these systems is a challenging problem especially because of the twist degree of freedom, which raises subtle geometrical and topological questions. This work studies the transition between energetic and fluctuation effects and shows how a simple approach to this problem may be a useful approximation. [Joseph Samuel, Supurna Sinha + Abhijit Ghosh (Max Planck Institute for Polymer Research, Germany)].

Free energy of twisted semiflexible polymers: The role of fluctuations in single molecule measurements of torque-link curves is investigated. For semiflexible polymers of finite persistence length, the torque versus link curve in the constant torque ensemble is distinct from the one in the constant link ensemble. Thus, one encounters the conceptually interesting issue of a 'free energy of transition' in switching ensembles while making torque-link measurements. The dependence on the semiflexibility parameter of this extra contribution to the free energy, which shows up as an area in the torque-link plane, is predicted. In this context, the inequivalence of torque-link curves for a stiff polymer is brought out and explicit analytical expressions are presented for the distinct torque-link relations in the two ensembles and also for the free energy difference in switching ensembles. The predictions of this work may be tested against single molecule experiments on torsionally constrained biopolymers. [Joseph Samuel, Supurna Sinha + Abhijit Ghosh (Max Planck Institute for Polymer Research, Germany)].

Writhe formulas and antipodal points in plectonemic DNA configurations - A perspective: Motivated by experiments on torsionally constrained stretched biopolymers the notion of writhe at high forces and its extension to lower forces have been re-investigated in the light of new developments in this area. This work clarifies the distinction between statistical mechanical and classical mechanical approaches to this problem, which have been the two main lines of investigation in this area of research. [Joseph Samuel + Abhijit Ghosh (Max Planck Institute for Polymer Research, Germany)].

Gravitation

Numerics on causal set homology: The spatial homology of causal sets that are manifoldlike was computed numerically for a large class of causal sets and the numerics systematically analysed. Earlier theoretical results placed constraints on the spatial slice of the causal set. The numerical analysis, however, demonstrated that the conditions are fairly generic and hence there is a strong correlation between causal set topology and continuum topology even at relatively weak sprinkling densities. [Sumati Surya + Seth Major (Hamilton College, USA) and David Rideout (Perimeter Institute, Canada)].

Quantum gravity and the information loss problem in the CGHS model: This work was part of a long term research project. An estimate of the rate of information recovery in the evaporation of 2-D dilatonic black holes was made by mapping the problem to one of the statistical mechanics of a particular ensemble of oscillators followed by an analysis of upper bounds of entropy of the latter system.

[Madhavan Varadarajan, Abhay Ashtekar + Victor Taveras (Penn State University, USA)].

Polymer quantization of the free scalar field and its classical limit: Building on prior work, free scalar field theory on the flat Lorentzian cylinder (in a generally covariant reformulation) was quantized using Loop Quantum Gravity (LQG) type 'polymer' representations. This quantization of the continuum classical theory yields a quantum theory which lives on a discrete spacetime lattice. A state in the polymer Hilbert space was explicitly constructed which reproduced the standard Fock vacuum-like 2 point function for long wavelength modes of the scalar field. This work constitutes the first complete LQG type quantization of a field theory together with the derivation of its classical limit. [Madhavan Varadarajan and Alok Laddha].

On the resolution of the big bang singularity in isotropic Loop quantum cosmology: In contrast to previous work, the Loop Quantum Cosmology (LQC) of the flat isotropic model with a massless scalar field was constructed in the absence of higher order curvature corrections to the Hamiltonian constraint. The matter part of the constraint contains the inverse triad operator which may be quantized with or without the use of a Thiemann-like procedure. With the latter choice, it was shown that the LQC quantization is identical to that of the standard Wheeler DeWitt theory wherein there is no singularity resolution. The former choice leads to singularity resolution in the sense of a well defined, regular evolution through and beyond the epoch where the size of the universe vanishes. [Madhavan Varadarajan].

LISA as a dark energy probe: The implications of the recently computed 3PN gravitational wave (GW) polarisations for GW astronomy are studied. Inclusion of higher signal harmonics leads to dramatic improvements in the angular resolution of the Laser Interferometer Space Antenna (LISA) allowing redshift determination of the host galaxy or galaxy cluster by electromagnetic means. The equation-of-state parameter ω of dark energy is constrained to within a few percent since the GW signal provides an accurate luminosity distance whose redshift depends sensitively on cosmology and thus ω. If the measured sky location is folded into the error analysis, the uncertainty on ω goes down by an additional factor of 2-3. [Bala R.Iyer, S. Sinha, C.K. Mishra + K.G. Arun (LAL, Orsay, France), C. Van Den Broeck and B.S. Sathyaprakash (Cardiff University, UK)].

Improved resummation of post-Newtonian multipolar waveforms from circularized compact binaries: The resummation method of post-Newtonian (PN) multipolar waveforms from circular compact binaries is improved and generalised. This resummation method replaces the usual additive decomposition of the standard post-Newtonian approach by a multiplicative decomposition of the complex multipolar waveform comprising several (physically motivated) factors: the 'Newtonian' waveform, a relativistic correction coming from an 'effective source', leading-order tail effects linked to propagation in a Schwarzschild background, a residual tail dephasing and finally residual relativistic amplitude corrections. The knowledge of the first PN corrections to multipole moments is also completed by computing ready-to-use explicit expressions for the first PN contributions to the odd-parity (current) multipoles. [Bala R.Iyer + T. Damour and A. Nagar (IHES, France)].

Third post-Newtonian head-on collision of compact objects: Gravitational energy flux and wave forms: Head-on collision of two compact objects with arbitrary mass ratios is investigated using the multipolar post-Minkowskian approximation method. At the third post-Newtonian order the energy-flux, in addition to the instantaneous contributions also includes hereditary contributions consisting of the gravitational-wave tails, tails-of-tails and the tail-squared terms. The results are given both for infall from infinity and also infall from a finite distance. Work is in progress to compute the gravitational waveforms associated with the head-on infall of the two compact objects of comparable masses. [C.K. Mishra and Bala R. Iyer].

Probing the nonlinear strucure of general relativity with blackhole binaries using 3PN full waveform model: The phasing of gravitational wave has been utilised to provide tests of the post-Newtonian (PN) approximation by treating the PN coefficients as parameters of the theory. The implications of the full waveform for such a test are being investigated for the Einstein telescope design study using the 3PN full waveform model. [C.K. Mishra, Bala R.Iyer + K.G. Arun (LAL, Orsay, France) and B.S. Sathyaprakash (Cardiff University, UK)].

An efficient numerical method for computing gravitational waves induced by a particle moving on eccentric inclined orbits around a Kerr Black Hole: A numerical code to compute gravitational waves induced by a particle moving on eccentric inclined orbits around a Kerr black hole was developed. In Kerr spacetime there are three constants of motion: energy, angular momentum and the Carter constant. Evolution of the Carter constant as well as energy and angular momentum were computed. This is the first time that evolution of the Carter constant was evaluated accurately. The accuracy was limited only by the truncation

of index of Fourier harmonics. The numerical code is useful for the computation of templates of the extreme mass ratio inspirals. [Ryuichi Fujita + Wataru Hikida and Hideyuki Tagoshi (Osaka University, Japan)].

Analytical solutions of bound timelike geodesic orbits in Kerr spacetime: The analytical solutions of the bound timelike geodesic orbits in Kerr spacetime were derived expressed in terms of the elliptic integrals using one parameter as the independent variable. The analytical expressions of the bound timelike geodesics in Kerr spacetime and its fundamental frequencies are derived for the first time, using which the orbits may be computed fast and accurately. Thus, they are useful not only in investigating physical properties of Kerr geodesics but, more importantly, in the case of gravitational waves from extreme mass-ratio inspirals. [Ryuichi Fujita + Wataru Hikida (Osaka University, Japan)].

Templates of generic extreme mass ratio inspirals in the frequency domain: Templates of gravitational waves produced by extreme mass ratio inspiral were discussed by using the black hole perturbation technique. This is the first study of the templates in the frequency domain including evolution of both eccentric and inclined orbits due to the emission of gravitational waves. This template in the frequency domain is very useful for data analysis of gravitational waves since the correlation between templates and data is performed in the frequency domain. [Ryuichi Fujita + Wataru Hikida, Hideyuki Tagoshi (Osaka University, Japan) and Hiroyuki Nakano (Rochester Institute of Technology, USA)].

The Universe in a Soap Film: It has been shown that quantum gravity models generically lead to a fluctuating cosmological constant, whose order of magnitude is in accord with astronomical observations. This follows from an analogy developed between the surface tension of fluid membranes and the cosmological constant of the universe. The analogy helps one understand better the cosmological constant, its conceptual foundations and its possible observational consequences. It is demonstrated using numerical experiments that the surface tension of fluid membranes shows small fluctuations that may be observable in real experiments. This opens up the possibility of ‘experimental quantum gravity’, using the analogy to bring Planck scale effects to the laboratory. The analogy indicates that the fluctuating cosmological constant is a generic feature of quantum gravity models and is far more general than the specific context of Causal Sets in which it was originally proposed. [Supurna Sinha, Joseph Samuel and Rohit Katti (VSP Student)].

Optics, Quantum Mechanics and General Physics

Quantum covers in quantum measure theory: It is well known that the standard measurement based interpretation of quantum theory poses serious problems to quantum gravity, especially in the context of quantum cosmology which has no 'external observers'. Without a resolution of this question, a physical interpretation to results in quantum gravity cannot be given. Recently, Sorkin proposed an alternative quantum interpretation in a measurement independent framework. This extends, in a natural way, the standard interpretation of classical stochastic theories to a quantum stochastic framework using a 'quantum measure'. Understanding the quantum measure in greater detail is the focus of current work. It was shown that there are strong constraints on the sets of zero quantum measure, which play an important role in Sorkin's new interpretation. These constraints were then shown to lead naturally to the notion of a quantum covering on the sample space, a generalisation of a topological cover. Moreover, it was shown that any inextendible antichain in the corresponding Boolean lattice is a quantum cover. [Sumati Surya and Petros Wallden].

Classical Langevin dynamics of a charged particle moving on a sphere and diamagnetism - A surprise: It is generally known that the orbital diamagnetism of a classical system of charged particles in thermal equilibrium is identically zero - the Bohr-van Leeuwen theorem. Physically, this null result derives from the exact cancellation of the orbital diamagnetic moment associated with the complete cyclotron orbits of the charged particles by the paramagnetic moment subtended by the incomplete orbits skipping the boundary in the opposite sense. Motivated by this crucial but subtle role of the boundary, simulations were performed for the case of a finite but unbounded system, namely that of a charged particle moving on the surface of a sphere in the presence of an externally applied uniform magnetic field. Following a real space-time approach based on the classical Langevin equation, the orbital magnetic moment was computed that now indeed turns out to be non-zero and has the diamagnetic sign. This is the first report of the possibility of finite classical diamagnetism in principle, and it is due to the avoided cancellation [N. Kumar and K. Vijay Kumar (IISc, Bangalore)].

Dependence of the properties of magnetic nanoparticles on the interparticle separation: Dependence of the magnetic properties of FePt nanoparticles with an average diameter, D, of 5 nm on the interparticle separation, d, has been investigated by employing different spacer molecules. The observed decrease in the blocking temperature and Curie-Weiss temperature with increase in d as well as the increase in saturation magnetization with increase in d have been explained on the basis of a simple model for the case $d \ll D$ where the magnetic

nanoparticles are treated as finite dipoles coupled through anisotropic multipolar interactions [R. Voggu (JNCASR, Bangalore), N. Kumar and C.N.R. Rao (JNCASR, Bangalore)].

Langevin dynamics in crossed magnetic and electric fields: Hall and diamagnetic fluctuations: Based on the classical Langevin equation, the problem of orbital motion of a charged particle in two dimensions for a normal magnetic field crossed with or without an in-plane electric bias, was re-visited. Two interesting fluctuation effects were found: first, not only a longitudinal 'workfluctuation' relation was obtained as expected for a barotropic type system, but also a transverse work-fluctuation relation perpendicular to the electric bias. This 'Hall fluctuation' involves the product of the electric and the magnetic fields. Second, for the case of harmonic confinement without bias, the calculated probability density for the orbital magnetic moment gives nonzero even moments, not derivable as field derivatives of the classical free energy. [Dibyendu Roy and N. Kumar]

Topological phase in two flavor neutrino oscillations: It has been shown that the phase appearing in neutrino flavor oscillation formulae has a geometric and topological contribution. A topological phase appearing in the two flavor neutrino oscillation formula was identified using Pancharatnam's prescription of quantum collapses between non-orthogonal states. Such quantum collapses appear naturally in the expression for appearance and survival probabilities of neutrinos. The analysis applies to neutrinos propagating in vacuum or through matter. For the minimal case of two flavors with CP conservation, this study shows for the first time that there is a geometric interpretation of the neutrino oscillation formulae for the detection probability of neutrino species. More precisely, the standard formulation of neutrino oscillations is in fact a realization of the Pancharatnam toplogical phase. [Poonam Mehta]

A geometric view of CP violation on two flavor neutrino oscillations: In vacuum or constant density matter, the two flavor neutrino oscillation formulae are insensitive to the presence of CP violating phases owing to the fact that the CP phase can be gauged away. It is shown that in the presence of an adiabatic evolution, it is no longer possible to gauge away the CP phase. This fact leaves a non-trivial imprint of the CP violating phases on the physics of neutrino oscillations in the two flavor case. Then the transition probability is also sensitive to a CP transformation and makes CP partners distinguishable. A pure geometric visualization of this effect is presented by exploiting Pancharatnam's prescription of cyclic quantum projections. [Poonam Mehta]

Degenerate neutrinos from non-degenerate seesaws: At the zeroth order, degenerate neutrino mass matrices may be considered as a sum of hierarchial and inverse hierarchial sub-matrices. This holds true irrespective of the kind of mixing present in each sub-matrix. It is shown that in two generations, the degeneracy requirement could ensure maximal mixing even if the individual sub-matrices contain only small mixing. In three generations, a straight forward extension of this 'degeneracy induced large mixing' may lead to maximally symmetric mixing matrix. A more suitable decomposition is presented in which this effect may be used to generate one large mixing while keeping another small. This scenario has been analyzed in a model independent way including the splittings required for the Solar and atmospheric data. Some specific models where the degenerate neutrinos arise from non-degenerate seesaw mechanisms are illustrated. [Poonam Mehta + Joydeep Chakrabortty (HRI, Allahabad), Anjan S. Joshipura (PRL, Ahmedabad) and Sudhir K. Vempati (CHEP, IISc, Bangalore)].

Computers

Operating system upgrades and patches were applied to all servers. Application packages were upgraded with available upgrades on hand. Routine maintenance of computer systems, printers and components part of the local area network was carried out to ensure reduced downtimes.

Security was further tightened to reduce threats to our network from outside.

Backup and storage requirements were looked into and increased storage needs were met by suitable augmentation. Need based improvements in the computational facilities were undertaken when required.

LIBRARY

The resources collection was updated with recent literature relevant to the Institute: in print as well as in electronic form. These include English and Hindi books (1005), journals (335), bound volumes (618), additional consortia subscriptions (38 publishers) and broad-spectrum Hindi, English and Kannada periodicals (31). The total collection at the end of the reporting period is: Books – 25,505; Bound volumes of journals: 37,181 and the total library collection is: 62,686.

The Library continued to provide need based information services to its readers within and outside the Institute. In order to add value and, at the same time, exercising economy in the expenses incurred in doing so, the Library continued a close liaison with appropriate libraries of other institutes in the country and this was further strengthened through FORSA and DST multi-institutional consortia. The Library is a participant in the FORSA consortium on-line subscription to Nature (4 journals), Springer (Physics and Astronomy Journals, both print and on-line), Institute of Physics Publishing (3 journals, both print and on-line), Scientific American and Lecture Notes in Physics. In addition, the Library has access to IEEE/IEE electronic library through INDEST consortium and to 14 publishers through CSIR-DST E-journal consortium.

Digital Library activities:

Digitization of archival material, Ph.D. theses and research papers continued and at the end of the period covered by this report the digital repository holds 3691 items covering a gamut of material relevant to the Institute.

Other activities:

The Library organized a 'Libsys Connect 2009' meet on 24th February 2009. Additionally, the Library organized the first DST Working Group Meeting at the Institute on 20th August 2008 for preparing the ground work for DST institutions to join the CSIR E-Journals Consortium.

OTHER ACTIVITIES

Ph. D.

Awarded

Santanu Kumar Pal	Synthesis characterization and self-assembly of functionalized soft nanomaterials *Jawaharlal Nehru University, New Delhi*
Sajal Kumar Ghosh	Influence of strongly bound counterions on the phase behaviour of ionic amphiphiles *Jawaharlal Nehru University, New Delhi*
Sutirtha Roy Chowdhury	Geometric flows and black hole entropy *Jawaharlal Nehru University, New Delhi*
Anija M.	Investigation of nonlinear effects induced in condensed matter by intense laser fields *Jawaharlal Nehru University, New Delhi*
Chandrayee Sengupta	HI content of galaxies in groups

Submitted

Brindaban Kundu	Experimental investigations on physical properties of some novel liquid crystals with banana-shaped and rod-like molecules
Dibyendu Roy	Charge and energy transport in the presence of disorder and interactions
Rahul Marathe	A study of fluctuations and transport in non-equilibrium systems
Alpana Nayak	Organization of discotic mesogenic amphiphiles at air-water and air-solid interfaces

Hindi Cell

As part of the official language implementation in the administration of the Institute, the training programme was continued during the year. In addition, periodic Hindi Workshops as well as Hindi-Divas were held during the year. As a part of the continued efforts by the Institute to meet the target set under the official language policy, the Institute took several fresh initiatives. Details of all these were presented during the visit by the Second Sub-Committee of the Parliament on Official Language in January 2009. The Committee, while expressing satisfaction on the efforts initiated, directed the Institute to achieve the target laid by the official language policy as well as take measures to comply with the assurances given to the Committee.

Publications

The research work done by the staff of the Institute has been published in a number of journals. A list of publications that have already appeared, as well as those submitted and in-Press is given in Annexure I (pages 62 - 82).

Visiting Students Programme (VSP)

Visiting Students Programme introduced in the year 2007 is aimed at offering research experience to highly motivated students who are pursuing their undergraduate or master's studies. Students seeking such opportunities during their summer vacations also continue to be supported under this programme.

During the period of the visit, the student works closely with at least one staff member of the Institute on a suitable project, or on a part of a project, as appropriate. The student's work and the interaction with the staff and the graduate students at the Institute are expected to provide a flavour of the research at the Institute, in general, and a first-hand experience of research, in particular.

During the year 68 students from different parts of the country participated in the research of the Institute as part of this programme. The duration of the working visits was mostly between 3 and 6 months; some visits were for a year.

Conferences/Seminars and Meetings

The members of the Institute visited various institutions in India and overseas and attended conferences and presented papers. In addition, lectures, seminars and colloquia were given by them at many institutions. Details are available in Annexure II (pages 83 - 110).

Colloquia

The scientists of the Institute and visiting scientists from within and outside the country delivered colloquia at the Institute on a variety of topics during the year (Annexure III, pages 111 - 120).

Journal Club Meetings

Forty meetings were held during the year. Preprints as well as recently published papers dealing with topics of current interest were reviewed in the meetings (Annexure IV, pages 121 - 124).

And, as in the past, several informal Group meetings in Theoretical Physics, Light & Matter Physics, Soft Condensed Matter, Astronomy & Astrophysics and in Signal Processing and Imaging were held on a regular basis throughout the year.

Visiting Scientists

A number of scientists from institutions within the country and from outside visited the Institute during the year. Their names are listed separately (pages 54 - 61).

In-House Meeting

An In-House Meeting, which is an annual feature at the Institute, was held during 4 to 7 November 2008, where the staff and students presented their research work. The presentations were followed by lively scientific discussions with critical comments and suggestions relevant to the reported research from the members. The organisation of this meeting was by the research students of the Institute.

General

The following grants were received from the Department of Science and Technology during the year:

PLAN (Recurring & Non-Recurring)	Rs.3,350.00 lakhs
NON-PLAN (Recurring)	Rs. 180.00 lakhs
Total :	Rs. 3,530.00 lakhs

COUNCIL

Dr. K. Kasturirangan Chairman	Member, Planning Commission
Prof. P. K. Kaw	Director, Institute of Plasma Research Gandhinagar 382 428
Prof. V. Radhakrishnan	Member-Secretary Raman Research Institute Trust Bangalore 560 080
Dr.T.Ramasami	Secretary, Department of Science & Technology Ministry of Science & Technology New Delhi 110 016
Prof. Ravi Subrahmanyan	Director, Raman Research Institute Bangalore 560 080
Prof. O. Siddiqi	National Centre for Biological Sciences Tata Institute of Fundamental Research GKVK Campus, Bangalore 560 065
Mr. K.P. Pandian	Joint Secretary & Financial Adviser Ministry of Science & Technology Government of India, New Delhi 110 016
Prof. A.K. Sood	Physical & Mathematical Sciences Division Indian Institute of Science Bangalore 560012

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Prof. V. Radhakrishnan	Member-Secretary Raman Research Institute Trust Bangalore 560 080
Prof. Ravi Subrahmanyan	Director, Raman Research Institute Bangalore 560 080

STAFF

RAVI SUBRAHMANYAN
Director

V. RADHAKRISHNAN
Distinguished Professor Emeritus

THEORETICAL PHYSICS

Research
Abhishek Dhar (Coordinator)
B.R. Iyer
Joseph Samuel
Madan Rao
Madhavan Varadarajan
N. Kumar (Homi Bhabha Distinguished Professor)
Sumati Surya
Sanjib Sabhapandit (from 7.7.2008)

Research Associate
Supurna Sinha

Post-Doctoral Fellows
Subhashish Banerjee (upto 30.7.2008)
Abhishek Chaudhuri
Petros Wallden
Poonam Mehta
Ryuichi Fujita (from 8.4.2008)
Alok Laddha (from 16.9.2008)

Research Students
Abhijit Ghosh (upto 5.5.2008)
K.G. Arun (upto 25.1.2007)
G. Kripa
Rahul Marathe (upto 21.1.2009)
Siddhartha Sinha (*JAP*)*
Anupam Kundu
Chaitra Hegde (upto 3.6.2008)
Suva Roy (upto 18.7.2008)
Chandrakant Mishra (*JAP*)*
Pragya Srivastava
Anirban Polley
Anagha Datar

Secretary
G. Manjunatha

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* *Joint Astronomy Programme*

LIGHT AND MATTER PHYSICS

Research
Andal Narayan (Coordinator)
Sadiqali Rangwala
Hema Ramachandran
Reji Philip

Scientific/Technical
M.S. Meena

Post-Doctoral Fellow
Sunita Sharma (from 1.12.2008)

Secretary
S.Harini

Research Students
M. Anija (upto 19.12.2007)
Archana Sharma
Arijit Sharma
Nandan Satapathy
K. Ravi
Suchand Sandeep
Deepak Pandey
Seunghyun Lee
Tridib Ray
Shabeeb P.K. (from 1.7.2008)
Sijo Joseph (from 24.7.2008)

Visiting Scientists
R. Srikanth
R. Srinivasan

SOFT CONDENSED MATTER

Research
V.A.Raghunathan (Coordinator)
Sandeep Kumar
Arun Roy
V. Lakshminarayanan
R. Pratibha
Ranjini Bandyopadhyay
T.N. Ruckmongathan
Yashodhan Hatwalne
Pramod Pullarkat
B.K.Sadashiva (upto 31.12.2008)
(INSA senior Scientist)
K.A.Suresh (upto 30.6.2008)
N.V.Madhusudhana (INSA senior Scientist)

Scientific/Technical
Mohammed Ishaq
N. Ravi Sankar
A.R.Shashidhara
H.T.Srinivasa
H. Subrahmonyam
K.N.Vasudha
D.Vijayaraghavan
A. Dhason

Research Students
Tripta Bhatia
Alpana Nayak
Antara Pal
Bharat Kumar
Bibhuranjan Sarangi
Brindaban Kundu
Dibyendu Roy
Harikrishna Bisoyi
A. Jayakumar
D.H. Nagaraju
A.V. Radhakrishnan
Md. Arif Kamal
S. Radhika
S. Madhukar
Rajib Basak (from 29.7.2008)
Debasish Saha (from 18.7.2008)
Renu Vishavkarma (from 15.7.2008)
Santosh Gupta (from 14.7.2008)
Seshagiri Rao
P.R.Venkatramanan
Rakesh Kumar Pandey
Sajal Kumar Ghosh (upto 10.4.2008)
Satyam Kumar Gupta
P. Suresh Kumar

Post-Doctoral Fellows
Soma Datta
Meenal Gupta
Kavitha G (from 4.8.2008)

Secretary
K. Radhakrishna

ASTRONOMY & ASTROPHYSICS

Research
Udaya Shankar (Coordinator)
Anish Roshi
R. Bhandari
Biman B. Nath
A.A. Deshpande
Dipankar Bhattacharya (upto 31.5.08)
B. Ramesh
S. Sridhar
C.R. Subrahmanya
N. Udaya Shankar
Biswajit Paul
Shiv Kumar Sethi
V. Radhakrishnan (Distinguished Professor Emeritus)

Research Associate
Mousumi Das (upto 31.3.09)

Secretary
V. Vidyamani

Research Students
Suchana Seth (from 14.7.08)
Peeyush Prasad
Raju Ramakrishna Baddi
Ruta Kale
Shahram Amiri (upto 20.1.09)
Wasim Raja
Yogesh Maan (*JAP*)
Mamta Gulati (*JAP*)
Nishant Kumar Singh (*JAP*)
Kanhaiya Lal Pandey
Nipanjana Patra (*JAP*) (from 1.8.08)
Chandreyee Maitra (*JAP*) (from 1.8.08)
Kshitij Thorat (*JAP*) (from 1.12.08)
Harsha Raichur (upto 13.8.08)

Visiting Scientists
P. Sreekumar
Tarun Deep Saini
Vinod Krishan

RADIO ASTRONOMY LAB

Scientific/Technical
Biswajit Paul, *In-charge*
P.G.Ananthasubramanian
K. Chandrashekara
M.S.Ezhilarasi
B.S.Girish
M.R.Gopala Krishna
P.A. Kamini
S. Kasturi
S. Madhavi
C. Vinutha
Deepak Kumar (upto 31.12.08)
H.N. Nagaraja
T. Prabhu
K.B. Raghavendra Rao
A. Raghunathan
P.V. Rishin
P. Sandhya
G. Sarabagopalan
P.S. Sasi Kumar
R. Somashekar
S. Sujatha
T.S. Mamatha
K.S. Srivani

Visiting Scientist
A. Krishnan

Secretary
R. Mamatha Bai

GAURIBIDANUR TELESCOPE

Technical

H.A. Aswathappa

Support Staff

Bheema Naik
Gangaram
M. Muniyappa
Papanna
N. Raja Rao
R.P. Ramji Naik
Ranoji Rao
Shivarudraradhya
Thippanna
Venkataswamy
N.R. Srinath

MECHANICAL ENGINEERING SERVICES

C.M. Ateequalla, *In-charge*
M. Achankunju
L. Charles Paul
V. Dhamodharan
R. Durai Chelvan
R. Elumalai
K.O. Francis
V. Gokula Chandran
N. Gopal
G. Gopi
I. Henry (upto 15.4.08)
M. Mani
K.M. Mohandas
V.K. Muthu
V. Nagarajan
N. Narayanaswamy
T. Puttaswamy
D. Sunand
S. Sunderaj
M. Suresh Kumar
V. Venu

TRANSPORT

V. Jayaraman, *In-charge*
Abdul Khader

LIBRARY

Y.M. Patil, *Librarian*
S. Geetha
Girija Srinivasan
Hanumappa
Kiran P. Savanur
M. Manjunath
M.N. Nagaraj
Vrinda J. Benegal

Raju Varghese (Graphic Arts)

Support Staff

K. Chowdasetty
C. Elumalai

COMPUTERS

R. Nanda Kumar, *In-charge*
Jacob Rajan
B. Sridhar
Krishna Murthy S.

ADMINISTRATION

K. Krishnama Raju, *Admin. Officer*
K. Raghunatha, *Dy. Admin. Officer*
L.P. Kumar (upto 16.1.09)
Marisa D'Silva
K. Radha
S.R. Ramasubramaniyan
V. Raveendran
R. Ganesh
V.S. Shailaja
G.V. Indira

ACCOUNTS

P.V. Subramanya *(Accounts Officer)*
V. Raghunath

R. Ramesh (Internal Auditor)

M. Balarama
R. Jayaram
C.K.Mohanan
G. Prakash
Rahamath Pasha
G. Raja
M.K. Raju Kutty

ESTATES & BUILDINGS
G.B. Suresh, *Civil Engineer*
R. Sasidharan, *Supervisor*
R. Anantha Subba Rao*, Consultant*
S. Anantha Raman
K. Bhoopalan
D. Gangappa (upto 31.5.08)
Gunashekar
C. Haridas
K. Palani
M. Rajagopal
C. Sampath
K.N. Srinivas
K.G. Narasimhalu
T. Subramaniyam Naidu
M. Ramesh

PURCHASE
S. Srinivasa Murthy, *Purchase Officer*
B. Srinivasa Murthy
Prema

STORES
C.N. Ramamurthy, *In-charge*
M.V. Subramanyam

AMENITIES (Guest Houses & Hostels)
C.V. Bhargavan (upto 31.1.09)
Mangala Singh
Muniratna
T. Naganna
N. Narayanappa, *In-charge*
D.B. Padmavathy
P.C. Prabhakar
N. Puttaswamy

MEDICAL
Consultant Paediatrician
Dr. M.R. Baliga

Consultant Physician
Dr. B.V. Sanjay Rao

Technician
R. Shanthamma

UPKEEP
Hanumantha
Jayamma
K.N. Kawalappa
D. Krishna
C. Lakshmamma
T. Mahadeva
T. Murali
Narayana
A. Ramanna
Ranjithamma
A. Sarojamma (upto 30.4.09)
Sidde Gowda
V. Venkatesh
M. Venkateshappa

HORTICULTURE
Bylappa
Govind K. Kundagol
Lingegowda
Marappa
D. Muniraja
S. Muniraju

D. Mahalinga
Mailarappa
Varalakshmi
Rahamathulla Khan
Rangalakshmi

SECURITY

V. Jayaraman, *In-charge*
B.M. Basavarajaiah
U.A. Earappa
H. Gangaiah
Joseph Kunjachan (upto 31.3.09)
Keshavamurthy
Suresha
K. Krishnappa
Munihobalaiah
K. Pushparaj
O.M. Ramachandra
G. Ramakrishna
M. Sannaiah
H. Vaderappa

Consultants

K. Balaji
S. Nagaraja
Ganapathy C.N. (from 1.10.2008)

V I S I T O R S

R.V. Mehta, R.J. Patel and Bhupendar Chudasama Department of Physics Bhavnagar University Gujarat	13-20 April 2008
Apoorva Nagar Korea Institute of Advanced Study Seoul, Korea	15 April 2008
Chirag Kalelkar University of Maryland USA	17 April 2008
D. Narasimha Tata Institute of Fundamental Research Mumbai	21-30 April 2008
Siddharth Malu Inter-University Center for Astronomy and Astrophysics Pune	24 April-8 May 2008
Arun Paramekanti University of Toronto Canada	29 April 2008
V. Sai Muthukumar Sri Sathya Sai Institute of Higher Learning Puttaparthy	2-31 May 2008
Tirthabir Biswas Penn State University USA	13-14 May 2008
Vinod Chandra Indian Institute of Technology Kanpur	15-31 May 2008
Arun Jayannavar Institute of Physics Bhubaneswar	18-23 May 2008

Keiji Saito University of Tokyo Japan	18-27 May 2008
Ishwara Chandra National Centre for Radio Astronomy Pune	19-28 May 2008
David Finkelstein Georgia Institute of Technology USA	19 May 2008
Ajit Srivastav Institute of Physics Bhubaneswar	21-24 May 2008
Pranesh A. Sundararajan Massachussetts Institute of Technology Cambridge, USA	29-30 May 2008
N. Narayanan Cochin University of Science and Technology Cochin	4-8 June 2008
Romila Thapar Jawaharlal Nehru University New Delhi	5-8 June 2008
Suchetana Chatterjee University of Pittsburg USA	12-13 June 2008
Pinaki Chauduri Laboratoire des Colloides Verres et Nanomateriaux Universite Montpellier II Montpellier, France	17 June 2008
R. Cowsik Washington University USA	2 July-13 August 2008
A.R.P. Rau Lousiana State University USA	7-10 July 2009

Dinesh Somanah Mauritius Radio Telescope Mauritius	15-28 July 2008
Muru Venkatapathi Purdue University USA	17-18 July 2008
Alak Ray Tata Institute of Fundamental Research Mumbai	17-23 July 2008 20-28 February 2009
Manjari Bagchi Tata Institute of Fundamental Research Mumbai	17-22 July 2008 21-26 February 2009
Soumya Mohanty The University of Texas at Brownsville USA	20-22 July 2008
Divya Sharma University of Strasburg France	20-27 July 2008
A.V. Ravi Kumar Institute of Plasma Research Bhat, Ghandinagar Gujarat	22-27 July 2008
B. Karthikeyan National Institute of Technology Trichy	25-27 July 2008 15-18 November 2008
Anders Kastberg Umea University Sweden	29 July-27 August 2008
Parameswaran Simon Fraser University Canada	29-31 July 2008
Ramesh Sharma University of New Haven USA	4-5 August 2008
Saikat Ghosh Massachussetts Institute of Technology USA	7-8 August 2008

Joseph Silk University of Oxford USA	7-10 August 2008
Deepak Mathur Tata Institute of Fundamental Research Mumbai	11-12 August 2008
Sucismita Chutia Universite Paris France	17-21 August 2008
Dibyendu Das Indian Institute of Technology Mumbai	20-22 August 2008
Ali Shakouri University of California USA	22 August 2008
Mukunda P. Das The Australian National University Australia	1-6 September 2008
Subhashish Bannerjee Institute of Mathematical Sciences Chennai	4-6 September 2008
Haida Liang Nottingham Trent University United Kingdom	15-22 September 2008
Boris Deshev Kaptyen Astronomical Institute Groningen	18 September-8 October 2008
Thomas Martinsson Kaptyen Astronomical Institute Groningen	18 September-8 October 2008
Marc Verheijen Kaptyen Astronomical Institute Groningen	18 September-8 October 2008
Sunita Sharma Guru Jambeshwar Univ. of Science and Technology Haryana	22-24 September 2008

Chandreyee Sengupta National Center for Radio Astronomy Pune	24-27 September 2008 16-23 February 2009
Subhadeep De Kernfysish Versneller Institute The Netherlands	29 September-1 October 2008
Sandeep Kumar Jawaharlal Nehru University New Delhi	5-13 October 2008
J. Ray Chaudhuri Katwa College Katwa, Burdwan	14-24 October 2008
Raj Gandhi Harish-Chandra Research Institute Allahabad	15-18 October 2008
Hideo Takezoe Tokyo Institute of Technology Japan	17 October 2008
Onkar Pannikar Birla Institute of Technology & Science Pilani, Goa	22-23 October 2008
Alexander Petrov Institute of Solid State Physics Bulgarian Academy of Sciences Sofia	28 October 2008
George Pabst Institute of Biophysics and Nanosystems Research Austrian Academy of Sciences Austria	26 November-9 December 2008
Shreyas Potnis Indian Institute of Technology Mumbai	30 November-10 December 2008
Fay Dowker Imperial College London	8-14 December 2008

Subir Sarkar University of Oxford United Kingdom	14-15 December 2008
Michele Leduc Directrix IFRAF, France	16-19 December 2008
Alain Omont Institut d' Astrophysique de Paris France	17-19 December 2008
Somnath Bharadwaj Indian Institute of Technology Khagrapur	18-19 December 2008
Fabienne Goldforb and Fabienne Bretenaker LAC, France	21-24 December 2008
Anantha Ramakrishna Indian Institute of Science Education and Research Punjab	21-24 December 2008
Arun Paramekanti University of Toronto Canada	22 December 2008-23 January 2009
Punkaj Jain Indian Institute of Technology Kanpur	24-25 December 2008
Bryan E. Penprase Pomona College Claremont, USA	2-15 January 2009
Vikram Soni National Physical Laboratory New Delhi	6-16 January 2009
Ramanpreet Kaur Aryabhatta Research Institute of Observational Science Nainital	11 January-10 March 2009

Deepak Dhar Tata Institute of Fundamental Research Mumbai	18-19 January 2009
Gautam Menon Institute of Mathematical Sciences Chennai	19 January 2009
G. Santhosh Institute of Mathematical Sciences Chennai	19-21 January 2009
Dwaipayan Chakrabarti University of Cambridge United Kingdom	23 January 2009
Aparna Baskaran Institute of Mathematical Sciences Chennai	1-5 February 2009
G. Baskaran Institute of Mathematical Sciences Chennai	5-8 February 2009
G. Swarup National Center for Radio Astronomy Pune	14-17 February 2009
Arindam Kundagrami University of Massachusetts Amherst, USA	17 February 2009
Machael Elbaum Weizmann Institute of Science Israel	19 February 2009
G. Werth University of Mainz Germany	20 February-12 March 2009
Mariano Mendez University of Groningen The Netherlands	25-28 February 2009
Jeff Peterson Carnegie Mellon University USA	26 February-2 March 2009

Kartik Ghorakavi University of Michigan USA	1-3 March 2009
Harsha Raichur Inter-University Center for Astronomy and Astrophysics Pune	1-14 March 2009
John H. Ipsen Centre for Biomembrane Physics University of Southern Denmark Denmark	2-4 March 2009
P.B. Sunil Kumar Indian Institute of Technology Madras	2-4 March 2009
Satya N. Majumdar CNRS, France	4-8 March 2009
Diego Altamirano Astronomical Institute The Netherlands	5-8 March 2009
Gabriel Dutier University of Paris France	16-22 March 2009
Subhashish Bannerjee Institute of Mathematical Science Chennai	18-22 March 2009
Tapas K. Das Harischandra Research Institute Allahabad	21-26 March 2009

ANNEXURE I

PUBLICATIONS DURING 2008-2009

Papers in Journals

1 Orbital phase spectroscopy of four high mass X-ray binary pulsars to study the stellar wind of the companion
Naik, Sachindra*; Mukherjee U*; Paul, Biswajit; Choi C S*
Advances in Space Research **43**, 900, 2009

2 Multiwavelength study of the bright X-ray source population in the interacting galaxies NGC 5774/NGC 5775
Ghosh K K*; Saripalli, Lakshmi; Gandhi P*; Foellmi C*; Gutierrez C M*; Lopez-Corredoira M*
Astronomical Journal **137**, 3263, 2009

3 Detection of the H92α recombination line from the starbursts in the Circinus galaxy and NGC 1808
Roy A L*; Goss W M*; Anantharamaiah K R
Astronomy and Astrophysics **483**, 79, 2008

4 A circumnuclear disk of atomic hydrogen in Centaurus A
Morganti R*; Oosterloo T*; Struve C*; Saripalli, Lakshmi
Astronomy and Astrophysics **485**, L5, 2008

5 A study of the long-term evolution of quasi-periodic oscillations in the accretion-powered X-ray pulsar 4U 1626-67
Kaur, Ramanpreet*; Paul, Biswajit; Kumar, Brijesh*; Sagar, Ram*
Astrophysical Journal **676**, 1184, 2008

6 On the relationship between a giant radio galaxy MSH 05-22 and the ambient large-scale galaxy structure
Subrahmanyan, Ravi; Saripalli, Lakshmi; Safouris, Vicky*;Hunstead, Richard W*
Astrophysical Journal **677**, 63, 2008

7 A search for 6.7 GHz methanol masers in M33
Goldsmith, P F*; Pandian J D*; Deshpande A A
Astrophysical Journal **680**, 1132, 2008

8 Dust sputtering by reverse shocks in supernova remnants
Nath, Biman B; Laskar, Tanmoy*; Shull, J Michael*
Astrophysical Journal **682**, 1055, 2008

9 Quasi-periodic oscillations in Cen X-3 and the long-term intensity variations
Raichur, Harsha; Paul, Biswajit
Astrophysical Journal **685**, 1109, 2008

10 Chandra observations of nuclear X-ray emission from low surface brightness galaxies
Das Mousumi; Reynolds C S*; Vogel S N*; McGaugh S S*; Kantharia N G*
Astrophysical Journal **693**, 1300, 2009

11 Variation of bar strength with central velocity dispersion in spiral galaxies
Das, Mousumi; Laurikainen E*; Salo H*; Buta R*
Astrophysics and Space Science **317**, 163, 2008

12 Viscosity and thermodynamic properties of QGP in relativistic heavy-ion collisions
Chandra, Vinod*; Ravishankar V
European Physical Journal C **59**, 705, 2009

13 Surface adjustment of the IRAM 30 m radio telescope
Morris D; Bremer M*; Butin G*; Carter M*; Greve A*; Lamb J W* ; Lazareff B*; Mattiocco F*; Penalver J*; Thum C*
IET Microwaves, Antennas and Propagation **3**, 99, 2009

14 The thickness of HI in galactic discs under Modified Newtonian Dynamics: theory and application to the galaxy
Sanchez-Salcedo F J*; Saha K; Narayan C A*
Monthly Notices of the Royal Astronomical Society **385**, 1585, 2008

15 Mean-field dynamo in partially ionized plasmas - I
Krishan, Vinod+; Gangadhara R T*
Monthly Notices of the Royal Astronomical Society **385**, 849, 2008

16 Multiwavelength study of the transient X-ray binary IGR J01583+6713
Kaur, Ramanpreet*; Paul, Biswajit; Kumar, Brijesh*; Sagar, Ram*
Monthly Notices of the Royal Astronomical Society **386**, 2253, 2008

17 Primordial magnetic fields and formation of molecular hydrogen
Sethi S K; Nath, Biman B; Subramanian, Kandaswamy*
Monthly Notices of the Royal Astronomical Society **387**, 1589, 2008

18 Long-term flux variations in Cen X-3: clues from flux-dependent orbital modulation and pulsed fraction
Raichur, Harsha; Paul, Biswajit
Monthly Notices of the Royal Astronomical Society **387**, 439, 2008

19 Dynamical friction of radio galaxies in galaxy clusters
Nath, Biman B
Monthly Notices of the Royal Astronomical Society **387**, L50, 2008

20 Hard electron energy distribution in the relativistic shocks of gamma-ray burst afterglows
Resmi L; Bhattacharya, D
Monthly Notices of the Royal Astronomical Society **388**, 144, 2008

21 MRCB0319-454: probing the large-scale structure with a giant radio galaxy
Safouris V*; Subrahmanyan, Ravi; Bicknell G V*; Saripalli, Lashmi
Monthly Notices of the Royal Astronomical Society **393**, 2, 2009

22 Chandra and XMM-Newton observations of the low-luminosity X-ray pulsators SAX J1324.4-6200 and SAX J1452.8-5949
Kaur R*; Wijnands R*; Patruno A*; Testa V*; Israel G*; Degenaar N*; Paul, Biswajit; Kumar, Brijesh*
Monthly Notices of the Royal Astronomical Society **394**, 1597, 2009

23 Optical observations of GRB 050401 afterglow : a case for double-jet model
Kamble, Atish; Misra, Kuntal*; Bhattacharya D; Sagar, Ram*
Monthly Notices of the Royal Astronomical Society **394**, 214, 2009

24 Physical and chemical conditions in methanol maser selected hot cores and UCH II regions
Purcell C R*; Longmore S N*; Burton M G*; Walsh A J*; Minier V*; Cunninghan M R*; Balasubramanyam R
Monthly Notices of the Royal Astronomical Society **394**, 323, 2009

25 Cancellation of simple optical anisotropies without use of a Faraday mirror
Bhandari R
Optics Letters **33**, 1839, 2008

26 Transpose symmetry of the Jones matrix and topological phases
Bhandari R
Optics Letters **33**, 854, 2008

27 An optical limiter based on ferrofluids
Nair, Swapna S*; Thomas, Jinto*; Sandeep, C S Suchand; Anantharaman M R* ; Philip, Reji
Applied Physics Letters **92**, 171908, 2008

28 Structural and nonlinear optical properties of self-assembled SnO_2-doped silicon nanorings formed by pulsed laser ablation
Rani J R*; Pillai, V P Mahadevan*; Sandeep, C S Suchand; Philip, Reji
Electrochemical and Solid-State Letters **11**, K73, 2008

29 Optical properties and ultrafast optical nonlinearity of Yb^{3+}doped sodium borate and bismuthate glasses
Karthikeyan B*; Sandeep, C S Suchand; Cha, Jaemine*; Takebe, Hiromichi*; Philip, Reji; Mohan S*
Journal of Applied Physics **103**, 103509, 2008

30 Fluorescent glass embedded silver nanoclusters: An optical study
Karthikeyan B
Journal of Applied Physics **103**, 114313, 2008

31 Fine structure in spatial self-phase modulation patterns: at a glance determination of the sign of optical nonlinearity in highly nonlinear films
Lucchetti L*; Suchand, Sandeep C S; Simoni F*
Journal of Optics A: Pure and Applied Optics **11**, 34002, 2009

32 Some directions beyond traditional quantum secret sharing
Singh, Sudhir Kumar* ; Srikanth R
Physica Scripta **77**, 065007, 2008

33 Electric-field-induced change of the alkali-metal vapor density in paraffin-coated cells
Kimball, D F Jackson*; Nguyen, Khoa*; Ravi K; Sharma, Arijit; Prabhudesai V S*; Rangwala S A*; Yashchuk V V*; Balabas M V*; Budker D*
Physical Review A **79**, 032901, 2009

34 Gödel incompleteness and the black hole information paradox
Srikanth R ; Hebri, Srikanth*
Quantum information processing **7**, 291, 2008

35 Optimization of the display parameters of a room temperature twisted nematic display material by doping single-wall carbon nanotubes
Dhar, Ravindra*; Pandey A S*; Pandey M B*; Kumar, Sandeep; Dabrowski R*
Applied Physics Express **1**, 121501, 2008

36 Thermodynamic, optical and dielectric studies of the homologous members of columnar discotic compound Rufigallol hexa-n-alkoxylates
Dhar R*; Kumar, Sandeep; Gupta M*, Agrawal V K*
Journal of Molecular Liquids **141**, 19, 2008

37 Characteristic dielectric parameters of columnar discotic hexa-n-alkoxyanthraquinones*,
Gupta M*, Agrawal V K*, Kumar, Sandeep
Phase Transitions **81**, 459, 2008

38 V-shaped electro-optic response observed in a chiral ferroelectric smectic liquid crystal
Manjuladevi V* ; Panarin Yu P* ; Song, Jang-Kun* ; Vij J K* ; Sadashiva B K
Applied Physics Letters **93**, 093507, 2008

39 An osmoregulatory basis for shape oscillations in regenerating hydra
Kucken, Michael*; Soriano, Jordi*; Pramod P A; Ott, Albrecht*; Nicola, Ernesto M*
Biophysical Journal **95**, 978, 2008

40 Mechanogenetic coupling of hydra symmetry breaking and driven Turing instability model
Soriano, Jordi*; Rudiger, Sten*; Pullarkat, Pramod; Ott Albrecht*
Biophysical Journal **96**, pp.1649, 2009

41 Stabilization of Langmuir monolayer of hydrophobic thiocholesterol molecules
Gupta, Raj Kumar ; Suresh K A
Colloids and Surfaces A: Physicochemical and Engineering Aspects **320**, 233, 2008

42 Influence of smectic liquid crystals on the Poisson-Boltzmann distribution of ions near charged surfaces
Roy, Arun ; Madhusudana N V
Europhysics Letters **84**, 36006, 2008

43 Unusual odd-even effects depending on the monomer chain length in nematic liquid crystals made of rod-like dimers
Kundu, Brindaban; Pal, Santanu Kumar; Kumar, Sandeep; Pratibha R; Madhusudana N V
Europhysics Letters **85**, 36002, 2009

44 Occurrence of transition between lamellar antiferroelectric and columnar ferroelectric phases in achiral seven-ring bent-core compounds derived from 5-methoxyisophathilic acid
Radhika S; Sadashiva B K; Raghunathan V A
Ferroelectrics **364**, 20, 2008

45 Mesh phases of surfactant-water systems
Raghunathan V A
Journal of the Indian Institute of Science, **88**, 197, 2008

46 Trapezoidal and triangular waveform profiles for reducing power dissipation in liquid crystal displays
Govind M*; Ruckmongathan T N
Journal of Display Technology **4**, 166, 2008

47 Power dissipation in multi-line addressed liquid-crystal displays
Saxena, Avi*; Ruckmongathan T N
Journal of Display Technology **4**, 204, 2008

48 Low power techniques for gray shades in liquid crystal displays
Ruckmongathan T N
Journal of Display Technology **5**, 49, 2009

49 Scanning matrix displays with wavelets
Ruckmongathan T N
Journal of Display Technology **5**, 86, 2009

50 Electrocatalytic studies of cytochrome *c* functionalized single walled carbon nanotubes on self-assembled monolayer of 4-ATP on gold
Nagaraju D H; Pandey, Rakesh K; Lakshminarayanan V
Journal of Electroanalytical Chemistry **627**, 63, 2009

51 Carbon nanotubes in triphenylene and rufigallol-based room temperature monomeric and polymeric discotic liquid crystals
Bisoyi, Hari Krishna; Kumar, Sandeep
Journal of Materials Chemistry **18**, 3032, 2008

52 Electrical conductivity studies on discotic liquid crystal-ferrocenium donor-acceptor systems
Kumar, P Suresh; Kumar, Sandeep; Lakshminarayanan V
Journal of Physical Chemistry B **112**, 4865, 2008

53 Mechanical properties of Langmuir-Blodgett films of a discogen-DNA complex by atomic force microscopy
Nayak, Alpana; Suresh K A
Journal of Physical Chemistry B **113**, 3669, 2009

54 Conoscopy of chiral smectic liquid crystal cells
Song, Jang-Kun*; Vij J K*; Sadashiva B K
Journal of the Optical Society of America A **25**, 1820, 2008

55 Electrochemical synthesis of thiol-monolayer-protected clusters of gold
Nagaraju D H; Lakshminarayanan V
Langmuir **24**, 13855, 2008

56 Structure of mesh phases in cationic surfactant systems with strongly bound counterion: Influence of the surfactant headgroup and the counterion
Ghosh, Sajal Kumar; Raghunathan V A
Langmuir **25**, 2622, 2009

57 Novel mesogenic azobenzene dimer at air-water and air-solid interfaces
Kumar, Bharat; Prajapati A K*; Varia M C*; Suresh K A
Langmuir **25**, 839, 2008

58 Liquid crystalline banana-shaped monomers derived from 2,7-naphthalene: synthesis and properties
Rahman M L*; Asik, Jahimin*; Kumar, Sandeep; Tschierske C*
Liquid Crystals **35**, 1263, 2008

59 Novel triphenylene-based ionic discotic liquid crystalline polymers
Pal, Santanu Kumar; Kumar, Sandeep
Liquid Crystals **35**, 381, 2008

60 Synthesis and characterisation of novel rod-disc oligomers
Pal, Santanu Kumar; Kumar, Sandeep; Seth, Jhumur*
Liquid Crystals **35**, 521, 2008

61 Room-temperature electron-deficient discotic liquid crystals: facile synthesis and mesophase characterization
Bisoyi, Hari Krishna; Kumar, Sandeep
New Journal of Chemistry **32**, 1974, 2008

62 Microwave-assisted facile synthesis of discotic liquid crystalline symmetrical donor-acceptor-donor triads
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Synthetic Metals

31 Enhanced Optical Nonlinearity of Polyaniline-Porphyrin nanocomposite
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The Low-Frequency Radio Universe ASP Conference Series, Vol. LFRU, 2009
Eds: D.J. Saikia, Dave Green, Y. Gupta and Tiziana Venturi

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The Low-Frequency Radio Universe, ASP Conference Series, Dec. 7-11, 2008

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XXIX URSI General Assembly, 2008

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Ramanandan, Gopika*; Dharmadhikari, Aditya K*; Ramachandran, Hema; Dharmadhikari, Jayasree A*; Mathur, Deepak*
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Sharma, Sunita; Mohan, Devendra*; Nasa, Vandana*; Ghoshal S.K.*
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17 Ultrafast light transmission behavior of surface plasmon excited Maxwell-Garnet type Ag nanocomposite polymer
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18 Optical and nonlinear optical properties of Co-doped ZnO nanostructures
Karthikeyan, Balasubramanian*; Sandeep Suchand; Philip Reji
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19 An Optical Limiter Based on Ferrofluids
Nair , Swapna*; Jinto Thomas*; Sandeep, Suchand C.S.; Anantharaman M R*; Philip, Reji
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20 An efficient numerical calculation of gravitational waves from extreme mass ratio inspirals
Fujita, Ryuichi; Hikida, Wataru*; Tagoshi, Hideyuki*
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J. Phys.; Conf. Ser. 154, 012052, 2009

21 Bound geodesics in Kerr space time
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2 Hubble's menagerie of galaxies
Nath, B B
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4 Fun With Beads and Number Patterns
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5 Like mother, like daughter
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Lilavati's Daughters
The Women Scientists of India
Indian Academy of Sciences, Bangalore

6 Multipolar Post Minkowskian and Post Newtonian Toolkits for Gravitational Radiation
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7 Microwaves only for novel discotic LC trimers
Gupta, Satyam Kumar; Raghunathan V A; Kumar, Sandeep
New J. Chem., 2008

***** denotes co-authors who do not belong to RRI
+ denotes Visitng Professors of RRI

Annexure II

CONFERENCES ATTENDED

Name	Conferences attended / Institutions visited	Title of paper / talk
Abhishek Dhar	Indo-Belgian Symposium on statistical physics of small systems, Indian Institute of Technology, Madras Chennai 9-10 November, 2008	Green-Kubo formula for open systems (*Invited*)
	International Conference on Non-Hermitian Hamiltonians in quantum physics, Bhabha Atomic Research Centre, Mumbai 12-16 January 2009	Scattering of electrons from an interacting region (*Invited*)
	Workshop on heat conduction in low-dimensional systems, International Centre for Theoretical Sciences, Bangalore 19 March 2009	Green-Kubo formula for open systems
	Frontiers and directions in condensed matter physics, Indian Institute of Science Bangalore 25-29 May 2009	Heat conduction and phonon localization in disordered harmonic lattices (*Invited*)
	Tata Institute of Fundamental Research, Mumbai 29 September 2008	Green-Kubo formula for open systems
	Jawaharlal Nehru Centre for Advanced Research, Bangalore 19 November 2008	Green-Kubo formula for open systems
	Indian Institute of Science, Bangalore 20 February 2009	Fourier's law and the understanding of heat conduction

Abhishek Dhar (*contd.*)	Pune University 2 March 2009	Fourier's law and the understanding of heat conduction
Anagha Datar	Mahabaleshwar Seminar Series: 'Mechanosignalling in Cell & Developmental Biology' NCBS, 14-17 February 2009	
Andal Narayan	International Conference on Atomic Physics 2008, University of Connecticut, USA. 28 July - 3 August 2008	Threshold Zeeman transitions in Rubidium.
	Indo-French P2R meeting, Tata Institute of Fundamental Research, Mumbai 10-14 December 2008	Non-linear transitions in Zeeman degenerate systems (*Invited*)
	International Conference on Cold Atoms, Indian Institute of Science Education and Research, Kolkata December 2008	Steady State Fluctuations of cold atoms in optical lattices (*Invited*)
	Tata Institute of Fundamental Research, Mumbai 18-23 April 2008	Coherent atom photon interaction: A two way quantum correlator
Anish Roshi	Radio Astronomy Centre, Ooty July and August 2008	Murchison Widefield Array – RRI's commitment
	MWA project meeting Boston, USA 28 June 2008	Status of MWA digital receiver work
Anupam Kundu	Bangalore Area Statistical Mechanics Meeting 2008 Fireflies, Bangalore 9-10 March 2009	Heat conduction and phonon localization in disordered harmonic crystals

Anupam Kundu (*contd.*)	Workshop on Heat Conduction in Low Dimensional Systems, International Centre for Theoretical Sciences, Bangalore 15-21 March 2009	Heat conduction and phonon localization in disordered harmonic crystals
Arijit Sharma	Indo-French Workshop on cold atoms, Tata Institute of Fundamental Research, Mumbai December 2008	
	International Conference on Cold Atoms, Indian Institute of Science Education and Research, Kolkata 10-14 December 2008	Electric field induced effects on paraffin-coated cells
Arun Roy	Conference on mesogenic and ferroic materials, Banaras Hindu University Varanasi 9-11 January 2009	Influence of smectic liquid crystals on the Poisson-Boltzmann distribution of ions near charged surfaces (*Invited*)
	Winter school on Nanoparticles-science and technology National Institute for Technology, Durgapur 14 January 2009	Experimental studies on the transient fluctuation theorem using liquid crystals (*Invited*)
Ateequlla C.M.	XXIX General Assembly of the International Union of Radio Science, Chicago, USA August 2009	Design and development of a 12m preloaded parabolic dish antenna
	National Workshop on the Design of Antenna & Radar System, ISRO Telemetry, Tracking and Command Network, Bangalore 13-14 February 2009	Photogrammetry measurements of a 12m preloaded parabolic dish antenna
Bharat Kumar	Conference on Disorder, Complexity and Biology II, Banaras Hindu University, Varanasi 5-8 January 2009	Star shaped mesogens at interfaces

Bharat Kumar (*contd.*)	15th National conference on Liquid Crystals, Indian Institute of Science, Bangalore 13-15 October 2008	Amphiphilic dimmers of disk shaped molecules at interfaces
Biman Nath	10th Asia-Pacific Regional International Astronomical Union Meeting, Chinese Astronomical Society, and Yunnan Astronomical Observatory, Kunming, China 3-6 August 2008	Active galaxies and galaxy clusters (*Invited)*
	Coorg Meeting on the intergalactic medium Coorg 30 Nov-4 Dec 2008	Galactic winds: a different approach (*Invited*)
	Workshop on radiation matter interactions under extreme conditions, Banaras Hindu University, Varanasi 19-20 December 2008	Radiation-matter interaction in galaxy clusters (*Invited*)
	Seminar on Universalizing the Universe, Indian Institute of Astrophysics, Bangalore 4 April 2008	Scientists and science writing
Biswajit Paul	Astrophysics with All-Sky X-Ray Observations - 3rd International MAXI Workshop, , Rikagaku Kenkyuju University and Japan Aerospace Exploration Agency, Japan 10-12 June 2008	ASTROSAT observations of variable X-ray sources: together with MAXI
	37th COSPAR Scientific Assembly, ICSU, Montreal, Canada 13-20 July 2008	
	7th Micro-quasar Workshop, Sabanchi University, Istanbul Turkey 1-5 September 2008	Micro-quasar observations with ASTROSAT

Biswajit Paul (*contd.*)	High-energy sources at different time scales, Italian Space Agency and the Data Centre, Kathmandu, Nepal 29 September-4 October 2008	QPOs as probe of accretion process in high magnetic field pulsars
	Two workshops on X-ray Timing with ASTROSAT and Broadband X-ray Spectroscopy with ASTROSAT, IUCAA, Pune October 2008 and February 2009	Delivered six lectures in these workshops and schools on various topics.
	X-ray Astronomy School February 2009	
	Indo - South Africa Workshop on Astronomy, ARIES, Nainital 30 October - 1 November 2008	1.Upcoming X-ray observing f acilities in India: ASTROSAT and beyond 2.Multi-wavelength observations of X-ray selected variable sources
	Workshop on Advances in Observational Astronomy, Mahatma Gandhi University, Kottayam 1-3 December 2008	1.Introductory X- ray Astronomy 2.X-ray Astronomy Programmes in India 3.Studying extreme conditions in the universe: ASTROSAT and future programmes
	Workshop on radiation matter interaction under extreme conditions, Banaras Hindu Unviersity, Varanasi 19-20 December 2008	
	Indian Science Congress North Eastern Hill University, Shillong 3-7 January 2009	Discussion on Future of Indian Astronomy

Biswajit Paul (*contd.*)	National Frontier of Science Meeting Indian National Science Academy, New Delhi 21-22 January 2009	Indian efforts in X-ray astronomy: ASTROSAT and beyond
	Annual Meeting of Directors and Scientists of DST Institutions, International Advanced Research Centre For Powder Metallurgy and New Materials, Hyderabad 17-18 January 2009	Study of Extreme Physical Phenomena in the Universe with X-rays
Brindaban Kundu	22nd International Liquid Crystal Conference, Seoul National University, Jeju, Korea 29 June-4 July 2008	1.Anomalous temperature dependence of the bend elastic constant K33 in mixtures of rod-like and bent-core molecules 2.Experimental determination of the order parameters and flexoelectric coefficients in the nematic phase of mixtures of rod-like and bent-core molecules 3.Physical studies on liquid crystals with dimeric molecules
	Japanese-Italian Workshop on Liquid Crystals, Nara, Japan 7-9 July 2008	1.Experimental determination of the order parameters and flexoelectric coefficients in the nematic phase of mixtures of rod-like and bent-core molecules 2.Physical studies on liquid crystals with dimeric molecules

Brindaban Kundu (*contd.*)	Conference on Mesogenic and Ferroic Materials, Banaras Hindu University, Varanasi 9-11 January 2009	Unusual odd-even effects depending on the monomer chain length in nematic liquid crystals made of rod-like dimmers
	Hyderabad Central University, School of Physics 7-17 May 2009	Anomalous temperature dependence of elastic constants in the nematic phase of binary mixtures made of rodlike and bent-core molecules
Chandra Kant Mishra	International Symposium on Experimental Gravitation 2009 Kochi, Kerala 5-9 January 2009	
	The 25th Indian Association for General Relativity and Gravitation meeting Saha Institute of Nuclear Physics, Kolkata 28-31 January 2009	Third Post-Newtonaian head-on collision of compact objects: gravitational energy flux and wave forms
Deepak Pandey	Indo-French Workshop Tata Institute of Fundamental Research, Mumbai 9-14 December 2008	
Dhason A	16th National Seminar on Application of New Sealing Technique for special types of glasses, Indian Institute of Science, Bangalore 29-30 December 2008	Atomic force microscope study of glass surfaces after etching with HF and alumina polish
	Special Sealing Techniques for quartz with tungsten, Indian Institute of Science, Bangalore 26-27 December 2008	
Durai Chelvan	XXIX General Assembly of the International Union of Radio Science, Chicago, USA August 2009	Design and development of a 12m preloaded parabolic dish antenna

Durai Chelvan (*contd.*)	National Workshop on the Design of Antenna & Radar System, ISRO Telemetry, Tracking and Command Network, Bangalore 13-14 February 2009	Photogrammetry measurements of a 12m preloaded parabolic dish antenna
	Astronomical Society of India Meeting, Indian Institute of Astrophysics, Bangalore, 18-20 February 2009	Development of X-ray Polarimeter
Dwarakanath K.S.	The Low-Frequency Radio Universe, National Centre for Radio Astronomy, Pune 8-12 December 2008	Steep-spectrum sources in the VLA 74 MHz survey
Geetha S.	Astronomical Society of India Meeting, Indian Institute of Astrophysics, Bangalore 19-20 February 2009	FORSA new initiatives
	Conference on Scholarly Communication in India in the age of the Commons, National Aerospace Laboratories Bangalore, 26 March 2009	
Girija S.	Astronomical Society of India Meeting, Indian Institute of Astrophysics, Bangalore, 19-20 February 2009	
Girish B.S.	27th Meeting of the Astronomical Society of India, Indian Institute of Astrophysics, Bangalore, 18-20 February 2009	
Hari Krishna Bisoyi	22nd International Liquid Crystal Conference, Seoul National University, Jeju, Korea 29 June-4 July 2008	1. Molecular engineering of room-temperature electron-deficient discotic liquid crystals 2.Carbon nanotubes in the supramolecular order of novel room-temperature liquid crystalline discotic monomers and polymers

Hari Krishna Bisoyi (*contd.*)	15th National conference on liquid crystals, Indian Institute of Science, Bangalore 13-15 October 2008	Molecular engineering of room-temperature electron-deficient discotic liquid crystals
	International Conference on Functional Material-2008, Indian Institute of Technology, Chennai 27-29 November 2008	Carbon nanotubes in supramolecular order of novel room-temperature liquid crystalline discotic monomers and polymers
	Shinsu University, Ueda, Japan 5-7 July 2008	Fourth form of carbon in the fourth state of matter
Hema Ramachandran	UM-DAE Centre for Excellence in basic Sciences, Mumbai March 2009	Towards absolute zero using lasers
	53rd DAE Solid State Physics Symposium, , Bhabha Atomic Research Centre 16-20 December 2008	Some new results on light scattering in random media-levy statistics and light localization (*Invited*)
	PRR Indo-French Meeting, Tata Institute of Fundamental Research, Mumbai December 2008	Localisation of light in ferrofluids by magnetically tuned correlated disorder (*Invited*)
	Discussion meeting on Quantum Computation, Institute of Mathematical Sciences, Chennai 1 December 2008	Quantum walks and quantum logic gates with cold atoms (*Invited)*
	Laboratoire Amie Cotton, Orsay, France July 2008	
	Centre for Excellence in Basic Sciences, Mumbai March 2009	Towards absolute zero using lasers
Iyer B.R.	Post Newton 2008, International Conference, Friedrich-Schiller Universitat, Jena, Germany, 12 June 2008	Gravitational waves from inspiralling compact binaries in quasi-elliptical orbits - A ready reckoner (invited)

Iyer B.R (*contd.*)	7th International LISA Symposium, Institut d'Estudis Espacials de Catalunya (IEEC) Barcelona 16-20 June 2008	1.3PN gravitational wave polarisations from inspiralling compact binaries 2.LISA as a dark energy probe
	Institut hautes etudes scientifiques, Bures Sur Yvette,France 1 June-30 June 2008 1 September-30 November 2008	
	Greco, Institut d' Astrophysique, Denfert Rochereau, France 1 September–30 November 2008	
	Gravitational Physics group, Cardiff University, United Kingdom 6 February 2009	Improved Resummation of post-Newtonian Multipolar Waveforms and Applications to Inspiralling and Coalescing Black Hole Binaries
Joseph Samuel	Joint Statistical Physics and Gravity Seminar, University of Maryland, College Park, USA 22 April 2008	Surface tension and the cosmological constant
	Nucelar and particle physics seminar, University of Iowa USA 30 April and 9 May 2008	1.Surface tension and the cosmological constant 2.The Ricci flow
Kiran Savanur	Workshop on Integrated Library Automation Packages, Indian Institute of Science, Bangalore 5-9 January 2009	
Lakshminarayanan V.	Conference on "Recent Advances in Surface Engineering 2009 National Aerospace Laboratories Bangalore 26 February 2009	Self assembled monolayer of organic thiols on metal surfaces (*Invited*)

Lakshminarayanan V. (*contd.*)	Workshop on modern trends in electrochemistry, Central Electrochemical Research Institute, Karaikudi 19 September 2008	Scanning probe microscopy in electrochemical studies
	Workshop cum lecture programme on Chemistry with purpose – Emerging trends in chemical sensors and sensor technology, SSSIHL, Prasanthi Nilayam, Andhra Pradesh 12 August 2008	Electrochemical sensors
	National Workshop on Synthesis, Characterization and Applications of nanostructured materials, SSIHL, Prasanthi Nilayam, Andhra Pradesh 28 February 2009	Scanning probe microscopy for characterization of nanomaterials
Madhavan Varadarajan	Indian Institute of Science, Bangalore 2 September 2008	Quantum Gravity and the Black Hole Information Loss Problem
	Jamia Millia Islamia University, New Delhi 21-28 November 2008	Black Hole Thermodynamics and Evaporation
	Saha Institute of Nuclear Physics, Kolkata 24 February-2 March 2009	Quantum Gravity and the Black Hole Information Loss Problem
	Field Theoretic Aspects of Gravity Meeting Indian Institute of Advanced Study, Shimla 14 November 2008	Quantum Gravity and the Black Hole Information Loss Problem (*Invited*)
	Black Holes and Loop Quantum Gravity Workshop, University of Valencia, Spain 26-28 March 2008	Quantum Gravity and the Black Hole Information Loss Problem (*Invited)*

Madhavan Varadarajan (*contd.*)	Delhi University, Delhi 16-20 March 2009	
	Instituto de Mathematicas y Fisica Fundamental, CSIC, Madrid, Spain March 30-April3, 2009	On the resolution of the big bang singularity in isotropic Loop Quantum Cosmology
Madhukar S	Mahabaleshwar Seminar Series: Mechanosignalling in Cell & Developmental Biology, NCBS, 14-17 February 2009	
	Bangalore Area Statistical Mechanics Meeting 2008 Fireflies, Bangalore 6-8 March 2009	
Manjunath M.	National Symposium on Open Access and building institutional repositories, National Aerospace Laboratories., Bangalore 21-23 January 2009	
Meenal Gupta	15th National conference on Liquid Crystals, Indian Institute of Science, Bangalore 13-15 October 2008	
	Conference on Disorder, Complexity and Biology II, Banaras Hindu University, Varanasi 5-8 January 2009	
	Conference on Mesogenic and Ferroic Materials, Banaras Hindu University, Varanasi 9-11 January, 2009	Experimental studies on Liquid Crystal-Nano-particle dispersions
Nagaraj M.N.	ASI Annual Meeting, Indian Institute of Astrophysics, Bangalore 19-20 February 2009	FORSA new initiatives

Nagaraj M.N. (*contd.*)	Workshop on Integrated Library Automation Packages, Indian Institute of Science, Bangalore 5-9 January 2009	
Nagaraju D.H.	International Conference, Functional Material-2008, Indian Institute of Technology, Chennai 27-29 November 2008	Myoglobin and composite Myoglobin-Single walled carbon nanotubes on SAM of 4-Aminothiophenol Electrocatalytic, AFM and STM studies.
	Conference on Recent Advances in Surface Engineering 2009, National Aerospace Laboratories, Bangalore 26-27 February 2009	Electrochemical Synthesis of Thiol Monolayer protected Clusters of Gold
Nandakumar R.	Fourth Garuda Partners Meet, Centre for Development of Advanced Computing Bangalore 28-29 November 2008	
Narendra Kumar	8th Sir J C Bose Memorial Lecture, Royal Society London, 16 September 2008	Quantum Phase and Phase Breaking: Decoherence (*Invited*)
	Diamond Jubilee of the Central Electrochemical Research Institute, Karaikudi 24 April 2008	Viewing Raman through his effects (*Invited*)
	Imperial College, London, 17 September 2008	Equipartition of Supercurrent in Parallel at N-S Transition: A Surprise
	London Centre for Nanotechnology and at Athaneum, The University College, London 18 September 2008	Fall of ultra-slow light on the laboratory length scale under earth's gravity (*Invited*
	Faraday Section of the Royal Institution, London 19 September 2008	Visited Faraday original experiments in physics and chemistry

Narendra Kumar (*contd.*)	The Abdus-Salam International Centre for Theoretical Physics, Trieste, Italy 31 May-9 July 2008 and 21 March-21 April 2009	Participating in the activities of the Condensed Matter Statistical Physics Section
	MOLMAT 2008, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore 4 December 2008	Re-visiting classical diamagnetism: a surprise (*Invited*)
	National Science Day, National Chemical Laboratory, Pune, 27 February 2009	Viewing Raman through his effects (*Invited*)
	Science Day Lectures 2009 National Science Day 2009 National Institute of Advanced Studies, Bangalore 28 February 2009	A random walk in science (*Invited)*
Peeyush Prasad	URSI General Assembly, Chicago, USA, 12 August, 2008	A New Approach to Improve the Dynamic Range of GMRT Low Frequency Images
	The Low Frequency Radio Universe, National Centre for Radio Astronomy, Pune 12 December 2008	Dynamic Range Improvement of GMRT Low Frequency Images
	Department of Physics, Dept. of Electrical Engineering, University of California, San Diego 27 August 2008	
	Berkeley Wireless Research Center, University of California Berkeley 25 August 2008	
Patil Y.M.	First DST Librarians' Meeting, International Advanced Research Centre For Powder Metallurgy And New Materials, Hyderabad 27 September 2008	DST libraries journals holdings and other statistical data

Patil Y.M. (*contd.*)	National Seminar on Indian Association of Special Libraries and Information Centres, Bose Institute, Kolkata 9-13 December 2008	
	Astronomical Society of India Meeting, Indian Institute of Astrophysics, Bangalore 19-20 February 2009	FORSA new initiatives
Prabu T.	National Workshop on the Design of Antenna & Radar System, ISRO Telemetry, Tracking and Command Network, Bangalore 13-14 February 2009	
	Astronomical Society of India Meeting, Indian Institute of Astrophysics, Bangalore 18-20 February 2009	1.RFI detection and mitigation strategies 2.A digital back-end receiver for the Murchison Widefield Array
Pramod A. Pullarkat	Bangalore Area Statistical Mechanics Meeting 2008 Fireflies, Bangalore 12-13 April 2008	Shape instabilities and oscillations in mammalian cells (*Invited*)
	HFSP Minisymposium on Functional Domains on Cell Membranes and their Role in Endocytosis, National Centre for Biological Sciences, Bangalore 5-7 October 2008	Undertanding cell mechanics (*Invited*)
	Mahabaleshwar Seminar Series: 'Mechanosignalling in Cell & Developmental Biology' NCBS, Bangalore 14-19 February 2009	Mechanical responses of cells and regulation (I*nvited*)

Pramod A. Pullarkat (*contd.*)	Young Investigators Meet, Estuary Island Resort, Trivandrum 24-28 February 2009	Mechanical responses of cells
	Seminar on Understanding Cellular Mechanics: from oscillating cells to shape instabilities in axons, Indian Institute of Science, Bangalore 4 September 2008	
Pratibha R	Department of Organic and Polymeric Materials, Tokyo Institute of Technology, Tokyo, Japan 15 Feb to 14 April 2008	Defects and Striped patterns in the biaxial smectic A phase
	Dept of Physics and Dept of Electrical and Computer Engineering, University of Colorado, USA 19 September 2008 - 19 March 2009	Gold Nanospheres in thermotropic smectic
Radhakrishnan A.V.	2nd Bangalore Area Statistical Mechanics Meeting, The Fireflies, Bangalore 6-8 March 2009	
Radhakrishnan V	Templeton Xiangshan Conference and 400th anniversary of Lipperhey's invention of the telescope Peking University Campus, Beijing, China 12-15 October 2008	
Radhika S.	15th National Conference on Liquid Crystals, Indian Institute of Science, Bangalore 13-15 October 2008	

Raghunathan V.A.	2nd Bangalore Area Statistical Mechanics Meeting, Fireflies, Bangalore 6-8 March 2009	Salt-induced melting of DNA-surfactant Complexes (*Invited*)
Rakesh Kumar Pandey	International Conference on Functional Materials 2008, Indian Institute of Technology, Madras 27-29 November 2008	Self-Assembled Monolayer Formation by Host-Guest Inclusion Complex of Thiocholesterol with Cyclodextrins
	Conference on Recent Advances in Surface Engineering 2009, National Aerospace Laboratories., Bangalore 26-27 February 2009	Tribological study of cyclodextrins Inclusion Complexes (IC) with Thiocholesterol on Gold Surface. A Combined Electrochemical and Lateral Force Microscopy (LFM) Analysis
Ramesh B	International Seminar on Sub-millimeterwave Science and Technology 2009, Bose Institute, Kolkata 14-16 January 2009	Millimeterwave Astronomy at the Raman Institute: the Technology and the Science (*Invited*)
	Low Frequency Radio Universe Conference, National Centre for Radio Astronomy, Pune 7-14 December 2008	12 GHz Radio-Holographic surface measurement of the RRI 10.4 m telescope
Ranjini Bandyopadhyay	Stress relaxation in a colloidal glass: strain induced jamming and microscopic viscosities JNCASR, Bangalore 27 August 2008	
	National Symposium on Soft Matter, Bose Institute, Kolkata, 18-19 September 2008	Rheology of a micellar polycrystal (*Invited*)
	Annual meeting of the New Champions, Tianjin, China 26-28 September 2008	

Ranjini Bandyopadhyay (*contd.*)	Bangalore Area Statistical Mechanics Meeting Fireflies,Bangalore 6-8 March 2009	Stress relaxaqtion in a colloidal glass of laponite clay
	Bose Institute, Kolkata 22-23September 2008	Strain-induced jamming in an aging colloidal suspension
Ravi Subrahmanyan	Vedic University, Tirupati June 2008	Since the Vedic times: our vision of the universe in colours the eye cannot see
	Symposium on Frontiers of Astronomy and Astrophysics, Peking University, Beijing, China June 27 - June 29 2008	Large-scale structure of the universe - as probed by giant radio galaxies (*Invited*)
	University of Sydney, Australia June 2008	Large-scale structure of the universe - as probed by giant radio galaxies
	Australian National University, Canberra, Australia, July 2008	Probes of large-scale structure in the gas
	Tata Institute of Fundamental Research, Mumbai August 2008	Probes of large scale structure in the gas
	National Optical Astronomy Observatory Site, La Sarena October 2008	Deep surveys of the Radio Universe
	University of California, Berkeley, October 2008	Deep surveys of the Radio Universe
	Kavli Institite for Particle Astrophysics and Cosmology October 2008	
	McDonnell Centre, Washington University October 2008	Deep surveys of the radio universe

Ravi Subrahmanyan (*contd.*)	Meeting on Cosmological evolution in diffuse baryons: Reionization epoch to the present day, Coorg December 2008	Intergalactic medium environment of luminous ellipticals - as probed by AGN jets
	The low-frequency radio universe, National Centre for Radio Astronomy, Pune 8-12 December 2008	Surveys of low surface-brightness radio sources (ATLBS survey) (*Invited*)
	Astronomical Society of India Meeting, Indian Institute of Astrophysics, Bangalore 18-20 February 2009	Radio-Jet IGM Interactions (*Invited*)
	ARIES, Nainital 12-21 March 2009	1. Deep surveys of the radio sky 2. Radio galaxies – a probe of the intergalactic medium
	St. Joseph's College, Bangalore, 6 March 2009	Astronomy: A journey in time: From the Big Bang to Galileo
Reji Philip	Department of Physics, Bangalore University 24 March 2009	Fundamentals of Nonlinear Optics
	Inter-University Accelerator Centre , New Delhi 13-14 March 2009	4 lectures
	Sri Sathya Sai Institute of Higher Learning, Prasanthi Nilayam, 8 July 2008	Ultrafast Laser pulses: Generation, properties and measurement
	Annual Photonics Workshop, Cochin University of Science and Technology, Cochin 27-28 February 2009	Nonlinear optics in the nanophase (*Invited*)

Reji Philip (*contd.*)	Cochin Nano – 2009, Cochin University of Science and Technology, Cochin 3-6 January 2009	Nonlinear optics of nanomaterials (*Invited*)
	National Seminar on Photonic Materials 2009, Kerala University, Trivandrum 26 -28 February 2009	Slow light experiments in normal dispersive media (*Invited*)
	National Conference on Nanophotonic Materials 2008, Cochin University of Science and Technology, Cochin 10-11 October 2008	Photonic applications of metal nanostructures (*Invited*)
	National workshop on advances in co-ordination compounds, National Institute of Technology, Surathkal 8-10 January 2009	Fundamentals of Nonlinear Optics (*Invited*)
	Discussion meeting on metamaterials and their applications (MetaIn-2008) University of Hyderabad Hyderabad 18-20 December 2008	
	First International Conference on Trends in Optics and Photonics, University of Calcutta, March 2009	1. Non-linear absorption and optical limiting in nano-aggregated acriflavine dye-polymer films 2. Three-photon absorption and high-performance optical limiting in nano-aggregated amido black 10b dye-polymer films
	7th International Conference on Materials Processing for Properties and Performance, Nanyang Executive Centre, Singapore November 2008	Optical power limiting in cobalt nanotubes and carbon nanotubes

Reji Philip (*contd.*)	National Laser Symposium, Laser Science & Technology Centre, Delhi 7-10 January 2009	Optical power limiting in Nd^{3+} doped strontium barium niobate ceramic system
Renu Vishavkarma	Mahabaleshwar Seminar on Mechanosignalling in cell and Developmental Biology, NCBS, Bangalore 14-18 February 2009	
Rishin P.V.	Astronomical Society of India Meeting, Indian Institute of Astrophysics, Bangalore 18-20 February 2009	Development of X-ray Polarimeter
Ruckmongathan T.N.	Society for Information Display (SID) Symposium, Los Angles, USA May 2008	1. Multi-line addressing of LCDs with simple diagonal matrices 2. Modified discrete cosine transform for addressing liquid crystal displays
	International Display Research Conference Orlando, USA November 2008	Low power by Energy multiplexing in Liquid Crystal Displays (*Invited*)
Ruta Kale	Giant Metrewave Radio Telescope, Pune 18 May 2008	Radio Astronomy
	Young Astronomers' Meet, Indian Institute of Technology, Kharagpur 14-16 March 2009-09	GMRT imaging of the Galaxy cluster Abell 2256
	Astronomical Society of India Meeting , Indian Institute of Astrophysics, Bangalore 8-10 February 2009	GMRT imaging of the galaxy cluster Abell 2256
	Low Frequency Radio Universe, National Centre for Radio Astronomy, Pune 8-12 December 2008	On the nature of diffuse radio emission in Abell 754

Ruta Kale (*contd.*)	Enrico Fermi School on Astrophysics of Galaxy Clusters, Varenna, Italy 14-26 July 2008	Diffuse radio emission from galaxy clusters
	Instituto di Radio Astronomie, Bologna, Italy 8-11 July 2008	Diffuse radio emission in Abell 754
	Max Planck Institute fur Astrophysik, Munich, Germany 27-30 July 2008	Diffuse radio emission in Abell 754
Ryuichi Fujita	The 7th International LISA Symposium, Institut d'Estudis Espacials de Catalunya and the Instuto de Ciencias del Espacio, Barcelona, Spain 16-20 June 2008	An efficient numerical calculation of gravitational waves from extreme mass ratio inspirals
	The 11th Capra Meeting on Radiation Reaction, CNRS, Orleans, France 26-29 June 2008	Templates of generic extreme mass ratio inspirals in the frequency domain
	The 18th Workshop on General Relativity and Gravitation, Hiroshima University, Japan 17-21 November 2008	Bound geodesics in Kerr space time
	The 25th IAGRG Meeting, Saha Institute of Nuclear Power, Kolkata 28-31 January 2009	Analytical solutions of bound geodesic orbits in Kerr spacetime
Sadiq Ali Rangwala	Indo-French Network Research Workshop, Tata Institute of Fundamental Research, Mumbai 10-11 December 2008	A cavity based light switch in hot atomic vapour (*Invited)*
	International Conference on Cold Atoms, Indian Institute of Science Education and Research, Kolkata 12-16th December 2008	1.Multi-species magneto-optical traps and their combination with ultra-cold ions (*Invited*) 2.Ultra-cold atom and ultra-cold ion mixtures

Sadiq Ali Rangwala (*contd.*)		3.Electric field induced change of alkali vapor density in paraffin coated cells
	University of California, Berkeley 1 April-20 May, 2008	Cold Dipolar Molecules: A Filtered Tale
Sandeep Kumar	Tamkang University, Taiwan 15 September 2008	Liquid crystals beyond display applications (*Invited*)
	National Dong Hwa University, Hualien,Taiwan 9 May 2008	Liquid crystals beyond display applications (*Invited*)
	National University, Taiwan, Kaohsiung, 17 September 2008	Discotic liquid crystals as a new class of organic semiconductors (*Invited)*
	International Liquid Crystal Conference, Jeju, Korea 29 June-4 July 2008	Self-assembled super lattice of gold nanoparticles in a discotic liquid crystal
	KUA Joint Workshop on New Horizons of Liquid Crystals Science and Application II, Jeonju, Korea 27 June 2008	Nanomaterials in the supramolecular order of discotic liquid crystals (*Invited*)
	National Workshop on 'Recent Trends in Polymer Science', Institute of Advanced study in Science and Technology, Guwahati 20-25 October 2008	1.Liquid Crystals and liquid crystal displays (*Invited*) 2.Liquid Crystals beyond displays (*Invited*)
	National Conference on Green Chemistry, V.N.South Gujarat University, Surat 6-8 February 2009	Green chemistry approach to the synthesis of liquid crystals (*Invited*)
	Confluence 2009, Indian Academy Centre for Research & Post Graduate Studies, Bangalore, 5 March 2009	Green chemistry approach to the synthesis of liquid crystals (*Invited*)

Sandeep Kumar (*contd.*)	15th National Conference on Liquid Crystals, Indian Institute of Science, Bangalore 14 October 2008	Carbon nanotubes in discotic liquid crystals. (*Invited*)
	Annual Meeting of Taiwan Liquid Crystal Society, National Chia Tung University, Hscinchu, Taiwan 19 December 2008	Discotic-functionalized nanomaterials (*Invited*)
	Workshop on Liquid Crystal Applications, Dept. Materials Science & Engineering, Taiwan 18 December 2008	Playing with Discs (*Invited*)
Sanjib Sabhapandit	Bangalore Area Statistical Mechanics Meeting, JNCASR, Bangalore 6-8 March 2009	Dynamics of polymers in shear flow (*Invited*)
	Heat transport in low dimensional system, Tata Institute of Fundamental Research, Bangalore 15-21 March 2009	Statistical properties of the final state in one-dimensional ballistic aggregation (*Invited*)
Satyam Kumar Gupta	15th National Conference on Liquid Crystals, Indian Institute of Science, Bangalore 13-15 October 2008	Synthesis and characterization of discotic liquid crystalline symmetrical don-acceptor-donor triads
	International Conference on Functional Materials 2008, Indian Institute of Technology Chennai 27-29 November 2008	Microwave-assisted facile synthesis of discotic liquid crystalline symmetrical donor-acceptor-donor triads
	Conference on Mesogenic and Ferroic Materials, Banaras Hindu University Varanasi 9-11 January 2009	

Satyam Kumar Gupta (*contd.*)	Conference on Disorder Complexity and Biology II, Banaras Hindu University,Varanasi 5-8 January 2009	
Seshagiri Rao R.V.	SERC School on computational statistical physics, Indian Institute of Technology, Guwahati 1-21 December 2008	Mechanical properties of axons
	Mahabaleshwar seminars on Mechano signalling, NCBS Bangalore 14-17 February 2009	
Shashidhara A.R	The 15th International Display Workshops, The Society for Information Display and The Institute of Image Information and Television Engineers Niigata, Japan,3-5 December'08	Low power LCD with low supply voltage
Shiv Sethi	Indian Institute of Technology, Kanpur 22-25 July 2008	Large scale-distribution of HI
	Indo-Brazil Meeting on Cosmology, University of Natal, Brazil October 2008	HI as a probe of the large scale structure in the post-reionisation era (*Invited*)
	Sao Paula University, Brazil 3-12 October 2008	Primordial magnetic fields and cosmology
Seunghyun Lee	International Conference on Cold Atoms 2008, Indian Institute of Science Education & Research Kolkata, 12-16 December 2008	Ultra-cold atom and ultra-cold ion mixtures
Soma Datta	Conference on Disorder, Complexity and Biology (DISCOMB09), Banaras Hindu University,Varanasi 5-8 January 2009	Experimental studies of transient fluctuation theorem using liquid crystals

Soma Datta (*contd.*)	Conference on Mesogenic and Ferroic Materials, Banaras Hindu University Varanasi 9-11 January 2009	
Sridhar S.	Chennai Mathematical Institute, Chennai 5 February 2009	1.Disc Galaxies and magnetic fields 2.Dynamo action in linear shear flows
Srivani K.S.	Astronomical Society of India Meeting, Indian Institute of Astrophysics, Bangalore 18-20 February 2009	A 32T digital receiver for the Murchison Wide Field Array
Subrahmanya C.R.	Low Frequency Radio Universe Conference2009, National Centre for Radio Astronomy, Pune	A new widefield frontend for Ooty Radio Telescope
Sumati Surya	Imperial College, United Kingdom 5-20 June 2008	2D causal set quantum gravity (*Invited*)
	DICE2008, Castiglioncello, Italy 22-26 September 2008	A result in 2D causal set theory
Sunita Sharma	Seventeenth International Conference on processing and fabrication of advanced materials, Indian Institute of Technology, New Delhi 15-17 December 2008	Z-scan measurement of nonlinear optical properties of Rhodamine6G doped polymeric samples
Supurna Sinha	Biophysics Seminar, Institute for Physical Sciences & Technology, University of Maryland, College Park, USA 21 April 2008	Biopolymer elasticity (*Invited)*
	Nuclear and Particle Physics Seminar, University of Iowa, 5 May 2008	Biopolymer elasticity (*Invited*)

Suresh Kumar P	59th Annual Meeting of International Society of Electrochemistry, Sevilla, Spain 11 September 2008	Electrochemical studies of redox probes in self-organized lyotropic liquid crystalline systems
	15th National Conference on Liquid Crystals, Indian Institute of Science, Bangalore	Electrical conductivity studies of discotic liquid crystal-ferrocenium donor-acceptor systems
	National Conference on Recent advances in Surface Engineering, National Aerospace Laboratories, Bangalore 26 February 2009	Mixed monolayers of functionalised organic thiols on gold surface
	University of Thessaloniki, Greece, 13-17 September 2008	Electron transfer studies in liquid crystalline media
Udaya Shankar	MWA Project Meeting, Haystack Observatory, Boston, USA 30 June-3 July 2008	A 150 MHz Survey using GMRT and MWA data sets
	Indian Association of Physics Teachers, Bangalore Convention 17 October 2008	A Journey in the Dark Universe
	The Low-frequency Radio Universe Conference, National Centre for Radio Astrophysics, Pune 8-12 December 2008	1.A 50 MHz system for GMRT 2.GMRT observations of H.E.S.S. sources 3.Homography-based correction of positional errors in MRT survey
	A meeting on Cosmological evolution in diffuse baryons: Reionization epoch to the present day Orange County, Coorg 30 November-4 December, 2008	Foregrounds and MWA

Udaya Shankar (*contd.*)	MWA Project Meeting, Australian National University, Australia 18-23 January 2009	1. MWA related activities at RRI 2. A 150 MHz Survey using GMRT and MWA data sets: Preliminary Results 3. A 50 MHz System for GMRT
	International Year of Astronomy-2009 Visvesvaraya Industrial & Technological Museum, Bangalore 6 February 2009	A journey in the dark universe
	Bangalore University & KSTA 25 March 2009	Impact of technical innovations on radio astronomy
Vinutha C	Astronomical Society of India Meeting , Indian Institute of Astrophysics, Bangalore 17 February 2009	

Annexure - III

COLLOQUIA

Name	Title	Date
Raghavendra Gadagkar Indian Institute of Science Bangalore	What can we learn from insect societies? (Diamond Jubilee Colloquium)	4.4.2008
Apoorva Nagar Korea Institute of Advanced Study, Seoul Korea	Steady states of passive particles sliding on fluctuating surfaces	15.4.2008
Abhishek Rawat Inter University Centre for Astronomy & Astrophysics, Pune	Galaxy evolution over the last ~ 8 Gyr	15.4.2008
R.V. Mehta Bhavnagar University Bhavnagar	Small-angle scattering by nanomagnetic particles	15.4.2008
Chirag Kalelkar University of Maryland College Park, USA	Statistical studies of decaying fluid and magnetohydrodynamic turbulence	17.4.2008
Rajesh Patel Bhavnagar University Bhavnagar	Certain unusual magneto-optical effects in ferrofluids	22.4.2008
Monika Sinha Saha Institute of Nuclear Physics, Kolkata	Damping of r-mode instability in neutron stars in presence of magnetic field	25.4.2008
Arun Paramekanti Department of Physics University of Toranto Canada	Dynamical instabilities in cold atom systems	29.4.2008
Vidyanand Nanjundaiah Indian Institute of Science Bangalore	The origin of species after 150 years (Diamond Jubilee Colloquim)	2.5.2008

Name	Title	Date
Tirthabir Biswas Penn State University USA	1.Towards non-singular alternatives to inflation 2.Dark energy vs. local void	13.5.2008 14.5.2008
Joachim Ullrich Max Planck Institute for Kernphysik, Heidelberg Germany	Atoms and molecules in extreme laser fields	16.5.2008
C. H. Ishwara Chandra National Centre for Radio Astronomy, Tata Institute for Fundamental Research Pune	Search for ultra steep spectrum radio sources using GMRT 150 MHz band	21.5.2008
Ajit Srivastav Institute of Physics Bhubaneswar	Super-horizon fluctuations and acoustic oscillations in relativistic heavy-ion collisions	22.5.2008
Pranesh A. Sundararajan Massachusetts Institute of Technology, Cambridge	Gravitational waves from extreme mass ratio inspirals	30.5.2008
Aditi Simha University of Leeds United Kingdom	Statistical mechanics for a class of boundary-driven steady states	03.6.2008
Romila Thapar Jawaharlal Nehru University New Delhi	Interpretations of early Indian history (Diamond Jubilee Colloquium)	06.06.2008
Suchetana Chatterjee University of Pittsburg Pittsburg, USA	The Sunyaev-Zeldovich effect as a probe of black hole feedback	13.6.2008

Name	Title	Date
Pinaki Chaudhuri Laboratoire des Colloïdes Verres et Nanomatériaux Université Montpellier II France	Modelling a transient-network fluid: from sol to glass via gelation	17.6.2008
G. Kavitha Jawaharlal Nehru University for Advanced Scientific Research, Bangalore	High pressure Raman and temperature dependent brillouin scattering studies of some organic liquids and solids	18.6.2008
S. Jeyakumar University of Guanajuato Mexico	Synchrotron self-absorption in young radio sources	20.6.2008
M.S.Valiathan Manipal University Manipal	A science initiative in Ayurveda (Diamond Jubilee Colloquim)	4.7.2008
S. Sridhar Northeastern University USA	Negative – index nanophotonics	11.7.2008
N. Kumar Raman Research Institute Bangalore	Deflection of ultra slow light by earth's gravity on laboratory length scale	14.7.2008
Muru Venkatapathi Purdue University USA	Laser-based interrogation of micro/nano particles and cells	18.7.2008
Soumya Mohanty University of Texas Brownsville, USA	Gravitational wave data analysis with and without prior models	21.7.2008

Name	Title	Date
Manjari Bagchi Tata Institute of Fundamental Research Mumbai	Binary-single star interactions in globular clusters: explanation of the observed eccentricity – orbital period distribution of the binary radio pulsars	21.7.2008
Divya Sharma Institut de Physique et Chimie des Materiaux de Strasbourg, France	Probing protein fluorescence dynamics through ultrafast spectroscopy	23.7.2008
Ravi A.V. Kumar Institute for Plasma Research, Gandhinagar	Plasma wakefield acceleration – the route to table-top accelerators	23.7.2008
Parameswaran Simon Fraser University Canada	MEMS and its applications in Biology and Chemistry	31.7.2008
Ramesh Sharma University of New Haven USA	Weyl conformal tensor and conformal symmetries of generalized Robertson - Walker spacetimes	4.8.2008
R. Cowsik Washington University St. Louis, USA	Internal dynamics and dynamical friction effects in the dwarf spheroidal in Fornax	5.8.2008
Joseph Silk University of Oxford United Kingdom	1.From the big bang to the milky way (Diamond Jubilee Colloquium) 2.Let there be light: galaxy formation for the novice	8.8.2008
Saikat Ghosh MIT-Harvard Center of Ultra-cold Atoms, USA	Single photon bus connecting spin wave quantum memories	8.8.2008

Name	Title	Date
Harsha Raichur Indian Institute of Science and Raman Research Institute	Orbital evolution and superorbital flux variations in X-ray binary pulsars	12.8.2008
Sucismita Chutia Université Paris, France	Valley splitting in strained silicon hetero-structures: a theoretical study	18.8.2008
Dibyendu Das Indian Institute of Technology, Mumbai	On the equivalence of the freely cooling granular gas to the sticky gas	21.8.2008
Ali Shakouri University of California USA	Nanoscale opto-thermo-electric energy conversion devices	22.8.2008
Anders Kastberg Umeå University Sweden	A three-dimensional Brownanian motor, realized with symmetric optical lattices	25.8.2008
Harsh Chaturvedi University of North Carolina, Charlotte, USA	Molecular interactions: single-walled carbon nanotubes and ruthenium metallodendrimers	26.8.2008
Rajendra Bhandari Raman Research Institute Bangalore	Reciprocity in polarization optics and topological phases	26.8.2008
Ambarish Ghosh Rowland Institute, USA	Detection and manipulation at the nanoscale	28.8.2008
M.P. Das Australian National University, Australia	High Tc superconductivity – what is new?	1.9.2008

Name	Title	Date
Manas Mukherjee Indian Association for Cultivation of Science Kolkata	A single ion as a two photon source	19.9.2008
P.K. Manoharan National Centre for Radio Astronomy, Pune	Solar dynamics and their effects on inner heliosphere	19.9.2008
Sunita Sharma Guru Jambheshwar University of Science and Technology, Haryana	Study of nonlinear properties in materials of optical waveguide	23.9.2008
Sanjib Sabhapandit Raman Research Institute Bangalore	Dynamics of polymers in shear flow	23.9.2008
Marc A.W. Verheijen Kapteyn Astronomical Institute, The Netherlands	WSRT ultra-deep neutral hydrogen imaging of galaxy clusters at z=0.2	26.9.2008
U. R. Ananthamurthy Bangalore	Being an Indian bhasha writer (Diamond Jubilee Colloquium)	26.9.2008
Subhadeep De University of Groningen The Netherlands	First laser cooling and trapping of barium	30.9.2008
T.G. Prabhashankar Premi Bangalore University Bangalore	Importance of Hindi Day	30.9.2008

Name	Title	Date
Debajyothi Gangopadhyay Annad College, Vinoba Bhave University, Hazaribagh	The failure that underscored Newton's success	16.10.2008
Hideo Takezoe Tokyo Institute of Technology, Japan	Smectic AP phase in bent-core mesogens	17.10.2008
Alexander Petrov Bulgarian Academy of Sciences, Sofia	Soft matter physics and the physics of living matter	28.10.2008
M.G.K. Menon Chairman, Raman Research Institute Trust	A dream: Sixty years after (Diamond Jubilee Colloquium)	7.11.2008
Georg Pabst Institute of Biophysics and Nanosystems Research Austria	Effect of ceramide on physical properties of membranes	4.12.2008
Subir Sarkar University of Oxford United Kingdom	Astroparticle probes of quantum gravity	15.12.2008
Michèle Leduc Laboratoire Kastler-Brossel, Ecole Normale Supérieure, Paris	Dark resonance with metastable atoms and exotic molecules in ultra cold helium gas	18.12.2008
Alain Omont Institut d'Astrophysique de Paris	High redshift ultra-luminous far-IR galaxies (submillimeter galaxies) in Spitzer surveys	18.12.2008
Somnath Bharadwaj Indian Institute of Technology, Kharagpur	What can we learn from visibility correlations?	19.12.2008
S. Anantha Ramakrishna Indian Institute of Technology, Kanpur	Coherent control of metamaterials	22.12.2008

Name	Title	Date
Fabien Bretenaker CNRS-Université Paris Sud, Orsay, France	Visible optical parametric oscillators for application to quantum memories: an all solid-state alternative to cw dye lasers?	23.12.2008
Fabienne Goldfarb CNRS-Université Paris Sud, Orsay, France	Electromagnetically induced transparency and slow light in a hot vapour of metastable helium undergoing collisions: experiment and theory	23.12.2008
Rahul Shetty Harvard Smithsonian Center for Astrophysics, Cambridge USA	Gaseous spiral arm structure and cloud formation in disk galaxies	6.01.2009
S.G. Bhongale Rice University, Houston USA	Matter wave probe for detecting BCS super fluidity in a trapped fermi gas	7.1.2009
Bryan E Penprase Pomona College Claremont, USA	Absorption line spectroscopy of quasar DLAs and gamma ray bursts	9.1.2009
Vikram Soni National Physical Laboratory, New Delhi	Magnetars	13.1.2009
Deepak Dhar Tata Institute of Fundamental Research Mumbai	Pattern formation in growing sandpiles	19.1.2009
Gautam Menon Institute of Mathematical Sciences, Chennai	Pressurized polymer loops	19.1.2009
Arun Paramekanti University of Toronto Canada	Superconductor insulator transition in atomic fermi gases	21.1.2009

Name	Title	Date
Santhosh G Institute of Mathematical Sciences, Chennai	Anomalous thermal transport in 1D lattices	21.1.2009
Dwaipayan Chakrabarti University of Cambridge UK	Routes to helicity	23.1.2009
Supratim Sengupta Jawaharlal Nehru University New Delhi	How does E.coli find its middle?	27.1.2009
Dutta Gupta S University of Hyderabad Hyderabad	Solarity pulses in atom-doped fibers	29.1.2009
Aparna Baskaran Syracuse University USA	Bacteria as a fluid: applying the materials physics paradigm to biology	2.2.2009
G. Baskaran Institute of Mathematical Sciences, Chennai	Strike while the iron is hot	5.2.2009
Dasari Durga Bhaktavatsala Rao Weizmann Institute of Science, Israel	Quantum dynamics in the presence of frequent measurements	16.2.2009
Arindam Kundagrami University of Massachusetts Amherst, USA	Physics of charged polymers: effective charge, size, phase transitions and other properties as soft materials	17.2.2009
Michael Elbaum Weizmann Institute of Science, Israel	Nucleocytoplasmic exchange – a physical machine at the heart of the cell	19.2.2009
Muthukumaram Packirisamy Concordia University Canada	BiomMEMS: A platform for bio-mechanical interaction based diagnosis	19.2.2009

Name	Title	Date
Mariano Mendez University of Groningen The Netherlands	Some aspects of the accretion flow in neutron stars and black holes	27.2.2009
Jeffrey Peterson Carnegie Mellon University Pittsburgh, USA	21-cm intensity mapping with a transit cylinder radio telescope	2.3.2009
John H. Ipsen University of Southern Denmark, Denmark	Detergent destabilization of vesicles	3.3.2009
Guenter Werth Johannes Gutenberg University, Mainz, Germany	Precision spectroscopy with single trapped particles: the magnetic moment of the electron bound in hydrogen-like ions	5.3.2009
Sunil Kumar P.B. Indian Institute of Technology Chennai	Strain hardening, rupture and aster formation in dense cross-linked actin networks	4.3.2009
Diego Altamirano Astronomical Institute The Netherlands	Accretion-powered millisecond X-ray pulsars: 10 years of discoveries	6.3.2009
T.G. Sitharam Indian Institute of Science, Bangalore	Seismic microzonation of Bangalore urban centre	19.3.2009
Gabriel Dutier University of Paris, France	Original atomic interferometry experiments	20.3.2009
Tapas K. Das Harish Chandra Research Institute, Allahabad	Analogue gravity phenomena in astrophysics & cosmology	23.3.2009
Archita Patnaik Indian Institute of Technology, Chennai	Directed electron transport in two dimensional molecular junctions	26.3.2009

Annexure IV

JOURNAL CLUB

Discussed by	Paper discussed	Date
Abhishek Dhar	Modeling friction on a mesoscale: Master equation for the earthquake like model O. M. Braun and M. Peyrard *Phys. Rev. Lett.,* **100**, 125501 (2008)	10.4.2008
Bibhu Ranjan Sarangi	Geckos: Nature's elite climbers Ardian Jusufi *et al.,* *PNAS,* **105(11)**, 4215-4219(2008)	10.4.2008
Tripta Bhatia	Amoebae anticipate periodic events Yoshiki Kuramoto *et al.,* *Phys. Rev. Lett*., **100**, 018101 (2008)	24.4.2008
Abhishek Chaudhuri	Cell commuters avoid delays Leonid Mirny *Nature Phys*., **4**, 93-95 (2008)	24.4.2008
Peeyush Prasad	The geometry of musical chords Dmitri Tymoczko *Science*, **313**, 72 (2006)	8.5.2008
Raghunathan A	Limits on fine-structure constant: Optical clock vs. astrophysics T. Rosenband *et al.* *Science*, **319**, 1808-18011 (2008)	8.5.2008
Anish Roshi	A laser frequency comb that enables radial velocity measurements with a precision of 1 cm./s. *Nature*, **452**, 610 (2008)	12.6.2008
Ananthasubramanian P.G.	The missing memristor found Dmitri B. Strukov *et. al.,* *Nature*, **453**, 80-83 (2008)	26.6.2008
Andal Narayanan	Single-photon atomic cooling Gabriel N. Price *et. al.,* *Phys. Rev. Lett*., **100 (9),** 93004-93007 (2008)	26.6.2008

Discussed by	Paper discussed	Date
Dibyendu Roy	Heat transport in nanostructures *Nature*, **404**, 974-977 (27 April, 2000) *Science*, **314**, 5802, 1121-1124 (2006) *Nature*, **451**, 163-167 (10 January 2008)	10.7.2008
Arvind Gupta Inter-Unviersity Centre for Astronomy & Astrophysics, Pune	Physics of toys (**Special Journal Club)**	24.7.2008
Arun Roy	Random organization in periodically driven systems L. Corte *et al.,* *Nature Phys.*, 4, 420 (2008)	14.8.2008
Shiv Sethi	Five year WMAP observations: Cosmological interpretation Komatsu *et al*., *arXiv: 0803.0547*	14.8.2008
Hari Krishna Bisoyi	Magnetic resonance imaging of pH in vivo using hyperpolarized ^{13}C-labelled bicarbonate Gallagher *et. al.,* *Nature*, **453,** 940-944 (2008)	28.8.2008
Wasim Raja	Near-field plates: subdiffraction focusing with patterned surfaces Anthony Grbic *et al.,* *Science vol*., **320**, 25 April 2008	28.8.2008
Lakshminarayanan V.	In situ formation of an oxygen-evolving catalyst in neutral water containing phosphate and Co^{2+} Matthew W. Kanan *et al.,* *Science*, **321**, (5892) 1072 2008	11.9.2008
Ravi Subrahmanyan	The micro-jansky radio source population Kellermann *et al*., *ApJS*., (astro-ph/0806.0843) 2008	11.9.2008

Discussed by	Paper discussed	Date
Reji Philip	Generation of stable, highly energetic (GeV) electron beams from a table-top laser plasma accelerator Hafz *et al.,* *Nature Photonics*, **2**, (571) 2008	25.9.2008
Nishant Kumar Singh	Event-horizon-scale structure in the super-massive black hole candidate at the galactic centre Doeleman S.S. *et al*., *Nature*, **455**, (78) 2008	25.9.2008
Ruta Kale	A low frequency radio halo associated with a cluster of galaxies Brunetti G. *et al*., *Nature Lett*., **455**, 944-947, 2008	23.10.2008
Jayakumar A.	Linked and knotted beams of light William T.M.Irvine *et al.,* *Nature Physics*, **4**, (9) 716-720, 2008	23.10.2008
Hari Dass N.D. Poornaprajna Institute of Scientific Research Bangalore	The Nobel Prize in Physics **Special Journal Club**	12.11.2008
Satyajit Mayor National Centre for Biological Sciences Bangalore	The Nobel Prize in Chemistry **Special Journal Club**	20.11.2008
B. Sury Indian Statistical Institute, Bangalore	Algorithms for primes **Special Journal Club**	15.1.2009
Suresh Kumar P	Surface-chemistry-driven actuation in nanoporous gold J. Biener *et. al*., *Nature Materials*, **8**, 47 (2009)	12.2.2009

Discussed by	Paper discussed	Date
Supurna Sinha	Recoil free scattering from a free gas Scott N. Sanders *et. al*., *arXiv:*0801:4951/1 (2008)	12.2.2009
Ravi K	High-resolution scanning electron micro-scopy of an ultracold quantum gas Tatjana Gericke *et al.,* *Nature Physics*, **4**, 949 (2008)	26.2.2009
Jayakumar A	The effect of plasticity in crumpling of thin sheets T. Tallinen *et al*., *Nature Materials*, **8** (1), 25-29 (2009)	26.2.2009
Avinash Deshpande	Altitude-dependent polarization in radio pulsars J. Dyks *et. al*., *arXiv:0806.0554v2[(astro-ph]*: (2008)	12.3.2009
Nishant Kumar Singh	Boundary layer control of rotating convection systems *Eric M. King et al.,* *Nature, **457*****,*** 301-304 (2009)	12.3.2009
Nandan Satapathy	Observation of collective excitation of two individual atoms in Rydberg blockade regime Gaetan *et al*., *Nature Physics*., **5**, 115-117 (2009)	26.3.2009
Biswajit Paul	Observation of pulsed gamma-rays above 25 GEV from the crab pulsar with magic Aliu, E. *et al*., *Science*, **322**, 1221 (2008)	26.3.2009