2010

2011

Annual Report

SATYENDRA NATH BOSE
NATIONAL CENTRE FOR
BASIC SCIENCES

2010

2011 Annual Report

CENTRE FOR BASIC SCIENCES 1986

S. N. BOSE NATIONAL

1894-1974

बिज्ञानेन परिपश्यन्ति धीराः

SATYENDRA NATH BOSE NATIONAL
CENTRE FOR BASIC SCIENCES

Annual Report 2010 - 2011

Satyendra Nath Bose National Centre For Basic Sciences

Publisher

Satyendra Nath Bose National Centre
For Basic Sciences

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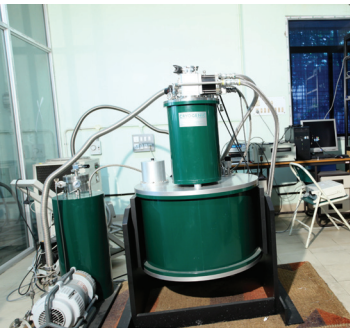

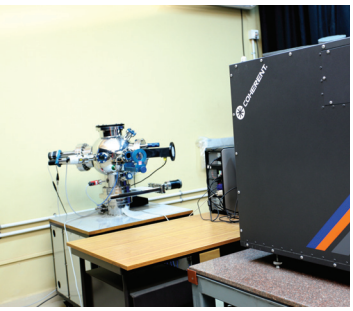

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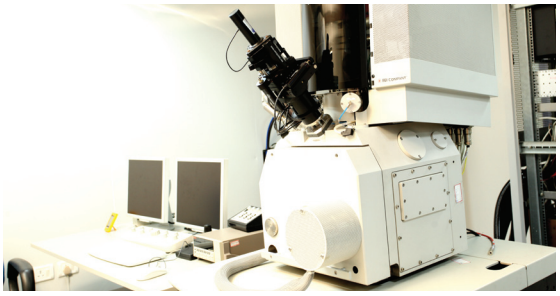


PEOPLE AT THE CENTRE

DEPARTMENT OF ASTROPHYSICS AND COSMOLOGY

DEPARTMENT OF CHEMICAL, BIOLOGICAL AND MACRO MOLECULAR SCIENCES

DEPARTMENT OF MATERIAL SCIENCES

DEPARTMENT OF THEORETICAL SCIENCES

FACILITIES

MESSAGE FROM THE DIRECTOR

I am delighted to present to you the annual report of our Centre for the year 2010-2011. The annual report tells the growth of the Centre over the year and also documents the future aspirations that are embedded in the growth. No institution can grow unless it has an aspiration to grow.

The Centre in last few years have made tremendous progress in building scientific infrastructure for research, which is the first priority of the Centre. This investment has yielded results. It makes me happy to note that this year the Centre has made more than 160 publications in referred journals: more than 5 papers/faculty. The enhancement of the output is collective yet an individual responsibility. Our first priority is research in basic sciences and the activities of the Centre reflects on that. We are also keen to work on the basic science for some important areas of societal applications. Some of our research publications and the submitted patents reflect on that.

The Centre remains committed to the development of advanced scientific manpower through its PhD programme. This is our investment for the future. It is a part of our institutional mandate. I note with pleasure that most of our faculty members take part in teaching. We consider teaching advanced courses as a part of our research activities. Over the years the number of PhD students working in the Centre has gone up and our students have made their presence felt in national and international conferences.

The Centre believes that a good ambience for research can only be built through a team effort. The administration is a part of our scientific team and has tried its best to facilitate our activities. We have started taking small steps to make some part of our administrative work on-line. Much remains to be done but we hope next year we will start to do many of our paper works in the cyber space.

I am deeply indebted to the members of our Governing Body, Academic and Research Programme Advisory Committee, Finance Committee and Building Committee for their advice, proactive policy and guidance. A number of internal committees, in particular Consultative Advisory Committee (CAC) strengthened our internal management.

I also would like to thank the Deans, Head of the Departments and Registrar and his team of very able officers and staff for the hard work they have put to run the Centre.

During this year I completed my first term of tenure as the Director. My sincere gratitude to the students, colleagues in the faculty and the administration for helping me to perform my duties. It is their efforts that allowed us to set the Centre on a path of high growth rate.

Thanks to the Annual Report Committee for making the report and prepare it on time.

Arup Kumar Raychaudhuri
Director

DEAN, FACULTY

The year gone by was somewhat special as it was the Silver Jubilee year of the Centre. It was particularly pleasant to note that the number of publications during the year (162 to be precise) reached an all time high for the Centre. We need to maintain this momentum in our continuing growth in research publications.

Sponsored projects do reveal a lot about how our research is perceived by funding agencies and also our status within the research community. In the year 2010-2011 as many as 40 projects were sanctioned to our faculty amounting to Rs . 4,83,19,968/-.

The DST Unit for Nanoscience (UNANST) which was running for last 5 years with participation of 7 faculty members concluded in April 2010. The project had total expenditure of Rs. 634 lakhs. It produced 155 papers, filed 11 patents, supported 20 students for their PhD thesis, 15 M.Sc/M.Tech project students and 32 summer students. The project has been closed with an "Excellent" grading. In March 2011 we received funding for UNANST-II (Total sanctioned amount approximately Rs. 461 lakhs). We expect to work on new and challenging problems in this area in future.

Strong collaboration continued between our faculty and scientist both from India and also from countries like Japan, Korea, South Africa, Brazil, Germany, Austria, USA, Sweden, UK, Poland, Italy, France, Australia, Nepal and Bangladesh.

Over the last year a significant number of new appointments have been made (not all have joined already but they are expected to in the coming year). The number of young post doctoral researchers has grown to become almost the same number as the regular faculty. All these are positive indicators and we can look forward to a very strong Centre when it is time for the next celebration.

Jayanta Kumar Bhattacharjee
Dean, Faculty

DEAN, ACADEMIC PROGRAMME

In this Silver Jubilee year of the Centre, the academic activity expanded considerably. A dozen of students who completed their Ph.D. under the supervision of our Faculty members were awarded the Degree. Another nine have submitted their thesis. The current Post B.Sc. programme (which has been renamed as the Integrated Ph.D. or IPhD program) had altogether 36 students in 2010-2011. The Post M.Sc. Program had 89 students supported by the Center or CSIR and UGC scholarships. Ten students were supported by various projects. Other than these, there were many external students and part-time students who are supervised by our faculties. Every year, many students from all over India carry out their summer projects in our Center and this year it was no exception. Altogether 27 students (supported by the Center or external agencies) came in summer and 4 came in Fall session. The mandatory UGC approved courses were formulated and the first batch of about 130 students (internal and external) have cleared the course work successfully. It has been agreed upon that henceforth the IPhD program would be conducted under the umbrella of Calcutta University which would be awarding both the Masters Degree and the Ph.D. degree to the IPhD students.

There was a continuous influx of scientists, collaborators and eminent personalities who delivered illuminating talks. Apart from regular seminars and colloquia, the following Memorial lectures, especially catered to enhance the overall understanding of nature, were delivered.

MEMORIAL LECTURES

- **1st G. N. Ramachandran Memorial Lecture**

Interrogating an Insect Society by Professor Raghavendra Gadagkar, Indian Institute of Science, Bangalore, 3rd November 2010.

- **21st S. N Bose Memorial Lecture (SNBNCBS) & 1st R. N. Tagore Memorial Lecture (IACS)**

Science for Musical Excellence by Vidhwan Dr. Umayalpuram Sivaraman, and Dr. T Ramasami with Dr. MD Naresh, 10th December 2010.

- **2nd S. Chandrasekhar Memorial Lecture**

Mathematical Beauty: Its power in scientific research by Professor Sir Roger Penrose, Mathematical Institute, Oxford, England, 7th January 2011.

- **9th C. K. Majumdar Memorial Lecture**

Main problems and current challenges in systems with strongly correlated electrons by Professor Daniel Khomskii, II Physikalisches Institut, Universititaet Zu Koeln, Koeln, Germany, 1st February 2011.

- **2nd G. N. Ramachandran Memorial Lecture**

Drugs and Drug Targets against the Malarial Parasite by Professor Govindarajan Padmanaban, Indian Institute of Science, Bangalore, 4th February 2011.

SEMINARS HELD

- 22.02.2011, *Molecular dynamics simulation of hot Brownian motion on GPUs*, Dr. Dipanjan Chakraborty, University of Leipzig, Germany.
- 27.12.2010, *A Blind Approach To High Tc Superconductivity*, Prof. Sanjoy K Sarker, University of Alabama, Tuscaloosa
- 16.12.2010, *Revolutionizing EDX Analytics in a TEM/STEM system*, P. Schlossmacher, D. O. Klenov, B. Freitag, and H.S. von Harrach, FEI Company, Eindhoven, The Netherlands
- *16.12.2010, Kohn Anomaly in the Conventional Superconductors : A Surprise*, Prof. Mukunda P. Das, Research School of Physics and Engineering, Australian National University, Canberra.

- 14.12.2010, *A Tale of two Oxides*, Dr. Prabuddha Sanyal, University of Hyderabad.
- 06.12.2010, *Steady State chemotaxis of E. Coli - a non Markovian random walk*, Dr. Sakuntala Chatterjee, Dept. of Physics, Technion, Haifa, Israel.
- 12.11.2010, *Gravitational-wave astronomy* by LIGO, Dr. Rahul Biswas, Center for Gravitational Wave Astronomy, University of Texas at Brownsville.
- 04.10.2010, *Weighted Scale-free Networks in Euclidean Space Using Local Selection Rule*, Dr. Goutam Mukherjee, Bidhanchandra College, Asansol.
- 04.10.2010, *Intergalactic Magnetic Field and Arrival Direction of Ultra-High Energy Protons*, Dr. Santabrata Das, Department of Physics, Indian Institute of Technology, Guwahati.
- 23.09.2010, *Fluctuation relations for systems driven far away from equilibrium*, Dr. Punyabrata Pradhan, II. Institut für Theoretische Physik, Universität Stuttgart, Germany.
- 15.09.2010, *Properties of High Temperature Superconductors in the Mixed Symmetry state*, Ms. Madhuparna Karmakar, Department of Physics, University of Pune.
- 31.08.2010, *The Formalism of Non-Commutative Quantum Mechanics and its Extension to Many-Particle Systems*, Mr. Andreas Hafver, Institute of Theoretical Physics, Stellenbosch University, South Africa.
- 30.08.2010, *Additional Degrees of Freedom associated with Non-Commutative Quantum Mechanical Position Measurements*, Mr. Chris Rohwer, Institute of Theoretical Physics, Stellenbosch University, South Africa.
- 16.8.2010, *One Day Seminar on Quantum Theory & Information* - 16.8.2010, Co-ordinator – Dr. Archan S. Majumdar, SNBNCBS.
- 11.08.2010, *Near horizon normal modes in black hole spacetime*, Dr. Pulak R Giri, Former PDF of University de Montreal, Montreal, Canada.
- 06.08.2010, *A new uncertainty principle from quantum gravity and its implications*, Prof. Saurya Das, University of Lethbridge, Canada.
- 6.07.2010, *Flavor equilibration studies of a QGP with nonzero baryon density*, Dr. Abhijit Sen, Dept. of Physics, Suri Vidyasagar College, West Bengal.
- 09.06.2010, *Collective decision making in cohesive flocks*, Dr. Kunal Bhattacharya, Department of Biological Physics, Eotvos Lorand University, Budapest.
- 25.05.2010, *Modeling Charge Transport Through Molecular Junctions*, Dr. Swapan K Pati, Theoretical Sciences Unit and New Chemistry Unit, JNCASR, Bangalore.
- 22.04.2010, *Dynamics of non-Abelian defects in biaxial liquid crystals*, Professor Ronojoy Adhikari, IMSc, Chennai.
- 19.04.2010, *Anti-linear deformations of integrable models*, Prof. Andreas Fring, Centre for Mathematical Science, City University, London.

MEETINGS ORGANIZED

- STATPHYS – Kolkata VII, Professor Jayanta Kumar Bhattacharjee, SNBNCBS and Professor Bikas K Chakrabarti, SINP, November 26-30, 2010

- 75 Years of Quantum Entanglement – Foundations and Information theoretic applications, Professor Archan S Majumdar, SNBNCBS and Professor Dipankar Home, Bose Institute, January 6-10, 2011

- Micro Seminar on Nonlinear Phenomena, Dr. Partha Guha, January 3, 2011

- Mesoscopic Physics and Spectroscopy, Dr. Prosenjit Singha Deo, November 22-24, 2010

- MAGMA 2011 [Magnetic Materials and Applications 2011], Dr. Pratip Kumar Mukhopadhyay, January 24-25, 2011

COURSES OFFERED

Post B.Sc Integrated Ph.D Programme

1st Semester: PHY101, Classical Dynamics, Samir Kumar Paul; PHY102, Mathematical Methods I, Ranabir Dutt; PHY103, Quantum Mechanics I, Biswajit Chakraborty; PHY104, Electromagnetic Theory I, M Sanjay Kumar; HUM/PHY105, Computational Methods in Physics I, Subhrangshu S Manna; PHY191, Basic Laboratory I, P K Mukhopadhyay, Anjan Barman

2nd Semester: PHY201, Statistical Mechanics, Jayanta K Bhattacharjee; PHY202, Mathematical Methods II, Samir Kumar Paul; PHY203, Quantum Mechanics II, Ranabir Dutt; PHY204, Electromagnetic Theory II, Ranabir Dutt; HUM/PHY205, Computational Methods in Physics II, Jaydeb Chakrabarti; PHY291, Basic Laboratory II, Kalyan Mandal

3rd Semester: PHY301, Quantum Mechanics III, M Sanjay Kumar; PHY302, Condensed Matter Physics, Abhijit Mookerjee; PHY303, Nuclear & Particle Physics, Debashis Gangopadhyay; PHY304, Project Based Courses, Faculty Supervisors as per choice of projects; PHY391, Methods of Experimental Physics, Kalyan Mandal (Co-ordinator) & Faculty Supervisors (Experimental)

4th Semester: PHY401, Project Based Course (Compulsory Course), Faculty Supervisors to float projects; PHY402, Seminar Course, Kinsuk Acharyya; PHY404, Advanced Mathematical Methods, Amitabha Lahiri; PHY410, Advanced Techniques in Experimental Methods, Students to choose Course Instructors; PHY413, Magnetism & Superconductivity, Ranjan Chaudhury, Kalyan Mandal; PHY415, Non-Linear Dynamics, Jayanta Kumar Bhattacharjee; PHY416, Optical Physics , Anjan Barman; PHY421, Quantum Theory of Many Body Systems, M Sanjay Kumar

Post M.Sc Ph.D Programme

Common to all the departments: PHY 501, Research Methodology, Sandip Kumar Chakrabarti, Pratip Kumar Mukhopadhyay, Kinsuk Acharyya; PHY 502, Review of the Topical Research, Faculty Supervisor

Department of Astrophysics & Cosmology: PHY 510, Astrophysics, Sandip Kumar Chakrabarti, Archan S Majumdar, Anuj Nandi (ICSP), Vipin Yadav (ICSP), Kinsuk Acharyya; PHY 506, Quantum Physics, Archan S Majumdar; PHY 509, Relativity & Cosmology, Archan S Majumdar; PHY 591, Project Work, Faculty Supervisor

Department of Theoretical Science: PHY 509, Relativity & Cosmology, Amitabha Lahiri; PHY 603, Statistical Physics, Jayanta Kumar Bhattacharjee; PHY 506, Quantum Physics, Jayanta Kumar Bhattacharjee; PHY 508, Numerical Methods, Subhrangshu S Manna; PHY 591, Project Work, Faculty Supervisors

Department of Material Science: PHY 503, Condensed Matter Physics (Theoretical), Abhijit Mookerjee; PHY 503, Condensed Matter Physics (Experimental), Arup Kumar Raychaudhuri; PHY 601, Advanced Condensed Matter Physics – Magnetism & Superconductivity, Ranjan Chaudhury & Kalyan Mandal; PHY 591, Project Work, Faculty Supervisor

Department of Chemical, Biological and Macromolecular Sciences: CB 527, Molecular Physics & Spectroscopy, Gautam Gangopadhyay; CB 521, Numerical Methods, Prosenjit Singha Deo; CB 525, Instrumental Methods of Analysis, Samir K Pal / Rajib Mitra; CB 526, Fundamentals of Biophysics, Samir K Pal / Rajib Mitra; CB 591, Project/Research Methodology, Faculty Supervisors

SUMMER PROJECTS

1. Chandrani Naik, Indian Institute of Technology, Bombay, Biswajit Chakraborty; Nairita Pal, Indian Institute of Technology, Delhi, Rabin Banerjee; Naveena Natarajan, University of Madras, Kalyan Mandal; Pratik Tarafdar, Indian Institute of Technology, Bombay, Archan S Majumdar; Pritam Khan, University of Calcutta, Sugata Mukherjee; Rituparna Nath, Indian School of Mines, Dhanbad, Subhrangshu Sekhar Manna; Sourav Sen Choudhury, Ramkrishna Mission Vivekananda University, Debashis Gangopadhyay; Tanmoy Goswami, Indian Institute of Technology, Bombay, Anjan Barman; Tushita Mukhopadhyay, University of Delhi, Ranjit Biswas; Partha Sarathi Dey, Indian School of Mines, Dhanbad, Pratip Kumar Mukhopadhyay

2. Aritra Mukhopadhyay, IISER, Kolkata, Biswajit Chakraborty; Sumanta Bandopadhyay, IISER, Kolkata , Amitabha Lahiri; Anirban Mukherjee, IISER, Kolkata, Amitabha Lahiri; Bibek Ranjan Samanta, IISER, Kolkata, Ranjit Biswas

3. Prabhat Shankar Jha, Fergusson College, Pune, Arup K Raychaudhuri; Prasoon Raj, St. Stephen's College, Archan S. Majumdar; Nachimuthu Poongodi, Bharatihar University, Pratip Kumar Mukhopadhyay; Projna Banerjee, Indian Institute of Technology, Kharagpur, Jayanta Kumar Bhattacharjee

4. Kaustubh Shrimali, IISER, Bhopal, Ranjit Biswas

5. Debanjan Datta, Indian School of Mines, Dhanbad, Bimalendu B Bhattacharyya; Suman Prasad Mehta, Indian School of Mines, Dhanbad, Bimalendu B Bhattacharyya; Ankur Mundhra, Indian School of Mines, Dhanbad, Bimalendu B Bhattacharyya

6. Arpan Das, Indian Institute of Technology, Bombay, Pratip Kumar Mukhopadhyay; Soma Ray, University of Calcutta, Pratip Kumar Mukhopadhyay; Somrita Dutta, Burdwan University, Pratip Kumar Mukhopadhyay; Soumen Deb, Indian Institute of Technology, Bombay, Jayanta K Bhattacharjee; Debapriya Chaudhuri, University of Delhi, Jayanta K Bhattacharjee

1. FUNDED BY SNBNCBS; 2. FUNDED BY KVPY; 3. FUNDED BY INDIAN ACADEMY OF SCIENCE; 4. FUNDED BY JNCASR; 5. FUNDED BY INSPIRE-SHE; 6. SELF SUPPORT

FALL SEMESTER PROJECTS

Prince Raj Anand, Indian School of Mines, Dhanbad, Pratip Kumar Mukhopadhyay; Arpan Kumar De, Indian Institute of Technology, Kharagpur, Subhrangshu S. Manna; Bijit Singha, Indian Institute of Technology, Delhi, Debashis Gangopadhyay

M. TECH. / M. SC. PROJECTS

Dhani Ram Mahato, Birla Institute of Technology, Mesra, Kolkata Centre, Ranjit Biswas and Mahua Ghosh

PH. D. AWARDED

- OPTICAL PROPERTIES OF ZNO BASED NANOSTRUCTURED MATERIALS, by Manoranjan Ghosh, Supervisor: Arup Kumar Raychaudhuri, in Jadavpur University, awarded on 12.04.2010.

- TUNING OF GROUND STATE AND PHASE TRANSITION IN COMPLEX OXIDE NANOMATERIALS, by Tapati Sarkar, Supervisor: Arup Kumar Raychaudhuri, in Jadavpur University, awarded on 12.04.2010.

- SYNTHESIS, CHARACTERIZATION AND INVESTIGATION OF ELECTRICAL TRANSPORT IN METAL NANOWIRES AND NANOTUBES, by M. Venkata Kamalakar, Supervisor: Arup Kumar Raychaudhuri, in Jadavpur University, awarded on 12.04.2010.

- UNDERSTANDING THE CANTILEVER DYNAMICS OF ATOMIC FORCE MICROSCOPE AND ITS APPLICATION TO NANOMANIPULATION, by Soma Das, Supervisor: Arup Kumar Raychaudhuri, in Jadavpur University, awarded on 09.06.2010.

- GROWTH, STRUCTURE AND PROPERTIES OF ULTRA-THIN METAL-ORGANIC FILMS, by Mrinal Kanti Bera, Supervisors: M K Sanyal (SINP) and S Dattagupta (IISERK), in West Bengal University of Technology, awarded on 25.06.2010.

- EQUILIBRIUM AND DYNAMICS OF STRUCTURAL TRANSITIONS, by Jayee Bhattacharya, Supervisor: Surajit Sengupta, in Jadavpur University, awarded on 11.08.2010.

- STUDY OF LOW FREQUENCY CONDUCTION FLUCTUATIONS IN PEROVSKITE MANGANITES, by Sudeshna Samanta, Supervisor: Arup Kumar Raychaudhuri, in Jadavpur University, awarded on 22.11.2010.

- THEORETICAL STUDIES ON STRUCTURE AND ENERGETICS OF DNA UNDER DIFFERENT CONDITIONS, by Sudipta Samanta, Supervisor: Jaydeb Chakrabarti, in West Bengal University of Technology, awarded on 07.12.2010.

- X-RAY STUDIES OF COMPACT OBJECTS: DATA ANALYSIS, DEVELOPMENT OF INSTRUMENTS AND THEIR CHARACTERISATON by Ritabrata Sarkar, Supervisor: Sandip K. Chakrabarti in JU, awarded on: 24.12.2010 (External).

- X-RAY PROPERTIES OF A FEW GALACTIC BLACK HOLE CANDIDATES DURING THEIR OUTBURSTS by Brojagopal Datta, Supervisor: Sandip K. Chakrabarti in CU, awarded on 27.12.2010 (External).

- X-RAY PROPERTIES OF THE SUN AND SOME COMPACT OBJECTS OF OUT GALAXY by Dipak Debnath, Supervisor: Sandip K. Chakrabarti in CU, awarded on 03.01.2011 (External).

- MAGNATIC TRANSPORT AND ELECTRONIC PROPERTIES OF INTERMETALLIC PEROVSKITE COMPOUNDS, by Abhishek Pandey, Supervisors: Sushanta Duttagupta, IISER, Kolkata and R. Ranganathan, SINP, in West Bengal University of Technology, awarded on 21.02.2011.

PH. D. THESIS SUBMITTED

- STUDY OF PATH SPACE, GAUGE THEORY AND HOLONOMY, by Saikat Chatterjee, Supervisor: Amitabha Lahiri, in Jadavpur University, submitted on 20.05.2010.

- SOME NON PERTURBATIVE ASPECTS OF GAUGE THEORIES, by Chandra S. Chatterjee, Supervisor: Amitabha Lahiri, in Jadavpur University, submitted on 07.06.2010.

- SELECTED TOPICS ON SYSTEMS FAR FROM EQUILIBRIUM, by Arnab Saha, Supervisor: Jayanta Kumar Bhattacherjee, in West Bengal University of Technology, submitted on 15.07.2010.

- ELASTO-PLASTIC THEORIES FOR MICROSTRUCTURE SELECTION IN SOLIDS, by Arya Paul, Supervisor: Surajit Sengupta & Jayanta Kumar Bhattacharjee, in West Bengal University of Technology, submitted on 02.09.2010.

- FLUORESCENCE SPECTROSCOPIC STUDIES OF CHARGE TRANSFER AND DYNAMICS IN SOLUTION PHASE: EFFECTS

OF SOLVENTS, ELECTROLYTE AND MOLTEN SALTS, by Harun Al Rasid Gazi, Supervisor: Ranjit Biswas, in Jadavpur University, submitted on 02.11.2010.

- QUANTUM TUNNELING IN BLACK HOLES, by Bibhas Ranjan Majhi, Supervisor: Rabin Banerjee, in Calcutta University, submitted on 13.12.2010.

- THEORETICAL STUDIES OF PROTEIN-NUCLEIC ACID INTERACTION RELATED TO GENE-EXPRESSION, by Navin Chandra, Supervisors: Siddhartha Roy, IICB and Surajit Sengupta, IACS, in West Bengal University of Technology, submitted on 15.12.2010.

- A FIRST PRINCIPLES STUDY OF COMPLEX OXIDES, by Hena Das, Supervisor: Tanusri Saha Dasgupta, in Calcutta University, submitted on 22.02.2011.

- DYNAMICAL HETEROGENEITIES AND NON-EQILIBRIUM PROCESSES IN CONDENSED PHASES, by Tamoghna Das, Supervisors: Surajit Sengupta, IACS & Jayanta K. Bhattacharjee, in West Bengal University of Technology, submitted on 28.03.2011.

PH. D. THESIS COLLOQUIA

- *Some non perturbative aspects of gauge theories*, Chandra S. Chatterjee, 30.04.2010.

- *Study of Path Space, gauge theory and holonomy*, Saikat Chatterjee, 30.04.2010.

- *Selected Topics on Systems far from Equillibrium*, Arnab saha, 22.06.2010.

- *Interplay of Collective and Magnetic rotation in Mass~100 region*, Santosh Roy, 16.08.2010.

- *Fluorescence Spectroscopic Studies of Charge Transfer and Dynamics in Solution Phase: Effects of Solvent, Electrolyte and Molten Salts*, Harun Al Rasid Gazi, 20.08.2010.

- Elasto-plastic Theories for Microstructure Selection in Solids, Arya Paul, 30.08.2010.

- Theoretical studies of Protein-Nucleic Acid Interaction related to Gene-Expression, Navin Chandra, 12.10.2010.

- *Electronic Structure of Alloys and Compounds*, Moshiur Rahaman, 30.12.2010.
- *Droplet fluctuations and mechanical behavior of solids*, Tamoghna Das, 28.2.2011.

- *Studies of magnetic and transport properties of disordered systems*, Mitali Banerjee, 25.03.2011.

RESEARCH SCHOLARS AT POST M. SC. PH.D. PROGRAMME

SENIOR RESEARCH FELLOW

2005 – 2006: Harun Al Rashid Gazi (Submitted Thesis on 02.11.2010), Mitali Banerjee (UGC) (Submitted Thesis on 19.04.2011), Moshiur Rahaman, TWAS-Bose Fellow, Sourav Bhattacharya

2006 – 2007: Bibhas Ranjan Majhi (Submitted Thesis on 13.12.2010), Debabrata Pal (Resigned on 09.07.2010), Hena Das (Submitted Thesis on 22.02.2011), Rajesh Kumar Neogy, Raka Dasgupta, Himadri Ghosh

2007 – 2008: Kapil Gupta (CSIR), Prashant Singh, Soumyajit Sarkar (CSIR), Swastika Chatterjee, Kinshuk Banerjee (CSIR), Sujoy Modak (CSIR), Ambika Prasad Jena (CSIR), Biswajit Das, Biswajit Guchhait (CSIR), Debraj Ray, Kinsuk Giri, Pramod Kumar Verma (CSIR), Abhinandan Makhal (CSIR)

2008 – 2009: Abhijit Chakraborty, Amit Das (CSIR), Arnab Sen (Resigned on 01.09.2010), Debmalya Mukhopadhyay, Manotosh Chakravorty (CSIR), Sandeep Agarwal (CSIR), Sandeep Singh, Shahnewaz Mondal (CSIR), Snehasis Das Chakraborty (CSIR), Sudipto Kanungo, Sujay Pal (CSIR), Tamal Basak (CSIR), Tanumoy Pramanik (UGC), Shyamsundar Ghosh (CSIR), Arka Choudhury, Rajib Nath (CSIR)

2009 – 2010: Dibakar Raychaudhury (CSIR)

JUNIOR RESEARCH FELLOW

2009 – 2010: Anupam Giri (UGC), Ashutosh Kumar Yadav, Bipul Kumar Mahato (CSIR), Biswajit Pal (CSIR), Bivas Rana (UGC), Dattatraya P Shinde, Debabrata Sinha (CSIR), Debashish Sarkar (CSIR), Deepak S Jalla (CSIR), Injamamul Arief (CSIR), Nirmal Goswami (CSIR), Putul Malla Chowdhury (CSIR), Rabaya Basori, Rajasree Das (CSIR), Ranajay Saha, Ruma Das (CSIR), Saikat Debnath (CSIR), Santu Baidya, Semanti Pal (UGC), Soma Banerjee (UGC), Soumi Roy Chowdhury, Soumik Sarkar (UGC),

Sreemoyee Mukherjee, Subrata Batabyal (CSIR), Sudipta Kumar Bera (CSIR), Sujit Sarkar (UGC), Sumit Ghosh (CSIR), Surajit Rakshit (CSIR), Swarnakamal Mukherjee (CSIR), Tamisra Pal, Tanumoy Mondal, Thaneshwor Prasad Kaloni (Resigned on 01.02.2011), Urbashi Satpathi, Wasim Iqbal

2010 – 2011: Anirban Karmakar, Anuradha Das (UGC), Arindam Lala (CSIR), Bandan Chakraborty (UGC), Sreeraj T P (CSIR), Subhajit Sarkar (CSIR), Susmita Saha (CSIR), Tanmoy Ghosh, Nandan Kumar Das (CSIR), Animesh Patra, Sandipa Indra (UGC), Yendrembam Chaoba Devi, Sisir Chowdhury (UGC), Sabyasachi Ghosh, Sandeep Chakraborty (INSPIRE)

RESEARCH SCHOLARS AT POST B. SC. INTEGRATED PH.D. PROGRAMME

EXTENDED SENIOR RESEARCH FELLOW

2003 – 2004: Arya Paul (Submitted Thesis on 02.09.2010), Arnab Saha (Submitted Thesis on 15.07.2010)

SENIOR RESEARCH FELLOW

2002 – 2003: Chandra S. Chatterjee (Submitted Thesis on 07.06.2010), Saikat Chatterjee (Submitted Thesis on 20.05.2010)

2003 – 2004: Tamoghna Kanti Das (Submitted Thesis on 28.03.2011), Bipul Das

2004 – 2005: Shreemoyee Ganguly

2005 – 2006: Abhinav Kumar (UGC)

2007 – 2008: Amartya Sarkar, Indrakshi Roychowdhury, Nilok Bose, Oindrila Ganguly, Rajiv Kumar Chouhan, Rudranil Basu (CSIR – SPM Fellow), Sudip Kumar Garain

JUNIOR RESEARCH FELLOW

2008 – 2009: Arup Bhowmik, Atanu Nath (Resigned on 16.06.2010), Debashis De Munshi (Resigned on 16.06.2010), Sanjib Ghosh (Resigned on 16.06.2010), Soumyadipta Pal, Srimoy Chakraborty (Resigned on 01.12.2010), Sukla Pal

M.SC. STUDENTS

2009 – 2010: Anand Kumar Gupta (Resigned on 12.11.2010), Arghya Das, Arijit Chatterjee, Arnab Ganguly, Ashutosh Kumar Singh, Biplab Bhattacharjee, Debanjan Polley, Kumar Jang Bahadur Ghosh, Subhasis Chakraborty

2010 – 2011: Ankita Chakrabarti, Arpan Krishna Mitra, Soumyokanti Bose, Suman Duttta, Tejas Rathod

RESEARCH SCHOLARS IN PROJECTS

SENIOR RESEARCH FELLOW

2008 – 2009: Hirak Kumar Chandra (Indo-German Project)

2009 – 2010: Ashutosh Rai (DST Project)

JUNIOR RESEARCH FELLOW

2009 – 2010: Prajna Mukherjee (AMRU) (Resigned on 14.09.2010), Dheeraj Kumar (DST Project), Milan Agarwal (Resigned on 26.11.2010) (DST Project), Subhadipa Das (DST Project), Arun Lakshmanan (DST Project), Shiladitya Mal (DST Project), Priyanka Chowdhury (DST Project), Ruma Mandal (DST Project)

PART TIME RESEARCH SCHOLARS OF THE CENTRE

- Asit Kumar Chaudhury, Astrophysics & Cosmology, under Sandip K Chakrabarti, Current Affiliation: LMSM High School
- Nirman Ganguly, Astrophysics & Cosmology, under Archan S Majumdar, Current Affiliation: Heritage Institute of Technology
- Pampa Pal, Material Science, under Alak K Majumdar (IISER-K), Current Affiliation: Christopher Road Govt. Sponsored H. S School for Girls
- Sarmistha Chaudhuri, Theoretical Science, under Rabin Banerjee, Current Affiliation: Camellia University of Technology
- Sovik Roy, Astrophysics & Cosmology under Archan S. Majumdar, Current Affiliation: Techno India
- Barun Khanra, Theoretical Science under Partha Guha, Current Affiliation: Sailendra Sircar Vidyalaya

Sandip Kumar Chakrabarti
Dean, Academic Programme

REPORT ON ADMINISTRATIVE MATTERS

The administrative and technical staff members of the Centre have very professionally and sincerely carried out their duties for making the various activities of the Centre in 2010-2011 successful. Staff comprising of strength of approximately 22 in permanent, 13 in temporary and 51 in contractual category as on 31st March 2011, have functioned effectively under the able leadership of the Director and the Registrar. The smooth running of the day to day activities of the Centre including guest house, security, EPABX, transport, cafeteria, electrical maintenance, AC maintenance, etc. has been made possible due to the professional services provided by the various services contract agencies working closely with the administrative departments of the Centre. The Centre has tried to enhance the capabilities of its administrative employees by encouraging them to attend various training programmes and workshops. The Centre has maintained a close communication with the Department of Science and Technology by replying to their various enquiries and answering Parliamentary Questions. The Hindi Cell of the Centre has been functioning effectively from April 2008 and substantial work has been undertaken regarding implementation of the Official Language. No cases related to vigilance and Complaints Committee has been reported during the period of 2010-2011. The Centre also adheres to the reservation policy as per Government of India norms. The Centre has also adhered to the norms of the Right to Information Act and so far has received one case under the said Act which has been successfully disposed off.

OFFICIAL LANGUAGE POLICY

The Centre paid emphasis on implementation of the Official Language in the year 2010-11. According to Rajbhasha Act, reply to Hindi letters was given in Hindi only. All the Official Registers, Forms, Visiting Cards and Letter heads are in bilingual format. Advertisements, tender notices, office orders and notices are circulated in Hindi also. Many of the internal noting and signing in the Attendance Register (on the first of every month) is done in Hindi. The Centre is a member of Calcutta Town Official Language Implementation Committee (CALTOLIC). The Centre has a Hindi Implementation Committee which meets regularly under the Chairmanship of Director. Almost 100% of the administrative staff now possess working knowledge of Hindi and have been successfully trained/ undergoing training in the 'Praveen' and 'Pragya' courses of the Department of Official Language, Government of India.

The newsletter of the Centre, published quarterly, contains at least one article in Hindi. Miscellaneous jobs like calendar, greetings cards and banners for different Seminars etc. are done in bi-lingual format.

The year also saw Hindi Diwas being celebrated in great zeal, with the month of September being declared as Hindi month. Quiz, debates, screening of Hindi movie and Hindi drama were organised as part of 'Hindi Mahina'.

Prof. Raj Nath Bhatt, Head of the Department of Linguistics, BHU, Varanasi delivered the Bose Colloquium titled "Swanimvijnan: Hindi Arya Bhasha Samoh ke Sandarbh Mein" on 16 April 2010.

WELFARE MEASURES POLICY

The Centre has its Contributory Medical Scheme under which bills for both outdoor and indoor facilities are reimbursed for the staff and their dependents and students as per CGHS rates. The Centre has its own medical unit for its staff members. Three doctors of different discipline viz. Allopathic, Homeopath and Ayurvedic pay regular visits to the medical unit and provide free consultation. Facilities like oxygen, wheel chair, stretcher, rest bed is readily available. The Centre also has tie ups with some of the renowned hospitals in Kolkata who provide cash less facility under CGHS Scheme to the employees and its family.

The Centre has also opened a Creche within it's premises by the name of 'Kishlay' for the children of staff and students of the Centre. The Centre has a modern Guest House comprising of 36 rooms and a newly renovated fully AC Dining Hall and Kitchen with modern facilities.

I would like to express my sincere thanks to the three Deputy Registrars of Administration, Finance and Accounts and Academic sections and to all administrative and academic staff members for their kind cooperation and help for smooth running of the Centre. I am also thankful to the Director for his valuable guidance and advice.

Sugata Mukherjee
Acting Registrar

GOVERNING BODY

Dr. T. Ramasami Chairman
Secretary Department of Science & Technology
Government of India, New Delhi

Prof. G. K. Mehta Member
Dist. Hon. Prof. IIT Kanpur & Hon. Eminent Scientist
Inter University Accelerator Centre, New Delhi

Prof. T. V. Ramakrishnan Member
DAE Homi Bhabha Professor
Banaras Hindu University, Varanasi

Prof. Mustansir Barma Member
Director, Tata Institute of Fundamental Research, Mumbai

Miss Sheila Sangawan Member
Additional Secretary & Financial Adviser
Department of Science & Technology, New Delhi

Prof. Arup Kumar Raychaudhuri Member
Director, S. N. Bose National Centre for Basic Sciences, Kolkata

Shri Samar K. Ghosh, IAS Member
Chief Secretary, Government of West Bengal, Kolkata

Prof. Sibaji Raha Permanent Invitee
Director, Bose Institute, Kolkata

Prof. Kankan Bhattacharya Permanent Invitee
Director, Indian Association for the Cultivation of Science, Kolkata

Dr. Sugata Mukherjee Non-Member Secretary
Acting Registrar, S. N. Bose National Centre for Basic Sciences, Kolkata

FINANCE COMMITTEE

Prof. Arup Kumar Raychaudhuri Chairman
Director, S. N. Bose National Centre for Basic Sciences, Kolkata

Prof. Sibaji Raha Member
Director, Bose Institute, Kolkata

Dr. Praveen Chaddah Member
Director, UGC-DAE Consortium for Scientific Research, Indore

Miss Sheila Sangawan Member
Additional Secretary & Financial Adviser, Department of Science & Technology, New Delhi

Dr. Sugata Mukherjee Member Secretary
Registrar, S. N. Bose National Centre for Basic Sciences, Kolkata

ACADEMIC AND RESEARCH PROGRAMME ADVISORY COMMITTEE

Prof. V. S. Ramamurthy Chairman
NIAS, Bangalore

Prof. Dipankar Das Sarma Member
IISc, Bangalore

Prof. Naresh Kumar Dadhich Member
IUCAA, Pune

Prof. Deepak Dhar Member
TIFR, Mumbai

Prof. Siddhartha Roy Member
IICB, Kolkata

Prof. Arup Kumar Raychaudhuri Member
Director, S. N. Bose National Centre for Basic Sciences, Kolkata

Prof. Sandip Kumar Chakrabarti Member
Dean (Academic Programme), S. N. Bose National Centre for Basic Sciences, Kolkata

BUILDING COMMITTEE

Prof. Arup Kumar Raychaudhuri Chairman
Director, S. N. Bose National Centre for Basic Sciences

Dr. Sugata Mukherjee Member-Secretary
Registrar, S. N. Bose National Centre for Basic Sciences

Mr. Asim Sinha Member
Chief Engineer (Retired) Electrical, CPWD

Prof. Sibabrata Halder Member
Head, Department of Architecture Bengal Engineering and Science University, Sibpur

Shri Ranadhir Dey Member
Outstanding Scientist, VECC

Mr. Jnanda Ranjan Bhattacharya Special Invitee
Superintending Engineer, S. N. Bose National Centre for Basic Sciences

Mr. Apurba Kanti Sarkar Special Invitee
Deputy Registrar (Finance), S. N. Bose National Centre for Basic Sciences

CONSULTATIVE ADVISORY COMMITTEE

Prof. Arup Kumar Raychaudhuri Chairman
Director

Prof. Jayanta Kumar Bhattacharjee Member
Dean (Faculty)

Prof. Sandip Kumar Chakrabarti Member
Dean (Academic Programme) & Head, Department of Astrophysics and Cosmology

Prof. Rabin Banerjee Member
Head, Department of Theoretical Sciences

Prof. Gautam Gangopadhyay Member
Head, Department of Chemical, Biological and Macromolecular Sciences

Prof. Pratip Kumar Mukhopadhyay Member
Head, Department of Material Sciences

Dr. Sugata Mukherjee Member
Registrar

Mr. Apurba Kanti Sarkar Member
Deputy Registrar (Finance)

Ms. Shohini Majumder Member
Deputy Registrar (Administration)

Mr. Sunish Kumar Deb Member - Secretary
Deputy Registrar (Academic)

OFFICIAL LANGUAGE IMPLEMENTATION COMMITTEE

Prof. Arup Kumar Raychaudhuri Chairman
Director

Dr. Sugata Mukherjee Member
Registrar

Dr. Ranjan Chaudhury Member
Associate Professor

Dr. Manu Mathur Member
Associate Professor

Mr. Apurba Kanti Sarkar Member
Deputy Registrar (Finance)

Ms. Shohini Majumder Member
Deputy Registrar (Administration)

Dr. Chhayabrita Biswas Member
Bose Fellow

Mr. Sirsendu Ghosh Member
In-charge, Hindi Cell

Mr. Santosh Kumar Singh Member
PCO (Purchase)

Ms. Sushmita Dasgupta Member
Hindi Officer


S. N. BOSE
সত্যেন্দ্রনাথ বসু
1894-1974

PEOPLE AT THE CENTRE

ACADEMIC MEMBERS

FACULTY MEMBERS

1	Arup Kumar Raychaudhuri	Director
2	Abhijit Mookerjee	Distinguished Professor
3	Jayanta Kumar Bhattacharjee	Distinguished Professor
4	Rabin Banerjee	Senior Professor
5	Sandip Kumar Chakrabarti	Senior Professor
6	Subhrangshu Sekhar Manna	Senior Professor
7	Anita Mehta	Professor
8	Archan Subhra Majumdar	Professor
9	Surajit Sengupta	Professor
10	Tanusri Saha Dasgupta	Professor
11	Amitabha Lahiri	Associate Professor
12	Anjan Barman	Associate Professor
13	Biswajit Chakraborty	Associate Professor
14	Debashis Gangopadhyay	Associate Professor
15	Gautam Gangopadhyay	Associate Professor
16	Jaydeb Chakrabarti	Associate Professor
17	Kalyan Mandal	Associate Professor
18	Manu Mathur	Associate Professor
19	Makhtedar Sanjay Kumar	Associate Professor
20	Partha Guha	Associate Professor
21	Pratip Kumar Mukhopadhyay	Associate Professor
22	Priya Mahadevan	Associate Professor
23	Prosenjit Singha Deo	Associate Professor
24	Ranjan Chaudhury	Associate Professor
25	Ranjit Biswas	Associate Professor
26	Samir Kumar Pal	Associate Professor
27	Samir Kumar Paul	Associate Professor
28	Sugata Mukherjee	Associate Professor
29	Rajib Kumar Mitra	Reader

EMERITUS SCIENTISTS

1	Alak Kumar Majumdar	Emeritus Scientist
2	Bimalendu Bhusan Bhattacharya	CSIR Emeritus Scientist
3	Subodh Kumar Sharma	Emeritus Scientist
4	A. K. Mallik	INSA Senior Scientist

RESEARCH SCIENTIST

Barnali Ghosh Saha	Research Scientist

BOSE FELLOWS

1	Chhayabrita Biswas	Material Sciences
2	Kinsuk Acharyya	Astrophysics and Cosmology

VISITING FACULTY

1	Nilakantha Nayak	Visiting Professor
2	Mahua Ghosh	Visiting Reader (CBMS)
3	Saikat Ghosh	Visiting Reader (MS)
4	Kuntal Chakrabarti	Visiting Faculty Fellow (MS)
5	Madhuri Mandal	Visiting Faculty Fellow (MS)
6	Sarathi Kundu	Visiting Faculty Fellow (MS)
7	Saswati Barman	Visiting Faculty Fellow (MS)
8	Sumita Datta	Visiting Faculty Fellow (CBMS)

POST DOCTORAL FELLOWS

1	Alok Kumar Pan	Astrophysics and Cosmology
2	Analabha Roy	Theoretical Sciences
3	Anindya Das	Material Sciences
4	Jaita Banerjee	Material Sciences
5	Kaustuv Das	Material Sciences
6	Madhuparna Karmakar	Material Sciences
7	Prasad Basu	Theoretical Sciences
8	Priya Rajdev	Material Sciences
9	Sharvari Nadkarni Ghosh	Theoretical Sciences

RESEARCH ASSOCIATES

1	Bhogoju Rajini Kanth	Material Sciences
2	Bipul Rakshit	Material Sciences
3	Gaurang Yashwant Mahajan	Theoretical Sciences
4	Gobinda Gopal Khan	Material Sciences
5	Jayee Bhattacharya	CBMS
6	Ponraj Sabareesan	Material Sciences
7	Ranja Sarkar	Theoretical Sciences
8	Sanjay Gupta	CBMS
9	Siddhartha Sinha	Astrophysics and Cosmology
10	Soumendu Datta	Material Sciences
11	Sudeshna Samanta	Material Sciences
12	Tae-Hun Lee	Theoretical Sciences

ADMINISTRATIVE AND TECHNICAL STAFF MEMBERS

1	Sugata Mukherjee	Acting Registrar
2	Apurba Kanti Sarkar	Deputy Registrar(Finance)
3	Shohini Majumder	Deputy Registrar(Administration)
4	Sunish Kumar Deb	Deputy Registrar (Academic)
5	Avijit Ganguly	Campus Engineer cum Estate Officer
6	Saumen Adhikari	Librarian-cum-Information Officer
7	Sukanta Mukherjee	Assistant Registrar (Projects)
8	Santosh Kumar Singh	Programme Coordinating Officer
9	Sirsendu Ghosh	Programme Coordinating Officer
10	Tapan Kumar Sen	Senior Programme Assistant
11	Jaydeep Kar	Programme Assistant
12	Prosenjit Talukdar	Programme Assistant
13	Shiba Prasad Nayak	Pump Operator
14	Bijoy Kumar Pramanik	Junior Assistant (Guest House)
15	Aditya Pal Choudhury	Project Assistant
16	Bhupati Naskar	Library Stack Assistant
17	Arun Kumar Bhattacharya	Library Stack Attendant
18	Sushanta Kumar Biswas	Driver
19	Pradip Kumar Bose	Tradesman 'A'
20	Partha Chakraborty	Attendant
21	Partha Mitra	Attendant
22	Ratan Acharya	Attendant
23	Swapan Ghosh	Attendant

Rabin Banerjee — **Vigilance Officer**
Saumen Adhikari — **Public Information Officer**

ADMINISTRATIVE AND TECHNICAL STAFF MEMBERS

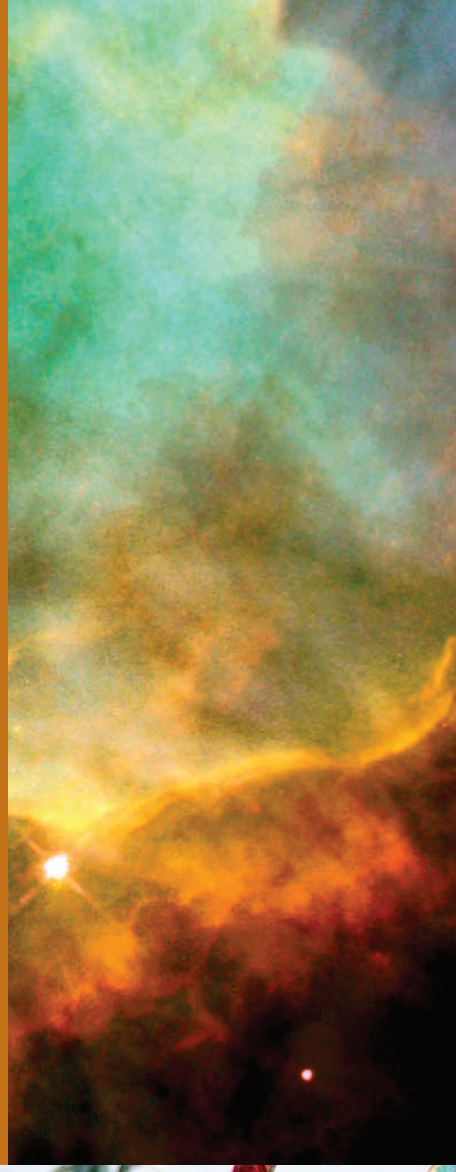
PERSONNEL WITH TEMPORARY STATUS

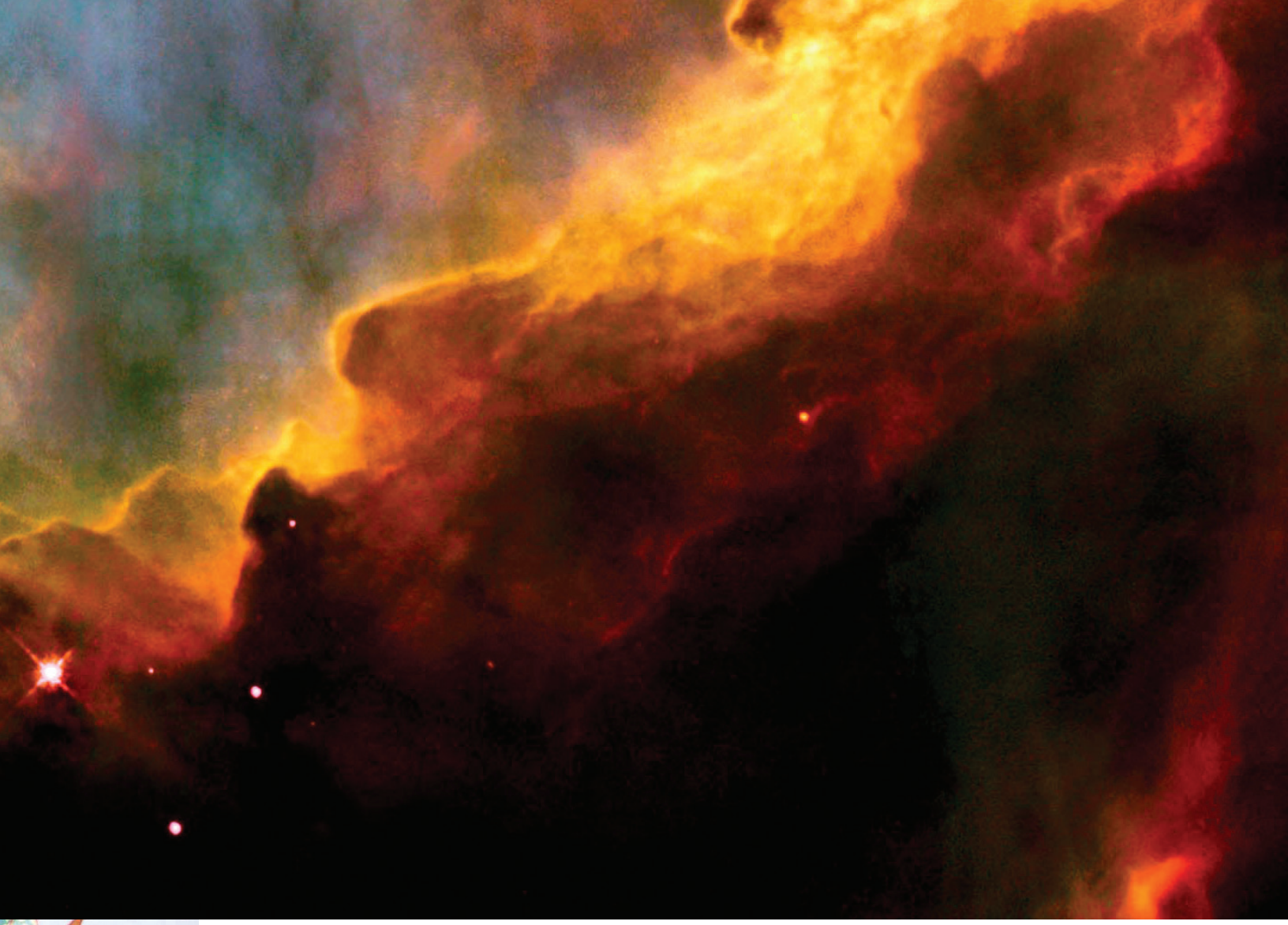
1	Biman Roy	Attendant (Administration)
2	Dulal Chatterjee	Attendant (Maintenance)
3	Somnath Roy	Attendant (Accounts)
4	Sudhanshu Chakraborty	Attendant (Technical Cell)
5	Sukamal Das	Attendant (Central Registry)
6	Hiralal Das	Cleaner
7	Kartick Das	Cleaner
8	Motilal Das	Cleaner
9	Prakash Das	Cleaner
10	Ramchandra Das	Cleaner
11	Biswanath Das	Garderner
12	Nimai Naskar	Garderner
13	Rabi Orao	Garderner

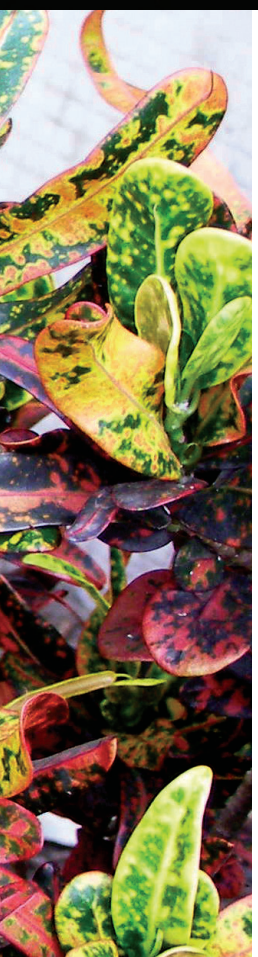
PERSONNEL ON CONTRACTUAL APPOINTMENT

1	Sukumar Sarkar	Consultant (Administration)
2	Jnanada Ranjan Bhattacharya	Superintending Engineer
3	Dr. Swapan Kumar Bhattacharyya	Authorized Medical Officer
4	Dr. Trideb Kumar Sarkar	Doctor of Homeopathy
5	Dr.Gopal Chandra Sengupta	Doctor of Ayurvedic
6	Sougata Bhattacharyya	Facilitation Officer
7	Sushmita Dasgupta	Hindi Officer
8	Achyut Saha	PS to Director
9	Mahua Mitra	Exec. Assistant (Admin.)
10	Amitava Ghosh	Senior Computer Engineer
11	Sanjay Sarkar	Senior Computer Engineer
12	Anjan Mukherjee	Junior Computer Engineer
13	Dipanwita Das	Junior Computer Engineer
14	Rajesh Das	Junior Computer Engineer
15	Sudeep Narayan Banerjee	Junior Computer Engineer
16	Gurudas Ghosh	Technical Assistant (Library)
17	Amit Roy	Technical Assistant (Library)
18	Dipankar Roy	Technical Assistant
19	Indrajit Chatterjee	Technical Assistant
20	Nasiruddin Mondal	Technical Assistant
21	Pallab Chakraborty	Technical Assistant
22	Piyali Bose	Technical Assistant
23	Shakti Nath Das	Technical Assistant
24	Subhabrata Chakraborty	Technical Assistant
25	Surajit Mukherjee	Technical Assistant
26	Ganesh Gupta	Jr. Engg (Electrical)
27	Supriyo Ganguly	Jr. Engg (Electrical)
28	Falguni Dutta	Jr. Engg (Civil)
29	Laxmi Sanpui	Jr. Engg (Civil)
30	Susanta Mitra	Jr. Engg (Civil)
31	Abu Torab Bin Aman	Office Assistant
32	Ayon Kumar Paul	Office Assistant
33	Swarup Dutta	Office Assistant
34	Indrani Laha	Office Assistant
35	Mitali Nanyasi	Office Assistant
36	Mitali Pal	Office Assistant
37	Subhodeep Mukherjee	Office Assistant
38	Subhodeep Seal	Office Assistant
39	Sutapa Basu	Office Assistant
40	Suvendu Datta	Office Assistant
41	Dipanjan Dey	Office Assistant
42	Lina Mukherjee	Junior Office Assistant
43	Debashish Mitra	Telephone Operator
44	Moumita Bhattacharya	Telephone Operator
45	Siddhartha Chatterjee	Telephone Operator
46	Abhijit Mishra	Mechanic
47	Harishikesh Nandi	Glass Blower
48	Gobinda Das	Driver
49	Arvind Paswan	Driver
50	Kalyani Ghosh	Caretaker (Creche)


TIGER
TIGER
EXPERT

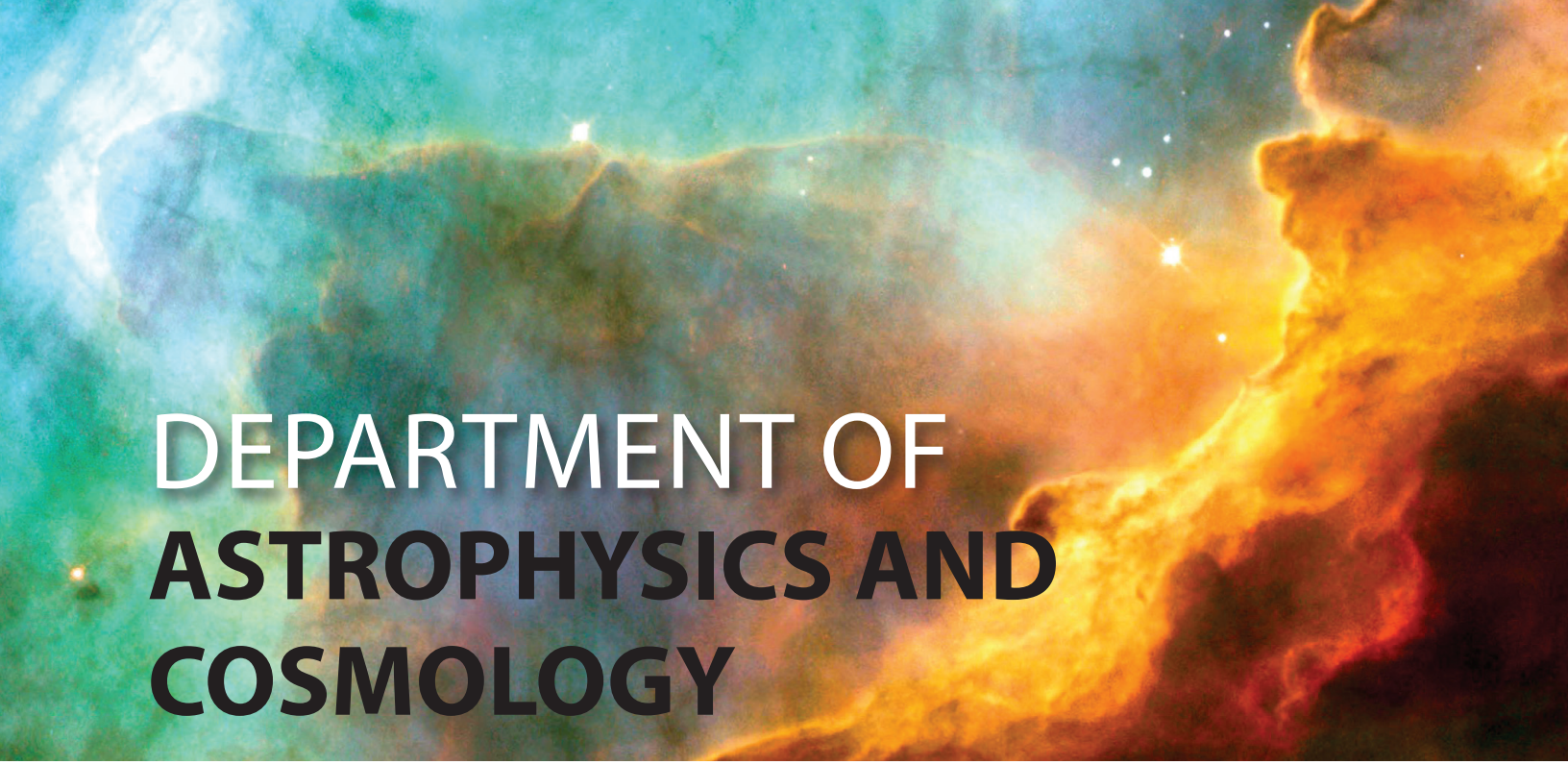






Department of

ASTROPHYSICS AND COSMOLOGY



DEPARTMENT OF ASTROPHYSICS AND COSMOLOGY

The department has three Faculty members, one Bose Fellow, two Post-Doctoral fellows and fourteen PhD students.

K. Acharyya concentrated on building the Astrobiology laboratory to mimic the Interstellar space. The installation of the ultra-high vacuum chamber with all its accessories is complete and the design for the gas deposition is complete. On the theoretical front he is studying the formation of hydrogen molecule on grain surfaces at high temperatures by using the continuous-time random-walk method.

S. K. Chakrabarti continued work on relativistic astrophysics around black holes, including accretion and outflows. He studied the evolution of quasi-periodic oscillations in the outburst sources. The Monte-Carlo simulations of the spectrum emitted by time dependent accretions and winds are studied. The effects of high energy processes on upper ionosphere have been observed and interpreted as events from the solar flares and gamma ray bursts. Correlations between the anomalous VLF signals and the seismic events have been established. Chemical composition and evolution of the multi-layer mantle of the grains have been studied by Monte Carlo simulations. In Collaboration with Indian Centre for Space Physics, balloon borne experiments are being conducted.

D. Gangopadhyay developed a formalism for estimating quantum fluctuations of the background temperature in the early universe using a Lagrangian for k-essence fields. Here, a single scalar field can account for the inflationary scenario as well as the dark matter and dark energy realms. He also works on the global Lorentz invariance and quantum gravity.

A. S. Majumdar continued to work on the basic problems in Cosmology as well as in quantum information science. He studies the origin of dark energy through various approaches and finds out the observational constraints on the dark matter in primordial black holes. In quantum information science, he studies the generation of entanglement through atom-photon interactions in various quantum optical systems. He also studies the implications of the causality principles.

All in all, the department published 24 research papers in refereed journal. One edited book on very low frequency radio waves was published by AIP, NY. One "Silver Jubilee International Symposium" was organized.

Sandip Kumar Chakrabarti
Head, Department of Astrophysics and Cosmology

Archan Subhra Majumdar

Professor

- Cosmology: Dark energy through various approaches; observational constraints on dark matter in primordial black holes
- Quantum information science: Generation of entanglement through atom-photon interactions in various quantum optical systems; implications of the information causality principle

Cosmology: Considering the evolution of primordial black holes in Brans-Dicke and other scalar-tensor models, we have obtained constraints on their number density from various observed astrophysical and cosmological effects.

Quantum information science: We have performed comparative studies of entanglement generation in various atom-photon interaction processes such as in multimode cavities, and under intensity-dependent couplings. The implications of the information causality principle are analyzed for Hardy-type nonlocal correlations.

PUBLICATIONS IN JOURNALS

- B. Nayak, A. S. Majumdar and L. P. Singh, Astrophysical constraints on primordial black holes in Brans-Dicke theory, J. Cosmol. Astropart. Phys., 2010, 08, 039.
- P. Saha, N. Nayak and A. S. Majumdar, Study of atomic entanglement in multimode cavity optics, Int. J. Theor. Phys, 2010, 14, 97.
- P. Saha, A. S. Majumdar, S. Singh and N. Nayak, Collapse and revival of atomic entanglement in an intensity dependent Jaynes- Cummings interaction, Int. J. Quant. Inf., 2010, 8, 1397.
- P. Saha, B. Ghosh, A. S. Majumdar and N. Nayak, Atomic entanglement in the multiphoton Jaynes-Cummings model, Int. J. Theor. Phys. Gp. Theor. Nonln. Opt., 2011, 15, 8.

OTHER PUBLICATIONS

P. Saha, B. Ghosh, A. S. Majumdar and N. Nayak, Environment induced entanglement in cavity-QED, Ind. J. Phys., 2010, 84, 1039.

SUPERVISION OF STUDENTS

Ph.D. Students: Nilok Bose, Tanumoy Pramanik, Deepak Jalla, External: Nirman Ganguly, Sovik Roy;

Project Students: Ashutosh Rai, Priyanka Chowdhury, Siladitya Mal,Subhadipa Das (Nonlocal correlations using pre-post selection rules, SNBNCBS), Prasoon Raj (Quantum mechanics of time-dependent potential barriers, St. Stephen's College, Delhi), Pratik Tarafdar (An introduction to General Relativity and Cosmology, IIT, Bombay).

POST DOCTORAL RESEARCHERS

Siddhartha Sinha, Alok K. Pan (up to July 2010).

STUDENTS' PUBLICATIONS

- M. Rajjak Gazi, Ashutosh Rai, S. Kunkri and R. Rahaman, Local randomness in Hardy's correlations: implications from the information causality principle, J. Phys. A: Math. Theor., 2010, 43, 452001.
- G. Kar, M. Rajjak Gazi, M. Banik, Subhadipa Das, Ashutosh Rai and S. Kunkri, A complementary relation between classical bits and randomness in local part in simulating the singlet state, J. Phys. A: Math. Theor., 2011, 44, 152002.

LECTURES DELIVERED

- Protocols for information transfer using hybrid entangled states, International Conference on Quantum Information, Kish Island, Iran, September 2010.
- Single particle entangled states as resource for quantum information processing, International Symposium on 75 years of Quantum Entanglement, Kolkata, January 2011.
- Quantum teleportation and identity, Sixth Nalanda Dialog, Nalanda, February 2011.
- Dark energy from various approaches, UGC Seminar on Recent advances in Relativity, Cosmology and Astrophysics, NBU, Siliguri, March 2011.
- Information processing through single particle hybrid entangled states, International Conference on Quantum Optics and Quantum Computation, JIIT, Noida, March 2011.
- Cosmology: a modern perspective, National Seminar on Science and Development, ISNA, Kolkata, March 2011.

COURSES TAUGHT

- PHY 510, Astrophysics, Fall semester.
- PHY 506, Quantum physics, Fall semester.
- PHY 509, Relativity and Cosmology, Fall semester.

PARTICIPATION IN COMMITTEES

Internal: Library Committee, Lecture Hall III Committee.

SPONSORED PROJECTS

PI in Fundamental Aspects of Quantum Theory and Quantum Information, DST.

MEETINGS ORGANIZED

1. Discussion meeting on Fundamental Aspects of Quantum Theory and Quantum Information, August 16 -17, 2010, SNBNCBS, Kolkata.
2. SNBNCBS Silver Jubilee International Symposium on 75 Years of Quantum Entanglement: Foundations and Information Theoretic Applications, January 6 – 10, 2011, CII-Neotia Centre of Excellence for Leadership, Salt Lake, Kolkata.

Debashis Gangopadhyay
Associate Professor

- Quantum field theory
- Cosmology
- Quantum Computation and Quantum Information Theory

- A cosmological invariant as an observational probe in the early universe has been set up (with Somnath Mukherjee, arXive : 1010.5355, astro-ph)
- Lorentz-preserving fields have been obtained in Lorentz-violating theories (with Oindrila Ganguly and Parthasarathi Majumdar, arXive: 1011.1206, hep-th).
- The k-essence scalar field is shown to be relevant in the context of Supernova Ia Observations (with Abhijit Bandyopadhyay and Arka Moulik, arXive: 1102.3554)
- It is possible to mask singularities with k-essence fields in an emergent gravity metric (with Gautam Manna and Sourav Sen Choudhury, arXive: 1103.3380, gr-qc).

SUPERVISION OF STUDENTS

Ph. D. Students: Somnath Mukherjee, Gautam Manna and Oindrila Ganguly; **Project Students:** Mr. Sourav Sen Choudhury (RMVU, Belur Math, k-Essence and Black Holes, SNBNCBS summer project student, 2010), Mr. Roopayan Ghosh (St. Xavier's School, KVPY Programme, 2010, Reading project on "q-oscillators"), Mr. Bijit Sinha (IIT Delhi, SNBNCBS Winter project student 2010, Reading Project student on General Relativity).

LECTURES DELIVERED

- Talks: "Dark Energy and Emergent Gravity" (One day workshop on GENERAL RELATIVITY, GRAVITATION AND COSMOLOGY) Ramakrishna Mission Vivekananda University, Belur Matth, 5th March, 2011.
- Lecture series: (1) Introduction to Differential Geometry, RKMVU, 2010.
- Lecture series: (2) Introduction to the Wilson Renormalisation Group, RKMVU, 2010.
- Lecture series: (3) Introduction to String Theory, RKMVU, 2010.

COURSES TAUGHT

Nuclear and Particle Physics (PHY-303), 3rd Semester, PBIR students of SNBNCBS, 2010.

PARTICIPATION IN COMMITTEES

External: Selection Committee (RKMVU, Belur Matth).

Kinsuk Acharyya
Bose Fellow

Astrochemistry and Astrobiology:

- Building a laboratory to study Astrobiology and Astrochemistry related problems
- Study of H_2 formation at higher temperature

We have procured and installed ultra high vacuum chamber, pressure gauges, Residual Gas Analyzer (RGA) and all metal leak valves. We have also tested all these components and they are working fine. We achieved UHV conditions (base pressure ~ 3 x 10^{-10} mbar) in side the vacuum chamber. We have also procured a liquid helium cryostat and completed design for gas deposition. In addition we studied molecular hydrogen formation at higher temperature. We have used the continuous-time random-walk (CTRW) Monte Carlo technique to study the formation of H_2 from two hydrogen atoms on the surface of interstellar dust grains. We have considered hydrogen atom mobility due both to thermal hopping and quantum mechanical tunneling. The temperature range between 5 K and 400 K has been explored. This helped us to understand overall picture of the efficiency of H_2 formation over a wide range of interstellar environments. We are particularly interested in under what conditions the detailed Monte Carlo results and the more widely used rate equation results differ strongly. These results allow us to determine how they affect various chemical models at high temperature.

PUBLICATIONS IN JOURNALS

- A. Das, K. Acharyya and S. K. Chakrabarti, Effects of initial condition and cloud density on the composition of the grain mantle, MNRAS, 2010, 409, 789.
- K. Acharyya, G. Hassel and E. Herbst, Effect of grain sizes and grain growth on the chemical evolution of dense cloud, ApJ, 2011, 732, 73.

SUPERVISION OF STUDENTS

Ph.D. Student: Wasim Iqbal.

LECTURES DELIVERED

AOGS 2010, Hyderabad International Convention Centre, India, July 5 - 9, 2010 and gave an invited lecture "*Interstellar Dusts and their Laboratory Analog*".

COURSES TAUGHT

501, Research Methodology (I have taken a part of this course); 510, Astrophysics (I have taken a part this course); PHY402, Semester IV.

PARTICIPATION IN COMMITTEES

Internal: Newsletter Committee, Technical Cell.

Sandip Kumar Chakrabarti
Senior Professor and Dean (Academic Program)

- Black hole accretion and outflows
- High energy astrophysics
- Instrumentation for X-ray/gamma-ray observations
- Ionospheric perturbations due to terrestrial and extra-terrestrial phenomena and their effects on very low frequency wave propagation
- Chemical Evolution of star forming regions

A major activity was to analyze the data of the RT-2 payloads which were built by Indian Centre for Space Physics and Tata Institute of Fundamental research in collaboration with VSSC, Trivandrum. A Gamma Ray Burst (GRB 090618) was observed which seems to have a very long precursor of about 60 seconds which indicates that the precursor may itself be another GRB. It could even be the signature of the formation of a black hole. Data is also analyzed of several black holes during outbursts and the evolution of the Quasi-Periodic Oscillations (QPOs) were studied. Black hole accretion was compared with the engineering problem of double de-Laval nozzles in Kerr geometry. Several works have been completed to show that the seismicity induces ionospheric perturbations several days before major seismic events and may affect the terminator times and night-time fluctuations etc. Monte-Carlo simulations of radiations emitted from the black hole accretion flow have been made and computation of spectral and timing properties are done. Spectral properties of Gamma-Rays bursts have been studied and possibility to see signatures of the progenitor is being checked. Chemical evolution along with hydrodynamic simulations of star forming regions have been carried out and the parameter space spanned by the initial abundances has been identified.

PUBLICATIONS IN JOURNALS

- B. G. Dutta and S. K. Chakrabarti, Evidence for two component flows around the black hole candidate XTE J1550-540 from spectral features during its 1998-1999 outburst, MNRAS, 2010, **404**, 2136.
- A. R. Rao, M. Hinger, A. Malakar, S. K. Chakrabarti et al., RT-2 Detection of Quasi-Periodic Pulsations in the 2009 July 5 Solar Hard X-ray Flare, Astrophysical Journal, 2010, **714**, 1142.
- D. Debnath, A. Nandi, A. R. Rao, J. P. Malakar, M. K. Hingar, T. B. Kotoch, S. Sreekumar, V. P. Madhav and S. K. Chakrabarti, Instruments of RT-2 Experiment on-board CORONAS-PHOTON and their test and evaluation I: RT-2/S and RT-2/G Payloads, Exp. Astron., 2010, **29**, 1.
- T. B. Kotoch, A. Nandi, D. Debnath, J. P. Malakar, A. R. Rao, M. K. Hingar, V. P. Madhav, S. Sreekumar and S. K. Chakrabarti, Instruments of RT-2 Experiment on-board CORONAS-PHOTON and their test and evaluation II: RT-2/CZT Payload, Exp. Astron., 2010, **29**, 27.
- A. Nandi, S. Palit, D. Debnath, S. K. Chakrabarti, T. B. Kotoch, R. Sarkar, V. K. Yadav, V. Girish, A. R. Rao and D. Bhattacharya, Instruments of RT-2 Experiment on-board CORONAS-PHOTON and their test and evaluation III: Coded Aperture Mask and Fresnel Zone Plates in RT-2/CZT Payload, Exp. Astron., 2010, **29**, 55.
- R. Sarkar, S. Mandal, D. Debnath, T. B. Kotoch, A. Nandi, A. R. Rao and S. K. Chakrabarti, Instruments of RT-2 Experiment on-board CORONAS-PHOTON and their test and evaluation IV: Background Simulations using GEANT-4 Toolkit, Exp. Astron., 2010, **29**, 85.
- S. Sreekumar, P. Vinod, E. Samuel, J. P. Malakar, A. R. Rao, M. K. Hingar, V. P. Madhav, D. Debnath, T. B. Kotoch, A. Nandi, S. Shaheda Begum and S. K. Chakrabarti, Instruments of RT-2 Experiment on-board CORONAS-PHOTON and their test and evaluation V: on-board software, Data Structure, Telemetry and Telecommand, Exp. Astron., 2010, **29**, 109.
- R. Sarkar and S. K. Chakrabarti, Feasibility of Spectro-Photometry in X-rays (SPHINX) from the Moon, Exp. Astron. 2010, **28**, 61.
- S. K. Chakrabarti, S. Sasmal and S. Chakrabarti, Ionospheric Anomaly due to Seismic Activities – II: Evidence from D-Layer preparation and disappearance times, Nat. Haz. Earth. Syst. Sc., 2010, **10**, 1751.
- C. B. Singh and S. K. Chakrabarti, Outflow rates in a black hole environment in presence of a dissipative standing shock, MNRAS, 2010, **410**, 2414.
- D. Debnath and S. K. Chakrabarti, Properties of the Propagating Shock wave in the accretion flow around GX 339-4 in 2010 outburst, Astron. and Astrophys., 2010, **520**, 98.
- K. Chakrabarti, M. M. Majumdar and S. K. Chakrabarti, Accretion problem in a Kerr Black Hole Geometry Viewed

as Flows in Converging-Diverging Ducts, Int. J. Mod. Phys. D., 2010, **19**, 2059.

- A. R. Rao, J. P. Malakar, M. K. Hingar, V. K. Agrawal, S. K. Chakrabarti, et al., Detection of GRB~090618 by RT-2 Experiment Onboard the Coronas-Photon Satellite, Astrophysical Journal, 2010, **728**, 42.
- A. Das, K. Acharyya and S. K. Chakrabarti, Effects of initial condition and cloud density on the composition of the grain mantle, MNRAS, 2010, **409**, 789.
- S. K. Chakrabarti, S. K. Mandal, S. Sasmal, D. Bhowmick, A. K. Choudhury, N. P. Patra, First VLF detections of ionospheric disturbances due to Soft Gamma Ray Repeater SGR J1550-5418 and Gamma Ray Burst GRB 090424, InJPh, 2010, **84**, 1461.

OTHER PUBLICATIONS

- Sandip K. Chakrabarti, S. Sasmal, S. Pal and S. K. Mondal, Results of VLF campaigns in Summer, Winter and during Solar Eclipse in Indian Subcontinent and Beyond, AIP Conf. Proc., 2010, **61**, 1286.
- Sujay Pal and S. K. Chakrabarti, Theoretical models for Computing VLF wave amplitude and phase and their applications, AIP Conf. Proc., 2010, **42**, 1286.
- D. Bhowmick, S. K. Chakrabarti, S. Sasmal, S. K. Mondal, Studies of VLF Signals using Balloon Borne and Undersea Antenna, AIP Conf. Proc., 2010, **345**, 1286.
- T. B. Kotoch, Sandip K. Chakrabarti, A. Nandi, D. Debnath and S. K. Mondal, Gamma-Ray Bursts from RT-2 payloads and VLF signal, AIP Conf. Proc., 2010, **339**, 1286.
- S. K. Mondal and S. K. Chakrabarti, Earth's Ionosphere as a Gigantic Detector of Extra-terrestrial Energetic Phenomena: A Review, AIP Conf. Proc., 2010, **311**, 1286.
- Suman Ray, S. K. Chakrabarti, S. Sasmal and A. K. Choudhury, Correlelations between the Anomalous Behaviour of the Ionosphere and the Seismic Events for VTX-MALDA VLF Propagation, AIP Conf. Proc., 2010, **298**, 1286.
- S. Sasmal, S. K. Chakrabarti and S. Chakrabarti, Studies of the Correlation Between Ionospheric Anomalies and Seismic Activities in the Indian Subcontinent, AIP Conf. Proc., 2010, **270**, 1286.
- Surya K. Maji, Sandip K. Chakrabarti and Sushanta K. Mondal, Partial Effects on VLF Data due to a Solar Flare During 2010 Annular Solar Eclipse, AIP Conf. Proc., 2010, **214**, 1286.
- Anuj Nandi, Sandip K. Chakrabarti, Dipak Debnath, Tilak B. Kotoch, A. R. Rao, S. K. Mondal, S. Maji and S. Sasmal, Simultaneous observation of Solar Events by Indian Payload (RT-2) and ICSP/VLF receiver, AIP Conf. Proc., 2010, **200**, 1286.
- Tamal Basak, S. K. Chakrabarti and S. Pal, Global effects on Ionospheric Weather over the Indian subcontinent at Sunrise and Sunset, AIP Conf. Proc., 2010, **137**, 1286.

BOOK PUBLISHED

S.K. Chakrabarti, Propagation effects of very low frequency radio waves, AIP Conf. Ser., 2010, 1286 (New York).

SUPERVISION OF STUDENTS

Ph.D. Students: R. Sarkar, B.G. Dutta and D. Debnath (Degree received in 2010-2011); Himadri Ghosh, K. Giri, S. Garain, S. Pal, T. Basak, S. Sasmal, P. S. Pal, C.B. Singh, S. Paliit, S. Mandal, L. Majumdar; **Project Students:** S. Mondal, S. Maji, S. Ray, A. Sen, A. Choudhuri.

PUBLICATION BY ASSOCIATE

Srikanta Sinha, Determination of spacecraft attitude and source position using non-aligned detectors in spin-stabilized satellites, Nuclear Instruments and Methods in Physics Research Section A, 2010, **621**, 534.

LECTURES DELIVERED

- *Status of RT-2 Payloads on board CORONAS-PHOTON Satellite*, ADCOS Committee, ISRO-HQ, April, 2010.
- *VLF Campaigns in summer, winter and during solar eclipse all over India*, AOGS conference, Hyderabad, July, 2010.
- *Accretion onto outbursting black holes: How do they do it?*, 2nd Galileo-Xu Guanqi meeting at Ventimiglia, Italy, July, 2010.
- *Presentations of RT-2 observations of Solar flares, Possible First Evidence of a double gamma ray burst, RT-2 observations of Gamma-Ray Bursts and Variability Classes of GRS1915+105: Physical Picture and Evidence of two component accretion flow around the black hole candidate XTE J1550-564 during the outbursts*, 10th COSPAR meeting, Bremen, Germany, July 17 - 25, 2010.
- A Series of 5 lectures to Erasmus Mundus Joint Astronomy Programme Students, University of Nice, France, September, 2010.

- *Accretion processes on Black Holes: the Spectral and temporal properties*, Accretion and Outflow in Black Hole Systems, Kathmandu, Nepal, October 10 -16, 2010.
- Chaired the sessions and gave Invited talk on *VLF Campaigns in Summer, Winter and Solar eclipses*, International Workshop on Seismo-Electromagnetics and Atmospheric Science (IWSE-AS 2010), Agra, November, 2010.
- Invited talk on the *Observational Evidence for Transonic Astrophysical Flows Around Black holes*, Wideband X-ray astronomy International Conference, IUCAA, Pune, January, 2011.
- Invited talk on Imaging in X-rays for space astronomy, DST SERC School on Guided Wave Optics and Devices, CGCRI, Kolkata, February, 2011.
- I*nvited talk on Excitements in Astronomy and Space Physics*, Students Reunion, St Xavier's College, Kolkata, February, 2011.
- *Invited talk on Astrochemistry in Relation to Origin of Life*, 41st Annual Re-union of Department Of Chemistry, Jadavpur University, March, 2011.
- Talks on *QPO of black hole spectra, Correlations between VLF anomaly and Seismic effects and VLF observations during total and annular Solar Eclipse*, ISRO-RESPOND meeting, PRL, Ahmedabad, March, 2011.

ACADEMIC VISITS

- Erasmus Mundus Joint Astronomy Programme, University of Nice, France, September, 2010.
- Annual Meeting of International Centre for Relativistic Astrophysics (ICRA), Pescara and University of Rome, December, 2010.
- Participation at the Third World Academy of Sciences (TWAS) meeting for discussion on TWAS-BOSE Fellowship, October, 2010.

COURSES TAUGHT

- PHY 501, Research Methodology, 1st Semester PMSc (part).
- PHY 510, Astrophysics and Cosmology, 1st Semester (part).

PARTICIPATION IN COMMITTEES

- **External:** International Advisory Committee: International Workshop on Seismo Electromagnetics and Atmospheric Science (IWSE-AS 2010), Agra; In Charge, Academic Affairs and General Secretary of the Governing Body of Indian Centre for Space Physics; Editorial Board member: Open Astronomy Journal, Indian Journal of Physics and Bulletin of Astronomical Society of India.
- **Internal:** Head of the Dept (Astrophysics and Cosmology); Academic & Research Advisory Committee (ARPAC); Departmental Research Committees (DRC); Consultative Advisory Committee (CAC); Students' Curriculum & Research Evaluation Committee (SCREC); Library Committee and several Thesis committees; Dean (Academic Programme).

AWARDS / RECOGNITIONS

Became Adjunct Faculty of International Centre for Relativistic Astrophysics network (ICRA-NET), Pescara, Italy.

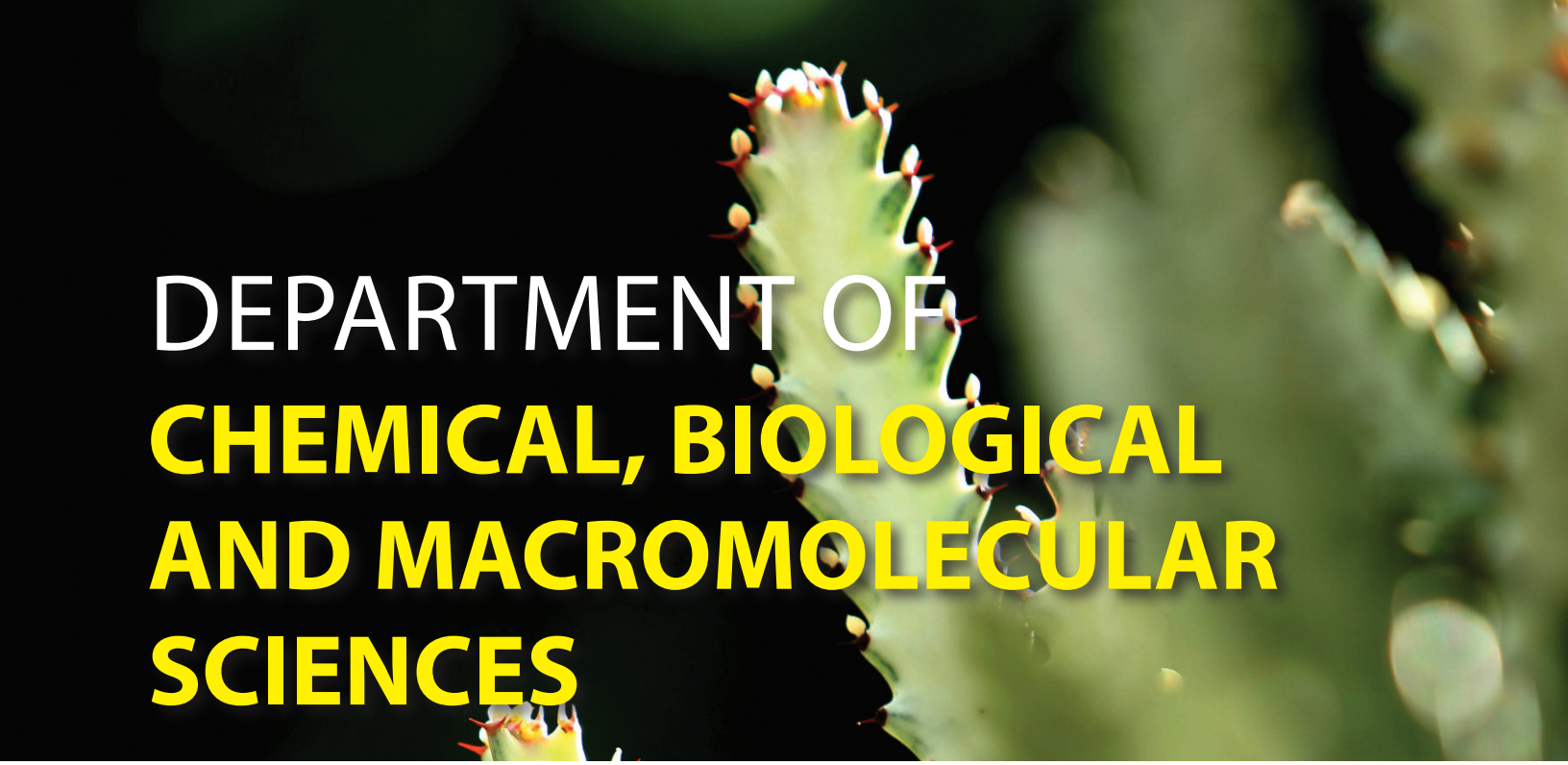
MEETINGS ORGANIZED

Co-convenor of the ELF-VLF Remote Sensing of the Ionosphere and Magnetosphere (ST14-AS04) Session at the Asia-Oceania Geophysical Sciences, Convention Centre, Hyderabad (July, 2010).

1st G. N. Ramachandran Memorial Lecture 3rd November, 2010

Department of

CHEMICAL, BIOLOGICAL AND MACROMOLECULAR SCIENCES



DEPARTMENT OF CHEMICAL, BIOLOGICAL AND MACROMOLECULAR SCIENCES

The department has multidisciplinary research activities. The subjects studied are broadly classified as follows: Chemical Physics; Spectroscopy and Solvation Dynamics; Biophysics; Physics and chemistry in Liquid State; Mesoscopic Physics and Biochemistry.

The research activities of Dr. S K Pal are mainly in the field of experimental Bio-Physics, Bio-Nano Interface, Biomimetics and biomedical instrumentation.

Research in the field of Experimental Biophysics: Research activities in the field of experimental Biophysics, are interdisciplinary in nature that applies the theories and methods of physics. The studies included under the umbrella of biophysics ranging from molecular recognition of small ligands/drugs by biological macromolecules to complicated protein-DNA, Protein-Protein complexation. For example, in a recent study the dynamics of bound water and ions present in the minor groove of a dodecamer DNA has been decoupled from that of the long-range twisting/bending of the DNA backbone, using the minor groove binder Hoechst 33258 as a fluorescence reporter in the picosecond-resolved time window.

Research in the field of Experimental Nano-physics and Bio-nano Interface: The group is involved in the synthesis of various bio-nano conjugates. Selective attachment of inorganic semiconductor/metal quantum dots (QD) to various biological macromolecules is the key feature of the nano-conjugates. For example in a recent study from our group, they have encapsulated a molecular magnet V15 in a hydrophobic cavity of a protein Human serum albumin and clearly demonstrated the efficacy of the magnet for the exploration of protein folding intermediates by using picosecond resolved FRET technique. A significant effort on the understanding of photo-induced processes in the nano-particles vigorously used in the dye sensitized solar cell (DSSC) is also in progress.

Research in the field of Experimental Biomimetics: Activities in the area of biomimetic systems, which are very useful to understand the complex biomolecular systems and works excellent as templates for the synthesis of nano-materials are also evident from the publications (see Phys. Chem. Chem. Phys., 2009, 11, 8467–8476 for example). For example in a recent study we attempt to correlate the dynamical states of water molecules in a nano-template (reverse micelle) with a solvolysis reaction in accordance with the activation energy barrier crossing model at the micellar interface. The work is not only important for the understanding the kinetics and underlying dynamics in the nano-reactor, is also equally important for the synthesis of nanomaterials, where water molecules in the nano-template play key role.

Research in the field of Biomedical Instrumentation: Finally the heartiest effort to bring the frontier research to common people in our society in terms of low cost spectroscopic gadgets for the biomedical/environmental usage are obvious from the patents. For example in a recent work from the group they have devised a low-cost fiber optic based spectroscopic instrument, which is essentially "A Portable, Affordable, Compact Machine for Biomedical and Gemological Application". As claimed in patent application,

very useful in Early Diagnosis of Jaundice (Billirubin Level), Diagnosis of Anemia (Hemoglobin Level), Diagnosis of Oxygen Deficiency (Oxymetry), Purity of Gemstones (Ruby etc), Purity of Organic Gemstones (Pearl, Coral etc).

The key topics of research of Dr. Ranjit Biswas are Ionic Liquids, Molecular Theory, Binary Mixture, Molecular Association, Heterogeneity, Fluorescence Spectroscopy, Computer Simulation.

The research works of Dr. Biswas and coworkers are based upon *the theme of developing a molecular level understanding of the structure and dynamics of various complex media and their relationship to simple chemical events occurring in them*. For this, an integrated approach is adopted to investigate phenomena which are either known for a long time or have not been studied in depth. The integration is done by using experiment, theory and computer simulation techniques where observations from one method are analyzed and complemented with the data provided by the other two. Experimental results are often backed by theoretical predictions whereas simulations are used to generate input for theory or knowledge on model systems which are subsequently used to provide a better understanding of the experimental and theoretical results.

The above trend is reflected in various research papers published from Biswas's laboratory during the last few years. For example, Biswas and his research group has developed the first molecular theory for solvation dynamics in room temperature ionic liquids (J. Phys. Chem. B, **2008**, 112, 12431). It was shown that much of the dynamics in these liquids could be understood in terms of polar solvation dynamics in neat polar solvents. This work was followed up by a further investigation (J. Phys. Chem. B, **2010**, 114, 254) where the ion-dipole and dipole-dipole contributions to the dynamics are separated out and a general framework is constructed to quantitatively understand the experimental data, regardless of the identity of the ionic liquid. The theory developed here also predicts increase of Stokes' shift with temperature for several dipolar ionic liquids and a near hydrodynamic behavior of solvation time scales in a number of ionic liquids (J. Phys. Chem. B, **2010**, 114, 16811). Moreover, this theory explained why simulation study was unable to find the effects of solute motion on its own rate of solvation (Indian J. Chem., **2010**, 49A, 685).

Very recently, Biswas and coworkers applied their theory to understand the Stokes' shift dynamics in binary mixtures of ionic liquids with polar solvents (J. Phys. Chem. B, 2011, 115, 4011) and found a good agreement between theory and experiments. Representative results are shown in *Fig. A. The ionic liquid work from this group is, in fact, a fundamental contribution to the overall understanding of the liquid phase dynamics in general and of ionic liquids in particular.*

Biswas' group has recently investigated the medium dynamics in supercooled electrolyte solutions of acetamide with various inorganic salts by using both the fluorescence spectroscopy and a classical theory (J. Phys. Chem. B, **2010**, 114, 5066-5081; Chem. Phys. Lett., **2011**, 501, 358-363). An important outcome of these studies is unequivocal rejection of previous claims in the literature for a colossal dielectric constant of such mixtures. In addition, these works reveal a break-down of the much celebrated Stokes-Einstein and Stokes-Einstein-Debye relations for solvation and anisotropy dynamics in these multi-component mixtures where the nature of solute-solvent and solvent-solvent interactions is still relatively ill-understood.

Dr. Jaydeb Chakrabarti and group are mainly working on Soft condensed matter and chemical physics.

They have studied fluorescence anisotropy measurements which reveals a non-monotonic density dependence for average rotation time (τ_R) of C153 (a polar solute) in supercritical CHF_3 (a polar fluid). The conventional Stokes-Einstein-Debye model, relating τ_R to the solvent viscosity, fails to explain the observed density dependence, because the experimental viscosity increases with density for a fluid, in general. Here, the density dependent is calculated by incorporating the wave vector dependent viscosity of the solvent and the solute-solvent interaction. A molecular hydrodynamic description is used for the wave vector dependent viscosity which is verified by molecular dynamics (MD) simulation. The applicability of our prescription is justified by reproducing the experimental viscosity of supercritical (SC) CHF_3. Solute-solvent interaction has been included via the fluctuating torque acting on the rotating solute. Incorporation of wave vector dependent viscosity leads to qualitative description of experimental density of τ_R which is further improved upon inclusion of solute-solvent interaction. We have extended the formalism to other solvents recently.

A large class of soft matter systems is structurally characterized

by self-assembled molecular aggregates. The molecules in such systems quite often show hydrophobic attraction as well as charge-charge repulsion. Despite a wide range of experimental data, there has been no systematic theoretical analysis to understand the role of these forces in the stability of self-assembled structures. We study here theoretically a model dispersion of charged macromolecules which repel the solvent molecules. The solvophobic macromolecules attract each other, induced by the tendency of repelling the solvent molecules. We derive an analytical form for the solvophobic attraction which is predominantly harmonic in nature. The solvophobic attraction competes with the charge-charge repulsion between the macromolecules. We calculate the phase diagram showing stable cluster of the macromolecules in the parameter space, characterizing these interactions. Stronger hydrophobic attraction induces larger aggregates which are destabilized by longer ranged electrostatic repulsion. Such phase diagram provides a unified understanding of aggregations driven by competing hydrophobic and charge-charge interactions. This may serve as a guide to control the self-assembled structures essential for diverse technological applications.

Dr. Rajib Kumar Mitra's works are: Time resolved fluorescence spectroscopy, high frequency (THz) spectroscopy, general physical chemistry, biomolecules (proteins, nucleic acids, enzymes etc.), bio-mimicking systems (micelles, reverse micelles, lamellae, vesicles etc.).

One of their primary research interests is focused on the altered physico-chemical properties of water molecules under confined and stressed conditions, e.g. in bio-mimicking (like micelles, reverse micelles, vesicles etc.) as well as in real biological (proteins, enzymes, nucleic acids etc.) systems. Spectroscopic tools like steady state and ultrafast fluorescence spectroscopy (fs and ps-resolved), FTIR, high frequency (THz) spectroscopy etc. are used to underline the structure and dynamics of such water molecules. The following are some interesting results obtained:

They have studied the slow solvent relaxation dynamics (of the order of hundreds of ps to a few ns) of water molecules entrapped in AOT lamellar systems and compared these results with those obtained from AOT reverse micellar systems with identical hydration and/or identical inter-layer separation. Our focus of interest was to understand how the geometry of the confining interface governs the dynamic of water and our study concludes that both the morphology (flat surface of lamellae and curved surface of reverse micelle) and the interlayer separation in these nano-confining macromolecular systems play equally important roles in determining the dynamics of water relaxation.

They have studied the effect of crowding, a commonly encountered phenomenon in real biological environment, on the enzymatic activity of Π-chymotrypsin (CHT) by adding polyethylene glycol (PEG-400) into the system. A decrease in the overall enzymatic activity was observed upon addition of PEG. A detailed thermodynamic consideration reveals that addition of PEG dehydrates the enzyme surface by ~150 water molecules which in turn decreases the overall enzymatic activity of CHT. Spectroscopic investigations also support this dehydration phenomenon. *The effect of solvent relaxation dynamics of protein hydration layer due to the modification of protein conformation upon thermal denaturation has been studied by THz absorption spectroscopy.*

Dr. Prosenjit Singha Deo recently works on the following topics: Quantum capacitance, electronic density of states, injectance, delay times in quantum mechanics.

They have found a microscopic derivation for quantum capacitance. Although such a parameter is being used for a couple of decades to interpret and analyze experimental data as well as numerical simulations, no microscopic understanding was there. Their work fulfills this gap. They could also show some paradoxical results in injectance. Namely semi-classical formula for injectance become exact at a resonance which is a purely quantum regime. It was known that semiclassical formula can become exact only if there is no backscattering or reflection. We have shown the converse, i.e., semi-classical formula can become exact even though there is backscattering and reflection. They also demonstrated a physical situation wherein negative delay times can be experimentally observed.

Recently Dr. G. Gangopadhyay is working on : Quantum Dynamics in model systems and Stochastic processes in reaction kinetics.

They have studied the effect of disorder on the luminescence spectra due to the orientational disposition of monomeric

chain units in the dimer aggregate of conjugated polymer. The dipolar interchain interactions are described considering static as well as dynamic disorder created by the torsion or shearing degree of freedom. For static disorder, the shearing angle is treated parametrically for different frozen configurations of positional defect. The inclusion of torsion angle dependence in the interchain interaction not only saves the 0-0 transition from total quenching but also generates a conical intersection in the adiabatic potential energy surfaces of the dimer aggregate. Due to the vanishing of the interchain coupling at the conical intersection point, the two chains become independent and the dimeric spectra passes through a monomeric pattern which can serve as an example of the presence of conical intersection in the aggregates of conjugated polymer chains. Also the presence of the low frequency torsion mode explicitly considered in the case of dynamic disorder can be detected from a significant Stokes shift in the steady state spectra.

In the spirit of Gillespie's stochastic approach they have formulated a theory to explore the advancement of the interfacial enzyme kinetics at the single enzyme level which is ultimately utilized to obtain the ensemble average macroscopic feature, lag-burst kinetics. They have provided a theory of the transition from the lag phase to the burst phase kinetics by considering the gradual development of electrostatic interaction among the positively charged enzyme and negatively charged product molecules deposited on the phospholipid surface. Different diffusion time scales of the enzyme over the fluid and product regions is responsible for the memory among the successive turnover events in the lag phase unlike the burst phase.

Dr. Mahua Ghosh mainly works on Biochemistry for understanding the macromolecular basis in biological system.

She has pursued study in the context of NMR spectroscopy, and/or through the crystallographic characterization of DNA and Protein as well as protein-protein complex. To address unanswered questions in context to the protein DNA interaction studies, obtaining proteins and performing preliminary biochemical characterization of the relevant proteins play a very important role. In this direction they worked on protein purification and biochemical characterization of crucial non-specific endonucleases.

Applying soft matter physics, structural information of the protein and protein-DNA complex and Biochemical analysis, they are intending to understand the basis of the site specificity of endonucleases having similar active site geometry and charge distribution. In the first part of the work they are carrying out detailed molecular simulation to figure out structural parameters, geometrical parameters and calculating the thermodynamic parameters associated with the EcorI and EcorV restriction enzymes bound with their respective DNA sequences. In a subsequent study they intend to study the catalytic activity and its sequence specificity of the site specific endonuclease EcorI and EcorV in the presence of divalent metal ion.

DEPARTMENTAL STATISTICS

Faculty members: **7**; Number of PhD students: **26**; Number of PDFs: **2**; Total number of publications: **32**; Total number of Projects: **2**.

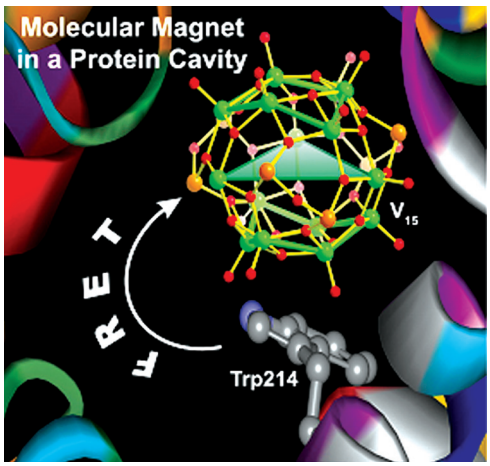
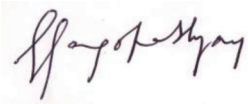


Fig.1: *The well known molecular magnet V15 (V green; As dark yellow; O red) is shown in a hydrophobic cavity of a human serum albumin with the single tryptophan fluorescence centre (Trp214) in its vicinity. The Förster resonance energy transfer (FRET) from Trp214 to V15 is represented schematically.*



Gautam Gangopadhyay

Head, Department of Chemical, Biological and Macromolecular Sciences

Gautam Gangopadhyay
Associate Professor

- Quantum Dynamics in model conjugated polymeric aggregate systems
- Stochastic processes in enzyme catalysis

We have studied the effect of disorder on the luminescence spectra due to the orientational disposition of monomeric chain units in the dimer aggregate of conjugated polymer. For static disorder, the shearing angle is treated parametrically for different frozen configurations of positional defect. The inclusion of torsion angle dependence in the interchain interaction not only saves the 0-0 transition from total quenching but also generates a conical intersection in the adiabatic potential energy surfaces of the dimer aggregate. Due to the vanishing of the interchain coupling at the conical intersection point, the two chains become independent and the dimeric spectra passes through a monomeric pattern which can serve as an example of the presence of conical intersection in the aggregates of conjugated polymer chains. Also the presence of the low frequency torsion mode explicitly considered in the case of dynamic disorder can be detected from a significant Stokes shift in the steady state spectra.

PUBLICATIONS IN JOURNALS

K. Banerjee and G. Gangopadhyay, *Role of positional disorder in the spectra of conjugated polymer aggregates: a conical intersection of potential energy surfaces*, J. Phys. B, 2010, **43**, 235104.

OTHER PUBLICATIONS

K. Banerjee and G. Gangopadhyay, *Spectra of conjugated polymer aggregates*, Recent Advances in Spectroscopy in Astrophysics and Space Science Proceedings, 2010, **85**.

SUPERVISION OF STUDENTS

Ph.D. Students: Kinshuk Banerjee, Biswajit Das and Anirban Karmakar; **Project Students:** Post M.Sc.: Anirban Karmakar (project on Quantum theory of damping for linear and nonlinear systems).

LECTURES DELIVERED

Talks on Stochastic processes in surface enzyme catalysis delivered at Theoretical Chemistry Symposium, at IIT Kanpur, December 9 -12, 2010.

COURSES TAUGHT

Post M.Sc. Course on Spectroscopy and Molecular Physics.

PARTICIPATION IN COMMITTEES

Internal: CAC, SAC, SCRE, Project Cell, Library Committee, in various committees as HOD, EVLP.

MEETINGS ORGANIZED

International conference in Mesoscopic Physics and spectroscopy, November 22 – 24, 2010 at Satyendra Nath Bose National Centre for Basic Sciences, Kolkata, India.

Jaydeb Chakrabarti
Associate Professor

- Soft condensed matter and chemical physics

Fluorescence anisotropy measurements reveal a non-monotonic density dependence for average rotation time (τ_R) of C153 (a polar solute) in supercritical CHF_3 (a polar fluid). The conventional Stokes-Einstein-Debye model, relating τ_R to the solvent viscosity, fails to explain the observed density dependence, because the experimental viscosity increases with density for a fluid, in general. Here, the density dependent τ_R is calculated by incorporating the wave vector dependent viscosity of the solvent and the solute-solvent interaction. A molecular hydrodynamic description is used for the wave vector dependent viscosity which is verified by molecular dynamics (MD) simulation. The applicability of our prescription is justified by reproducing the experimental viscosity of supercritical (SC) CHF_3. Solute-solvent interaction has been included via the fluctuating torque acting on the rotating solute. Incorporation of wave vector dependent viscosity leads to qualitative description of experimental density dependence of τ_R which is further improved upon inclusion of solute-solvent interaction.

PUBLICATIONS IN JOURNALS

- A. Das, R. Biswas and J. Chakrabarti, Dipolar solute rotation in a supercritical polar fluid, J. Phys. Chem A, 2011, **115**, 973.
- E. Shibu et al, Gold nanoparticle superlattices as functional solids for concommitant conductivity and SERS tuning, Nanoscale, 2011, **3**, 1066.

SUPERVISION OF STUDENTS

Ph.D. Students: Amit Das, Arup Bhowmik T.

LECTURES DELIVERED

- *Talk on Dipolar rotation in supercritical fluids*, University of Duesseldorf, Germany, September, 2010.
- Institute Colloquium on *Aggregation via hydrophobic and Electrostatic interactions*, Bose Institute, Kolkata, February, 2011.

ACADEMIC VISITS

Collaboration with Prof. H. Loewen, under CODEF project (University of Duesseldorf, Germany).

COURSES TAUGHT

- Physical Chemistry: Theory and Experiments (Fall 2010).
- Computational Methods (PBSc.) (Spring 2011).

PARTICIPATION IN COMMITTEES

Internal: Newsletter Committee; Project Cell.

MEETINGS ORGANIZED

Computational Techniques in Soft Matter 2010 (jointly with T. Saha-Dasgupta and S. Sengupta), Satyendra Nath Bose National Centre for Basic Sciences, Kolkata, India, December 6 - 10, 2010.

Mahua Ghosh
Visiting Reader

My research interests are driven by the quest of understanding the macromolecular basis in biological system by studying their structure and the correlation between structure and biochemical function. Some of my research problems I worked on are:

- Mutational studies and biochemical characterization of DNA-entry nuclease Endonuclease A, a non-specific endonuclease from Streptococcus pneumonia.
- Large scale protein production (expression) and characterization of recombinant protein preparations of Endonuclease G-homologs from yeast, C. elegans and humans.

Endonuclease A (EndA) is a membrane-attached surface-exposed DNA-entry nuclease known to be required for genetic transformation of Streptococcus pneumoniae. This enzyme plays an important role during the establishment of invasive infections by degrading extracellular chromatin in the form of neutrophil extracellular traps (NETs), enabling streptococci to overcome the innate immune system in mammals. As a virulence factor, EndA is an interesting target for drug design. We presented the first mutational and biochemical analysis of recombinant forms of EndA. We identify His160 and Asn191 to be essential for catalysis and Asn182 to be required for stability of EndA. The role of His160 as the putative general base in the catalytic mechanism is supported by this study. Our study paves the way for the identification and development of protein or low-molecular-weight inhibitors for EndA in future high-throughput screening assays.

Nuc1p, CPS-6, EndoG and EXOG are evolutionary conserved mitochondrial nucleases from yeast, Caenorhabditis elegans and humans, respectively. These enzymes play an important role in programmed cell death as well as mitochondrial DNA-repair and recombination.Biochemical and structural analysis of mitochondrial nucleases by the toxicity of these enzymes upon cloning and overexpression in E. coli. We established a uniform E. coli expression system for these four evolutionary related nucleases. We compared biochemical properties and the substrate specificities of these related nucleases on selected substrates. Our study found that Nuc1p and EXOG in addition to their endonuclease activity exert 5′-3′-exonuclease activity.

PUBLICATIONS IN JOURNALS

- M. Midon, P. Schaefer, A. Pingoud, Mahua Ghosh, A. Moon, M. Cuneo, R. E. London and G. Meiss, *Mutational and biochemical analysis of the DNA-entry nuclease EndA from Streptococcus pneumonia*, Nucleic Acids Research, 2010, **36(12)**, 4032 - 4037.
- J. Kieper, C. Lauber, O. Gimadutdinow, A. Urbańska, I. Cymerman, Mahua Ghosh, B. *Szczesny* and G. Meiss, *Production and characterization of recombinant protein preparations of Endonuclease G-homologs from yeast, C. elegans and humans*, Protein Expression and Purification, 2010, **73(1)**, 99- 106.

SUPERVISION OF STUDENTS

Project Student: Dhani Ram Mahato (M.Sc Project Student, BIT Mesra).

LECTURES DELIVERED

Structure of a Non-specific endonuclease-inhibitor complex reveals insight for drug development,
Durham University, Durham, UK, February, 2011.

COURSES TAUGHT

Physical chemistry: Theory and experiments (macro molecular structures) Autumn 2010.

Prosenjit Singha Deo
Associate Professor

- Quantum capacitance electronic density of states injectance delay times in quantum mechanics

We found a microscopic derivation for quantum capacitance. Although such a parameter is being used for a couple of decades to interpret and analyze experimental data as well as numerical simulations, no microscopic understanding was there. Our work fulfills this gap. We could also show some paradoxical results in injectance. Namely semi-classical formula for injectance become exact at a resonance which is a purely quantum regime. It was known that semiclassical formula can become exact only if there is no backscattering or reflection. We have shown the converse, i.e., semi-classical formula can become exact even though there is backscattering and reflection. We also demonstrated a physical situation wherein negative delay times can be experimentally observed. All these papers are submitted and not published yet.

SUPERVISION OF STUDENTS

Ph.D. Students: Sreemoyee Mukherjee, Asutosh Yadav, Urbashi Satpathi, Sumit Ghosh.

POST DOCTORAL RESEARCHERS

Dr. S. Gupta.

LECTURES DELIVERED

Delivered a talk on Quantum capacitance, Indo Singapore joint symposium, National University of Singapore, February, 2011.

COURSES TAUGHT

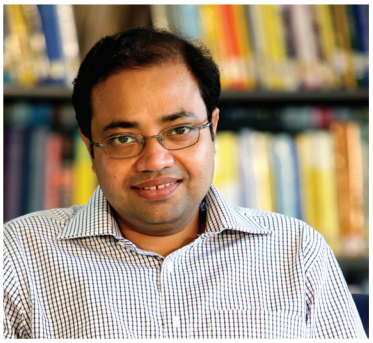
Offered a course to Post M. Sc. students for which exam was conducted on 01.12.10, CB-521 (Numerical methods).

SPONSORED PROJECTS

Thermodynamic and transport properties of mesoscopic system, DST.

MEETINGS ORGANIZED

Organized and convened an International conference on mesoscopic physics and spectroscopy.



Rajib Kumar Mitra
Reader

- Time resolved fluorescence spectroscopy
- High frequency (THz) spectroscopy
- General physical chemistry
- Biomolecules (proteins, nucleic acids, enzymes etc.)
- Bio-mimicking systems (micelles, reverse micelles, lamellae, vesicles etc.)

One of our primary research interests is focused on the altered physico-chemical properties of water molecules under confined and stressed conditions, e.g. in bio-mimicking (like micelles, reverse micelles, vesicles etc.) as well as in real biological (proteins, enzymes, nucleic acids etc.) systems. Spectroscopic tools like steady state and ultrafast fluorescence spectroscopy (fs and ps-resolved), FTIR, THz spectroscopy etc. are used to underline the structure and dynamics of such water molecules. Following are some interesting results obtained,

We have studied the slow solvent relaxation dynamics (a few ns to sub-ns) of water molecules entrapped in AOT lamellae and reverse micelles and our study concludes that both the morphology and the interlayer separation in these nano-confining macromolecular systems play important roles in determining the dynamics of water relaxation.

We observed an overall decrease in the enzymatic activity of α-chymotrypsin in presence of polyethylene glycol (PEG). Detailed thermodynamic consideration and spectroscopic studies reveal a dehydration of the enzyme surface by PEG which reduces its activity.

The effect of collective solvent relaxation dynamics of protein hydration layer due to the modification of protein conformation upon thermal denaturation was studied by THz absorption spectroscopy. Our studies identified that solvation dynamics is effectively governed by the surface topography of proteins, specially upon the exposure of hydrophobic residues during thermal unfolding.

A gradual evolution of hydrogen bonded collective network of water in nonpolar 1,4-dioxane continuum has been investigated. FTIR studies in far- and mid-IR region reveal that a collective hydrogen bonded network of water molecules develops at and beyond Xw≥0.1. The relaxation dynamics of water molecules, as determined from a Double Debye fitting of Dielectric Relaxation data in THz region, and their nucleophilic activity, as measured by solvolysis of benzoyl chloride, show an identical transition at Xw≥0.1.

PUBLICATIONS IN JOURNALS

P. K. Verma, R. Saha, R. K. Mitra, and S. K. Pal, *Slow water dynamics at the surface of macromolecular assemblies of different morphologies*, Soft Matter, 2010, 6, 5971-5979.

BOOKS PUBLISHED

R. K. Mitra, P. K. Verma, D. Banerjee and S. K. Pal, *Hydrogen Bonding Barrier Crossing Dynamics at Bio-mimicking Surfaces*, Chapter 11 in Excited-State Hydrogen Bonding and Hydrogen Transfer, Ed. Ke-Li Han and Guang-Jiu Zhao, John Wiley, 2010, **Vol. 1**, 217-260.

SUPERVISION OF STUDENTS

Ph.D. Student: Animesh Patra.

LECTURES DELIVERED

Invited lecture entitled *Application of THz Spectroscopy in Biophysics* delivered in the Workshop on Terahertz Radiation Generation and Application, IIT, Delhi, March 26 - 27, 2011.

ACADEMIC VISITS

Ruhr University, Germany, October 19 - 23, 2010 and March 7 - 12, 2011.

PARTICIPATION IN COMMITTEES

Internal: Annual Report Committee, Library Committee, Newsletter Committee, various purchase committees and Technical Cell.

Ranjit Biswas
Associate Professor

- Development of first molecular theory for fluorescence dynamics in ionic liquids
- Integration among results on solvation in ionic liquids from different experiments and simulations
- Characterization of heterogeneity and dynamics of supercooled melts
- Understanding hydrophobicity driven molecular association in liquid mixtures
- Effects of confinement on miscibility of liquids, and on transport properties

Our molecular theory predicts the Stokes' shift dynamics for a dipolar solute, C153, in six different alkylimidazolium ionic liquids (ILs) containing a fixed anion, tetra (hexafluoroisopropoxy) aluminate. Calculated shifts in these ILs at ~343 K range ~2300-3700 cm-1, and a dominating contribution (~75-85%) arises from the solute-IL dipole-dipole interaction. Inclusion of solvent-libration predicts ~50% ultrafast component in the total dynamics. Although the predicted dynamics is faster than in other ILs, calculated shifts follow the same linear correlation with ion size-ratio. Furthermore, model calculations explore the solute-IL size-ratio dependence of the interaction contributions to the shift, and investigate the relative importance of solvent rotational and translational modes for IL dynamics (See Fig. 1).

On experimental front, we explored fluorescence dynamics of a polar solute probe in molten (CH_3CONH_2 + $Ca(NO_3)_2$·4.37H_2O) mixtures in order to understand the solute-medium interactions in such complex systems. Steady state and Time-resolved measurements decisively negate the earlier claim of mega-value of the static dielectric constant, and extremely slow relaxation times for these molten mixtures. Subsequent applications of a semi-molecular theory explains, in molecular terms, the mechanism of Stokes shift dynamics in these supercooled melts.

Temperature dependence of the hydrophobicity-driven molecular association in binary mixtures of water and tertiary butanol (TBA) was investigated by using the steady state and time-resolved spectroscopic experiments within the temperature range *278≤T/K≤373*. Extent of association was found to be at 0.04 mole fraction of alcohol at any given temperature. However, unlike in SANS experiments, we did not find any temperature maximum for the association.

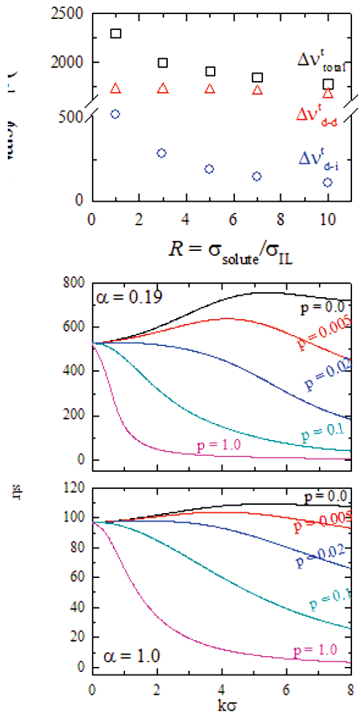


Fig. 1: *Solute size dependence of dynamic Stokes shift (upper panel) and relative importance of solvent rotational and translational modes for solvation energy relaxation in ILs (middle and lower panels). Various interaction contributions to the calculated total shift (squares) are labeled as follows: triangles denote the solute-IL size ratio (R) dependence of dipole-dipole interaction contribution, and circles the ion-dipole contribution. Note the size of an IL molecule has been kept fixed. The calculations are for C153 in [C4-mim]+ [Al(hfip)4]- at 343 K. The role of solvent translation is quantified for both heterogeneous (middle panel) and homogeneous liquids (lower panel). Note the results shown in the lower panel have been obtained with the same dielectric relaxation data as used for results in the middle panel but with a = 1.0.*

PUBLICATIONS IN JOURNALS

- Snehasis Daschakraborty and Ranjit Biswas, Stokes' Shift Dynamics in (Ionic Liquid + Polar Solvent) Binary Mixtures: Composition Dependence, Journal of Physical Chemistry B, 2011, 115, 4011- 4024 (14 pages).
- Harun Al Rasid Gazi, Biswajit Guchhait, Snehasis Daschakraborty and Ranjit Biswas, Fluorescence Dynamics in Supercooled (Acetamide + Calcium Nitrate) Molten Mixtures, Chemical Physics Letters, 2011, 501, 358-363 (6 pages).
- Harun Al Rasid Gazi and Ranjit Biswas, Heterogeneity in Binary Mixtures of (Water + Tertiary Butanol): Temperature Dependence Across Mixture Composition, Journal of Physical Chemistry A, 2011, 115, 2447-2455.
- Harun Al Rasid Gazi and Ranjit Biswas, Excited State Charge Transfer Reaction in (Mixed Solvent + Electrolyte) Systems: Role of Reactant-Solvent and Reactant-Ion Interactions, Journal of Chemical Sciences, 2011, 123, 1-13 (13 pages).
- Amit Das, Ranjit Biswas and J. Chakrabarti, Theory of Dipolar Solute Rotation in Supercritical Fluoroform, Journal of Physical Chemistry A, 2011, 115, 973-978 (6 pages).
- Hemant K. Kashyap and Ranjit Biswas, Stokes' Shift Dynamics in Imidazolium Ionic Liquids: Temperature Dependence, Journal of Physical Chemistry B, 2010, 114 , 16811 – 16823 (13 pages).
- Tuhin Pradhan, Harun Al Rasid Gazi and Ranjit Biswas, Excited State Intramolecular Charge Transfer Reaction of 4-(morpholenyl) benzonitrile in Solution: Effects of Hetero Atom in the Donor Moiety, Journal of Chemical Sciences, 2010, 122, 481-490 (10 pages).

SUPERVISION OF STUDENTS

Ph.D. Students: Mr. Biswajit Guchhait, Mr. Snehasis Daschakraborty, Ms. Tamisra Pal, Ms. Anuradha Das, Ms. Sandipa Indra, Mr. Harun Al Rasid Gazi (Thesis Submitted); **Project Students:** Mr. Bibek Ranjan Samanta (KVPY fellow), Ms. Krishna Kumari Swain (IAS fellow).

LECTURES DELIVERED

- Invited International Year of Chemistry Talk entitled F*luorescence Dynamics in Supercooled Molten Mixture* , IISER, Pune, April 15, 2011.
- Invited Talk entitled *Stokes' Shift Dynamics in Pure Ionic Liquid and (Ionic Liquid + Polar Solvent) Binary Mixtures: Molecular Mechanisms for the Observed Bimodal Dynamics*, BARC, Mumbai, April 13, 2011.
- Invited Talk entitled *Heterogeneity in Solution Structure: Impact on Simple Chemical Events*, IISER, Kolkata, April 6, 2011.
- Invited Talk in the symposium entitled, *Chemistry in the 21st Century:* Challenges and Opportunities, Kalyani University, May 28, 2010.
- Invited Talk in the International Conference on *Emergent Properties and Novel Behavior at the Nanoscale*, JNCASR, Bangalore, April 27 - 28, 2010.
- Invited Talk in the "*special session on ionic liquids*" of the ACS National Meeting in San-Francisco, California, March 21 – 25, 2010.

COURSES TAUGHT

Physical Chemistry: Theory and Experiments (Fall).

Samir Kumar Pal
Associate Professor

- Experimental biophysics
- Bio-nano Interface
- Biomedical/environmental Instrumentation

PUBLICATIONS IN JOURNALS

- O. F. Mohammed, D. S. Yang, S. K. Pal and A. H. Zewail, 4D Scanning Ultrafast Electron Microscopy: Visualization of Materials Surface Dynamics, J. Am. Chem. Soc. (Communication), 2011, 133, 7708.
- D. Zhong, S. K. Pal and A. H. Zewail, Biological water: A critique, Chem. Phys. Lett., 2011, 503, 1 (FRONTIERS ARTICLE).
- S. Batabyal, A. Makhal, K. Das, A. K. Raychaudhuri and S. K. Pal, Ultrafast dynamics of excitons in semiconductor quantum dots on a plasmonically active nano-structured silver film, Nanotechnology, 2011, 22, 195704.
- T. Mondol, P. Rajdev, A. Makhal and S. K. Pal, Interaction of an Antituberculosis Drug with a Nanoscopic Macromolecular Assembly: Temperature-Dependent Förester Resonance Energy Transfer Studies on Rifampicin in an Anionic Sodium Dodecyl Sulfate Micelle, J. Phys. Chem. B, 2011, 115, 2924.
- P. Rajdev, T. Mondol, A. Makhal, and S. K. Pal, Simultaneous binding of anti-tuberculosis and anti-thrombosis drugs to a human transporter protein: A FRET study, J. Photochem. Photobiol. B, 2011, 103, 153.
- P. L. Xavier, K. Chaudhari, P. K. Verma, S. K. Pal, and T. Pradeep, Luminescent quantum clusters of gold in transferrin family protein, lactoferrin exhibiting FRET, Nanoscale, 2010, 2, 2769.
- A. Giri, A. Makhal, B. Ghosh, A. K. Raychaudhuri and S. K. Pal, Functionalization of manganite nanoparticles and their interaction with biologically relevant small ligands: Picosecond time-resolved FRET studies, Nanoscale, 2010, 2, 2704.
- N. Goswami, A. Makhal and S. K. Pal, Toward an Alternative Intrinsic Probe for Spectroscopic Characterization of a Protein, J. Phys. Chem. B, 2010, 114, 15236.
- P. K. Verma, R. Saha, R. K. Mitra and S. K. Pal, Slow water dynamics at the surface of macromolecular assemblies of different morphologies, Soft Matter, 2010, 6, 5971.
- M. A. Habeeb Muhammed, P. K. Verma, S. K. Pal, A. Retnakumari, M. Koyakutty, S. Nair and T. Pradeep, Luminescent Quantum Clusters of Gold in Bulk by BSA-induced Core Etching of Nanoparticles: Metal ion sensing, Metal Enhanced Fluorescence and Biolabeling,Chemistry: A European Journal, 2010, 16, 10103.
- P. K. Verma and S. K. Pal, Ultrafast Migration of Optical Radiation in Bio-Molecular Systems, The European Physical Journal D, 2010, 60, 137.
- A. Makhal, S. Sarkar, S. Baruah, T. Bora, J. Dutta, A. K. Raychaudhari and S. K. Pal, Role of Resonance Energy Transfer in Light Harvesting of Zinc Oxide based Dye Sensitized Solar Cells, J. Phys. Chem. C, 2010, 114, 10390.

BOOK PUBLISHED

R. K. Mitra, P. K. Verma, D. Banerjee and S. K. Pal, *Hydrogen Bonding Barrier Crossing Dynamics at Bio-mimicking Surfaces (Book Chapter), in Excited-State Hydrogen Bonding and Hydrogen Transfer*, Edited by Ke-Li Han and Guang-Jiu Zhao, John Wiley, 2010, Chapter 11.

SUPERVISION OF STUDENTS

Ph.D. Students: Pramod K. Verma, Abhinandan Makhal, Nirmal Goswami, Surajit Rakhshit, Subrata Batabyal, Soma Banerjee, Anupam Giri, Soumik Sarkar, Ranajay Saha, Tanumoy Mondal.

POST DOCTORAL RESEARCHERS

Dr. Priya Rajdev

ACADEMIC VISITS

Visiting Faculty, Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California, USA.

COURSES TAUGHT

- Fundamental of Biophysics.
- Instrumental methods of analysis.

PATENTS AWARDED/ APPLIED

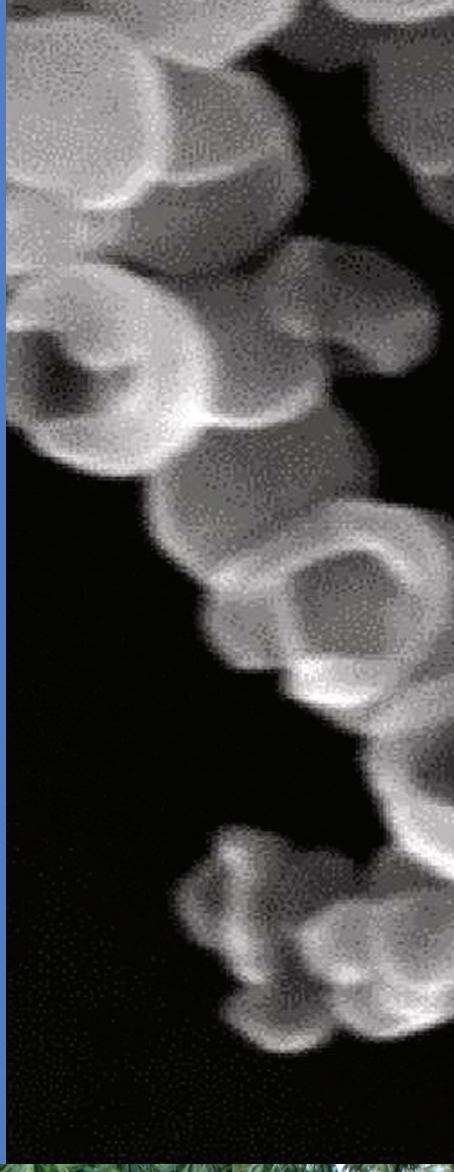
- A simple biophysical route for quantitative detection of aqueous gold ion (au3+) in sub-ppm level, Indian Pat. Appl. (2007), IN 2007KO01656. (approved)

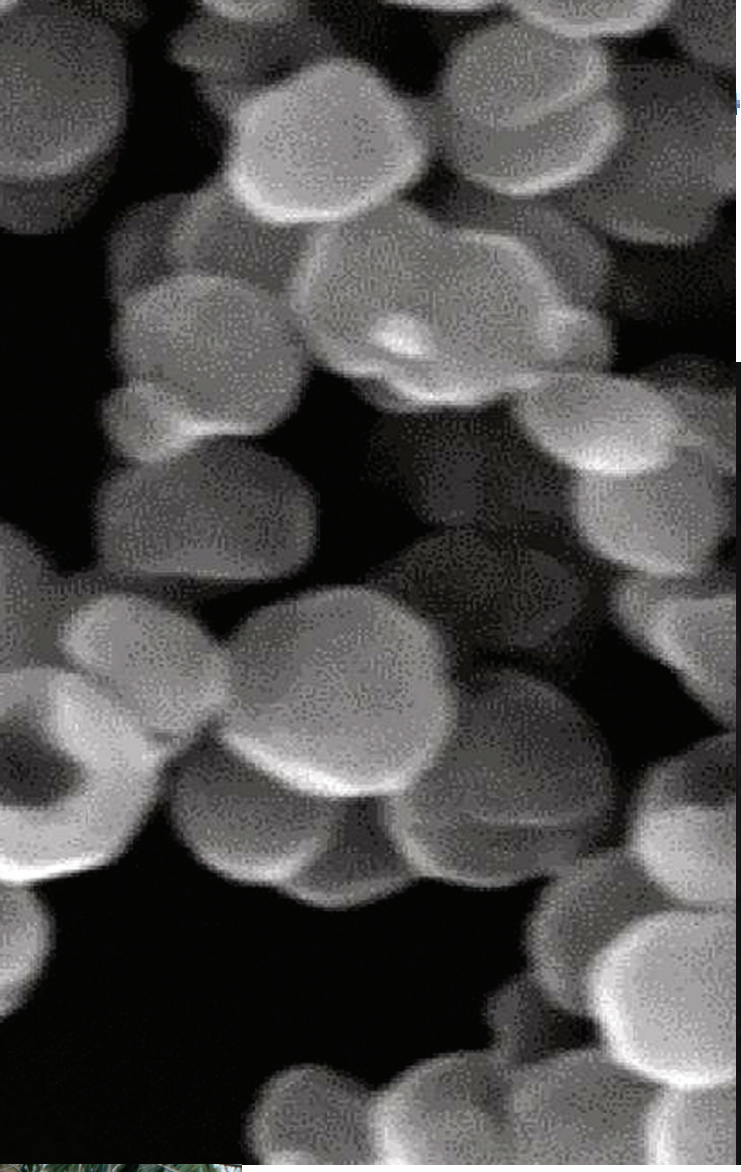
- A method and system for non-invasive quantitative estimation of Billirubin in human body, Indian Pat. Appl. (2009), 467/KOL/2009 dated 17th March, 2009.
- A method and system for non-invasive quantitative estimation of Hemoglobin in human blood, Indian Pat. Appl. (2009), 466/KOL/2009 dated 17th March, 2009.
- A method and system for non-invasive quantitative estimation of Oxygen content in human blood, Indian Pat. Appl. (2009), 465/KOL/2009 dated 17th March, 2009.
- A method and system for non-destructive characterization of Gemstones, Indian Pat. Appl. (2009), 546/KOL/2009 dated 27th March, 2009.
- A method and system for non-destructive characterization of Organic Gems, Indian Pat. Appl. (2009), 545/KOL/2009 dated 27th March, 2009.

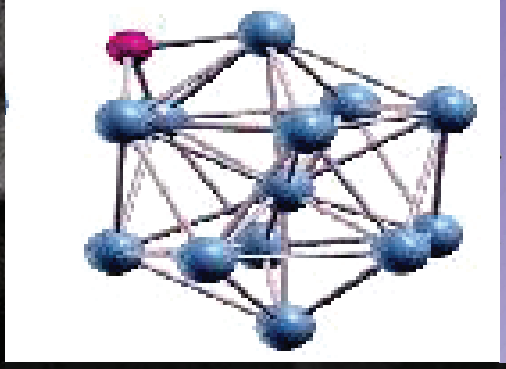
SPONSORED PROJECTS

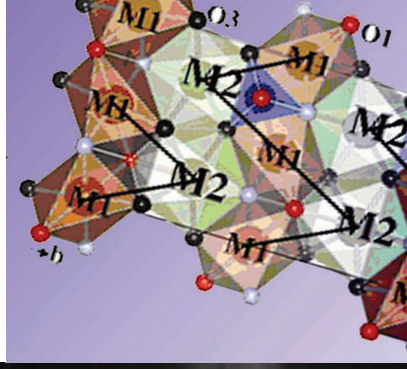
Study of Biomolecular Recognition with Time-resolved Optical Spectroscopy, DST.

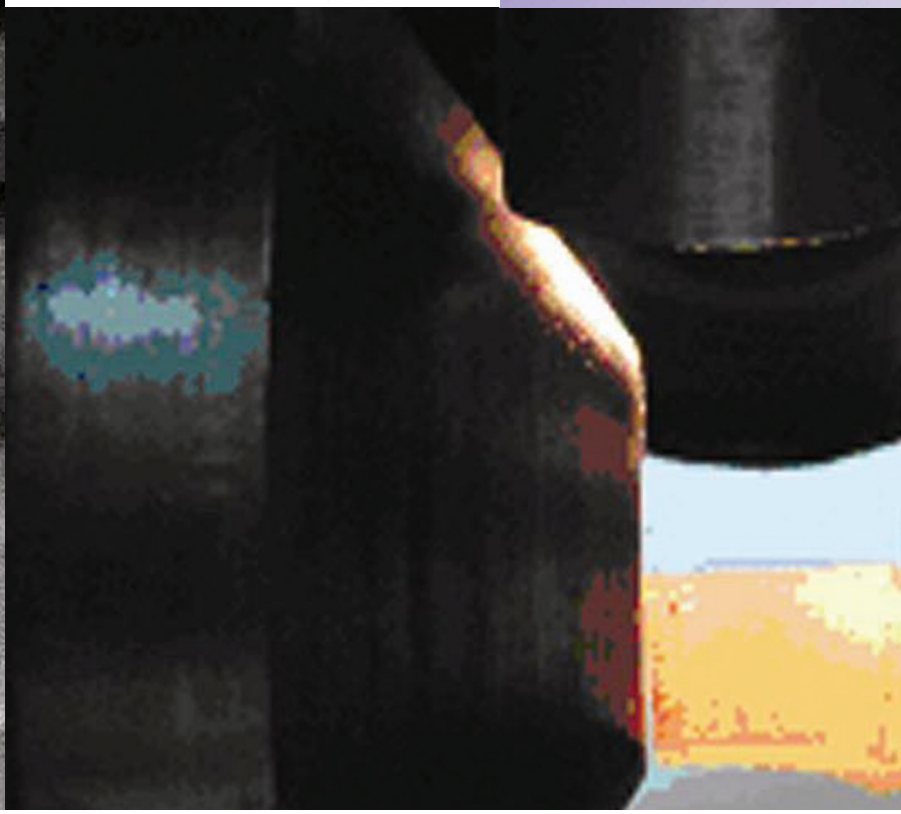
9th C. K. Majumdar Memorial Lecture
1st February, 2011

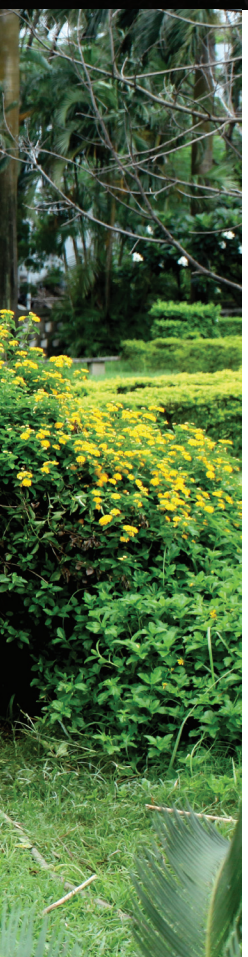












Department of
MATERIAL SCIENCES

DEPARTMENT OF MATERIAL SCIENCES

The department, as in yester years, is striving hard to keep up its excellence in research and teaching. In the research areas, there are two main branches – theory and experiment. We have 4 regular faculties and a bose fellow in the experimental group, and in theory we have 4 regular faculties. One professor from each group left this year. We also had two visiting faculty fellows, one of which left to become research scientist later on. Finally, there are a few research associates in the department, a few EVLP associates even from out of the state and some 46 students with the institute, CSIR or other fellowships.

In the experimental section, the majority of work revolved round nano structured materials. Dr. K. Mandal's group searched for the origin of magnetism in transition metal doped oxide semiconductors. They worked on SnO_2 and ZnO based nano and bulk structures, and also prepared hollow Fe_3O_4 spheres.

Dr. A. Barman's group investigated ultrafast dynamics of interacting magnetic nanostructures, with varying geometric configurations, and static magnetic configuration; and magnetic multilayer's by using experimental and numerical simulation techniques. The dynamical processes were investigated in the time domain by a time resolved magnetooptical Kerr effect microscope and in the frequency domain by a broadband ferromagnetic resonance spectrometer.

Dr. S. Barman's main work was on study of dynamics of one dimensional chain of magnetic nanodisks, under local and global excitations. Another problem she tackled was of the curious case of very high thermal conductivity of boron nitride. She could show that the usually neglected N-drift scattering mechanism was behind this behaviour. This could be useful for use in semiconductor devices.

Prof. A. K. Raychaudhuri's group worked on various aspects of nanomaterials, which among other things include measurements on single nanowires prepared using different nanolithographic tools. Investigations on finite size effect on phase transitions have been done on Ni nanowires and ferromagnetic manganite nanoparticles. A collaborative work on directed self-assembly has been done for forming large scale ordered nano-arrays.

In other areas of experiments, Prof. A. K. Majumder's group worked on magnetism and electrical measurements on permalloy type materials, as a function of temperature and magnetic field.

Dr. P. K. Mukhopadhyay's group focussed on various aspects of smart materials, namely ferromagnetis shape memory alloys. Some really novel experiments were done in collaboration with a group in Singapore. Additionally, some work in polymerized materials and thin films of WO_3 were also done.

Dr. B. Ghosh (Saha) fabricated oxide nanowires for transport measurements. She also investigated perovskite oxide system under high pressure with neutron diffraction study. In addition, she did some fabrication work of resistive switching devices of multifunctional oxides to characterize the nature of the film /electrode interface and microstructure.

Dr. C. Biswas and her group worked on another set of ferromagnetic shape memory alloys. They have followed the Austanite and Martensitic phases in some particular alloys and found interesting results. They have also tried to theoretically understand it.

In the theoretical side, Dr. R. Chaudhury has worked on microscopic theory of superconductors and occurrence on Kohn anomaly in the superconducting phase. Finally he also looked at the topological excitations in quantum spin models on low dimensional lattices.

Prof. A. Mookerjee worked on various aspects of electronic and magnetic structures of different classes of binary and ternary metallic alloys both in the bulk form and in doped clusters. They developed a code which for non-collinear magnetic structures in disordered and frustrated systems. He has also looked at the effect of disorder on superconductivity.

Dr. T. Saha-Dasgupta worked on electronic structure and orbital ordering in some unusual spinels, ruthenates, piezoelectric properties of ultra thin superlattices, low dimensional quantum spin systems, metallic nanoclusters and on site preferences of metallic ions in minerals.

The group of Dr. P. Mahadevan has over this period looked at orbital ordering in p-shell oxides, magnetism in ruthenates, bulk modulus of nanocrystals of semiconductors and the formation of ultraflat films of graphene on a substrate. In the case of graphene, they have shown how ultraflat films on graphene are possible on a substrate, explaining some recent exciting experimental results.

In terms of research publications, there were 59 papers in refereed journals. There were many other talks (invited and contributed) talks and posters given in various national and international meetings/conferences. There were also many academic visits to various universities and centres, in India and abroad.

In term of externally funded projects, this department is fortunate to have PIs that have attracted about ₹ 33.9 crores (total sanctioned budget), the largest share in the whole centre. Indeed, the number of projects, 33 (running and concluded in this year), is also the most in the centre. There is a good involvement of teaching in the IPhD and PMsc levels from the faculty from the department.

Finally, on awards and recognition front, we find that Dr. T. Saha-Dasgupta was elected a fellow of the National Academy of Science. Dr. P. Mahadevan was awarded TWOWS Prize for young woman scientist in Physics/ Mathematics in Asia region for 2010. She also received the NASI-SCOPUS young scientist award in Physics for 2010. Dr. R. Chaudhury was invited as a visiting professor at AUST (Abuja) under NMI (Washington DC, USA) for teaching a course there.

Pratip Kumar Mukhopadhyay
Head, Department of Material Sciences

Abhijit Mookerjee
Distinguished Professor

- Structural, electronic and magnetic properties of finite clusters
- Study of electronic, magnetic and phase diagrams of ternary alloys
- Development and applications of a code to study non-collinear magnetism in disordered alloys
- Study of the effect of disorder on a multi-band attractive Hubbard model of superconductivity

The tight-binding linear muffin-tin orbitals based augmented space recursion codes developed by us earlier has been now generalized and modified to take into account non-collinear magnetism. The new codes have been applied to study non-collinear phases in Mn based disordered alloys. The orbital-peeling and Lichtenstein formula approaches have been used to obtain the exchange interactions accurately and map the alloy problem onto an effective Ising-like model. This allowed us to study the magnetic phase diagrams of a class of ternary alloys on which experimental data are available.

We have continued to study the structural, electronic and magnetic properties of bi-metallic and oxide clusters suitably doped with electrons or holes.

We have also continued further study of the effect of disorder on a multi-band attractive Hubbard model of superconductivity.

PUBLICATIONS IN JOURNALS

- M. K. Yadav and A. Mookerjee, Nitrogen absorption and dissociation on small Tantalum clusters, Physica B, 2010, 405, 3940.
- Shreemoyee Ganguly, Indra Dasgupta and Abhijit Mookerjee, A real space approach to study the effect of off-diagonal disorder on superconductivity,Physica C, 2010, 470, 640.
- Mitali Banerjee, Rudra Banerjee, A. K. Majumdar, Abhijit Mookerjee, Biplab Sanyal amd A. K. Nigam, Magnetism in NiFeMo disordered alloys: Experiment and theory, Physica B: Condensed Matter, 2010, 405, 4287.
- Mitali Banerjee, Abhijit Mookerjee, A. K. Majumdar, Rudra Banerjee, Biplab Sanyal and A. K. Nigam, Magnetism in FeNiW disordered alloys: Experiment and theory, J. Magn. Magn. Mater, 2010, 322(21), 3558.
- D. I. Sheka, G. V. Tretyak, A. M. Korol, A. K. Sen and A. Mookerjee, New possibilities for obtaining steeply non-linear current-voltage characteristics in some semiconductor devices, Int. J. Mod. Phys. B., 2010, 24, 3273.
- Prashant Singh and A. Mookerjee, Effect of donor (I) or acceptor (N) co-doping on Cr doped ZnTe clusters, J. Magn. Magn. Mater., 2010, 323, 167.
- B. Sanyal and A. Mookerjee, Study of the electronic and structural properties of ZnO clusters, Int. J. Mod. Phys. B, 2010, 24, 3297.
- R. K. Chouhan and A. Mookerjee, Magnetic phase diagram for CuMn, J. Magn. Magn. Mater., 2010, 323, 868.
- S. Ganguly, M. Kabir, B. Sanyal and A. Mookerjee, Unusual structure and magnetism in MnO nanoclusters, Phys Rev B (Rapid Commun), 2011, 83, 020411.
- R. Banerjee, M. Banerjee, A. K. Majumdar, A. Mookerjee, B. Sanyal, J. Hellsvik, O. Eriksson and A. K. Nigam, Fe3.3 Ni83.2 Mo13.5: a likely candidate to show spin-glass behaviour at low temperatures, J. Phys : Condens Matter, 2011, 23, 106002.
- A. Alam, R. K. Chouhan and A. Mookerjee, Phonon modes and vibrational entropy of disordered alloys with short ranged order: a first principles calculation, Phys Rev B, 2011, 83, 054201.
- M. Rahaman, A. V. Ruban, A. Mookerjee and B. Johansson, Magnetic state effect upon the order-disorder phase transition in Fe-Co alloys: A first-principles study, Phys Rev B, 2011, 83, 054202.
- S. Ganguly, M. Costa, A. B. Klautau, A. Bergman, B. Sanyal, A. Mookerjee and Olle Eriksson, The augmented space recursion formulation of the study of disordered alloys with non-collinear magnetism and spin-orbit coupling: application to MnPt and Mn3Rh, Phys Rev B, 2011, 83, 094407.
- S. Datta, M. Kabir, A. Mookerjee and T. Saha-Dasgupta, Engineering the magnetic properties of Mn13 clusters by doping, Phys Rev B, 2011, 83, 075425.

- M. Rahaman, K. Tarafder, B. Sanyal and A. Mookerjee, Study of optical response in disordered alloys using generalized recursion in augmented space: application to ferromagnetic FeCo alloy, Physica B, 2011, 406, 2121.

SUPERVISION OF STUDENTS

Ph.D. Students: Moshiour Rahaman, Mitali Banerjee, Shreemoyee Ganguly, Rudra Banerjee,
Prashant Singh, Ambika Prasad Jena, Rajiv K. Chouhan, Gopi Chandra Kaphle.

LECTURES DELIVERED

- The interacting electron liquid: density functional approach, Invited Lecture, ISNA conference, in memory of Prof. Arabinda Mukherjee, Bose Institute, January, 2011.
- Fe3.3 Ni83.2 Mo13.5: is it a spin-glass?, Invited Lecture, MAGMA-11 conference, Satyendra Nath Bose National Centre for Basic Sciences, February, 2011.

ACADEMIC VISITS

TWAS-NH56, University of Hyderabad, Hyderabad, February, 2011

COURSES TAUGHT

- PHY 302, Condensed Matter Theory, Semester 3.
- Superconductivity (at West Bengal State University, Barasat), Semester 4.
- Many-Body Theory (at Lady Brabourne College, Kolkata), Semester 4.

PARTICIPATION IN COMMITTEES

- **External:** Member, Executive committee JBNSTS; Member, Academic Committee, West Bengal State University, Barasat; Nominee Chairman, Vidyalaya Management Committee, Kendria Vidyalaya II, Salt Lake.
- **Internal:** President, Indian Society of non-linear analysts.

SPONSORED PROJECTS

TWAS Network Project NH-56, Third World Academy of Science.

Alak Kumar Majumdar
Emeritus Scientist

Magnetism in NiFeW/Mo bulk disordered alloys:

- Experiment and theory
- Signature effects of spin clustering and distribution of spin couplings on magnetization in NiFeMo/W alloys
- Electron scattering in Ni-rich NiFeV/Mo/W alloys
- Electrical resistivity in disordered Ni100-xMnx ($15 \leq x \leq 37$) alloys
- Structural and magnetic characterization of nanometer size NiFeMo films

Magnetization studies of disordered FeNiW/Mo alloys show that W alloys have only para-ferro transitions with no indication of spin-glass (SG) phase whereas SG phase is observed in $Mo_{13.5.}$ We supplemented the data with theoretical analyses using first-principles TBLMTO-based ASR method giving good agreement of magnetic moment and Curie temperatures with experiments. Our mean-field phase analysis supports the absence/presence of SG phase in W/Mo alloys. M(T) shows it is well described by Bloch's $T^{3/2}$ law, an extraordinary enhancement of spin-wave parameter B, and reduced coefficient $B_{3/2} = BT^{3/2}$ with increasing Fe dilution as compared to 3d ferromagnets, whereas the critical amplitudes decrease systematically. We propose that these distinctive features provide macroscopic indicators of signature effects of spin clustering on M (T) in disordered ferromagnets.

We isolated different scattering mechanisms through electrical resistivity studies in disordered Ni-Fe-V, Ni-Fe-Mo, and Ni-Fe-W alloys. The observed low-temperature minima, unaffected in fields till 5 T ruling out Kondo effect, are due to e-e interactions. Enhancements of electron–magnon and e-e scattering strength are observed with Fe dilution.

ρ(T) of disordered $Ni1_{00-x}Mn_x$ alloys (x = 15-37) for T = 5-350 K show distinct behavior below and above the multicritical point x = 25. In ferromagnetic/ferro-SG (x £ 25) phase, r(T) is dominated by large electron-phonon and electron-magnon s-d scattering while in SG/antiferromagnetic regime ($x \geq 25$) resistivity minima appear due to larger disorder with r0 ~ (150-185) Wmcm with ρ(T) dominated by e-e interaction and electron-phonon s-d scattering.

The RBS measurements of PLD grown ferromagnetic thin films from bulk Ni-Fe-Mo alloys revealed that the target thickness ~ 55 % of that found from XRR analysis while that found from Z-SEM image shows better agreement with XRR. The Z-SEM even supports the three-layer XRR model. RBS and EDXS also reveal that the targets and the films have somewhat similar compositions but with an enhanced yield of Fe. Detailed analysis of magnetization data gives higher values of TC, D, and MS in the films due to the enhancement of Fe content in the films at the cost of Ni.

PUBLICATIONS IN JOURNALS

- Mitali Banerjee, Rudra Banerjee, A. K. Majumdar, Abhijit Mookerjee, Biplab Sanyal, and A. K. Nigam, Magnetism in NiFeMo disordered alloys: Experiment and theory, Physica B, 2010, 405, 4287.
- Mitali Banerjee, Abhijit Mookerjee, A. K. Majumdar, Rudra Banerjee, Biplab Sanyal, and A. K. Nigam, Magnetism in FeNiW disordered alloys: Experiment and theory, J. Magn. Magn. Mater., 2010, 32, 3558.
- R. S. Patel and A. K. Majumdar, Temperature dependence of the giant magnetoresistance in Fe-Cr multilayers – intralayer and interlayer exchange energies, J. Magn. Magn. Mater., 2011, 323, 646.
- Rudra Banerjee, Mitali Banerjee, A. K. Majumdar, Abhijit Mookerjee, Biplab Sanyal, Johan Hellsvik, Olle Eriksson, and A. K. Nigam, Fe3.3Ni83.2Mo13.5: does it show spin-glass behaviour at low temperatures ? J. Phys.: Condens. Matter, 2011, 23, 106002.

SUPERVISION OF STUDENTS

Ph.D. Students: Mitali Banerjee (SRF/UGC, Submitted thesis on April 19, 2011), Pampa Pal (Part time); Project Student: Post B.Sc.: Arijit Chatterjee.

LECTURES DELIVERED

Magnetotransport studies in bulk disordered NiMn alloys, Invited talk at the Russian-Indian Seminar on "Research on ferromagnetic shape memory alloys and related materials: state of the art in India and Russia", Moscow, October 15-18, 2010.

ACADEMIC VISITS

Tata Institute of Fundamental Research, Mumbai, February 13 - March 13, 2011.

PARTICIPATION IN COMMITTEES

External: Chairman, Expert Committee on Magnetoencephalogram project at IGCAR, Kalpakkam, Dept. of Science & Technology, Govt. of India (DST), 2007-2011.

Anjan Barman
Associate Professor

- Nanomagnetism
- Spin dynamics
- Magnonics, Magnonic Crystals
- Femto and Picosecond Magneto-optical Kerr Effect
- High Frequency Measurements

We have investigated the ultrafast magnetization dynamics of interacting magnetic nanostructures with varying shapes, sizes and static magnetic configurations and magnetic multilayers by using experimental and numerical simulation techniques. The samples were fabricated by a combination of nanolithography and thin film deposition or by chemical and electrochemical methods. The ultrafast magnetization dynamical measurements were done both in the time-domain by a home-built time-resolved magneto-optical Kerr effect microscope and in the frequency domain by a broadband ferromagnetic resonance spectrometer. Some important results obtained this year are as below.

Observation of broadly tunable magnonic frequency and damping and observation of a correlation between perpendicular magnetic anisotropy and Gilbert damping in [Co/Pd]8 multilayers with varying Co layer thickness.

Experimental observations of dynamics of coupled vortices in pairs of ferromagnetic disks both by ac current excitation and Oersted field excitation.

Observation of different collective precessional dynamical modes in arrays of ferromagnetic dots with varying inter-element separation.

Measurement of the femto- and picosecond dynamics from magnetostatically isolated 50 nm ferromagnetic dots.

PUBLICATIONS IN JOURNALS

- S. Pal, B. Rana, O. Hellwig, T. Thompson, and A. Barman, T*unable magnonic frequency and damping in [Co/Pd]8 multilayers with variable Co layer thickness*, Appl. Phys. Lett., 2011, **98**, 082501.
- S. Sugimoto, Y. Fukuma, S. Kasai, T. Kimura, A. Barman and Y. Otani, *Dynamics of coupled vortices in a pair of ferromagnetic disks*, Phys. Rev. Lett., 2011, **106**, 197203.
- S. Pal, D. Kumar and A. Barman, *Micromagnetic study of size-dependent picosecond dynamics in single nanomagnets*, J. Phys. D: Appl. Phys., 2011, **44**, 105002.
- M. Krawczyk, S. Mamica, J. W. Kłos, J. Romero-Vivas, M. Mruczkiewicz and A. Barman, *Spin waves in multilayered nanograins with perpendicular anisotropy: competition between dipolar and exchange interactions*, J. Appl. Phys., May 15, 2011, **10**, 109.
- S. Barman, A. Barman and Y. Otani, *Controlled propagation of local magnetic excitation in one-dimensional chains of nanomagnets*, J. Phys. D: Appl. Phys., 2010, **43**, 335001.
- A. Barman, S. Barman, T. Kimura, Y. Fukuma, and Y. Otani, *Gyration mode splitting in magnetostatically coupled magnetic vortices in an array*, J. Phys. D: Appl. Phys., fast track communication, 2010, **43**, 422001.

SUPERVISION OF STUDENTS

Ph.D. Students: Bivas Rana, Semanti Pal, Dheeraj Kumar, Milan Agrawal, Bipul Kumar Mahato, Sushmita Saha, Ruma Mandal; **Project Students:** Arnab Ganguly, Debanjan Polley, Tanmoy Goswami (IITB), Krishna Prasad Bera (RKM, Narendrapur).

POST DOCTORAL RESEARCHERS

P. Sabareesan.

LECTURES DELIVERED

- *Ultrafast magnetization dynamics in 1-D and 2-D magnonic crystals*, A. Barman, MAGMA 2011, S. N. Bose National Centre for Basic Sciences, Kolkata, January 24 - 25, 2011 (invited).
- *Magnetization processes in magnetic nanostructures and their applications*, A. Barman, 5th DST school on Nanoscience and Nanotechnology, Bangalore, January 17 – 23, 2011 (invited).

- *Ultrafast Magnetization Dynamics in Magnetic Multilayers and nanomagnet Arrays*, A. Barman, JST-DFG Workshop, Kaiserslautern, Germany, October 4 – 6, 2010 (invited).
- *Ultrafast Magnetization Dynamics in Magnetic Multilayers and Coupled Magnetic Vortices*, A. Barman, Recent Trend in Condensed Matter Physics, IACS, Jadavpur, Kolkata, December 3, 2010 (invited).
- *Ultrafast magnetization dynamics in nanomagnet arrays with varying areal density*, B. Rana, S. Pal, Y. Fukuma, Y. Otani and A. Barman, National Seminar on Nanomaterials and their Applications, ISM Dhanbad, February 10 – 11, 2011.
- T*unable magnonic frequency and damping in* $[Co/Pd]_8$ *multilayers with variable Co layer thickness*, S. Pal, B. Rana, O. Hellwig, T. Thomson and A. Barman, National Seminar on Nanomaterials and their Applications, ISM Dhanbad, February 10 – 11, 2011.
- *Gyrotropic mode splitting in pair of magnetostatically coupled permalloy disks in an ordered array*, A. Barman, S. Barman, T. Kimura, Y. Fukuma and Y. Otani, Progress In Electromagnetics Research Symposium (PIERS) 2010, Cambridge, MA, USA, July, 2010.
- *Simulation studies of propagation of local magnetic excitation in one dimensional chains of nanomagnets*, S. Barman, A. Barman, Y. Fukuma and Y. Otani, Progress In Electromagnetics Research Symposium (PIERS) 2010, Cambridge, MA, USA, July, 2010.
- *The effect of magnetic nonuniformity on exchange and magnetostatic spin-waves in layered nanostructures*, S. Mamica, M. Krawczyk, and A. Barman, MML, Berkley, 2010.
- *Time-resolved observation of gyration mode splitting in a magnonic vortex lattice*, A. Barman, S. barman, T. Kimura, Y. Fukuma and Y. Otani, ICMM, Kolkata, October 25 – 29, 2010.
- *Magnetization reversal in Ni nanoclusters and naochains of different geometries*, B. Rana, M. Agrawal and A. Barman, ICMM, Kolkata, October 25 – 29, 2010.
- *Magnetization dynamics in single nanomagnets of varying aspect ratios*, S. Pal, D. Kumar and A. Barman, ICMM, Kolkata, October 25 – 29, 2010.

ACADEMIC VISITS

- Visiting Scientist Program, RIKEN-ASI, Saitama, Japan, September – November, 2010.
- Visitor, University of Kaiserslautern, Germany, October, 2010.

COURSES TAUGHT

- PHY191, Basic Laboratory – I, Semester 1
- PHY292, Project based course-I, Semester 2
- PHY304, Project based course-II, Semester 3
- PHY416, Optical Physics, Semester 4
- PHY410, Advanced Techniques in Experimental Physics, Semester 4

PARTICIPATION IN COMMITTEES

- External: Co-ordinator, DYNAMAG, India-EU consortium; Joint Coordinator, JEST 2011.
- Internal: In-charge of the Technical Cell; Member of Works Committee; Member of Research Committee; Member of Library Committee; Member of various purchase committees and selection committees.

SPONSORED PROJECTS

- Quasistatic and Ultrafast Magnetization Dynamics in Nanomagnet Arrays, DST.
- Spin-wave and domain wall dynamics in vertical magnetic nanowires, UKIERI-DST.
- Advanced computational studies of dynamic phenomena in magnetic nano-materials, DST- European Commission.
- Magnonic Crystals: New paradigm towards microwave communications, DST-JST.
- Development of GHz frequency filters and attenuators using nanoscale magnonic crystals, Department of Information Technology.

Arup Kumar Raychaudhuri
Director and Senior Professor

- Science of Nanomaterials
- Nanofabrication
- Nanolithography
- Physics of correlated oxides
- Opto-electronics with ZnO
- Some of the specific problems investigated include (a) Finite size effects in Ni nanowires and CMR (manganite) oxides, (b) Observation of a novel gate controlled persistent photoconductivity in single crystals of ZnO,(c) Pattern formation in nanoscale

ZnO, a wide band gap semiconductor, has attracted recent attentions as an opto-electronic material for use in the Ultra-violet region of the electromagnetic spectrum. We investigated the nature of natural defects in ZnO that make it a n--type semiconductor, using positron-annihilation spectroscopy. We also discovered a novel effect, through serendipity, that the defect induced persistent photoconductivity in ZnO can be controlled using a gate made from a polymeric ionic conductor. The discovered effect has the potential for application as an erasable UV image plate. Investigation done in collaboration with other colleagues of the centre led to a fundamental understanding in the mechanism of energy transfer and energy harvesting in ZnO based nanomaterials.

The physics of size reduction in magnetic and correlated oxides was investigated. In the first investigation of its kind, critical behavior close to the ferromagnetic transition (T_C) in Ni nanowires (down to diameter of 15nm) was investigated through very high precision resistivity measurements. The results show how the critical behavior evolves as a finites size scaling when the size (diameter) becomes less than the growing correlation length near T_C. Experiments using neutron scattering (down in collaboration with BARC), showed that the ferromagnetic transition temperature as well as the ferromagnetic moments in complex materials follow effects arising in tandem from finite size scaling as well as enhancement of the ferromagnetic state due to surface pressure. A high precision calorimetric measurements of DNA denaturation showed how the thermal fluctuations evolve when DNA undergo denaturation.

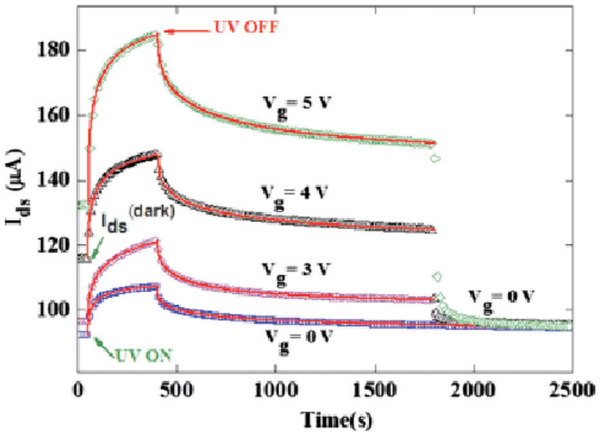


Fig.1: *The photocurrent, persistent photocurrent PPC, and the gate control of the PPC. The photocurrent data with and without illumination have been taken with a series of Vg from 0 to 9 V. Note that the photocurrent is maintained at a high value when Vg is high and the illumination is turned off.*

PUBLICATIONS IN JOURNALS

- Rabibrata Mukherjee, Soma Das, Anindya Das, Satinder Sharma, A. K. Raychaudhuri and Ashutosh Sharma, *Stability and Dewetting of Metal Nanoparticles Filled Thin Polymer Films: Control of Instability Lengthscale and Dynamics*, ACS NANO, 2010, **4**, 3709.
- K. S. Nagapriya, A. K. Raychaudhuri, *Thermal fluctuation spectroscopy of DNA thermal denaturation*, Biophysical Journal, 2010, **99**, 2666.
- Abhinandan Makhal, Soumik Sarkar, Tanujjal Bora, Sunandan Baruah, Joydeep Dutta, A. K. Raychaudhuri and Samir Kumar Pal, *Dynamics of light harvesting in ZnO nanoparticles*, Nanotechnology , 2010, **21**, 265703.
- Abhinandan Makhal, Soumik Sarkar, Tanujjal Bora, Sunandan Baruah, Joydeep Dutta, A. K. Raychaudhuri and Samir Kumar Pal, *Role of Resonance Energy Transfer in Light Harvesting of Zinc Oxide-Based Dye-Sensitized Solar Cells*, J. Phys. Chem. C., 2010, **114**, 10390.
- S. K. Chaudhuri, Manoranjan Ghosh, D. Das and A. K. Raychaudhuri, *Probing defects in chemically synthesized ZnO nanostrucures by Positron Annihilation and Photoluminescence Spectroscopy*, Journal of Applied Physics, 2010, **108**, 064319.

- Anupam Giri, Abhinandan Makhal, Barnali Ghosh, A. K. Raychaudhuri and Samir Kumar Pal, *Functionalization of Manganite Nanoparticles and their interaction with biologically relevant small ligands: Picosecond Time-Resolved FRET Studies*, RSC NANOSCALE, 2010, **2**, 2704.
- M. Venkata Kamalakar and A. K. Raychaudhuri, *Resistance anomaly near phase transition in confined ferromagnetic nanowires*, Physical Review B, 2010, **82**, 195425.
- Tapati Sarkar, A. K. Raychaudhuri, A. K. Bera and S. M. Yusuf, *Effect of size reduction on the ferromagnetism of the manganite* $La_{1-x}Ca_xMnO_3$ *(x=0.33).*, New Journal of Physics, 2010, **12**, 123026.
- Sarathi Kundu and A. K. Raychaudhuri, *Effect of water and air-water interface on the structural modification of Ni-Arachidate Langmuir-Blodgett films*, Journal of Colloid and Interface Science, 2011, **353**, 316.
- S. Chandra, A. I. Figueroa, Barnali Ghosh, M. H. Phan, H. Srikanth, and A. K. Raychaudhuri, *Phase coexistence and magnetic anisotropy in polycrystalline and nanocrystalline* $LaMnO_{3+\delta}$, J. Appl. Phys, 2010, **109**, 07D720.
- Shanewaz Mandal and A. K. Raychaudhuri, *Observation of a large gate- controlled persistent photoconduction in single crystal ZnO at room temperatures*, Applied Physics Letters, 2011, **98**, 023501.

SUPERVISION OF STUDENTS

Ph.D. Students: Rajesh Neogy, Shanewz Mandal, Manotosh Chakravorty, Rajib Nath, Rabeya Basori, Putul Malla Chowdhury, Sabyasachi Ghosh.

POST DOCTORAL RESEARCHERS

Dr. Kaustuv Das, Dr. Sudeshna Samanta.

LECTURES DELIVERED

- *Size Induced Tuning of Ground States in Nanostructured Oxides*, Invited talk, Materials Research Society, San Fransisco, USA, April, 2010.
- *Revisiting insulator-metal transition in correlated oxides: Ferromagnetic insulating state of manganites*, Seminar/ IFW.Dresden, Dresden, Germany, September, 2010.
- *Ferromagnetic insulating state of manganites: Is it an electron glass?*, Laboatorie CRISMAT, ENISICAEN Colloquium, Caen, France, September, 2010.
- *Revisiting insulator-metal transition in condensed matter*, IACS Discussion Meeting, Kolkata, December, 2010.
- *The never ending surprises of perovskite oxides: The hot issues of a cold area*, Current Trends in Condensed Matter Physics, NISER, Bhubaneswar, December, 2010.
- *Growth of nanowires using FIB: Agony and Ecstasy*, Ion beam induced nano-patterning of materials, IOP, Bhubaneswar, February, 2011.
- *Combining top-down and bottom-up fabrications: Experiments on single nanowires and devices*, Discussion meeting on New Materials, Central University, Hyderabad, March, 2011.

ACADEMIC VISITS

- Attended the Spring Meeting of the Materials Research Society and delivered invited talk, San Fransisco, USA, April 4 - 14, 2010.
- To perform experiments at the India Beamline, Photon Factory, KEK, Tsukuba, Japan, May 15 - 25, 2010.
- For scientific collaborative work with Professor D.E. Logan, Oxford University, UK, August 5 - 22, 2010.
- Carrying out experiment, ILL, Grenoble, France, August 30 - September 11, 2010.
- To work on the collaborative project with Prof. P.D. Prewett, Birmingham, UK, October 23 - November 1, 2010.

PARTICIPATION IN COMMITTEES

- External: Science and Engineering Council, DST; Programme Advisory Committee, International Division, DST; Chair, Project Review and Advisory Group , DIT; Nanoscience Advisory Group, Nanomission; Visitor's Nominee for Selection Committees for Faculty in IIT, Guwahati and IIT, Kharagpur.
- Internal: Governing Body; Chairman, Finance Committee; Chairman, Building Committee.

PATENTS SUBMITTED

- A stable nanosized silver colloid and its process of preparation thereof.
- A rot resistant jute comprising silver nanoparticles.

SPONSORED PROJECTS

- Unit for Nano Science & Technology Phase-II, DST.
- Centre for Nano Technology, DST.
- Development of cryostats and electronic measurement units for physical properties measurements using a zero-loss dewar, DST.
- Design and Fabrication of Nanomachined Thermal Sensors using FIB, DST.
- J. C. Bose Fellowship, DST.
- Utilization of Synchrotron Radiation Sources and Neutron Sources abroad, DST.

Barnali Ghosh (Saha)
Research Scientist

- Neutron diffraction study in complex oxide systems
- Fabrication of resistive switching devices of multifunctional perovskite oxide systems
- Transport in single nanowire of multifunctional oxide systems

Phase coexistence and magnetic anisotropy in polycrystalline and nanocrystalline $LaMnO_{3+\delta.}$: The phase coexistence and magnetic anisotropy was measured in polycrystalline (bulk) and nanocrystalline (15 nm) of perovskite magnate $LaMnO_{3+\delta}$. Radio-frequency transverse susceptibility (TS) based on a very sensitive, self-resonant tunnel diode oscillator method was used to probe magnetic anisotropy and switching fields in the samples. The results revealed a coexistence of the ferromagnetic and antiferromagnetic phases in both samples. For the bulk sample, the Anti ferromagnetic phase significantly changed in volume fraction at 30 K and completely vanishes around 120 K. Size reduction to the nanometer scale (15 nm) significantly suppressed the antiferromagnetic phase while inducing surface spin disorder in the material. Our studies showed that the magnetic properties of bulk $LaMnO_{3+\delta}$ were strongly modified by size reduction.

Functionalization of manganite nanoparticles and their interaction with biologically relevant small ligands: We report molecular functionalization of the perovskite oxide manganite nanoparticles (NPs) of $La_{0.67}Sr_{0.33}MnO_3$ (LSMO) for their solubilization in aqueous environments. One of the most useful applications of nanoparticles is to use them as vehicle for targeted drug delivery at the cellular level. The UV-VIS spectroscopic study on the functionalized NPs shows an intense peak at visible region as a consequence of electronic interaction of the citrate ligands with the surface atoms of the NPs. The size selective solubilization of the functionalized LSMO nanoparticles with sizes around 2.6 nm, in aqueous solution has also been demonstrated from High Resolution Transmission Electron Microscope. Picosecond time-resolved Förster resonance energy transfer (FRET) studies on the small ligands (like 4-Nitrophenyl anthranilate and 2-Amino purine) with the functionalized NPs, confirm the dipolar interactions of the ligands with the NPs and reveals the ligand binding sites of the NPs in the aqueous solutions.

Work done other than research activities: As a Research Scientist in Technical Cell, I am directly and actively involved in maintenance of equipments, purchase and installation of new instruments under Technical cell. I am also involved in the appointment and Job allotment of Technical staffs.

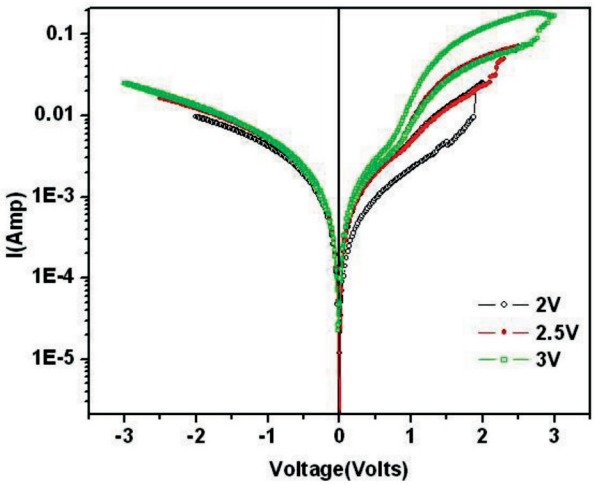


Fig: *I-IV characteristics of Ag/PCMO/Nb:STO device*

PUBLICATIONS IN JOURNALS

- S. Chandra, A. I. Figueroa, Barnali Ghosh, M. H. Phan, H. Srikanth, and A. K. Raychaudhuri, *Phase coexistence and magnetic anisotropy in polycrystalline and nanocrystalline $LaMnO_{3+\delta}$*, J. Appl. Phys, 2010, **109**, 07D720.
- Anupam Giri, Abhinandan Makhal, Barnali Ghosh, A. K. Raychaudhuri and Samir Kumar Pal, *Functionalization of Manganite Nanoparticles and their interaction with biologically relevant small ligands: Picosecond Time-Resolved FRET Studies*, Nanoscale, 2010, **2**, 2704.

ACADEMIC VISITS

- Collaborative Research Schemes (CRS) using facility under Solid state physics division, National Facility for Neutron Beam Research (NFNBR), BARC & UGC-DAE consortium for scientific research, Mumbai Centre, India, June, 2010.
- Utilization of International Synchrotron Radiation and

Neutron Scattering facilities (A project supported by the Department of science and Technology), Institut Laue-Langevin, Grenoble, France, August, 2010.

- Collaborative Research Schemes (CRS) using facility under Solid state physics division, National Facility for Neutron Beam Research (NFNBR), BARC & UGC-DAE consortium for scientific research, Mumbai Centre, India, Feb, 2011.

PARTICIPATION IN COMMITTEES

- **External:** Member of Editorial Board/ Referee - Referee of two journals: i) Journal of Material Science and Engineering B, and ii) Journal of Applied Physics.
- **Internal:** Technical cell, Various purchase committees.

SPONSORED PROJECTS

Women Scientist Scheme, DST.

Chhayabrita Biswas
Bose Fellow

- Electronic structure investigation of Ni-Mn based Heusler alloys, exhibiting martensitic transition, using photoelectron spectroscopy
- The transport, magnetotransport and magnetic properties of Ni-Mn based Heusler alloys with magnetic field induced reverse phase transition

The magnetoresistance (MR) of $Ni_2Mn_{1+x}Sn_{1-x}$ ($0.40 \leq x \leq 0.52$) is studied as functions of temperature and magnetic field in austenitic and martensitic phase. The maximum MR obtained is -36% (x = 0.4) at 170 K with 7 T magnetic field during martensitic transition. This MR is a combined effect of mainly magnetic field induced reverse phase transition and disorder related residual resistivity. The MR in the martensitic phase (MP) (maximum -2.2%) is less than that in austenitic phase (maximum -4.6%). The origin of less MR below and above martensitic transition is also understood through the experimental data fitting with magnetic field dependence (H^n) of MR. The variation of n suggests that in Austenitic phase s – d scattering is responsible for negative MR. In MP the negative MR is due to rotation of magnetization within inhomogeneous FM-AFM mixed magnetic phase. The scattering from impurity d-band localized states give rise to negative MR at 5 K in MP.

PUBLICATIONS IN JOURNALS

- A. G. Rybkin, A. M. Shikin, V. K. Adamchuk, D. Marchenko, C. Biswas, A. Varykhalov and O. Rader, *Large spin-orbit splitting in light quantum films: Al/W(110)*, Phys. Rev. B, 2010, **82**, 233403.

SUPERVISION OF STUDENTS

Ph.D. Students: Sandeep Singh, Soumyadipta Pal;
Project Student: Post B.Sc.: Ashutosh Singh.

LECTURES DELIVERED

- *Electronic structure of $Ni_{2+x}Mn_{1-x}Ga$ and $Ni_2Mn_{1+x}Sn_{1-x}$ Heusler alloys exhibiting martensitic transition*, Helmholtz Zentrum Berlin, Germany, May 18, 2010.
- *Electronic structure modification in $Ni_{50}Mn_{35}Sn_{15}$ as a function of temperature*, IVC-18/ ICN+T 2010/ ICSS-14/ VASSCAA-5, Beijing, China, August 23 – 27, 2010.
- *Quasi-Freestanding Graphene by Au intercalation: Dirac cone and Rashba splitting, Discussion meeting on Graphene*, IACS, Kolkata, India, November 1, 2010.

ACADEMIC VISITS

- Neutron facility user, Helmholtz Zentrum Berlin, Germany, May 2010.
- High resolution photoelectron spectroscopy, Tata Institute of Fundamental Research, Mumbai, India, January 2011.

PARTICIPATION IN COMMITTEES

Internal: Technical Cell, S.N. Bose Newsletter, Rajbhasha, Various Thesis and Interview Committees.

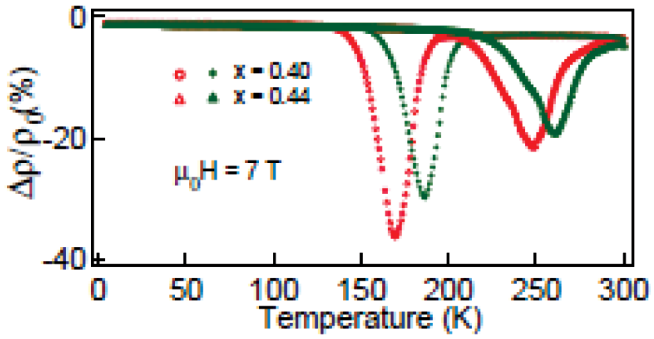


Fig 1: *Magnetoresistance (MR) as a function of temperature at 7 Tesla for x = 0.40 and 0.44 during cooling (open symbol) and heating (filled symbol).*

Kalyan Mandal
Associate Professor

- Dilute magnetic semiconductors
- Multiferroic materials
- Magnetic nanostructures
- Magnetocaloric effect

The origin of magnetism in transition metal doped oxide semiconductors is the most debating issue during the last decade. To throw some light on this problem we have prepared Co doped SnO_2 and ZnO dilute magnetic semiconductors in both nano and bulk state by solvothermal and mechanosyhtesis route, respectively. Interestingly, we observed that paramagnetism is the intrinsic magnetic property in single-phase Sn_{1-x} Co_xO_2 ($x \leq 0.08$) whereas non-DMS related ferromagnetism is associated only with the corresponding nanostructures. $Zn_{1-x}Co_xO$ also showed the similar properties.

We have successfully prepared Fe_3O_4 hollow spheres (SEM micrograph shown) with diameter 100 – 250nm by solvothermal method and studied their structural and magnetic properties. We have also investigated permalloy ($Ni_{80}Fe_{20}$) nanowires prepared in our laboratory by electrodeposition technique. Ba-doped Bismuth ferrite thin films have been prepared by pulsed laser deposition method.

PUBLICATIONS IN JOURNALS

- S. Ghosh and K. Mandal, Study of $Zn_{1-x}Co_xO$ ($0.02 \leq x \leq 0.08$) *dilute magnetic semiconductor prepared by mechanosynthesis route*, Journal of Magnetism and Magnetic Materials, 2010, 322, 1979.
- D. Pal and K. Mandal, *Magnetic and Magneto-Transport Properties of Nickel-Rich Ni-Mn-Ga Heusler Alloys*, Japanese Journal of Applied Physics, 2010, **49**, 073002.
- D. Pal, K. Mandal and O. Gutfleisch, *Large negative magnetoresistance in nickel-rich Ni-Mn-Ga Heusler alloys, Journal of Applied Physics*, 2010, **107**, 09B103.
- S. Ghosh, D. De Munshi and K. Mandal, *Paramagnetism in single-phase $Sn_{1-x}Co_xO_2$ dilute magnetic semiconductors*, Journal of Applied Physics, 2010, **107**, 123919.
- D. Pal and K. Mandal, *Magnetoresistance and magnetocaloric effect of Ni-Fe-Ga alloys*, Journal of Physics D: Applied Physics, 2010, **43**, 455002.
- D. Pal, M. Mandal, A. Chaudhuri, B. Das, D. Sarkar and K. Mandal, *Micelles induced high coercivity in single domain cobalt-ferrite nanoparticles*, Journal of Applied Physics, 2010, **108**, 124317.

OTHER PUBLICATIONS

- A. Chaudhuri and K. Mandal, *Synthesis and study of nanostructured Lanthanum doped Bismuth Ferrite*, Proceedings of Seventh International Conference on Inorganic Materials, Biarritz, France, September 12 - 14, 2010.
- B. Das and K. Mandal, *Magnetization study of ferromagnetic thin films and isolated nanowires*, Proceedings of International Conference on Magnetic Materials, Saha Institute of Nuclear Physics, October 17 – 19, 2010.

SUPERVISION OF STUDENTS

Ph.D. Students: Ph.D. degree awarded: Suman Sinha (October 2010 from Jadavpur University), Presently working: Bipul Das, Arka Chaudhuri, Shyamsundar Ghosh, Debasish Sarkar, Rajasree Das; **Project Students:** Srimoy Chakraborty, Debasish De Munsi, Ashutosh Kumar Singh.

POST DOCTORAL RESEARCHERS

Dr. Gobinda Gopal Khan, Dr. Madhuri Mandal.

LECTURES DELIVERED

- *Magnetic properties of nanostructured iron oxides*, 4th India-Singapore Joint Physics Symposium, National University of Singapore, Singapore, February 25, 2011.
- *Synthesis and study of nanostructured iron oxides suitable for biomedical applications*, International Conference and Humboldt Kolleg on Interface between Chemistry and biology: A perspective, Indian Institute of Chemical Technology, Hyderabad, September 23, 2010.
- *Activities on magnetism and magnetic materials*, Departmental Review Committee meeting, Satyendra Nath Bose National Centre for Basic Sciences, September 16, 2010.

ACADEMIC VISITS

- DST-UKIERI programme, Durham University, Durham, UK, March 14 – 29, 2011.
- Royal Institute of Great Britain, London, UK, March 29 - 31, 2011.

COURSES TAUGHT

- PHY-413, Magnetism and Superconductivity, 4th (spring) semester 2010, 4th (spring) semester 2011.
- PHY-601, Advanced Condensed Matter Physics – II, 2nd (Spring) semester 2010, 2nd (spring) semester 2011.
- PHY-291, Basic Laboratory, 2nd (spring) semester 2010, 2nd (spring) semester, 2011.

PARTICIPATION IN COMMITTEES

- **External:** Member, Council of Indian Physical Society; Member of Board of Judges for Young Physicists' Colloquium-2010 of Indian Physical Society.
- **Internal:** Admission Committee, Students' Curriculum and Research Evaluation Committee, Transport Committee, PBIR course review committee.

AWARDS / RECOGNITIONS

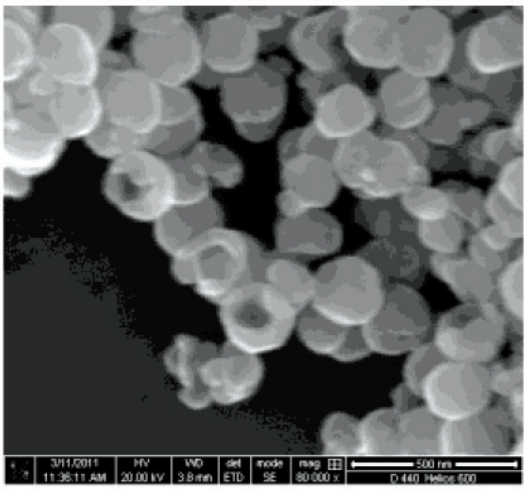
Silver Jubilee Special Grant for long standing association with Satyendra Nath Bose National Centre for Basic Sciences in its Silver Jubilee celebration year 2010-2011.

SPONSORED PROJECTS

- Development of a vibrating sample magnetometer using a superconducting magnet, Department of Science and Technology.
- Study of ferrite nanoparticles, Department of Science and Technology.
- Contacting 3D electrodeposited nanowires: new opportunities for spintronics technology, DST-UKIERI Research Award–2008.
- Preparation and study of magnetic nanowires, Board of Research in Nuclear Sciences.
- Preparation and study of nanostructured dilute magnetic semiconductors, Council of Scientific and Industrial Research.

MEETINGS ORGANIZED

National Conference on Magnetic Materials & Applications (MagMA 2011), Satyendra Nath Bose National Centre for Basic Sciences, January 24-25, 2011.



Madhuri Mandal
Visiting Faculty Fellow

- Synthesis of several nanoparticles by DNA, micelles organic polymer etc. templated way and their necessary surface functionalization for biomedical application

We have received an interesting result that is micelles induced high coercivity in Co-Ferrite magnetic nanoparticles. Here micelles form a cage like structure and surface spins movements are restricted and surface anisotropy is enhanced due to which Co-ferrite nanoparticles of ~17 nm shows high coercivity simply at room temperature.

PUBLICATIONS IN JOURNALS

- Debasish Sarkar, Kalyan Mandal, Madhuri Mandal, *Synthesis of chainlike α-Fe_2O_3 nanoparticles in DNA template and their characterization*, Nanoscience and nanotechnology letters, 2011, **3**, 1 - 5.
- S. Ghosh, M. Mandal, K. Mandal, *Effects of Fe doping and Fe–N co-doping on magnetic properties of SnO_2 prepared by chemical co-precipitation*, Journal of Magnetism and Magnetic Materials, 2011, **323**, 1083 – 1087.
- M. Mandal, D. Pal, A. Chaudhuri, B. Das, D. Sarkar, K. Mandal, *Micelles induced high coercivity in single domain cobalt-ferrite nanoparticles*, J. Appl. Phys., 2010, **108**, 124317.
- A. Chaudhuri, S. Mitra, M. Mandal, K. Mandal, *Nanostructured bismuth ferrites synthesized by solvothermal process*, Journal of Alloys and Compounds, 2010, **491**, 703 - 706.

OTHER PUBLICATIONS

- M. Mandal, Synthesis of Snow-ball Flower like Superparamagnetic Ni Nanoparticles directed by Negatively Charged Micelles, Cond. Mat. Days, 2010.
- M. Mandal, Self assembly ….. cell identification, 12TH INTERNATIONAL CONF. OF IAPS. CONIAPS XII, Jaipur.
- D. Sarkar, M. Mandal, K. Mandal, Fabrication and characterization of DNA templated electrically conducting chain like magnetic nanoparticles, ICMAT, Singapore, 2011.

SUPERVISION OF STUDENTS

Ph.D. Students: Debasish Sarkar.

LECTURES DELIVERED

- Synthesis of Snow-ball Flower like Superparamagnetic Ni Nanoparticles directed by Negatively Charged Micelles, Kalyani University, Cond. Mat. Days-2010.
- Self assembly ….. cell identification, 12TH INTERNATIONAL CONF. OF IAPS. CONIAPS XII 2010, Rajasthan University, Jaipur.

PARTICIPATION IN COMMITTEES

External: MSI (Magnetic Society of India), ANS (American Nano Society).

Internal: Technical Cell of S.N.B.N.C.B.S.

SPONSORED PROJECTS

Synthesis of DNA and micelles templated magnetic nanoparticles and their necessary surface functionalization for biomedical application, DST.

Pratip Kumar Mukhopadhyay

Associate Professor

The thrust in this year is again on Ferromagnetic Shape Memory Alloys. While we tried to develop the thin films of these materials more, we also are working on polymer composites and magneto-rheological aspects of these materials. In addition, we are also measuring the magnetic field induced strain in them.

The main area of work this year was on various areas of ferromagnetic shape memory alloys. We were interested in developing thin films and metallic glasses of these materials. A new setup was made with summer and winter project students on the centre's first pulsed magnetic field magnetometer. We are also trying to develop polymer composites of these materials, so as to introduce flexibility in them. In the same line, we are studying magneto-rheological properties of fine particles of these materials. With the help of the theoretician who joined recently, we are working on trying to understand our own data on magneto-elastic properties of some of these materials. Relaxation of underlying structures through magnetic properties was also attempted. Finally, our main work revolved round measuring MFIS in them. We had some success with this. Some more experiments of Magneto Optical couplings were also performed.

There is some interest to theoretically understand a few peculiar magnetic alloys. We are working with a theoretical group to solve problems on some of these alloys.

We also worked partly on fabrication of ZnO nano structures as an extension to our earlier work on MoO_3 and WO_3, and tried to develop transparent and conducting Mo:ZnO films. A recent side interest is to work on impregnation of mesoporous fly ash with conducting polymers.

OTHER PUBLICATIONS

- B. Rajini Kanth, N. V.Ramarao and P. K. Mukhopadhyay, *Physical and Magnetic Properties of Boron doped NiMnGa thin films*, International Conference on Magnetic Materials(ICMM 2010), October 25 - 29, 2010.
- Sandeep Agarwal, B. Rajini Kanth and P. K. Mukhopadhyay, *Frequency dependent Susceptibility study of as prepared CoNiAl Ferromagnetic Shape memory alloy*, International Conference on Magnetic Materials (ICMM 2010), October 25 - 29, 2010.
- B. Rajini Kanth, N. V.Ramarao and P. K. Mukhopadhyay, *Fabrication and Characterization of R.F. Magnetron Sputtered NiMnGa thin films, National Conference on Magnetic Materials & Applications (MagMA 2011)*, January 24 – 25, 2011.
- S. Kalpana, B. Rajini Kanth and P. K. Mukhopadhyay, *Synthesis, Characterization and study of Magnetic properties of Co-Ni nanostructured alloy thin films*, National Conference on Magnetic Materials & Applications (MagMA 2011), January 24 – 25, 2011.
- S. K. Bandyopadhyay, N. Surajkumar Singh, A. K. Himanshu, Keka R. Chakraborty, D. Das, P. K. Mukhopadhyay and Nagendra Mondal, *Magnetic Studies of Co-doped ZnO Nanoparticles*, DAE Solid State Physics Symposium, December 26 - 30, 2010.
- A. Sarkar, S. Viswakarma and P. K. Mukhopadhyay, *Deposition of polyaniline on mesoporous material prepared from fly ash,* NanoMat 2011, February 10 - 11, 2011.
- P. K. Mukhopadhyay, Madhuparna Karmakar, Rajini Kanth B. and S.N. Kaul, *Experimental and theoretical investigations into the twinning energy of an FSMA system*, APS March meeting, March 21 – 25, 2011.
- Prince Raj Anand and P. K. Mukhopadhyay, *Design and Development of High Field Pulsed Magnetometer*, National Conference on Magnetic Materials & Applications (MagMA 2011), S. N. Bose National Centre for Basic Sciences, Kolkata, India, January 24 – 25, 2011.
- Tanmoy Ghosh, Abhijit Mookerjee and P. K. Mukhopadhyay, *Electronic Structure and Magnetic Properties of Disordered* $Fe_{1-x}Al_x$ *Alloy*, National Conference on Magnetic Materials & Applications (MagMA 2011), S. N. Bose National Centre for Basic Sciences, Kolkata, India, January 24 – 25, 2011.

SUPERVISION OF STUDENTS

Ph.D. Students: Sandeep Agarwal, Sudipta Bera, Nandan Das, Tanmay Ghosh, Md. Injamamul Arief, Arun Laxmanan (project

trainee); **Project Students:** PBIR: Anand Gupta, Arghya Das, Biplab Bhattacharya; Summer project: Somrita Dutta, Soma Ray, Partha Sarathi Dey, Arpan Das, N. Poongodi; Winter project: Prince Raj Anand; M.Sc. external project: S. Kalpana.

POST DOCTORAL RESEARCHERS

Dr. B. Rajini Kanth, Dr. M. Karmakar, Dr. V. Raja (EVLP), Dr. K. Srinivasa Rao (EVLP).

LECTURES DELIVERED

- Mechanical properties of FSMA systems, SNBNCBS, April 1, 2010
- Ferromagnetic Shape Memory related activities in the LCMP, DMRL, May 14, 2010.
- FSMA materials - a new class of smart materials, NIT, Rourkella, August 4, 2010.

ACADEMIC VISITS

Visited the Physics department of NUS, Singapore, August 11 - 16, 2010. It was supported by SNBNCBS, IRI Singapore and Dept. of Physics, NUS, in connection with a collaboration.

COURSES TAUGHT

- Phy 191, Basic Laboratory 1, 1st semester.
- Phy 501, Research Methodology, Fall semester.
- Phy 391, Methods of experimental Physics, 3rd semester.

PARTICIPATION IN COMMITTEES

- **External:** Convenor, organizing committee of National conference on Magnetic Materials and applications (MagMA2011); Member of international advisory board, 3rd. International Conference on Ferromagnetic Shape Memory Alloys, to be held in Germany in 2011 (I started this international conference series and named it ICFSMA. The international series is now called as such); Member of international advisory board, Symposium B, Conferences Internationales Materiaux et Technologies (CIMTEC), to be held in Italy, in 2012; Council member, IPS; Reviewer – several Indian and foreign physics journals, like Pramana, Indian Journal of Physics, European Physics Journal, Journal of Physics (condensed matter), new Journal of Physics etc.; Thesis (M.Sc. and Ph.D.) examiner for students from NML, IACS & SINP.
- **Internal:** Convenor, Project cell; Convenor, Technical Committee; Member, SCRE committee (ex officio); Member, library committee (ex officio); Member of many thesis committees (ex officio); Incharge, mechanical workshop; Incharge, Glass blowing section; Indenter, liquid helium plant; Indenter, Rigaku XRD machine.

MEETINGS ORGANIZED

- Convenor, Organizing Committee of Magnetic Materials (MagMA 2011).
- Member of international advisory board, 3rd. ICFSMA, to be held in Germany, 2011
- Member of international advisory board, Symposium B, CIMTEC, to be held in Italy, 2012.

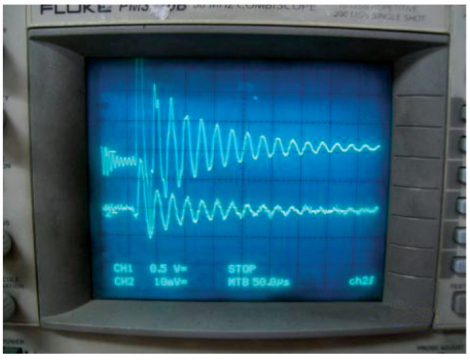


Fig.1: *Pulsed Magnetic Field testing, top trace – search coil output, bottom trace, discharge current in the main coil.*

Priya Mahadevan
Associate Professor

- Models for magnetism in ruthenates, orbital ordering in KO_2
- Absence of ripples in biaxially strained graphene
- Bulk modulus variation in semiconductor nanocrystals

We have examined orbital ordering in a p-band oxide, KO_2. Jahn Teller physics is found that results in orbital ordering. The model describing the orbital ordering is different from the Kugel-Khomskii model that has been used in the case of the 3d transition metal compounds. This orbital ordering transition precludes any possibility of high magnetic ordering temperatures in these systems.

The bulk modulus of semiconductor nanocrystals have been examined as a function of a size. The same empirical form is found to be valid across systems. This also gets the bulk value of the modulus correctly within 8% of its independently calculated value.

A single monolayer of graphene grown on a substrate was found to be ultraflat. The origin of this was found to be the biaxial strain experienced on a surface.

The role of $GdFeO_3$ distortions in modifying the magnetic interaction strengths was clarified for the first time in the context of t_{2g} orbital systems.

PUBLICATIONS IN JOURNALS

- R. Cherian, C. Gerard, Priya Mahadevan, N. T. Cuong and R. Maezono, *Size dependence of the bulk modulus of semiconductor nanocrystals from first-principles calculations*, Phys. Rev. B, 2010, **82**, 235321.
- S. Middey, P. Mahadevan and D. D. Sarma, *Dependence of magnetism on the $GdFeO_3$ distortion in the t_{2g} system $ARuO_3$ (A=Sr, Ca)*, Phys. Rev. B, 2011, **83**, 014416.
- Bipul Rakshit and Priya Mahadevan, *Absence of rippling in graphene under biaxial tensile strain*, Phys. Rev. B, 2010, **82**, 153407.
- A. Nag, R. Cherian, Priya Mahadevan, Achanta Venu Gopal, A. Hazarika, A. Mohan, A. S. Vengurlekar and D. D. Sarma, *Size-Dependent Tuning of Mn^{2+} d-Emission in Mn^{2+}-doped CdS Nanocrystals: Bulk vs. Surface*, Journal Physical Chemistry C, 2010, **114**, 18323.
- A. K. Nandy, Priya Mahadevan, P. Sen and D. D. Sarma, *KO_2: Realization of orbital ordering in a p-orbital system*, Phys. Rev. Lett., 2010, **105**, 056403.

SUPERVISION OF STUDENTS

Ph.D. Students: Ashis Kumar Nandy, Abhinav Kumar, Kapil Gupta, Hirak Kumar Chandra, Saikat Debnath, Ruma Das.

POST DOCTORAL RESEARCHERS

Dr. Bipul Rakshit.

LECTURES DELIVERED

- Invited talk at Discussion meeting on *Fronteirs in electronic structure calculations*, ARCHEM, University of Hyderabad, January, 2011.
- Invited talk at *Current Trends in Condensed Matter Physics 2010*, NISER, Bhubhaneshwar, December, 2010.
- Talk at One day discussion meeting on *graphene*, Indian Association for the Cultivation of Sciences, Kolkata, November, 2010.
- Contributed talk at the International conference on magnetic materials (ICMM 2010), Kolkata, October, 2010.
- Talk at Institute of Solid State Research, Forschungszentrum, Juelich, Germany, September, 2010.
- Invited talk at International Conference on Physics of Novel Oxide Materials, Pohang, Korea, July, 2010.
- Invited talk at TWOWS (Third World Organization for Women in Science), Fourth General Assembly and International Conference in Beijing, China, June, 2010.
- Invited talk at Villa Conference on *Complex Oxide Heterostructures*, Santorini, Greece, June, 2010.
- Talk at Nanosystem Research Institute, Tsukuba, Japan, April, 2010.
- Talk at Department of Physics, University of Tokyo, Tokyo, Japan, April, 2010.

- Talk at Department of Physics, National Taiwan University, Taiwan, April, 2010.

ACADEMIC VISITS

- DST Indo-Taiwan project, National Taiwan University, Taipei, March – April, 2010.
- Collaborative visit, AIST, Tsukuba, April, 2010.
- Collaborative visit, IFF, Juelich, September, 2010.
- DST Indo-EU project, Brussels, January, 2011.
- DST Indo-EU project, University of Vienna, March, 2011.
- Collaborative visit, JNCASR, Bangalore, February, 2011.

PARTICIPATION IN COMMITTEES

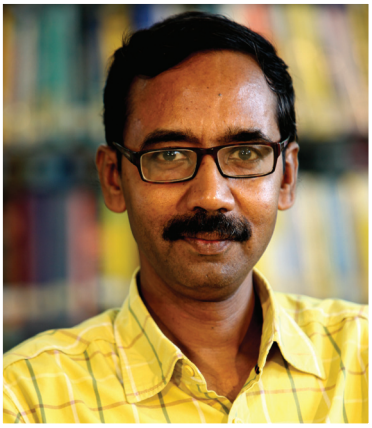
- **External:** Thesis committees of several students in IACS, Kolkata.
- **Internal:** In-charge computer centre, hostel warden (till March 2011), canteen committee, SAC, various other committees as computer-centre incharge, various thesis committees of students of the centre.

AWARDS / RECOGNITIONS

- TWOWS Prize for young woman scientist in Physics/ Mathematics in Asia region for 2010.
- NASI-SCOPUS young scientist award in Physics for 2010.
- Executive Board member, MRSI Kolkata chapter.
- Council member, MRSI.
- Editorial board member, Chinese Journal of Physics.

SPONSORED PROJECTS

- Charge and orbital ordering, DST.
- Advanced Material Research Unit, DST.
- Indo-EU project (ATHENA), DST.
- Indo-Taiwan project, DST



Ranjan Chaudhury
Associate Professor

Investigations of topological excitations in quantum spin models on low-dimensional lattices have been continued in collaboration with Dr. S.K. Paul (SNBNCBS) and Shubhojit Sarkar (our Ph.D. Student at SNBNCBS). The analysis of occurrence of Kohn Anomaly in the superconducting phase of Pb has been initiated with the help of the BCS theory and the Debye model, in collaboration with Professor M.P. Das (ANU, Canberra). A microscopic framework has been formulated to investigate superconducting pairing in a system with covalency and ionicity effects in the presence of weak or strong correlations as well as charge and spin fluctuations, partly in collaboration with Soumi Roychowdhury (my Ph.D. Student at SNBNCBS).

The occurrence of Kohn Anomaly in the superconducting phase of Pb has been satisfactorily resolved theoretically. Making use of the coupling between the phonons and the Bogoliubov quasi-particles (quasi-holes), the phonon self energies have been calculated. The phonons have been modelled by the Debye model and the superconducting quasi-particles have been constructed from s-wave pairing mediated by the phonons. The dressed phonon dispersion function is found to exhibit a sharp deviation from the usual behaviour at $\hbar\omega = 2\Delta$, where ω is the phonon frequency and Δ is the superconducting gap. The linewidth of the phonon spectral function is under investigation.

The importance of quantum corrections to the classical topological excitations in spin models on low-dimensional lattices have been brought out. Some quantitative estimates have been made by comparing Bishop et al's analytical and Monte-Carlo-molecular dynamics based calculational results and the inelastic neutron scattering results of Hirakawa et al obtained for K_2CuO_4, after convoluting both of them with the appropriate spectral window function.

For strongly correlated conducting systems, the effective interaction relevant for superconducting pairing has been expressed in terms of the charge and the spin stiffness constants and a correspondence with the Landau parameters have been suggested. A theoretical model has been proposed to investigate superconducting pairing in a system with both covalency and ionicity effects.

PUBLICATIONS IN JOURNALS

- Ranjan Chaudhury and Samir K. Paul, *Physical realization of topological excitations in quantum Heisenberg ferromagnet on lattice*, Eur. Phys. J. B, 2010, **76**, 391.
- Ranjan Chaudhury and M. P. Das, *Kohn Anomaly Energy In Conventional Superconductors Equals Twice the Energy of the Superconducting Gap: How and Why?*, Int. J. Mod. Phys. B, 2010, **24**, 5172.

OTHER PUBLICATIONS

M. P. Das and R. Chaudhury, Kohn Anomaly in conventional superconductors: A Surprise, Proceedings of 34th Annual Condensed Matter & Materials Meeting, Auckland, New Zealand, 2010, 26.

SUPERVISION OF STUDENTS

Ph. D. Students: Soumi Roychowdhury, Subhojit Sarkar.

LECTURES DELIVERED

- *Mechanism for superconducting pairing in layered systems*, International Conference on Superconductivity And Magnetism (ICSM 2010), Antalya, Turkey, April, 2010.
- *Some studies on mechanisms for superconductivity and magnetic excitations in strongly correlated Copper Oxides*, SNBS-BARC joint meeting at SNBNCBS, Kolkata, April, 2010.

COURSES TAUGHT

- PHY 413, MAGNETISM & SUPERCONDUCTIVITY, 4th semester
- PHY 601, ADVANCED CONDENSED MATTER PHYSICS (PART B), 2nd semester. These courses were taught at SNBNCBS both during 2010 - 11 as well as during 2009 – 10.
- STATISTICAL PHYSICS II, 2nd semester. This course was taught at AUST (Abuja) under NMI (Washington DC, USA) for the M.Sc. Students in Theoretical Physics department during November 2010 (I was a Visiting Professor at AUST (Abuja) under NMI (Washington DC, USA) during November 1, 2010 – December 1, 2010).

PARTICIPATION IN COMMITTEES

Internal: Visitors' Programme Coordinator, EVLP; Chairman, Housing Allotment Committee; Chairman, Security Monitoring Committee; Member, Medical Committee; Member, PF Trustee Board; Chairman, Internal renovation Committee.

AWARDS / RECOGNITIONS

- Biography selected and published in the 28th Edition of "Marquis Who's Who In The World" , New Jersey, USA, 2011.
- Became a Member of American Chemical Society since 2010.

MEETINGS ORGANIZED

Member of the Organizing Committee for the National Conference "MaGMa 2011" held at Satyendra Nath Bose National Centre for Basic Sciences during January 2011.

Saswati Barman
Visiting Faculty Fellow

- Static and Dynamic properties of nanomagnets: Micromagnetic Simulation of dynamics of dipolar coupled vortices, Hysteresis loop of magnetic multilayer with high perpendicular magnetic anisotropy
- Monte Carlo Simulation of Ising and Heisenberg spin system: Monte Carlo simulation of magnetic thin film element and magnetic nanoparticles
- Thermal properties of Semiconductors: Theoretical study of very high thermal Conductivity of pure Boron Nitride

One dimensional chain of magnetic vortices has been studied under local and global excitation. In case of local excitation at one end of the chain, transmission of peak amplitude of gyrotropic excitation modes along the chain has been actively controlled by manipulating the geometry and condition of preparation magnetic ground states of the chains. The transmission is maximum for direct magnetostatic coupling and identical chirality with geometric asymmetry. The dynamics of the disks are partly due to the intrinsic dynamics and partly due to the energy transfer from the excited disk to subsequent disks.

Maximum thermal conductivity of pure Boron Nitride is very high (~105 W/m^3) and it is comparable to thermal conductivity of Carbon Nanotube. Thermal conductivity of pure Boron Nitride is two orders of magnitude higher than that of Boron Nitride with 50 % B^{10}. We find that very high contribution (~95 %) of usually neglected N-drift scattering is the reason for such an increase in thermal conductivity of pure Boron Nitride. Purest form of Boron Nitride can be used for thermal management in semiconductor devices.

PUBLICATIONS IN JOURNALS

- S. Barman, A. Barman and Y. Otani, *Dynamics of 1-D Chains of Magnetic Vortices in Response to Local and Global Excitations*, IEEE transactions on Magnetics, 2010, **46**, 1342.
- A. Barman, S. Barman, T. Kimura, Y. Fukuma and Y. Otani, *Gyration Mode Splitting in magnetostatically coupled magnetic vortices in an array*, J Phys. D: Applied Phys 2010, **43**, 422001.

SUPERVISION OF STUDENTS

Ph.D. Students: Soumi Roychowdhury, Subhojit Sarkar.

ACADEMIC VISITS

Visiting Scientist, Quantum Nanoscale Magnetics Laboratory, RIKEN, Wako-Shi, Japan, September – November, 2010.

AWARDS / RECOGNITIONS

WOS-A (DST).

SPONSORED PROJECTS

Investigation of static and dynamic magnetic properties of nanomagnetic systems, DST (Fast Track).

Sugata Mukherjee
Associate Professor

- Electronic structure of Nanostructured Materials
- Computational Condensed Matter Physics
- Electronic properties of Graphene and related Nanomaterials

First principles electronic structure calculations of electronic properties of Carbon and Boron Nitride based nanomaterials. Ab-initio plane wave pseudopotential method was used to investigate graoundstate electronic properties, e.g. cohesive energy, lattice constants, bulk modulus, band structure of Graphite, Graphene, hexagonal Boron Nitride (h-BN), doped Graphene and multilayers of Graphene and h-BN. The calculated groundstate properties of Graphite, Graphene and h-BN agree quite well with experimental results. Calculations on Graphene doped by Boron (B) and Nitrogen (N) and co-doped by both B and N were performed in detail. Upon B (N) doping the Dirac point in bandstructure tend to shift upward (downwards) from the fermi energy. It was found that upon co-doping by B and N, Graphene exhibits semiconducting behaviour with a small band gap. These results are in agreement with recent experimental measurements. Calculations on multilayers of Graphene and h-BN indicate that these novel multilayered nanomaterials are narrow band gap semiconductor.

OTHER PUBLICATIONS

Contribution in *Assessment report on nanomaterials research needs in the EU and India*, Euro-Indo forum of nanomaterials research for sustainable energy, 2011.

SUPERVISION OF STUDENTS

Ph.D. Students: Thaneswaor P Kaloni (till January, 2011), Sandeep Chakrabarty (INSPIRE fellow, joined in Feb 2011); **Project Student:** Pritam Khan (M.Sc. Student of Calcutta University, wrote a summer-project on Bimetallic nanoalloys, July, 2010).

LECTURES DELIVERED

- *Calculation of electronic properties of carbon and boron nitride based nanomaterials*, talk given at Graphene Meeting, IACS, Kolkata, November 1, 2010.
- *Electronic structure and properties of Graphene doped by Boron and Nitrogen*, talk given at Nanotech India 2010, Cochin, November 19 – 21, 2010.
- *Electronic properties of carbon and boron nitride based nanomaterials*, talk given at International Conference on Carbon Nanotechnology, IIT Kanpur, December 15 – 17, 2010.
- *Electronic properties of carbon and boron nitride based nanomaterials*, talk given at JNCASR, Bangalore, March, 2011.

ACADEMIC VISITS

Visited JNCASR, Bangalore, March, 2011.

PARTICIPATION IN COMMITTEES

Internal: TPSC Convener; Governing Body; Finance Committee; Building committee; PF-Trustee Board and numerous other internal committees as Acting Registrar.

SPONSORED PROJECTS

EU-India EICOON project on nanomaterials research for sustainable energy (co-PI), University of Twente.

MEETINGS ORGANIZED

TPSC Conveners meeting in March, 2011.

Tanusri Saha-Dasgupta
Professor

- Electronic Structure and orbital ordering in spinels having both A-site and B-site orbitally active
- Electronic Structure of ruthenates
- Low-dimensional quantum spin systems
- Large and controllable piezoelectric response of ultrathin superlattices
- Metallic nanoclusters
- Study of ordering and site preference in minerals

The correlated electron systems of transition metal (TM) oxides has been a source of constant attention to researchers. A pertinent question in this context has been how the electron-electron correlation behaves as one moves down the periodic table from 3d to 4d to 5dTM oxides. In this context, we carried out local density approximation coupled with dynamical mean field theory (LDA+DMFT) study of 4d TM-based perovskite ruthenates, $SrRuO_3$ and $CaRuO_3$, compounds which have been discussed in great detail in recent literature. Our calculations could reproduce the observed mass enhancements, the magnetic properties and were found to be in reasonable agreement with the measured photoemission spectra. Our calculations produced rather different coherence temperatures between $SrRuO_3$ and $CaRuO_3$, providing a possible explanation for the observed differences between $SrRuO_3$ and $CaRuO_3$. We also present k-resolved spectra for the sake of comparison with future angle-resolved photoemission experiments (see figure below).

PUBLICATIONS IN JOURNALS

- Sudipta Kanungo and T. Saha-Dasgupta, *Pressure-driven changes in electronic structure of $BiCoO_3$*, Phys. Rev. B, 2011, **83**, 104418.
- Hena Das, Prabuddha Sanyal, T. Saha-Dasgupta, and D. D. *Sarma, Origin of magnetism and trend in Tc in Cr-based double perovskites: Interplay of two driving mechanisms*, Phys. Rev. B, 2011, **83**, 104418.
- E. Jakobi, S. Kanungo, S. Sarkar, S. Schmitt, and T. Saha-Dasgupta, *LDA+DMFT study of Ru-based perovskite $SrRuO_3$ and $CaRuO_3$* [Phys. Rev. B 83, 041103(R) (2011)], Phys. Rev. B, 2011, **83**, 079902.
- Hena Das, U. Waghmare and T. Saha-Dasgupta, *Piezoelectric by Design: A route through short-period perovskite superlattices*, J. Appl. Phys., 2011, **109**, 066107.
- E. Jakobi, S. Kanungo, S. Sarkar, S. Schmitt, and T. Saha-Dasgupta, *LDA+DMFT study of Ru-based perovskite $SrRuO_3$ and $CaRuO_3$*, Phys. Rev. B (Rapid Commun), 2011, **83**, 041103.
- Soumendu Datta, Mukul Kabir, Abhijit Mookerjee, and Tanusri Saha-Dasgupta, *Engineering the magnetic properties of the Mn_{13} cluster by doping*, Phys. Rev. B, 2011, **83**, 075425.
- Swastika Chatterjee, Sirshendu Bhattacharyya, Surajit Sengupta and T. Saha-Dasgupta, *Crossover of cation partitioning in olivines: a combination of ab initio and Monte Carlo study*, Phys. Chem. Minerals, 2011, **38**, 259.
- S. Lupi, L. Baldassarre, B. Mansart, A. Perucchi, A. Barinov, P. Dudin, E. Papalazarou, F. Rodolakis, J. Rueff, J . Itie, S. Ravy, D. Nicoletti, P. Postorino, P. Hansmann, N. Parragh, A. Toschi, T. Saha-Dasgupta, O. K. Andersen, G. Sangiovanni, K. Held and K. M. Marsi, A *microscopic view on the Mott transition in chromium-doped V_2O_3*, Nature Comm, 2010, **1**, 105.
- Soumyajit Sarkar, Sudipta Kanungo, and T. Saha-Dasgupta, *Ab initio study of low-dimensional quantum spin systems Sr_3NiPtO_6, Sr_3CuPtO_6, and Sr_3NilrO_6*, Phys. Rev. B, 2010, **82**, 235122.
- Debdutta Lahiri, T. Shibata, S. Chattopadhyay, Sudipta Kanungo, T. Saha-Dasgupta, R. S. Singh, Surinder M. Sharma, and Kalobaran Maiti, *Evidence of active role played by the nonmagnetic element Sr in magnetostructural coupling in $SrRuO_3$*, Phys. Rev. B, 2010, **82**, 094440.
- S. Sarkar, T. Maitra, Roser Valentí, and T. Saha-Dasgupta, *Comparative study of $FeCr_2S_4$ and $FeSc_2S_4$: Spinels with orbitally active A site*, Phys. Rev. B (Rapid Comm), 2010, **82**, 041105.
- R. T. Clay, H. Li, S. Sarkar, S. Mazumdar, and T. Saha-Dasgupta, *Cooperative orbital ordering and Peierls instability in the checkerboard lattice with doubly degenerate orbitals*, Phys. Rev. B, 2010, **82**, 035108.

SUPERVISION OF STUDENTS

Ph.D. Students: Hena Das (PhD submitted in February 2011), Soumyajit Sarkar, Swastika Chatterjee, Sudipta Kanungo, Santu Baidya, Swarnakamal Mukherjee.

POST DOCTORAL RESEARCHERS

Soumendu Datta, Jaita Paul (Banerjee).

LECTURES DELIVERED

- *Fascinating World of Double perovskites*, Technische Universität Darmstadt, June, 2010.
- *Spinels: Interplay of charge, orbital and spin*, Uppsala University, June, 2010.
- *Electronic structure of V_2O_3*, ICMR, Santa Barbara, August, 2010.
- *Correlated Electron Systems*, CNR-SPIN L'Aquila, Italy, September, 2010.
- *Electronic Structure of Spinels*, JNCASR Conference on Chemistry of Materials, Kerala, October, 2010.
- *From first-principles to materials modeling*, NISER, Bhubaneswar, December, 2010.
- *Effect of size reduction in manganites*, Bangalore, January, 2010
- *From first-principles to materials modeling*, University of Wuerzburg, January, 2010.
- *Double pervskites: compounds with promises*, HRI, April, 2011.

ACADEMIC VISITS

- Indo-German, TU Darmstadt, Germany, June, 2010.
- Indo-Sweden, Uppsala University, Sweden, June, 2010.
- Indo-German, University of Wuerzburg, Germany, January, 2011.

PARTICIPATION IN COMMITTEES

- **External:** Member of the committee for IUSSTF-APS Professorships and Student Visitations between India and USA; Member of organizing committee for the research workshop to be held in IIP, Natal, Brazil; Member of organizing committee for conference to be held in Uppsala University, Sweden; Member of organizing session committee on Bulk Properties of Complex Oxides at 2012 APS March meeting.
- **Internal:** Computer committee.

AWARDS / RECOGNITIONS

Elected fellow of Indian Academy of Sciences; Elected fellow of National Academy of Sciences.

SPONSORED PROJECTS

- Advanced Materials Research Unit (AMRU), DST.
- Swedish Research Link program, Swedish Research Council.
- Swarnajayanti Fellowship, DST.
- Indo-EU (MONAMI), DST.
- Indo-US network project, Indo-US Science and Technology Forum.
- Max-Planck-India partner group project, Max-Planck Society.

MEETINGS ORGANIZED

Computational Techniques in Soft Matter 2010 (jointly with J. Chakrabarty and S. Sengupta), Satyendra Nath Bose National Centre for Basic Sciences, Kolkata, India, December 6-10, 2010.

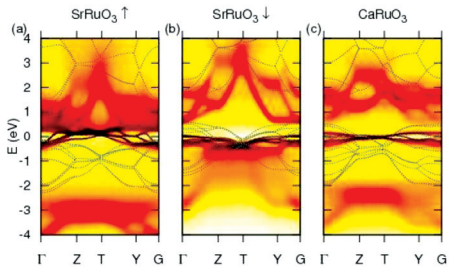
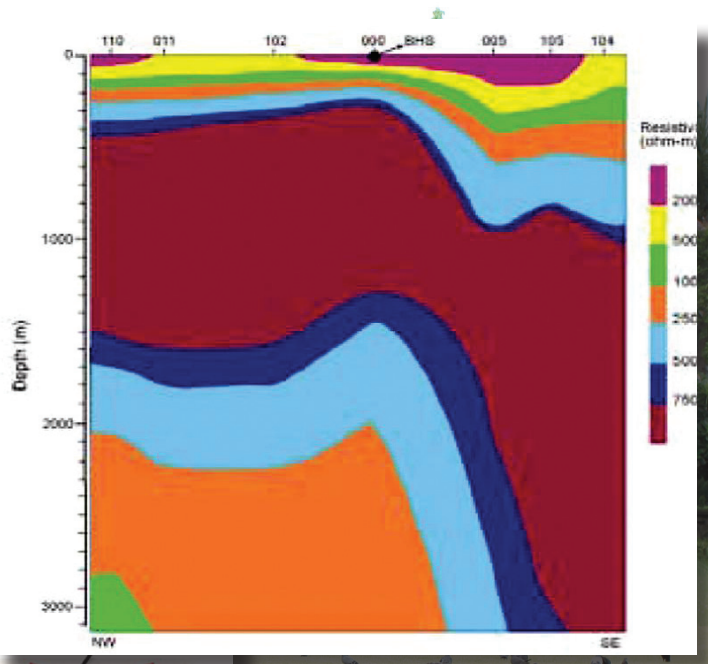
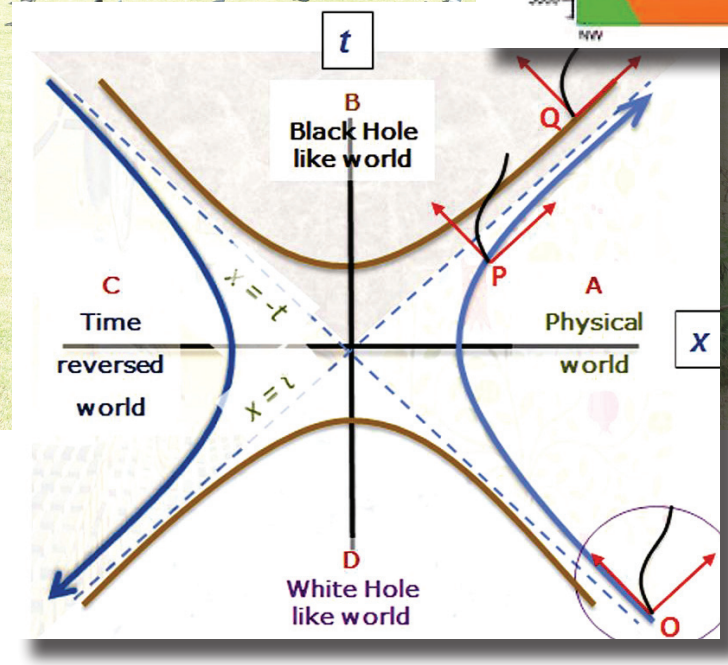


Fig1: *Intensity plot of the k-resolved spectral function A(k,w) calculated by LDA+DMFT for FM $SrRuO_3$ in majority and minority spin channels and that of $SrRuO_3$. The LDA band structure, shown with dots, has been superimposed for comparison*

2ND S Chandrasekhar Memorial Lecture - 7th January, 2011





Department of
THEORETICAL SCIENCES

DEPARTMENT OF THEORETICAL SCIENCES

The theory group was actively engaged in research and teaching. Significantly, the students of our department were able to publish independent papers in journals with high impact factors. The research carried out may be broadly classified under five heading. These are briefly summarized.

QUANTUM MECHANICS AND FIELD THEORY

Single and multiparticle spectra for noncommutative oscillators have been obtained using Drinfeld twist deformations. Comparison of results employing Wigner-Weyl or Voros star products has been done in the context of noncommutative nonrelativistic quantum mechanics.

A new relativistic particle model which naturally yields a noncommutative (Snyder de-Sitter) algebra was given and its implications were discussed.

Aspects of coherence and decoherence in a strongly damped Kerr oscillator are being studied.

GRAVITY AND BLACK HOLES

General conditions were found for the existence of a cosmological or outer horizon for various spacetime metrics with or without a black hole.

A generalised Smarr formula for arbitrary dimensional black holes was obtained from a statistical approach which highlighted the role of Killing symmetries. Phase transitions of black holes were studied. Contrary to standard thermodynamic transitions, here the phase transition curves were smeared and divergent near the critical point.

Poincare gauge symmetries of a gravity theory were studied in a Lagrangian approach.

Gravity in 2 + 1 dimensions with a negative cosmological constant and a Barbero – Immirzi like parameter on toric spatial foliation was analysed. A procedure for calculating the Euclidean partition function in this context was given.

MATHEMATICAL PHYSICS

It was shown that parallel transport over path spaces combine to form a generalization of a group, called a categorical group.

SU(N) irreducible Schwinger bosons satisfying certain constraints were constructed. Their representations were as simple as SU(2). Also, these irreducible Schwinger bosons were used to build SU(N) coherent states.

The Euler-Poincare formalism of various 2 + 1 dimensional KdV type equations was given using loop Virasoro algebra. Certain new classes of isochronous dynamical systems were constructed. The connection of higher order Riccati equations with the Gambier equation was established. Some Hamiltonian aspects of the Gambier family were also discussed.

A duality was found in two dimensional quantum Heisenberg spin systems. Specifically, vortices of antiferromagnets are dual to anti vortices of ferromagnets. Aspects of geometric quantization of moduli spaces were considered.

STATISTICAL PHYSICS

The emergence of a mean field regime where clusters, rather

than individual grains, reorganize to minimize space was shown. A statistical analysis of real cognitive processes was done.
A model is proposed where the biased link occupation rule is manifested in the Gamma distribution of cluster sizes. In certain limits it coincides with models given in the literature .

A procedure for handling the issue of mixing of critical and non-critical components in the study of acoustic attenuation in binary liquids has been developed. All aspects of non linear dynamics have been studied by renormalization group methods.

OTHER PHYSICS

Agent-based models of competitive learning and game-theoretic approaches to neurosciences were analysed.

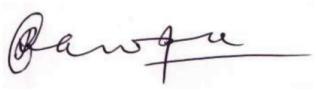
Theoretical light scattering techniques for characterizing soft biomedical tissues were developed. Formulas in closed forms were obtained for the extinction spectrum of astronomical graphite and silicates in the wavelength range of 1000 – 22,500 angstroms.

The hydrological system of thermal fluid flow of Bakreswar hot spring (Eastern India) was studied by using audiomagnetotelluric and magnetotelluric methods.

DEPARTMENTAL STATISTICS

Faculty strength: **12** (including an INAE distinguished professor and an emeritus scientist); PhD. students: **26** (excluding 3 who have left after receiving degrees); Postdoctoral fellows: **4**; Sponsored projects: **5**; Number of publications (in journals): **42** (including an independent publication by a student); Number of other (physics related) publications: **7**.

For any specific detail concerning any specific faculty of the department, the reader should see the individual report.



Rabin Banerjee
Head, Department of Theoretical Sciences

Amitabha Lahiri
Associate Professor

- Mathematical physics
- Application of category theory in physics
- Differential geometry
- Principal fiber bundles and connections on path spaces
- Uniqueness properties of black hole solutions
- No-hair theorems for black holes
- Quantization of classical point particle in background gauge field as a constrained system

A principal fiber bundle on the path space of a manifold was constructed and a connection was defined on this bundle. Parallel transport on path space was constructed as a path ordered exponential of the connection along paths on the path space, which are surfaces on the background manifold. It was shown that this is well defined only when these surfaces can be combined in different ways to give the same result. Then the parallel transport combines not as a group as for gauge theories, but as a generalization called a categorical group. General conditions were discovered for the existence of a cosmological or outer horizon, for both static and spherically symmetric, and stationary and axisymmetric space-times, with or without a black hole inside. It was found that the required condition is the violation of the strong energy condition by the matter fields, the simplest example of which is a positive cosmological constant.

PUBLICATIONS IN JOURNALS

- A. Lahiri, S. Chatterjee and A. N. Sengupta, *Parallel Transport over Path Spaces*, Rev. Math. Phys., 2010, **22**, 1033.
- A. Lahiri and S. Bhattacharya, *On the existence of cosmological event horizons*, Class. Quant. Grav., 2010, **27**, 165015.

OTHER PUBLICATIONS

- A. Lahiri, *Review of Geometric phases in adiabatic Floquet theory, abelian gerbes and Cheon's anholonomy by David Viennot*, Mathematical Reviews, MR2539329 (2010).
- A. Lahiri, *Review of Total space of abelian gerbes by Marcin Szamotulski and Dorota Marciniak*, Mathematical Reviews, MR2543780 (2010).

SUPERVISION OF STUDENTS

Ph.D. Students: Awarded: Saikat Chatterjee (Study of path space, gauge theory and holonomy, Jadavpur University, received 2011), Chandrasekhar Chatterjee (Some nonperturbative aspects of gauge theories, Jadavpur University, received 2011), Working: Sourav Bhattacharya, Debmalya Mukhopadhyay; **Project Students:** Post B. Sc.: Subhasish Chakraborty (Different Actions for (3+1) Dimensional Gravity), Kumar Jang Bahadur Ghosh ((2+1) Dimensional Gravity as Chern Simons Theory).

POST DOCTORAL RESEARCHERS

Dr. Tae-Hun Lee

STUDENTS' PUBLICATIONS

- Sourav Bhattacharya and A. Saha, Goedel black hole, *closed timelike horizon, and the study of particle emissions*, Gen.Rel.Grav., 2010, **42**, 1809.
- Sourav Bhattacharya, *A Note on Hawking radiation via complex path analysis*, Class.Quant.Grav., 2010, **27**, 205013.

LECTURES DELIVERED

Non-abelian strings and surface holonomy, Harish-Chandra Research Institute, Allahabad, November, 2010.

ACADEMIC VISITS

Harish-Chandra Research Institute, Allahabad, November, 2010.

COURSES TAUGHT

- PHY 304, Project based course, Autumn 2010.
- PHY 401, Project based course, Spring 2011.
- PHY 404, Advanced Mathematical Methods, Spring 2011.

SPONSORED PROJECTS

Symmetries of non-Abelian two-form gauge theories, Department of Science & Technology.

Anita Mehta

Professor

- Synaptic metaplasticity
- Agent-based models of competitive learning
- Game-theoretic approaches to neuroscience
- Dynamics of surfaces in driven systems
- Heterogeneous dynamics in granular media
- Statistical analysis of real cognitive processes
- Optimization of NP-hard problems
- Zero-temperature dynamics and its mathematical formulations

My publications over the past year include an invited review article on spatiotemporal heterogeneities in soft matter, which is an emerging research area. In a paper on the effects of strong frustration in a granular column (with J M Luck, Saclay), we have shown the emergence of an interesting mean-field regime where clusters, rather than individual grains reorganize to minimize space. In a paper on strategic networking in a winner-takes-all model (with N Nirmal Thyagu, SNBNCBS and Rutgers), we show how it is possible to feed off not just weaker species, but also peers, in order to survive. Finally, in a paper on the effect of self-interaction in a game-theoretic model of competitive learning (with G Mahajan, SNBNCBS), we demonstrate that different models of self-interaction interpolate between interfacial and cooperative behaviour. My current work includes power-law forgetting in models of synaptic metaplasticity (with JM Luck, Saclay), the role of encodings in the optimization of NP-hard problems (with K Klemm and P F Stadler, Leipzig), a game-theoretic approach to synaptic plasticity (with G Mahajan, SNBNCBS), the role of updating paradigms and memory in competitive learning (with A A Bhat, SNBNCBS), the dynamics of driven surfaces (with B Chakraborty, SNBNCBS), the mathematical analysis of zero-temperature dynamics (with J M Luck, Saclay and L S Schulman, Clarkson), the modeling of saccades and fixations in visual cognition (with D P Shinde, SNBNCBS and R K Mishra, CBCS Allahabad), and heterogeneous dynamics in granular media (with G C Barker, IFR Norwich and D P Shinde, SNBNCBS).

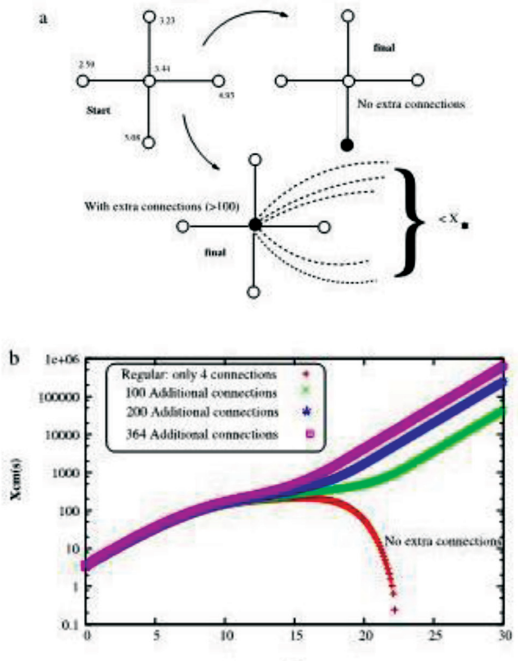


Fig.1: *(Color online). (a) The central cluster dies in its original configuration without extra connections. On addition of more and more clusters it becomes a survivor. (b) A crossover is seen here as the central cluster becomes a survivor from being a nonsurvivor, with the increased number of connections to non-surviving clusters (<X⋆). (From N. Nirmal Thyagu and Anita Mehta, Physica A, 2011, 390, 1467).*

PUBLICATIONS IN JOURNALS

- Anita Mehta, *Spatial, dynamical and spatiotemporal heterogeneities in granular materials, Soft Matter (Invited review on Emergent Areas in Themed issue on granular and jammed materials*, eds S. R. Nagel and A J Liu), 2010, **6**, 2875 - 2883.
- J. M. Luck and Anita Mehta, T*he effects of grain shape and frustration in a granular column near jamming*, European Journal of Physics B, 2010, **77**, 505 – 521.
- Gaurang Mahajan and Anita Mehta, *Competing with oneself: introducing self-interaction in a model of competitive learning*, Theory in Biosciences, 2010, **129**, 271 – 282.
- N. Nirmal Thyagu and Anita Mehta, *Competitive cluster growth on networks: complex dynamics and survival strategies*, Physica A, 2011, **390**, 1458 – 1473.

OTHER PUBLICATIONS

- Anita Mehta, The Perspective of an Indian Woman Scientist, Vidushi: Indian women in science and technology, National Council of Science Museums, India, August 2010, 139 – 157.

SUPERVISION OF STUDENTS

Ph.D. Students: A. A. Bhat, B. Chakraborty, D. P. Shinde.

POST DOCTORAL RESEARCHERS

Dr. G. Mahajan.

LECTURES DELIVERED

- Invited talk at conference on "*Particulate matter: does dimensionality matter?*", Max Planck Institute for Complex Systems (MPIPKS), Dresden, June, 2010.
- Invited talk at Asia Pacific Physics Conference (APPC11) in Shanghai, November 2010
- Plenary speaker at Women in Physics Conference, APPC11, Shanghai, November 2010.
- Invited talk at Statphys 7, Kolkata, November 2010.
- Invited talk at 4th Indo-Singapore Joint Physics Symposia, Singapore, February 2011

ACADEMIC VISITS

Senior Visiting Scientist at the Institut de Physique Theorique, Saclay, France, May - June 2010.

COURSES TAUGHT

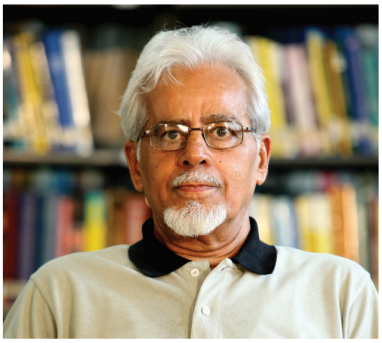
- PHY 502.
- PHY 591.

AWARDS / RECOGNITIONS

- Appointed Member, Working Group for Women in Physics, Asia-Pacific Physics Conferences, 2010 - .
- Appointed Expert Reviewer, European Research Council Executive Agency, 2010 – 2013.
- Appointed Member, Board of Graduate Studies, Indus International University, Himachal Pradesh, 2011 - .
- On Editorial Board, Granular Matter and CHAOS.
- Member of Scientific Committee, Association pour l'Etude de la Micromécanique des Milieux Granulaires since its inception.
- Fellow, American Physical Society.

SPONSORED PROJECTS

- Code-switching in normative multilingualism, DST.
- Generativity in cognitive networks, DST.



Bimalendu Bhusan Bhattacharya
INAE Distinguished Professor

- Application of Audiomagnetotelluric (AMT) and Magnetotelluric (MT) methods to study the Bakreswar Hot Spring (BHS) Province of Eastern India.
- Particle Swarm Optimization (PSO) for the interpretation of geoelectrical data.
- Application of Differential Evolution (DE) for the interpretation of geophysical data.

Hydrological system of thermal fluid flow of Bakreswar Hot Spring (BHS) has remained a challenging problem. Several workers from GSI, PRL, AMD, VECC, Jadavpur University and others have carried out work in this area but the problem remained unsolved. Audiomagnetotelluric (AMT) study has been carried out jointly with the geoelectromagnetic team of ISM, Dhanbad. Phase-tensor analysis of the AMT data shows that the region is broadly 2D. Rapid Relaxation Inversion for both transverse-electric and transverse-magnetic modes has been carried out to obtain resistivity images of the subsurface. The results show that the north-south fault close to Bakreswar is a shallow feature, not deeper than 300 m, and thus cannot act as a heat source. The subsurface formation below the fault zone is highly resistive up to a great depth (figure 1), indicating the absence of a heat source and geothermal reservoir in the vicinity of the BHS. The results further indicate that the location of the geothermal reservoir is deep in the northwestern side of BHS.

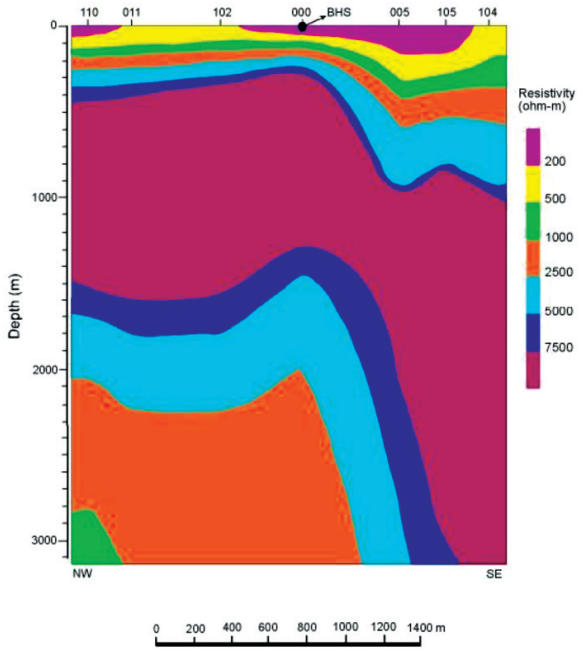


Fig.1: *2D RRI along E-W traverse passing through BHS. Differential Evolution (DE) technique has been applied to invert SP data. DE is global population based optimization algorithm in which newer solutions are created by the fusion and inheritance of existing solutions in the population. Low population size and fast convergence are the main advantages of this algorithm where accurate solutions have been attained with 100 solutions and 100 iterations. Both noise free and noise corrupted synthetic data of single as well as multiple anomalies have been analysed. Its application on the well known real earth problems proves its suitability.*

PUBLICATIONS IN JOURNALS

Rajib K. Sinharay, Shalivahan, and Bimalendu B. Bhattacharya, *Audio magnetotelluric studies to trace the hydrological system of thermal fluid flow of Bakreswar hot spring*, Eastern India: A Case History, Geophysics (SEG, USA), 2010, **75**, B187-B195.

OTHER PUBLICATIONS

- Vishal Das, Ghosal, A., Shalivahan and Bhattacharya, B. B., *A Comparative analysis of particle swarm optimization (PSO) and very fast simulated annealing techniques for self-potential (SP) anomalies, SEG*, International Exposition and Eighteith Annual Meeting, Denver, Colorado, USA, 2010.
- Ghosal, A., Vishal Das, Shalivahan and Bhattacharya, B. B., *Self-Potential data inversion using Particle Swarm Optimization*, 20th EM Induction Workshop, Cairo, Egypt, 2010.
- Bimalendu B. Bhattacharya, Shalivahan and Surajit Gorain, *Mapping Sediments below Deccan Trap*, 20th EM Induction Workshop, Cairo, Egypt, 2010.
- Shalivahan, Bimalendu B. Bhattacharya and Rajib K. Sinharay, *Audio magnetotelluric studies over Bakreswar hot spring*, Eastern India, 20th EM Induction Workshop, Cairo, Egypt, 2010.

SUPERVISION OF STUDENTS

Project Students: M. Sc. students of Department of Applied Geophysics, ISM, Dhanbad: Ankur Mundhra, Suman Mehta and Debanjan Dutta (participated in Summer Project under the INSPIRE scheme of DST).

LECTURES DELIVERED

- INSPIRE Programme on topics of Global Warming, Tsunami, Dynamic Earth, Exploration Antarctica and Ozone Hole, ISM, Dhanbad; NIT, Durgapur; BIT, Meshra, Ranchi; KIIT, Bhubaneswar and Kalyani University, Kalyani, April, 2010 - December, 2010.
- S. K. Bose Memorial Lecture on Carbon Sequestration, ISM, Dhanbad, December, 2010.

PARTICIPATION IN COMMITTEES

External: Independent Director, South Eastern Coal Field Limited (SECL), Bilaspur (Ministry of Coal); Member Management Council of Atomic Minerals Division, Hyderabad (Department of Atomic Energy); Member, Management Council of Directorate General of Hydrocarbons (Ministry of Petroleum and Chemicals; Member Advisory Council for Frontier Basins, ONGC, Dehradun (Ministry of Petroleum and Chemicals); Member, DCS Committee of DST (Ministry of Science and Technology); Member, FIST Programme (Earth, Ocean, Atmospheric and Environmental Sciences), DST (Ministry of Science and Technology); Member, FIST-NER Programme, DST (Ministry of Science and Technology); Member, Special Bihar Package Programme, DST (Ministry of Science and Technology); Expert Member of Technical Education Quality Improvement Programme (TEQIP) – Phase II for West Bengal.

Biswajit Chakraborty
Associate Professor

Research area:
- Quantum Field Theory
- Noncommutative Quantum Mechanics and Field Theory

Problems worked on:
- A first principle derivations of the spectra of single and multi-particle Noncommutative oscillators are provided by considering Drinfeld twist in a Hopf algebraic set-up. Symmetry aspects are then studied.
- The Moyal and Voros formulations of Noncommutative quantum mechanics are shown to emerge from two different choice of bases. Equivalence of these two formulations are then studied from both mathematical and physical considerations.

Noncommutative oscillators are first quantised through an abelian Drinfeld twist deformation of a Hopf algebra and its action on a module. Here, a noncommutative Moyal space is replaced by a commutative one, while the noncommutativity is incorporated through the deformed generators, obtained through a Hopf algebraic prescription. Single and multi-particle spectra are then obtained and the symmetry aspects are studied.

The issue of (in)equivalence between various star products in the formulation of noncommutative quantum theories has been a controversial point in the literature. We address this issue in the context of Noncommutative nonrelativistic quantum mechanics. We show, in particular, that the Moyal and Voros star products are just associated with different choices of bases in quantum Hilbert space. Both the mathematical and physical aspects are then analyzed.

PUBLICATIONS IN JOURNALS

- P. Basu, B. Chakraborty and S. Vaidya, *Fate of Superconducting ground state on the Moyal Plane*, Phys. Lett. B, 2010, **690**, 431.
- B. Chakraborty, Z. Kuznetsova and F. Toppan, *Twist deformation of rotationally invariant Quantum Mechanics*, Jour. Math. Phys., 2010, **51**, 112102.
- P. G. Castro, B. Chakraborty, Z. Kuznetsova and F. Toppan, *Twist deformations of the Supersymmetric Quantum Mechanics*, Central Eur. J. Phys., 2011, **9**, 841.
- P. G. Castro, B. Chakraborty, R. Kullock and F. Toppan, *Noncommutative oscillators from a Hopf algebra twist deformation: A first principle derivation*, Jour.Math. Phys., 2011, **52**, 032102.

SUPERVISION OF STUDENTS

Ph.D. Students: Debabrata Sinha, Y.Chaoba Devi.

POST DOCTORAL RESEARCHERS

Dr. Prasad Basu.

LECTURES DELIVERED

Gave an invited talk on *Symmetries in Noncommutative Quantum Systems*, one-day meeting on Non-perturbative aspects of Quantum Field Theory, Indian Association for the Cultivation of Sciences, Kolkata, as a part of Diamond Jubilee celebration, December 20, 2010.

ACADEMIC VISITS

- Visited African University of Science & Technology (under Nelson Mandela Institute, Washington DC, USA), Abuja, Nigeria, during April 2010 for a teaching assignment.
- Visited the National Institute of Theoretical Physics (NITheP), Stellenbosch, South Africa, during November - December 2010 for collaborative research exchange programme under Indo-South African project.

COURSES TAUGHT

- Taught a course on Quantum Mechanics (PHY 103) for the 1st semester Post-B.Sc. batch during August - December 2010.
- Taught a 3-week course on Quantum Field Theory to the second year M.Sc. Physics students of African Universities of Science & Technology (AUST), Abuja, Nigeria, during April 2010.

SPONSORED PROJECTS

Indo-South African project entitled "Astrophysical and Cosmological implications of Noncommutative space-time", supported by DST, Govt. of India and South African National Research Foundation.

Jayanta Kumar Bhattacharjee
Distiguished Professor

- Critical phenomena
- Dynamics of cold atoms
- Classical dynamical systems and renormalization group

The question of an intricate mixing of critical and non critical components has always been a problem in the confrontation between theory and experiment in the area of critical phenomena. This is most acute in the study of acoustic attenuation in binary liquid mixtures. An effective procedure for handling such cases has been developed.

Renormalization group techniques have been used to handle almost all aspects of non linear dynamics.

PUBLICATIONS IN JOURNALS

- M. Sinha Roy, P. Titum, JKB, *Reaction diffusionequation in the ultra cold coexisting atomic and molecular condensates*, Eur Phys J D, 2010, **58**, 23.
- JKB, U. Katze and S. Mirzaev, *Sound attenuation near the demixing point of binary liquids: interplay of critical dynamics and non critical kinetics*, Rep Prog Phys, 2010, **73**, 066601.
- A. Sarkar and JKB, *Renormalization group for nonlinear oscillators in the absence of linear restoring force*, Europhys Lett, 2010, **91**, 60004.
- S. Biswas, JKB, H. S. Samanta, S. Bhattacharyya and B. Hu, T*he critical Casimir force in the superfluid phase*, New J Phys, 2010, **12**, 063039.
- A. Saha, JKB and S. Chakraborty, *Work probability distribution and tossing a biased coin*, Phys Rev E, 2011, **83**, 011104.
- D. Das, D. Banerjee, JKB, A. K. Mallik, *Counting limit cycles with the help of the renomalization group*, Eur Phys J D, 2011, **61**, 443.
- T. Roy, JKB, A. K. Mallik, *Periodic orbits in glycolytic oscillators*, Eur Phys J E, 2011, **34**, 19.

SUPERVISION OF STUDENTS

Ph.D. Students: Arnab Saha, Raka Dasgupta, Amartya Sarkar, Arghya Datta, Sukla Pal; Project Students: Post B.sc.: Biplab Chatterjee.

POST DOCTORAL RESEARCHERS

Dr. Analabha Roy.

STUDENTS' PUBLICATIONS

Raka Dasgupta, *Effects of three-body scattering processes on BCS-BEC crossover*, Phys. Rev. A, 2010, **82**, 063607.

LECTURES DELIVERED

- *RG for dynamical systems*, University of Goettingen, November, 2010.
- *Hydraulic jump*, Saha Institute, February, 2011.
- *Hydraulic jump*, National Central University, Taiwan, March, 2011.
- *Hydraulic jump*, Calcutta University, March, 2011.

COURSES TAUGHT

- Phys 201, Statistical Mechanics, Spring.
- Phys 401, Nonlinear Dynamics, Spring.
- Lady Brabourne College, Dynamical System, Spring.
- Academy sponsored short course, BESU, Quantum Physics, May, 2010.
- IISER, Pune, short course, RG and critical phenomena, February, 2011.

PARTICIPATION IN COMMITTEES

- **External:** DST PAC High energy, Plasma, Non linear dynamics; WB DST executive committee.
- **Internal:** CAC.

MEETINGS ORGANIZED

Statistical Phys, Statphys, SINP, Kolkata, December, 2010.

Makhtedar Sanjay Kumar

Associate Professor

- Semiclassical aspects of scattering and bound states inthe attractive inverse square potential with a hard core
- Aspects of coherence and decoherence in a strongly damped Kerr oscillator

We have studied the quantum-classical correspondence in the case of a particle moving in an inverse-square potential. To regularize the problem we have considered a spherical core at the origin. The closed trajectories of the particle in the case of bounded motion exhibit interesting flowery shapes. The signatures of such bounded orbits in the quantum mechanical case are intriguing and we have been trying to understand these. The optical analogy (transition from wave to geometrical optics) is also being studied.

The role of environment on the coherent dynamics of a quantum system in bringing about decoherence and in particular in bringing about transition to classical dynamics is an important topic of study. The particular example of a Kerr oscillator (mimicking light propagating through a medium with Kerr nonlinearity) has been well studied in the literature. How a weak coupling to the environment destroys the cat-like states characteristic of the quantum dynamics is also well studied. Our aim is to investigate in what manner a strong (rather than weak) coupling to the environment modifies this behavior.

Partial progress has been achieved on the above topics since last year and work is in progress.

SUPERVISION OF STUDENTS

Project Student: Debanjan Polley (PBIR, 3rd and 4th semester projects).

COURSES TAUGHT

- PHY104, Electromagnetic Theory I, Semester I
- PHY301, Quantum Mechanics III, Semester III
- PHYE2N, Quantum Theory of Many-Body Systems, Semester IV

PARTICIPATION IN COMMITTEES

Internal: Admissions Committee.

Manu Mathur
Associate Professor

- SU(N) Irreducible Schwinger Bosons.
- SU(N) Coherent States.

SU(N) Irreducible Schwinger Bosons: We construct SU(N) irreducible Schwinger bosons satisfying certain U(N-1) constraints which implement the symmetries of SU(N) Young tableaues. As a result all SU(N) irreducible representations are simple monomials of (N – 1) types of SU(N) irreducible Schwinger bosons. Further, we show that these representations are free of multiplicity problems. Thus all SU(N) representations are made as simple as SU(2).

SU(N) Coherent States: We exploit the SU(N) irreducible Schwinger boson to construct SU(N) coherent states. This construction of SU(N) coherent state is analogous to the construction of the simplest Heisenberg-Weyl coherent states. The coherent states belonging to irreducible representations of SU(N) are labeled by the eigenvalues of the (N – 1) SU(N) Casimir operators and are characterized by (N – 1) complex orthonormal vectors describing the SU(N) group manifold.

PUBLICATIONS IN JOURNALS

- Manu Mathur, Indrakshi Raychowdhury (Bose Natl. Ctr., Kolkata) and Ramesh Anishetty (IMSc, Chennai), *SU(N) Irreducible Schwinger Bosons, J.Math.Phys.*, March 2010, **51**, 093504 (27pp.).
- Manu Mathur and Indrakshi Raychowdhury (Bose Natl. Ctr., Kolkata), *SU(N) Coherent States and Irreducible Schwinger Bosons*, J. Phys. A, July 2010, **44**, 035203 (12pp.).

SUPERVISION OF STUDENTS

Ph.D. Students: Indrakshi Raychowdhury, Sreeraj T. P.

PARTICIPATION IN COMMITTEES

Internal: Ex-Acting Librarian; Chairman, Library committee (till August 3, 2010); Member of Hindi committee; Member of Canteen committee.

Partha Guha
Associate Professor

- Euler-Poincare flows on infinite-dimensional groups and integrable systems.
- First integrals of nonlinear ODEs using symmetries and isochronous dynamical systems.
- Metriplectic dynamics, Dissipative system and Pattern formation.

Using loop Virasoro algebra we have given Euler-Poincar\'e formalism of the Calogero-Bogoyavlenskii-Schiff equation and various other (2+1)-dimensional Korteweg--deVries (KdV) type systems.

We constructed certain new classes of isochronous dynamical systems based on the recent constructions of Calogero and Leyvraz. We show how a (Nambu) Poisson structure can be ascribed to such equations.

We considered the hierarchy of higher-order Riccati equations and establish their connection with the Gambier Equation. Moreover we have investigated the relation of equations of the Gambier family to other nonlinear differential systems. Finally the conjugate Hamiltonian aspects of certain equations belonging to this family and their connection with superintegrability are explored.

PUBLICATIONS IN JOURNALS

- P. Guha, *Euler-Poincar\'e Flows on the Loop Bott-Virasoro, Group and Space of Tensor Densities and 2+1 Dimensional Integrable Systems*, Reviews in Mathematical Physics, 2010, **22**, 485-505.
- P. Guha and A. Ghose Choudhury, On *Planar and Non-planar Isochronous Systems and Poisson Structures*, Int. J. Geometrical Methods in Modern Physics, 2010, **7**, 1115-1131.
- P. Guha, A. Ghose Choudhury and B. Khanra, *A First Integral for the Time Dependent Higher-Order Riccati equations by nonholonomic transformation*, Communications in Nonlinear Science and Numerical Simulation, 2011, **16**, 3062-3070.
- P. Guha, A. Ghose Choudhury and Basil Grammaticos, *Dynamical Studies of Equations from the Gambier Family, Symmetry*, Integrability and Geometry: Methods and Applications (SIGMA), 2011, **7**, 028 (15 pages).
- P. Guha and A. Ghose Choudhury, On *Lagrangians and Hamiltonians of Some Fourth-Order Nonlinear Kudryashov ODEs*, Communications in Nonlinear Science and Numerical Simulation, 2011, **16**, 3914-3922.

SUPERVISION OF STUDENTS

Ph.D. Students: Barun Khanra (external).

LECTURES DELIVERED

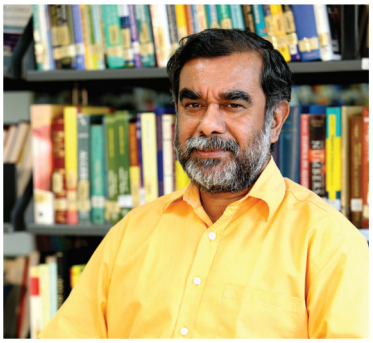
- *Hamiltonian flows on infinite-dimensional groups and integrable systems*, Micro meeting, Indian Statistical Institute, Kolkata, April 21, 2010.
- *The Role of the Jacobi Last Multiplier and Isochronous Systems*, Invited speaker, 24th StatPhys satellite meeting - Perspective of Nonlinear Dynamics, Indian Institute of Science, Bangalore, July 26 - 29, 2010.
- *A Geometric Approach to Time-Dependent Riccati Chain, Invited speaker*, ICM 2010 Satellite Meeting on Integrable Systems and Geometry, Pondicherry University, August 12 - 17, 2010.
- *Area-preserving 2D flows, hydrodynamical motions and metriplectic dynamics*, Invited speaker, Mathematical Modelling for Natural Phenomena, Bose Institute, Calcutta, October 29, 2010.
- *Urabe Functions, Isochronous Systems and Jacobi Last Multiplier*, Invited speaker, The Sixth National Conference on Nonlinear Systems and Dynamics (NCNSD 2011), Centre for Nonlinear Dynamics, School of Physics, Bharathidasan University, Tiruchirappalli, January 27 – 30, 2011.
- *Group and Hamiltonian description of higher-dimensional integrable systems*, International Conference on Frontiers in Applied Mathematics and its Computational Aspects, March 15 - 17, 2011.

AWARDS / RECOGNITIONS

- Received Indo-UK joint networking workshop grant to organize a conference at University of Kent, UK. Royal Society paid 7,365 British Pound and DST provided International Travel for up to 5 Indian participants.
- NBHM Travel Grant to attend International Congress of Applied Mathematics at Vancouver, Canada (Amount ` 1,75,000).

MEETINGS ORGANIZED

Convenor of Fourth microlocal meeting on nonlinear dynamics, January 3, 2011.



Rabin Banerjee
Senior Professor

- Phase transitions in black holes
- Quantum gravitational correction to Hawking temperature
- Quantization of black hole area
- Generalized Smarr formula and Killing symmetries
- Relativistic particle models displaying Snyder de-Sitter symmetries
- Lagrangian analysis of Poincare guage symmetries

Phase transitions in black holes were studied from different points of view. A new type of phase transition was observed which was distinct from standard thermodynamic phase transitions. A continuous transition was observed which was smeared (instead of sharp) while the discontinuity in the specific heat was found to be divergent (instead of being finite).

A generalized Smarr formula for arbitrary dimensional black holes was obtained using a statistical approach. The roles of Killing symmetries were elucidated.

Poincare guage symmetries were studied by using a Lagrangian approach. The generators were explicitly constructed.

A new relativistic particle model, which naturally led to the Snyder de-Sitter algebra, was discussed. Implications of this new model were considered in details.

PUBLICATION IN JOURNALS

- Rabin Banerjee, Kuldeep Kumar and Dibakar Roychowdhury, *Symmetries of Snyder-de Sitter space and relativistic particle dynamics*, JHEP, 2011, **060**, 1103.
- Rabin Banerjee, Sumit Ghosh and Dibakar Roychowdhury, *New type of phase transition in Reissner Nordstrom - AdS black hole and its thermodynamic geometry*, Phys.Lett. B, 2011, **696**, 156.
- Rabin Banerjee, Bibhas Ranjan Majhi, Sujoy Kumar Modak and Saurav Samanta, *Killing Symmetries and Smarr Formula for Black Holes in Arbitrary Dimensions*, Phys.Rev. D, 2010, **82**, 124002.
- Rabin Banerjee, Sunandan Gangopadhyay and Shailesh Kulkarni, *Hawking radiation and near horizon universality of chiral Virasoro algebra*, Gen.Rel.Grav., 2010, **42**, 2865.
- Rabin Banerjee, Claus Kiefer and Bibhas Ranjan Majhi, *Quantum gravitational correction to the Hawking temperature from the Lemaitre-Tolman-Bondi model*,, Phys. Rev. D, 2010, **82**, 044013.
- Rabin Banerjee, Debraj Roy and Saurav Samanta, *Lagrangian generators of the Poincare gauge symmetries*, Phys.Rev. D, 2010, **82**, 044012.
- Rabin Banerjee, Bibhas Ranjan Majhi and Elias C. Vagenas, *A Note on the Lower Bound of Black Hole Area Change in Tunneling Formalism*, Europhys.Lett., 2010, **92**, 20001.
- Rabin Banerjee, Sujoy Kumar Modak and Saurav Samanta, *Glassy Phase Transition and Stability in Black Holes*, Eur. Phys.J. C, 2010, **70**, 317.

OTHER PUBLICATIONS

Rabin Banerjee, *From black holes to emergent gravity*, Int.J.Mod.Phys. D, 2010, **19**, 2365. (Received Honorable Mention in GRF Essay Competition).

SUPERVISION OF STUDENTS

Ph.D. Students: Bibhas Ranjan Majhi, Sujoy Kumar Modak, Debraj Roy, Dibakar Roychowdhury, Arindam Lala, Biswajit Paul, Sarmistha Kumar (Ext.).

LECTURES DELIVERED

- *Black-holes: an entrée*, Lady Brabourne College, Kolkata, June, 2010.
- *Hawking radiation and anomalies*, Vienna Technical University, Vienna, September, 2010.
- *Black holes demystified*, Physics department, University of Vienna, September, 2010.
- *Pedagogic introduction to black holes*, Mathematics department, Jadavpur University, December, 2010.
- *Introduction to black holes*, G. S. College, Silchar, February, 2011.

ACADEMIC VISITS

Quantum symmetries program sponsored by EU, Vienna University, Vienna, September, 2010.

COURSES TAUGHT

QFT 1, Introduction to quantum field theory (Special paper for M.Sc., West Bengal State University, Barasat), Fall semester.

PARTICIPATION IN COMMITTEES

External: Member, Board of UG studies, Presidency college/ university.

Internal: Chairman, Library Committee.

AWARDS / RECOGNITIONS

- Honorable mention in the Gravity Research Foundation essay competition.
- Black-holes: an entrée, Lady Brabourne College, Kolkata, June, 2010 (C.K.Majumdar memorial lecture organized by IAPT for college students/teachers).

MEETINGS ORGANIZED

Contemporary trends of research in physical sciences, National conference, G.C. College, Silchar, February, 2011.

Samir Kumar Paul
Associate Professor

- 2+1 Quantum Gravity
- Topological excitations in two dimensional Heisenberg spin systems
- Some aspects of Geometric Quantization

The main results obtained in 2+1 quantum gravity with negative cosmological constant and Berbero – Immirzi -like parameter has been determination of the physical parameters in a specific range, apart from the dependence of the dimension of the Hilbert space on the parameter. This occurs in a toric spatial foliation .In particular the above said parameter turns out to be less restricted than what has been known before. We have also formulated a procedure for calculating partition function for our action when it is Euclidean. This will help us to understand BTZ black hole with the above parameter. Also we have studied the possibility of calculating the partition function with a positive cosmological constant in lens spaces. This is done in collaboration with Rudranil Basu SNBNCBS.

The interesting result obtained in our study of quantum Heisenberg spin system on two dimensional square lattice has been a 'duality' in the topological excitations of strongly anisotropic Heisenberg ferromagnet and anti-ferromagnet in the sense that vortices of anti-ferromagnet correspond to anti-vortices of ferromagnet . In an attempt to understand the dynamical structure factors which has been our main aim in formulating our study of these 2D quantum spin systems we have carried out some computations for dynamical structure factor taking into account a Maxwell-Boltzmann distribution of mobile vortices in a ferromagnet. Here we use the physical parameters of {K_2}Cu{F_4} and compare with the results of neutron scattering experiments on it , which are available. The available classical theoretical calculations has not been compared with the experimental results which are quantum mechanical , prior to our calculations .This work is being carried out in collaboration with Subhajit Sarkar and Ranjan Chaudhury at SNBNCBS. The first hand calculations show some conformity with the experimental ones.

Geometric prequantization of moduli spaces of non-abelian vortices has been carried out. We have explicitly calculated the symplectic form arising from {L^2} metric and calculated a prequantum line bundle. The curvature of this bundle turns out to be that of Quillen's determinant line bundle with a modified Quillen metric. We have discussed possible construction of Hilbert space by passing from prequantization to quantization. This is done in collaboration with Rukmini Dey, HRI Allahabad.

PUBLICATIONS IN JOURNALS

- Rudranil Basu and Samir K. Paul, 2+1 *quantum gravity with a Berbero – Immirgi – like parameter on toric spatial foliation*, Class. Quantum Grav., 2010, **27**, 125003.
- R. Chaudhury and S. K. Paul, *Physical realization of topological excitations in quantum Heisenberg ferromagnet on lattice*, Euro. Phys. J. B., 2010, **76**, 391.
- Rukmini Dey and Samir K. Paul, *Quillen bundle and geometric prequantization of non-abelian vortices on a Riemann surface*, Proc. Indian Acad. Sci., Math. Sci., 2011, **121**, 27.

SUPERVISION OF STUDENTS

Ph.D. Students: Rudranil Basu (Joint: Parthasarathi Majumdar, SINP), Subhajit Sarkar (Joint: Ranjan Chaudhury, SNBNCBS); **Project Students:** Post B Sc.: Arijit Chatterjee (Quantization of
Yang – Mills fields), Arghya Das (Quantization of Kinks).

COURSES TAUGHT

- Phy 101, Classical Dynamics, 1st Semester.
- Phy 202, Mathematical Methods, 2nd Semester.

PARTICIPATION IN COMMITTEES

- **External:** Moderation Board for 2nd and 3rd semester exams of M. Sc. Physics Programme by Bose Institute and St. Xaviers College.
- **Internal:** SCRE committee, Admission Committee.

Subhrangshu Sekhar Manna
Senior Professor

- Explosive Percolation
- Flocking Phenomena

A new route to Explosive Percolation: The biased link occupation rule in the Achlioptas process (AP) discourages the large clusters to grow much ahead of others and encourages faster growth of clusters which lag behind. In this paper we propose a model where this tendency is sharply reflected in the Gamma distribution of the cluster sizes, unlike the power law distribution in AP. In this model single edges between pairs of clusters of sizes s_i and s_j are occupied with a probability $\alpha(s_i s_j)^{\alpha}$. The parameter α is continuously tunable over the entire real axis. Numerical studies indicate that for $\alpha<\alpha_c$ the transition is first order, $\alpha_c = 0$ for square lattice and $\alpha_c = -1/2$ for random graphs. In the limits of $\alpha = -\infty, +\infty$ this model coincides with models well established in the literature.

PUBLICATIONS IN JOURNALS

S. S. Manna and Arnab Chatterjee, *A new route to Explosive Percolation*, Physica A, 2011, **390**, 177.

SUPERVISION OF STUDENTS

Ph.D. Students: Abhijit Chakraborty; **Project Students:** Post B. Sc.: Ashutosh Singh, Biplab Bhattacherjee, Summer Project: Rituparna Nath.

LECTURES DELIVERED

- *International Trade Network* at the meeting on Complex Networks of Trade & Credit, Indian Institute of Mathematical Sciences, Chennai, April 10 - 11, 2010.
- *International Trade Network* at the meeting on The Economy as a Complex System II: Economic Dynamics, Indian Institute of Mathematical Sciences, Chennai, December 27 - 29, 2010.

COURSES TAUGHT

PH105, Computational Methods I.

PARTICIPATION IN COMMITTEES

Internal: Road Map Committee, Annual Report Committee, Committee for Renovation of Computer Facilities, Committee for procuring security system in Computer Centre.

MEETINGS ORGANIZED

Statphys – Kolkata VII, Organizing Committee Member, Saha Institute of Nuclear Physics, Kolkata, November 26-30, 2010.

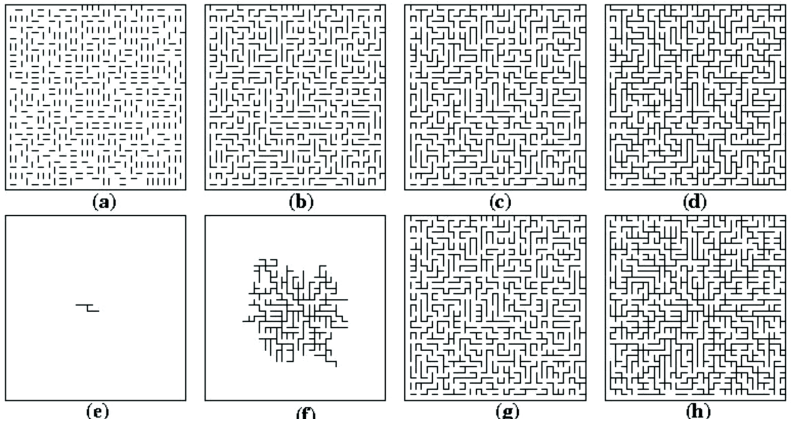


Fig.1: *Percolation with $\alpha \rightarrow -\infty$ on square lattice (L=24) and with loop-less condition. (a) Only links are deposited (b) clusters of size up to 4 (c) clusters of size up to 8 and the (d) the spanning tree. Similarly percolation with $\alpha \rightarrow +\infty$ are: (e) growth starts from a single link (f) cluster of N/4 bonds (g) cluster of N/2 bonds (h) the spanning tree cluster.*

Subodh Kumar Sharma
Emeritus Scientist

- Developing theoretical light scattering techniques for characterization of soft bio-medical tissue with particular reference to early detection of cancer.
- Development of analytic formulas for extinction spectrum of electromagnetic waves by major interstellar dust components.

Analyzing the phase function obtained for a fractal tissue model, we showed that the size distribution of the scatterers in the tissue can be inferred from its phase function. This finding has important consequences for the tissue diagnosis – in particular for early detection of cancers of soft tissues. In addition, some aspects of monte carlo simulation of light propagation in a tissue were also examined. Both the findings were published in journals.

Analytic formulas in closed form were obtained in 2009-2010 for the extinction spectrum of astronomical graphite and silicates in the wave length range 1000-22,500 Angstrom. Work on obtaining similar formulas for polycyclic aromatic hydrocarbons is continuing.

PUBLICATIONS IN JOURNALS

- S. K. Sharma, *A possible method for retrieval of particle size distribution from its phase function in a fractal tissue model*, Journal of modern optics, 2010, **57**,849 - 853.
- R. K. Saha, S. K. Sharma and M. C. Kolios, *Single cell estimation from backscattered spectrum by using some weak scattering approximations*, Canadian Acoustics, 2010, **38**, 31-34.
- S. Banerjee and S. K. Sharma, *Use of monte carlo simulations for propagation of light in bio-medical tissues*, Applied Optics, 2010, **49**, 4152 - 4159.

SUPERVISION OF STUDENTS

Ph.D. Students: Pritesh Randive (IUCAA Pune).

LECTURES DELIVERED

- *Role of elastic light scattering in bio-medical tissue characterization*, North Eastern Hill University (Workshop on Modelling Biological Systems), Shillong, October, 2010.
- *Electromagnetic wave scattering in cosmic dust: Theory and Experiments*, M G Science Institute (Workshop on Laboratory physics: Applications to cosmic dust), Ahmedabad, November, 2010.
- *Role of light scattering in soft tissue characterization*, Nagpur University, Nagpur, March, 2011.

ACADEMIC VISITS

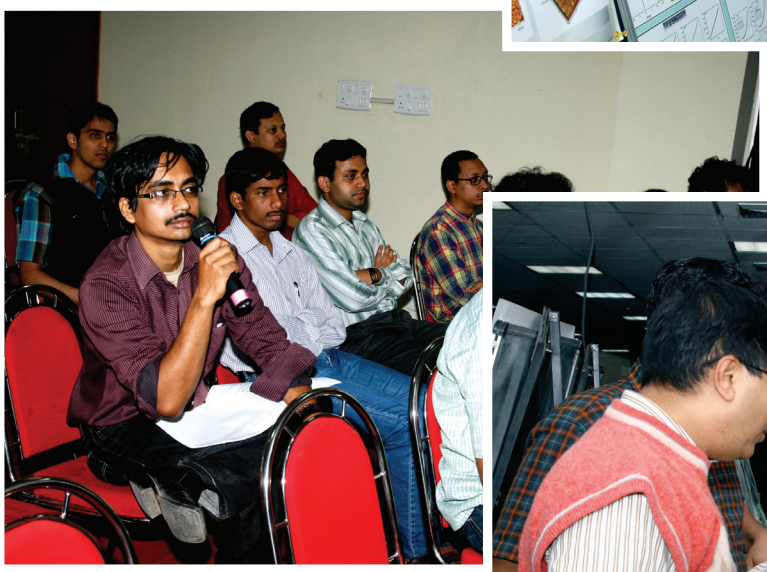
- IUCAA, Pune, February, 2010.
- Nagpur University.

SPONSORED PROJECTS

Interpretation of observed extinction in the optical-UV region from TAUVEX and ASTROSAT-UVIT Satellite, ISRO.

BOSE FEST


rowth and Electrical Transport Investigations on Nanowires of
Charge Transfer Complex Cu-TCNQ (1-5mm)




AN INTRODUCTION TO BIOMEDICAL OP
Surfaces and Interfaces for Biomaterials
Tissue Engineering II
The Human Genome
Human Molecular Biology
Applied Bioelectricity
Cardiovascular Solid Mechanics
Neurobiology
Toxicology
Medicinal Plants
Nanoparticulates as Drug Carriers
Carbon Nanotubes
MEDICINAL CHEMISTRY
AN INTRODUCTION TO
Human Molecular Genetics
THE MERCK INDEX
THE CHEMISTRY OF PROCESS INDUSTRIES
PHARMACEUTICAL INDUSTRY


Aon

FACILITIES

LIBRARY

ABOUT LIBRARY

Library of Satyendra Nath Bose National Centre for Basic Sciences was established since its inception in the year 1986. The library took an important role in the promotion of teaching and learning activities. The library has been providing information support to all the faculty members, researchers and numerous professionals working on basic sciences throughout the country. Centre's library is a special library having a rich collection of books and journals related to basic sciences.

LIBRARY COLLECTION

The Library has a collection of more than 11450 books and more than 8000 bound volume journals. The Library subscribes a good number of reputed journals mostly in electronic version. In addition, being a member of National Knowledge Resource Consortium, INDEST etc. consortia, library can access a wide range of online journals. The library is also equipped with databases like web of Science, SciFinder Scholar, ICSD etc. Apart from books on basic sciences, the library has a good collection of books on Hindi and Bengali literature, history, environmental sciences etc. There is also a wide collection of audio-visual materials. The Library has separate magazine and newspaper reading section. 25 popular magazines and 13 daily newspapers in different languages are subscribed regularly. The library is enriched with a valuable archive of Satyendra Nath Bose. This archive includes some rare books of his personal collection.

LIBRARY HOURS

The Library is open from Morning 8.00 A.M. to Night 12.00 A.M. except Sundays and national holidays. However circulation counter is open from 9:00 AM to 5:30 PM.

LIBRARY SERVICES

- Document Lending service: Each member is entitled to issue 6 books and 2 bound volumes of journals at a time.
- Reference Service: Reference service is given via e-mail, telephone or personally with the help of different reference tools like encyclopedias, directories, dictionaries, atlases, yearbooks etc.
- OPAC: Library offers Online Public Access Catalogue (OPAC) which allows user to browse library collection through web.
- E-resources and Internet Facility: Library is well equipped with a good number of computers with internet connection through cable LAN and wireless networking facility for laptop users. Library is having access to plenty of electronic journals, databases, archives and consortiums. Users are having full access to the e-resources.
- Reprographic Services: Library has two photocopy machines. In addition, there are some laser printers including one colour laser printer.
- Bibliometric Services: Library helps to prepare various bibliometric reports specially usage statistics, citation analysis, h-index, Impact factor of Journals etc.
- Library Resource Sharing Activities: The library shares its resources with all important academic / research

institutions in India. As a member of National Knowledge Resource Consortium (NKRC), the library keeps close contacts with other libraries under DST and CSIR. SNB library has institutional membership of Saha Institute of Nuclear Physics (SINP) and British Council Library, Kolkata.

- Library is for leisure: Library has a separate section for Bengali, Hindi, and English literature, fiction, classic literature, novel etc.
- Digital Repository: Library has digital archives of "Satyendra Nath Bose Archive and Digital Multimedia", Ph.D. Thesis, "Multimedia collection of different seminar and cultural program", E-books etc.

Resources and Services added in the F.Y. 2010 - 11

- Extension of Library hours from morning 8.00 AM to night 12 AM. Previously it was 9.00 AM to 8.00 PM.
- Library started organizing Audio-visual show on Video Lectures / Educational Films / Documentary Films.
- Following resources added in the Library: 1 Colour Printer, 5 desktop Computers, 1 Laptop, 1 Projector, 1 External Hard Disk, 1 External DVD Writer, 5 UPS, 1 Scanner, 1 Spiral Binding Machine, 2 Almirah, 14 Library Racks.
- To enrich the Library 700 new books added with the existing Library Collection.

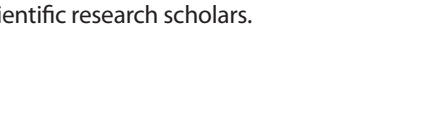
Saumen Adhikari
Librarian – cum – Information Officer

ENGINEERING SECTION

With constant untiring effort of Engineering unit of S. N. Bose National Centre for Basic Sciences, different types of construction work as well as maintenance work, both of civil & electrical, to a comprehensive amount of ₹ 1.45 crore, has been completed with the minimum existing infrastructure of the engineering unit of the Centre.

To name a few important works:

- Complete renovation of big Dining Hall, Kitchen Room with provision of latest kitchen equipments & thorough electrical modification along with the living rooms and toilets.
- Complete set up of fully high quality air-conditioned Lecture Hall-No-3(LH-3) with the provision of latest projector with projection screen, sound system, electrical modification along with most up to date type of Discussion Room-1, Visitor's room, Secretary's room, Discussion Room-2 for the benefit of scientific research scholars.
- Rehabilitation, retrofitting & strengthening of RCC over head reservoir.
- Provision for installation of Transmission, Electronic Microscope (TEM) after construction of vibration isolation pedestal with installation of costly precession AC machine.
- A Clean Room Building for placing costly Focused Ion Beam instrument over specially prepared console base after providing boring and casting 450 mm diameter 24 m long pile for vibration isolation arrangement which is rare in eastern India including laying of dedicated cable from sub-station block with ultramodern facility of AHU (Air Handling Unit).
- To accommodate increasing influx of students, a multi-storied (G+3) Hostel Building cum Transit Quarter Complex which is nearing completion with the provision of further two stories above G+3.



Jnanada Ranjan Bhattacharya
Superintending Engineer

COMPUTER CENTRE

The Computer Centre on the third floor serves the computational needs of the S.N.Bose National Centre. At the end of the academic year 2010-2011, there were about 500 users with accounts in the central file server (NFS), including all faculty, academic staff and students. These accounts were distributed according to departmental affiliations among four SuperMicro servers, each with a 2.2GHz AMD processor and 300 GB hard disk, one for each department and these have been augmented.

The email accounts are held in a mail server of the same specifications as above, which also hosts the webpages. The Centre has an 100Mbps internal network with a 8Mbps external (internet) link. Recently, we have also become a part of the National Knowledge network which will give us access to a 100 Mbps leased line. In addition wireless facilities are available at several locations. Several laser printers are available for meeting printing needs.

Computational facilities include a parallel computing cluster built by SuperMicro was installed, containing 32 nodes (256 processors). Each node has four quad-core processors, 16GB RAM and 500 GB hard disk. In addition the cluster has a 2 Terabyte Network Access Storage device. Recently, this cluster has been augmented with 96 more processors available for parallel users. In addition we have a small cluster consisting of 96 processors for serial users. Three smaller clusters and another similar cluster, bought under individual research projects funded by the DST, are also installed in the Computer Centre. The computational facilities of the AMRU project, including a parallel computing cluster, are maintained separately, and are networked with the Computer Centre.

Computational facilities at a glance

Type	Name of the machine	Details
Serial	Photon	Intel Xeon cluster # of processors = 96
Parallel	HPC	Intel Xeon cluster # of processors = 352

Since last year an intranet server was set up to fulfill internal requirements of official notification etc. The server runs a web-based general notice board, where the Centre's general, official, academic, seminar related, placement related or lost & found related notices are posted. The server also hosts web pages for on line booking of lecture halls and guest house internally. This year the Computer Centre also implemented on line admission application and online registration for new students. In addition all forms related to various administrative procedures are available in a downloadable format.

A senior computer engineer, Mr. Sanjay Sarkar, and two junior computer engineers, Mr. Rajesh Das and Mr. Sudeep Narayan Banerjee, help in the maintenance of the computers and networking of the Centre.

Priya Mahadevan

Priya Mahadevan
In-charge, Computer Centre

PROJECT CELL

Like previous years, the cell was busy in channelling properly the intended project application forms to and from the PI and the authorities. For the external projects, the project grants were obtained from DST, CSIR, DRDO, UKERI etc. The list of the funds and the funds obtained are detailed below. The project cell has a website – http://bose.res.in/~prjcell. The relevant forms can be downloaded from there. In addition, the PI can correspond with the cell through the email account.

The following table summarizes the details of the externally funded projects in the centre, for the last five years.

Year	No. of Projects	Amount Received (₹)
2006-2007	21	5,10,87,471=00
2007-2008	25	6,07,13,160=00
2008-2009	27	1,15,61,417=00
2009-2010	39	5,51,44,887=00
2010-2011	40	4,83,19,968=00

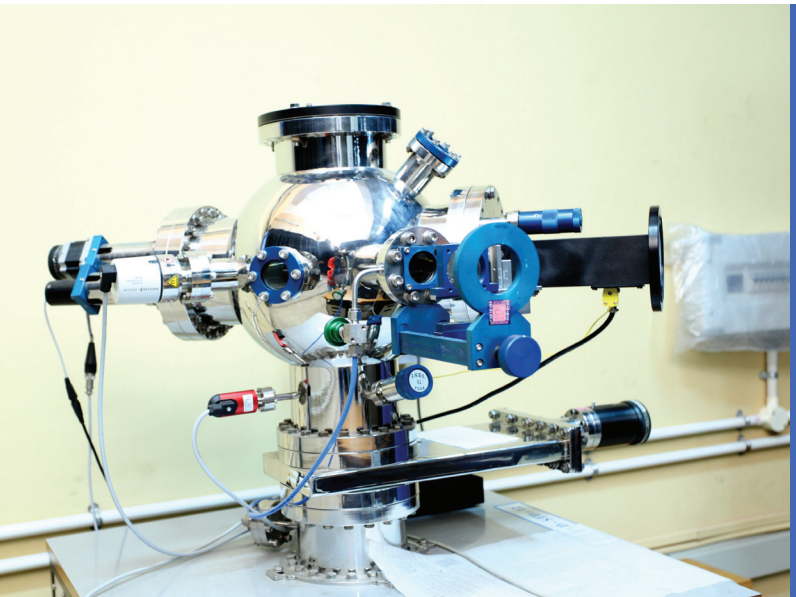
The following projects were running during 2010-2011 :

- *Unit on Nano Science & Technology (UNANST)* by Prof. A. K. Raychaudhuri, funded by DST.
- *Swarnajayanti Fellowship* by Dr. T. Saha Dasgupta, funded by DST.
- *Understanding Physics and Chemistry of novel material using NMTO Wannier Functions* by Dr. T. Saha Dasgupta, funded by Indo-German.
- *Advanced Materials Research Unit (AMRU)* by Dr. T. Saha Dasgupta, funded by DST.
- *J.C. Bose Fellowship* by Prof. A. K. Raychaudhuri, funded by DST.
- *Centre for Nano Technology* by Prof. A. K. Raychaudhuri, funded by DST.
- *Development of cryostats and electronic measurement units for physical properties measurements using a zero-loss dewar* by Prof. A. K. Raychaudhuri, funded by DST.
- *Utilization of Synchrotron Radiation Sources and Neutron Sources abroad* by Prof. A. K. Raychaudhuri, funded by DST.
- *Elastic Property measurements on Ferro Magnetic shape memory alloy system* by Dr. P. K. Mukhopadhyay, funded by DST.
- *Development of a vibrating sample magnetometer using a superconducting magnet* by Dr. K. Mandal, funded by DST.
- *Study of ferrite nano particles* by Dr. K. Mandal, funded by DST.
- *INAE (Emeritus Scheme)* by Prof. B. B. Bhattacharya, funded by INAE.
- *Charge and orbital ordering* by Dr. Priya Mahadevan, funded by DST.
- *Synthesis of nanostructures by asymmetric self organization of nano-particles and its applications* by Prof. A. K. Raychaudhuri, funded by DST.
- *Study of Biomolecular recognition with Time-resolved Optical Spectroscopy* by Dr. Samir Kr. Pal, funded by DST.
- *Functional Oxides* by Dr. Priya Mahadevan, funded by

DST (Joint Research Proj) (Indo Taiwan Prog).

- *Growth, characterization and study of resistive switching in multifunctional perovskite oxide systems* by Dr. Barnali Ghosh Saha, funded by DST (WOS-A).
- *Electronic states and transport in mesoscopic systems* by Dr. Prasenjit Singha Deo, funded by DST.
- *Astrophysical and cosmological implication of noncumulative space time* by Dr. Biswajit Chakraborty, funded by DST (Indo SA Jt. Proj).

- *Symmetries of non-abelian two-form gauge theories* by Dr. Amitabha Lahiri, funded by DST.
- *Quasistatic and Ultrafast Magnetization Dynamics in Nanomagnet Arrays* by Dr. Anjan Barman, funded by DST.
- *DYNAMAG: Advanced Computational Studies of Dynamic Phenomena in Magnetic Nano-Materials* by Dr. Anjan Barman, funded by DST & European Commission.
- *Fundamental Aspects of Quantum Theory and Quantum information: A Multidisciplinary Approach* by Dr. Archan S. Majumdar, funded by DST.
- *Synthesis of DNA and Micelles Templated Magnetic Nanoparticles and their Necessary Surface Functionalization for Bio -Medical Applications* by Dr. Madhuri Mandal, funded by DST (SERC Fast Track).
- *ATHENA – Advanced Theories for Functional Oxides: New Routes to Handle the Devices of the Future (India European Union Research Project)* by Dr. Priya Mahadevan, funded by DST.
- *Investigation of Static and Dynamic Magnetic Properties of Nanomagnetic Systems* by Dr. Saswati Barman, funded by DST (Fast Track).
- *Study of magneto caloric effect* by Dr. Kalyan Mandal, funded by DRDO.
- *Spin wave and domain wall dynamics in vertical magnetic nanowires (DST-UKIERI)* by Dr. Anjan Barman, funded by DST.
- *Preparation and study of nanostructured dilute magnetic semiconductors* by Dr. Kalyan Mandal, funded by CSIR.
- *Generativity in Cognitive Networks* by Prof. Anita Mehta, funded by DST.
- *Magnonic Crystals: New paradigm towards microwave communications* by Dr. Anjan Barman DST (DST-JST Prog).
- *Preparation and study of magnetic nanowires* by Dr. Kalyan Mandal, funded by BRNS (DAE).
- *MONAMI – Modeling of NANO – Scaled Advanced Materials Intelligently* by Dr. T. Saha Dasgupta, funded by DST (Int Div).



- *Magnetism in organic materials* by Dr. T. Saha Dasgupta, funded by Swedish Research Council.
- *Design and Fabrication of Nanomachined Thermal Sensors using FIB (DST – UKIERI)* by Prof. A. K. Raychaudhuri, funded by DST.
- *Contacting 3D electrodeposited nanowires: new opportunities for sprintonics technology (DST – UKIERI)* by Dr. Kalyan Mandal, funded by DST.
- *Neutron diffraction studies of collapse of charge ordering in narrow band half-doped manganite* $Y_{0.5}Ca_{0.5}MnO_3$ *nanoparticles* by Prof. A. K. Raychaudhuri, funded by UGC DAE CSR.
- *EICOON – Euro Indo forum for nano materials research coordination & cooperation of researchers in sustainable energy technologies* by Prof. A. K. Raychaudhuri and Dr. Sugata Mukherjee, funded by University of Twente.
- *Unit on Nanoscience & Technology – Phase – II UNANST – II* by Prof. A. K. Raychaudhuri, funded by DST.
- *Development of GHz Frequency Filters and Attenuators using Nanoscale Magnonic Crystals* by Dr. Anjan Barman, funded by DIT.

Pratip Kumar Mukhopadhyay
Convenor, Project Cell

TECHNICAL CELL

The technical cell looks after a number of high end and state of the art equipments, which are available for free to the centre's staffs and students and are made available to the external users on payment basis. The details are available on the centre's website http://www.bose.res.in/~technicalcell/.

At present the major equipments falling under technical cell are

1. X-ray Diffraction #1: This is a PANalytical X-PERT PRO XRD unit installed in 2005 and it has the capability of performing

a. Powder diffraction
b. Thin film reflectivity
c. high resolution rocking curve analysis
d. stress/texture analysis
e. Small angle x-ray scattering (SAXS)

The system has been upgraded in 2009 with high temperature (1500C) attachment and pixel detector.

X-ray Diffraction #2: A XRD (model: MiniFEX II) had been installed in our center this year for regular phase analysis of samples. This is a table-top system from Rigaku.

The X-Ray tube is having Cu target with fixed output voltage of 30 kV and fixed output current of 15 mA. The X-ray tube is water cooled and the water flow rate needed is ~ 3 lts/min. The system is having vertical goniometer with radius 150 mm. The 2θ scanning range is from -3^0 to $+145^0$. The scan speed can be varied from 0.01^0 to 100^0 per min. We have both Scintillation and Solid State Detectors.

The system has been inaugurated by the director and opened for users on 11th March 2011. It operates only in room temperature, but because it uses solid state line detector, it is very fast compared to ordinary XRD machines. It is therefore to be used for routine phase identification of samples, freeing the bigger Pananalytical machine for other specialized works.

2. Environmental SEM (ESEM): This is a FEI QUANTA 200 ESEM with W-filament and has a resolution of 2.4nm under high vacuum and 3.0nm under low vacuum. The system can be used in the EDAX mode for compositional analysis. The system has recently been upgraded with E-beam lithographic facility. The system serves both metallurgical and biological communities.

3. High Resolution Transmission Electron Microscope (HRTEM): Model: Technai G^2 S-Twin (FEI, Netherlands) has been installed in our center.
   Specifications:
   Resolution 0.2 nm
   Magnification range:25 x to 1M x
   Source: 200 kV FEG source
   Specimen stage have X & Y movement up to 2 mm and α and β tilt of maximum ±40°.
   The system also has High resolution HAADF STEM detector with magnification range 200 x to 1M x.
   EDAX detector is there as analytical tool with resolution < 136 eV.

In order to minimize the thermal drift during high resolution imaging High-precision AC from Blue Box had been installed. It will maintain the room temperature at 22±0.6°C.

Our Director Prof. A. K. Raychaudhuri had inaugurated the instrument on 1st April, 2011 and opened it for users. Till date more than 50 samples have been studied in this microscope.

4. **Vibrating Sample Magnetometer (VSM):** This is a Lakeshore (Model no: 7407) VSM which presently works in the temperature range of 77K to 1273K and magnetic field range of ±1.6 Tesla. The current resolution of the system is 1.25 micro-emu.

5. **Atomic Force Microscopy (AFM):** Currently we have a Veeco CPII system, which can be used as atomic, magnetic, conducting and scanning tunneling microscopes. It has the capability of doing AFM lithography and also getting images under liquid environment. We are in the process of upgrading it to Innova. It will have modified high-end controller 'Nanodrive' with better controlling capabilities with built-in lock-in amplifier. Tapping frequency down to 1kHz for delicate biological samples in liquid. Lift-mode technology for high performance MFM with better accuracy. Conducting AFM with femto-ampere resolution Piezo response Force Microscopy Better precision in Nanolithography and Nanomanipulation.

6. **Differential Scanning Calorimeter (DSC):** Model: DSC Q 2000 (TA Instruments) The temperature range is –175^{0}C to 725^{0}C. The ramp rate is 10^{0}C/min. Purge has that can be used is either N_2 or He. The sample holders are mainly Al or Pt for slid and powder samples. One can set 50 samples at a time. The system is running from 31st Jan, 2011 and al total of 40 samples have been done till date.

7. **TG-DTA:** This is a Perkin Elmer made system by which the variation of weight and heat energy during phase transition of a material is measured in a variety of gaseous environment and in the temperature range of 50C to 1200C.

8. **Dynamic Light Scattering (DLS):** This is a Zetasizer system by which the hydrodynamic diameter of nanosize systems is measured and refers to how a particle diffuses within a fluid. The current system has a resolution of < 1nm and it does not require any special sample preparation and high concentration and turbid samples can be measured.

9. **Spectroscopic Ellipsometer:** This is WVASE32 system (J. A. Woollam Co. Inc.) primarily used for measurement of the thickness of thin films

10. **Liquid Nitrogen Plant:** This is a Stirlab 200 (Stirling made) system with a production capacity of 1.7L/hour.

11. **Sputtering/evaporation unit:** This a HINDHIVAC made planar magnetron sputtering system equipped with dc and rf sputtering sources. The system can also be used in resistive evaporation mode with automated thickness control in different gaseous ambience. The system has substrate heating arrangement.

12. **Pulsed Laser Deposition (PLD) Unit:** This is a Pulsed Excimer Laser based thin film deposition unit. The Excimer laser (Compex Pro made by Coherent Inc.) delivers a maximum of 700mJ power at the wavelengths of 193 nm (ArF) and 248nm (KrF) with a repetition rate of 10 Hz. The deposition chamber (Ms. Excel Instruments) is equipped with turbo pump (base pressure ~ 10^{-7} mbar) and works under various gaseous environment. The substrate can be heated upto 900C and it has six automated target carousel.

The Technical Cell consists of the following members:

Dr. Anjan Barman (In-charge), Ms. Shohini Majumder (Member), Dr. Kaustuv Das (Member), Dr. Kinshuk Acharyya (Member), Dr. Barnali Ghosh (Member), Dr. Chayabrita Biswas (Member), Dr. Rajib Mitra (Member), Dr. Madhuri Mandal (Member), Dr. B. Rajanikanth (Member), Dr. Samir Pal (on sabbatical)

The Technical Cell has following staffs, who perform the daily operation and maintenance of the equipments under the Technical Cell. Some of them are also responsible for the Teaching Laboratory (C. K. M Laboratory).

Secretary: Mr. Shudhanshu Chakraborty; **Technical Assistants:** Mr. Shakti Nath Das, Ms. Piyali Bose, Mr. Surajit Mukherjee, Mr. Dipankar Roy, Mr. Subhabrata Chakraborty.

Anjan Barman
for Technical Cell

MECHANICAL WORKSHOP

In this year, the mechanical workshop has added a few hand held tools to its inventory, and did all the 124 works against the orders. As usual, it is catering to the needs of different labs, as well as to the various requirements of different departments.

In addition to the mechanical workshop, a new glass blowing facility has come up inside it. A new person was appointed on a contractual basis. Basic glassblowing equipments – like torches, oxygen and LPG cylinders, high vacuum pumping station and UHP argon flushing arrangements are available. He now works on quartz ampouling of samples and making of small glass apparatuses. His regular working day is Tuesday, but he can come on other days if required, and if prior intimation was given to him. Finally, the director inaugurated it on December 9, 2010.

Pratip Kumar Mukhopadhyay
In-charge, Mechanical Workshop

EXTENDED VISITORS' LINKAGE PROGRAMME

BOSE COLLOQUIUM

- Raj Nath Bhat, BHU, Varanasi, Swanimvijnan: Hind Arya Bhasha Samoh ke Sandarbh Mein, 23.04.2010
- Mukunda P Das, The Australian National University, Canberra, Australia, Super- Phenomea In Quantum Physics, 14.05.2010
- Sumit K Sen, Birdwatching - Citizens and Scinece, 21.05.2010
- Girish S Agarwal, Nobel Foundation Chair and Regents Professor, Oklahoma State University, USA, Electromagnetically Induced Transparency and Quantum Optics in Nano Mechanical Systems, 16.08.2010
- Prof. N Mukunda, Indian Institute of Science, Bangalore, The Relation Between Mathematics and Physics, 24.08.2010
- Deepak Dhar, Tata Institute of Fundamental Research, Mumbai, Equation of state of a model glass, 28.09.2010
- Richard Packard, University of California, Berkeley, Superfluid weak links; physics and applications, 18.11.2010

DISTINGUISHED LECTURES (Silver Jubilee Celebrations)

- S. C. Chakravarty, Ex Programme Director and Brahma Prakash (ISRO), Member, GB, ICSP, Kolkata, Honorary Scientist, Kalpana Chawla Centre for Space and Nano Sciences, Kolkata, Ionospheric Science- Overall Introduction, Basic Space Science- Introduction, Neutral Atmosphere and photochemistry (Spectroscopy), Troposphere-Stratosphere system (Ozone chemistry), Ionospheric layer formation and distribution, Mesospheric dynamics, D-region ion chemistry, Mesospheric response to solar eruptions, Ionospheric Observations and Techniques of measurements, Summary and Future Prospects, 10.11.2010 – 13.11.2010
- Lecture Series on Many Body Physics

a. David Logan, University of Oxford, Correlated Quantum Dots: how to start thinking about them (Parts I, II & III), 11.01.2011-13.01.2011

b. Krishnendu Sengupta, IACS, Kolkata, Aspects of Dirac materials: grapheme and topological insulators (Parts I, II & III) 12.01.2011- 14.01.2011

c. D Khomskii, University of Koeln, Germany,

(1) Orbitals, superstructures and spin gaps in correlated oxides;

(2) Multiferroics: different ways to combine magnetism and ferroelectricity;

(3) Spontaneous currents and polarization in Mott insulators: are electrons really localized?, 27.01.2011- 02.02.2011.

d. H.R. Krishnamurthy, IISc., Bangalore, Ultra Cold Atoms in Optical Lattice as Emulators of Strongly Correlated Quantum Systems (Parts I & II), 27.01.2011

e. Pinaki Majumdar, HRI, Allahabad, Many body theory in terms of coupled quantum- classical variables, from solid state to ultra cold atoms (Parts I, II & III), 31.01.2011-01.02.2011

- Yakov. M. Mukovskii, National Science and Technology University, Moscow, Russia,

(1) Growth of Magnetite single crystals, their real structure and properties;

(2) Anomalous Magnetic Behavior in $La_{1-x}A_xMnO_3$ (A=Ca, Ba) Single Crystal;

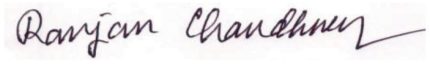
(3) Study of $La_{1-x}Ca_xMnO_3$ by Neutron Scattering;

(4) Thin film fabrication and their properties, 02.02.2011-04.02.2011

EVLP VISITORS

- Narayan Adhikari, Central Department of Physics, Tribhuvan University, Kathmandu, Nepal. 19.04.2010 - 26.04.2010 - visited Prof. Abhijit Mookerjee
- Gopi Kafle, JRF, Department of Physics, Tribhuvan University, Kathmandu, Nepal 19.04.2010 - 26.04.2010 - visited Prof. Abhijit Mookerjee
- Souvik Ghosh, University of North Bengal, Darjeeling. 19.04.2010 - 30.04.2010. - visited Prof. Archan S. Majumdar
- Andreas Fring, City University, London, 01.05.2010 - 08.05.2010 - visited Dr. Partha Guha.
- M. Sivakumar, School pf Physics, University of Hydrabad (Emergent gravity and matrix models), 07.05.2010 - 20.05.2010 - visited Prof. Rabin Banerjee
- Anjana Sinha, Applied Mathematics Department, Calcutta University (Non Hermitian Quantum Mechanical Systems Some Interesting Features), 20.05.2010 - visited Prof. Rabin Banerjee

- Bijay Singh, Department of Geology, Ranchi University, Jharkhand. 20.05.2010 - 02.06.2010 – visited Dr. Samir K. Pal
- Pradip Mukherjee, Department of Physics, Presidency College, Kolkata, 21.05.2010 - 20.06.2010 – visited Prof. Rabin Banerjee
- Swapan K Pati, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore (Modeling Charge Transport Through Molecular Junctions), 25.05.2010 - 29.05.2010 - visited Dr. Ranjit Biswas
- Anindya Ghose Choudhury, Department of Physics, Surendranath College, Kolkata, 26.05.2010 - 15.06.2010 – visited Prof. Jayanta K. Bhattacharya and Dr. Partha Guha
- Uttam K Bhui, School of Petroleum Technology, Pandit Deendayal Petroleum University, Gujarat, 27.05.2010 - 01.06.2010 – visited Dr. Rajib K. Mitra
- Rukmini Dey, HRI, Allahabad. 01.06.2010 - 30.06.2010- visited Dr. Samir K. Paul
- Joydeep Dutta, Centre of Excellence in Nanotechnology, Asian Institute of Technology, 04.06.2010 - 05.06.2010 - visited Dr. Samir K. Pal
- Mrinal Pal, Department of Physics, University of Burdwan, Burdwan. 04.06.2010 - 11.06.2010 – visited Dr. Samir K. Pal
- Tushar Kanti Dey, Guruchanran College, Silchar, Assam. 06.06.2010 - 20.06.2010 – visited Dr. Gautam Gangopadhyay
- Surajit Sen, Guruchanran College, Silchar, Assam 15.06.2010 - 30.06.2010 – visited Gautam Gangopadhyay
- Shalivahan, Indian School of Mines, Dhanbad 15.06.2010 - 01.07.2010 – visited Prof.Bimalendu B.Bhattacharya
- Sunandan Gangopadhyay, West Bengal State University, Barasat. 21.06.2010 - 12.07.2010 - visited Dr. Rabin Banerjee
- Nilashis Nandi, Department of Chemistry, Kalyani University, Nadia. (Steps of Protein Synthesis in Active Sites: Chirality and Fidelity application), 29.06.2010 – visited Dr. Ranjit Biswas
- Pulak R Giri, (Near horizon normal modes in black hole space-time), Former PDF of University de Montreal. 01.07.2010 - 31.08.2010 -visited Dr. Biswajit Chakraborty
- C.B. Basak, Bhabha Atomic Research Centre, Mumbai. 06.07.2010 - 23.07.2010 - visited Dr. Tanusri Saha Dasgupta
- Shailesh G. Kulkarni, Harish Chandra Research Institute, Allahabad 10.07.2010 - 25.07.2010 -visited Dr. Rabin Banerjee
- Girish Agarwal, University of Oklahoma, USA (Quantum interference and nonlocality of independent photons), 16.08.2010 - 17.08.2010 - visited Dr. Archan S. Majumdar
- Vasudeva Siruguri, UGC-DAE Consortuim for Scientific Research, Mumbai Centre, 21.09.2010 - 25.09.2010 – visited Prof. Arup K. Raychaudhuri and Dr. Barnali Ghosh
- Santabrata Das, (Intergalactic Magnetic Field and Arrival Direction of Ultra-High Energy Protons (Talk for Associateship)) IIT Guwahati, Assam, 04.10.2010 and 03.12.2010 - 28.12.2010 – visited Prof. Sandip K. Chakrabarti
- Omprakash P. Chimankar, Department of Physics, RTM, Nagpur university, Nagpur 18.10.2010 - 23.10.2010 – visited Dr. Subodh K Sharma
- Pradip Mukherjee, Department of Physics, Presidency College, Kolkata 25.10.2010 - 09.11.2010 – visited Dr. Rabin Banerjee
- V. Raja, Department of Physics, NBKR, Science & Arts College, Vidyanagar, Andra Pradesh 09.11.2010 - 13.11.2010 – visited Dr. Pratip K. Mukhopadhyay
- Mukunda P Das, Department of Theoritical Physics, The Australian National University, Canberra, Australia, 22.11.2010 -02.12.2010 – visited Dr. Ranjan Chaudhury
- Kotari Srinivas Rao, P.G. Centre, P.B. Siddarth College of Arts & Science, Vijaywada, Andhra Pradesh. 11.11. 2010 - 18.12. 2010 – visited Dr. Pratip K. Mukhopadhyay
- Kuldeep Kumar, Punjab University, Chandigarh. 13.12. 2010 - 07.01. 2011 - visited Prof. Rabin Banerjee
- H.S. Sharatchandra, The Institute of Mathematical Science, Chennai (3 lectures on Integrating topological degrees of freedom with perturbation theory - YM-3), 13.01.2011- 18.01. 2011 - visited Dr. Manu Mathur
- Tom Gehrels, Lifetime Fellow of PRL Ahmedabad. Also associated with Department of Planetary Sciences, The University of Arizona, USA (1.Planetary Explorations 2.The Multiverse Makes New Understanding Possible), 31.01. 2011 - 04.02. 2011 – visited Prof. Sandip K. Chakrabarti



Ranjan Chaudhury
Co-ordinator, EVLP

GUEST HOUSE

GUEST HOUSE

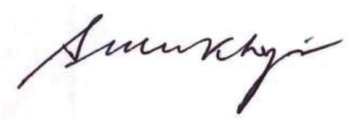
The Centre has its own modern guest house and cafeteria located within the premises. In the guest house there are five (5) fully air conditioned suites and three (3) transit rooms each having attached bath and kitchenette, four (4) double-bed and twenty seven (27) single bed air –conditioned fully furnished rooms. The second and the third floor of the guest house comprising forty four (44) single rooms and eight (8) double rooms are being presently used for accommodating students. A small seminar room with sitting capacity of thirty (30) people has been developed within the guest house premises for hosting seminars, conferences, meetings etc. The Centre has a modern cafeteria and a kitchen which serves around ninety (90) persons. Apart from serving regular meals to the staff members of the Centre and to the visitors, the cafeteria also serves as a venue for hosting lunches and hi-tea on special occasions viz. seminars, conferences etc. of the Centre. The guest house provides 24 hours STD/ISD, Internet, Laundromat, ATM and car parking facilities.

STUDENTS' HOSTEL

The Centre provides residential accommodation to around one hundred and thirty (130) students currently enrolled in various programmes. The second and third floor of guest house comprising forty four (44) single rooms and eight (8) double rooms are used for accommodating students. The New Hostel Block provides accommodation for thirty (30) students and Essential Staff Quarters has accommodation for approximately twenty (20) students. The remaining students, approximately thirty four (34) in number are provided accommodation in rented apartments located within close proximity to the Centre. The Centre also provides accommodation to post doctoral fellows. A large Hostel is being built within the campus of the Centre to accommodate all the students.

ESSENTIAL STAFF QUARTER

The Essential Staff Quarter building located within the Centre's premises currently houses several scientists and one permanent staff. Rest of the rooms provides accommodation to the students.



Sugata Mukherjee
Acting Registrar

THEORETICAL PHYSICS SEMINAR CIRCUIT

WORKSHOPS FUNDED

National Workshop on Quantum Perspective of Advanced Materials – 2011 (QPAM - 2011) – March 23 - 25, 2011; Organized by Vidyasagar University, Midnapore; Venue: DDE Hall, VU; Fund supported: 2.0 L; Total participants: 150 (student participants: 115; List of contributed papers: 19; Convener: Professor Radha Raman Pal, Department of Physics, VU.

VISITS AND SEMINARS

- Professor Puru Jena, "Hyperhalogens: Discovery of a new class of highly electronegative species", December 2010.
- Professor Sumit Agarwal, January 2011 – Collaboration with Professor Anita Mehta.
- Professor Pankaj Kumar Mishra, Collaborative work on Convective Turbulence, January 27 - February 4, 2011.
- Dr Tribikram Gupta, Institute of Mathematical Science, Chennai, (March 19 - April 18, 2010) Physics of interface: Mott insulator barrier sandwiched between two metallic planes.
- Dr Prasad Basu, Centre for High Energy Physics, IISc, Bangalore (March 15 - 19, 2010) - "Some aspects of twisted quantization; Effects on Quantum Statistics, Super conductivity and Quantum entanglement".
- Dr Rajesh Ravindran, IMSc Chennai (May 16 - 19, 2010) - "Shock propagation in a Granular Gas".
- Dr Krishna Kumar, Indian Institute of Technology, Kharagpur (July 12 - 15, 2010).
- Dr Tribikram Gupta, Institute of Mathematical Science, Chennai, (April 19 – May 18, 2010) Physics of interface: Mott insulator barrier sandwiched between two metallic planes.

DISBURSEMENT OF FUNDS

Total Amount of Fund disbursed: ` 6,00,000/-

MEETING OF THE TPSC CONVENERS

TPSC Conveners Meeting was held on 25.03.2011 in the Centre, which was attended by 11 TPSC Conveners. It was decided that the TPSC grants of Delhi, Allahabad, Kharagpur and Viswabharati will be discontinued due to non-performance.

TPSC grants of other institutes receiving a grant of ` 50,000/- may be raised to ` 75,000/-. It was also decided that TPSC will make an impact assessment of its performance over last 10 years.

Sugata Mukherjee
Convener, Theoretical Physics Seminar Circuit

CRÈCHE

Kishlay – A home away from home for the children of staff and students of S. N. Bose National Centre for Basic Sciences was inaugurated within the Centre's premises on 4 August 2010.

The purpose of Kishlay is to meet, to the best of ability, the child's basic needs (social, intellectual, physical and emotional) with love, integrity, hard work and self-discipline. Kishlay provides a nurtured environment where the child can build a foundation for continued learning.

Kishlay also provides a family – friendly workplace for its employees. Parents need to be assured that their children are being looked after in an environment, which is safe and provides a stimulus for intellectual as well as emotional growth leading to increased productivity at the workplace.

Shohini Majumder
Deputy Registrar, Administration

CULTURAL PROGRAMMES

Throughout the year, the Centre organized a number of cultural events to ensure that there is healthy interaction between all the staff and students of the Centre.

On the occasion of 64th Independence Day on 15th August 2010, Prof. Jayanta Kumar Bhattacharyya, Distinguished Professor and Dean (Faculty) hoisted the national flag. To celebrate the 62nd Republic Day on 26th January 2011, Prof. Arup Kumar Raychaudhuri, Director hoisted the national flag. On both the occasions, national anthem was sung by students and staff present and parade was performed by the Centre's Security personnel. On this occasion small replicas of national flag were distributed amongst the members present in the gathering and tea and snacks were served in the canteen.

The Centre celebrated Satyendra Nath Bose's 117th birthday on 1st January 2011. The bust of Satyendra Nath Bose was garlanded by the Director and other senior faculties and sweets were distributed on the occasion.

On the occasion of Bose Fest held during 28-29 January 2011, Family Day was celebrated on the evening of 29th January 2011. Famous Bangla band, "Surma Dohar" performed folk songs. The function was followed by a grand dinner. The programme was attended by friends and family members of staff and students and was a huge success.

Like in previous years, the Centre also organised number of programmes for the Hindi Month. As a part of the programme, the following programme was undertaken:

- √ Signing of Attendance Register in Hindi
- √ Quiz programme in Hindi
- √ Every day one new Hindi word with its English meaning displayed in the Reception area.
- √ Cultural programme.

The official inauguration of the Hindi Diwas was made by the Director on 14th September, 2010. Also present on the occasion were Dy. Director, Hindi Teaching Scheme (ER), Hindi Teacher and Head, Dept. of Hindi, Presidency University.

The Centre also organised a one-act-play named 'Antar hote udas' by Dolly Bose and rendering of songs by Mr. Ashok Tripati in Rabindra Okakura Bhawan on 23rd September, 2010.

The students and staff of the Centre together organised a cultural night to mark the Silver Jubilee celebrations of the Centre. On 1st October 2010, they presented an evening of songs, dance, recitations, instrumental performance, Bengali skit and a dance-drama called "Agomoni" at the Easter Zonal Cultural Centre. The function was attended by all students and staff members, their family members and friends who have been a part of the Centre in the last 25 years. The cultural function was followed by a grand dinner. The programme was a grand success.

Somajumder

Shohini Majumder
Deputy Registrar, Administration

OPTICAL PROCESSES IN MICROCAVITIES
BEAUTY OF PHYSICS
Modern Mathematical Phys
QUANTUM THEORY OF MANY-PARTICLE SYSTEMS
Wavelets in Physics

PUBLICATIONS

LIST OF PUBLICATIONS

ASTROPHYSICS AND COSMOLOGY

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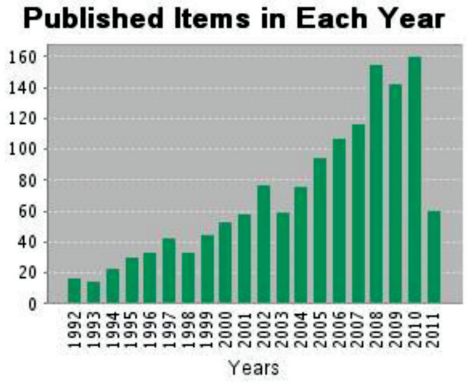

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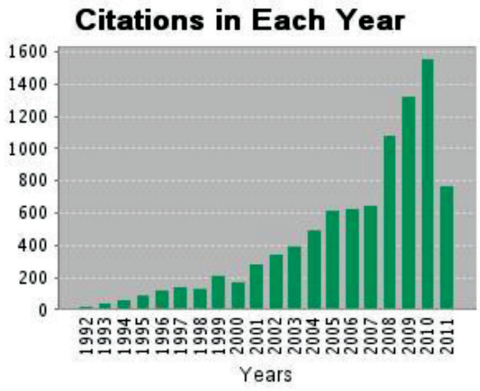


The latest 20 years are displayed.

Results found	:	1,428
Sum of the Times Cited	:	9,213
Average Citations per Item	:	6.45
h-index	:	37

Total no. of Papers published	Total no. of Citation received	Citations per paper	Citation per year*	h - index
1428	9213	9213/1428 = 6.45	9213/24 = 383.88	37

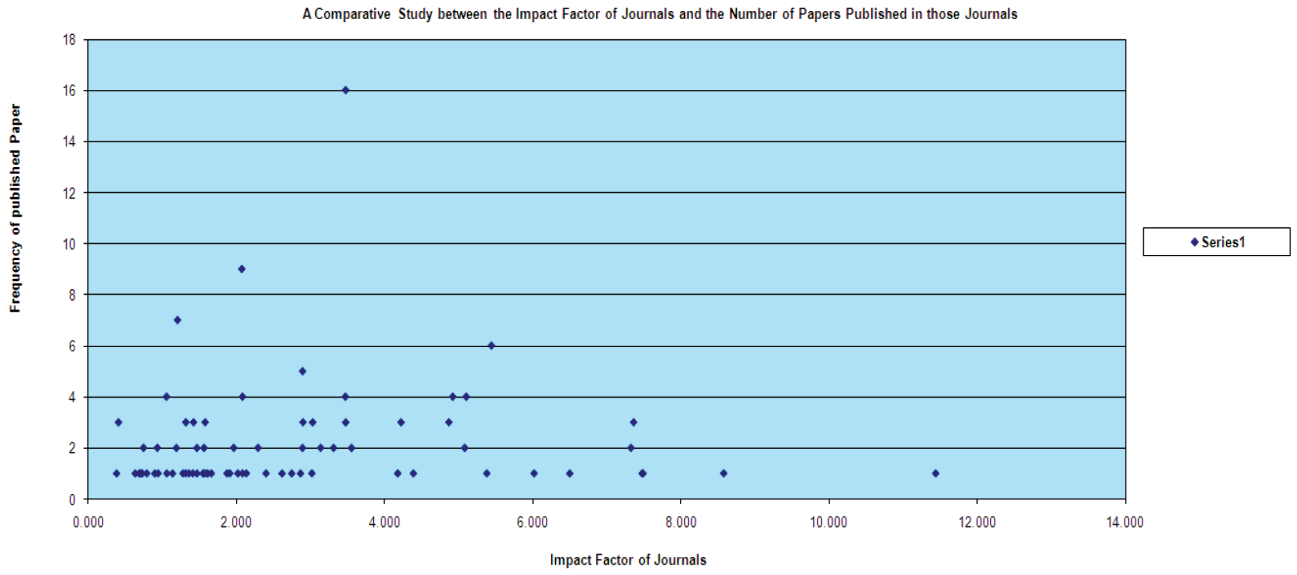
*Year of establishment of the centre is 1986. Citation received from 1987 to 2011 = 24 years

IMPACT FACTOR CHART

SL	Name of Journal	Jr. Impact Factor	NO. OF PAPERS PUBLISHED	Total of Impact factor in the Journal
1	ACS NANO	7.493	1	7.493
2	Applied Optics	1.410	1	1.410
3	Applied Physics Letters	3.554	2	7.108
4	Astron. and Astrophys.	4.179	1	4.179
5	Astrophysical Journal	7.364	3	22.092
6	Biophysical Journal	4.390	1	4.390
7	Central Eur. J. Phys.	0.728	1	0.728
8	Chemical Physics Letters	2.291	2	4.582
9	Chemistry: A European Journal	5.382	1	5.382
10	Class. Quant. Grav.	3.029	3	9.087
11	Communications in Nonlinear Science and Numerical Simulation	0.931	2	1.862
12	Eur. Phys. J. B	1.466	2	2.932
13	Eur. Phys.J. C	2.746	1	2.746
14	Eur. Phys.J. D	1.420	3	4.260
15	Eur. Phys.J. E	2.019	1	2.019
16	European Journal of Physics B	1.466	1	1.466
17	Europhys.Lett.	2.893	2	5.786
18	Exp. Astron.	5.444	6	32.664
19	Gen.Rel.Grav.	2.616	1	2.616
20	Geophysics	1.662	1	1.662
21	IEEE transactions on Magnetics	1.061	1	1.061
22	InJPh	0.701	1	0.701
23	Int. J. Geometrical Methods in Modern Physics	1.612	1	1.612
24	Int. J. Mod. Phys. B	0.408	3	1.224
25	Int. J. Mod. Phys. D.	1.550	1	1.550
26	Int. J. Theor. Phys	0.688	1	0.688
27	Int. J. Theor. Phys. Gp. Theor. Nonln. Opt.	0.899	1	0.899
28	Int. Jr. Quant. Inf.	0.632	1	0.632
29	J. Am. Chem. Soc. (Communication)	8.580	1	8.580
30	J. Cosmol. Astropart. Phys.	6.502	1	6.502
31	J. Photochem. Photobiol. B	1.871	1	1.871
32	J. Phys : Condens Matter	1.964	2	3.928
33	J. Phys. A	1.577	3	4.731
34	J. Phys. B	1.910	1	1.910
35	J. Phys. Chem. C.	4.224	3	12.672

SL	Name of Journal	Jr. Impact Factor	NO. OF PAPERS PUBLISHED	Total of Impact factor in the Journal
36	J. Phys. D: Appl. Phys., fast track communication	2.083	1	2.083
37	Japanese Journal of Applied Physics	1.138	1	1.138
38	JHEP	6.019	1	6.019
39	Jour. Math. Phys	1.318	3	3.954
40	Journal of Alloys and Compounds	2.134	1	2.134
41	Journal of Applied Physics	2.072	9	18.648
42	Journal of Chemical Sciences	0.745	2	1.490
43	Journal of Colloid and Interface Science	3.019	1	3.019
44	Journal of Magnetism and Magnetic Materials	1.204	7	8.428
45	Journal of modern optics	0.942	1	0.942
46	Journal of Physical Chemistry A	2.899	3	8.697
47	Journal of Physical Chemistry B	3.471	4	13.884
48	Journal of Physics D: Applied Physics	2.083	4	8.332
49	MNRAS	5.103	4	20.412
50	Nanoscale	2.894	5	14.470
51	Nanotechnology	3.137	2	6.274
52	Nat. Haz. Earth. Syst. Sc.	1.357	1	1.357
53	New Journal of Physics	3.312	2	6.624
54	Nuclear Instruments and Methods in Physics Research Section A	1.317	1	1.317
55	Nucleic Acids Research	7.479	1	7.479
56	Phys Rev B	3.475	16	55.600
57	Phys Rev B (Rapid Commun)	3.475	3	10.425
58	Phys Rev E	2.400	1	2.400
59	Phys. Chem. Minerals	1.597	1	1.597
60	Phys. Rev. A	2.866	1	2.866
61	Phys. Rev. Lett.	7.328	2	14.656
62	Phys.Lett. B	5.083	2	10.166
63	Phys.Rev. D	4.922	4	19.688

SL	Name of Journal	Jr. Impact Factor	NO. OF PAPERS PUBLISHED	Total of Impact factor in the Journal
64	Physica A	1.562	2	3.124
65	Physica B	1.056	4	4.224
66	Physica C	0.723	1	0.723
67	Proc. Indian Acad. Sci., Math. Sci.	0.382	1	0.382
68	Protein Expression and Purification	1.563	1	1.563
69	Rep Prog Phys	11.444	1	11.444
70	Reviews in Mathematical Physics	1.190	2	2.380
71	Soft Matter	4.869	3	14.607
72	Symmetry, Integrability and Geometry: Methods and Appl.(SIGMA)	0.789	1	0.789
73	Theory in Biosciences	1.278	1	1.278
74	Canadian Acoustics	New Journal	1	
75	Nanoscience and nanotechnology letters	New Journal	1	
76	Nature Comm	New Journal	1	
	Total		**162.000**	**467.638**




सितम्बर 2010
राजभाषा हिन्दी महीना


S. N. BOSE
1894-1974


S. N.

ACCOUNTS

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES
BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

BUDGET SUMMARY 2010-2011

The funds come from the Department of Science and Technology, New Delhi. The following is the summary of the budget estimates for the year 2010-11.

			Figure in Lakhs (₹)
	Actuals 2009-2010	Budget Estimate 2010-2011	Revised Estimate 2010-2011
Non-Plan	24.94	26.88	25.14
Plan	2799.15	3148.21	3072.14
TOTAL	**2824.09**	**3175.09**	**3097.28**

*Sanctioned by DST Plan ` 2872 lakhs, Non-Plan ` 28 lakhs and released as under:

Non-Plan

1.	Sanction Letter No. AI/SNB/003/2010/NP dated 09.07.10	₹ 2500000
2.	Sanction Letter No.AI/SNB/003/2010/NP/2 dated 03.03.11	₹ 300000
		₹ 2800000

Plan		
1.	Sanction Letter No. AI/SNB/003/1/2010 dated 28.04.10	₹ 47600000
2.	Sanction Letter No. AI/SNB/003/2010/2 dated 19.06.10	₹ 68900000
3.	Sanction Letter No. AI/SNB/003/2010/3 dated 30.08.10	₹ 73185500
4.	Sanction Letter No. AI/SNB/003/2010/4 dated 13.09.10	₹ 48790300
5.	Sanction Letter No. AI/SNB/003/2010/5 dated 29.12.10	₹ 30000000
6.	Sanction Letter No. AI/SNB/003/2010/6 dated 04.02.11	₹ 15000000
7.	Sanction Letter No. AI/SNB/003/2010/FINAL dated 17.03.11	₹ 3724200
		₹ 290000000
TOTAL		₹ **287200000**

For ROY & BAGCHI
Chartered Accountants

1A, Raja Subhodh Mullick Square
3rd Floor, Kolkata – 700 013
Phone No. (033) 2236 8172
Fax No. (033) 2225 2338
E-mail: roybagchi@vsnl.net

AUDITORS' REPORT TO THE GOVERNING BODY OF
SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

1. We have audited the attached BALANCE SHEET of Satyendra Nath Bose National Centre for Basic Sciences, as at 31st March, 2011 and also the INCOME AND EXPENDITURE ACCOUNT for the year ended on that date annexed thereto. These financial statements are the responsibility of the Centre's management. Our responsibility is to express an opinion on these financial statements based on our audit.

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

3. (i) We have obtained all the information and explanations, which to the best of our knowledge and belief were necessary for the purpose of our audit.

   (ii) In our opinion, proper books of account as required by law have been kept by the Centre so far as appears from our examination of those books.

   (iii) The Balance Sheet and the Income and Expenditure Account dealt with by this report are in agreement with the books of account.

   (iv) In our opinion, the Balance Sheet and the Income and Expenditure Account dealt with by this report comply with the applicable accounting standards.

4. In our opinion and to the best of our information and according to the explanations given to us, the said accounts give a true and fair view in conformity with the accounting principles generally accepted in India.

   (i) in the case of the Balance Sheet, of the state of affairs of the Centre as at 31st March 2011 ; and

   (ii) in the case of the Income and Expenditure Account, of the surplus for the year ended on that date.

Date: 24.06.2011
Place: Kolkata

For ROY & BAGCHI
Chartered Accountants

(Amit Mitra)
Partner

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES
BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

BALANCE SHEET AS AT 31ST MARCH 2011			
	Schedule	Current Year	Previous Year
FUNDS AND LIABILITIES		₹	₹
CORPUS/CAPITAL FUND	1	738682068.05	595334394.38
RESERVES AND SURPLUS	2	-	
EARMARKED/ENDOWMENT FUNDS	3	101739937.75	87729719.75
SECURED LOANS AND BORROWINGS	4		
UNSECURED LOANS AND BORROWINGS	5		
DEFERRED CREDIT LIABILITIES	6		
CURRENT LIABILITIES AND PROVISIONS	7	23122846.69	39091197.69
TOTAL		**863544852.49**	**722155311.82**
ASSETS			
FIXED ASSETS	8	557412114.27	456263823.77
INVESTMENTS-FROM EARMARKED/ENDOWMENT FUNDS	9	21586378.00	27363302.00
INVESTMENTS - OTHERS	10	161989592.00	96442875.00
CURRENT ASSETS, LOANS, ADVANCES ETC.	11	122556768.22	142085311.05
MISCELLANEOUS EXPENDITURE (to the extent not written off or adjusted)			
TOTAL		**863544852.49**	**722155311.82**
SIGNIFICANT ACCOUNTING POLICIES	24		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		

Per our report of even date

Date: 24.06.2011
Place: Kolkata

For ROY & BAGCHI
Chartered Accountants

(Amit Mitra)
Partner

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES
BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH 2011			
	Schedule	Current Year	Previous Year
INCOME		₹	₹
Income from Sales/Services	12	2275668.50	1871922.50
Grants/Subsidies	13	140060788.00	121358146.00
Fees/Subscriptions	14		
Income from Investments (Income on Investment from earmarked/endowment Funds transferred to Funds)	15		
Income from Royalty, Publication etc.	16		
Interest Earned	17	7240634.00	3685626.00
Other Income	18	1015339.00	1719808.96
Increase/(decrease) in stock of finished goods and works-in-progress	19		
TOTAL (A)		**150592429.50**	**128635503.46**
EXPENDITURE			
Establishment Expenses	20	59559351.00	64811226.00
Other Administrative Expenses etc.	21	78475566.83	60062447.76
Expenditure on Grants, Subsidies etc.	22		
Interest	23		
TOTAL (B)		**138034917.83**	**124873673.76**
Balance being excess of Income over Expenditure(A-B)		12557511.67	3761829.70
Prior period adjustments (Credit)		332860.00	13177.00
Transfer to/from Corpus / Capital Fund			
BALANCE BEING SURPLUS/(DEFICIT) CARRIED TO CORPUS/CAPITAL FUND		**12890371.67**	**3775006.70**
SIGNIFICANT ACCOUNTING POLICIES	24		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		

Per our report of even date

Date: 24.06.2011
Place: Kolkata

For ROY & BAGCHI
Chartered Accountants

(Amit Mitra)
Partner

RECEIPTS	Current Year	Previous Year	PAYMENTS	Current Year	Previous Year
I. Opening Balances			**I. Expenses :**		
a) Cash in hand	12816.00	17216.00	a) Establishment Expenses	69087344.00	62148523.00
b) Bank Balances :			b) Administrative Expenses	81834332.00	69012673.50
I. In current accounts	34845481.85	30764265.87			
ii. In deposit accounts			**II. Payments made against funds for various Projects**		
Schedule - 10	96442875.00	30063004.00			
Schedule - 11A	51523070.00	10401082.00			
iii. Savings accounts	24090014.02	18921338.00			
iv. Remittance-in-Transit					
II. Grants Received			**III. Investments and deposits made**		
a) From Government of India			a) Out of Earmarked/Endowment/ Own funds	78850495.00	9613409.00
-For the year	345197345.00	355602164.00	b) CPWD Deposit and NBCC Deposit	45841211.00	25782513.00
-For the previous year			c) Bank Gurantee & LC A/C	295880.00	33863360.00
b) From State Government					
c) From Other sources (details)					
(Grants for capital & revenue exp.					
To be shown separately)					
			IV. Expenditure on Fixed Assets & Capital Work-in-Progress		
			a) Purchase of Fixed Assets	103182395.50	60010439.00
			b) Expenditure on Capital Work-in-Progress		1775997.00

contd

continues

RECEIPTS	Current Year	Previous Year	PAYMENTS	Current Year	Previous Year
III. Income on Investments from					
a) Earmarked/Endow Funds					
b) Own Funds (Oth. Investment)	6373921.00	2605376.00	**V. Refund of surplus money/Loans**		
			a) To the Government of India		
IV. Interest Received			b) To the State Government		
a) On Bank deposits	868941.00	1139702.00	c) To other providers of funds		
			VI. Finance Charges (Interest)		
V. Other Income	4098275.50	2631798.50			
`			**VII. Other Payments**	23082306.00	26122152.00
VI. Amount Borrowed					
			VIII. Closing Balances		
VII. Any other receipts	12961996.00	1975389.00	a) Cash in hand	28797.00	12816.00
			b) Bank Balances :		
VIII. Amount transferred to Current	79146375.00	41121988.00	I. In current accounts	39835843.85	33310293.85
/Savings Account from Deposit Account			ii. In deposit accounts		
			Schedule - 10	161989592.00	96442875.00
			Schedule - 11A	14524667.00	51523070.00
			iii. Savings accounts	37008247.02	25625202.02
			iv. Remittance-in-Transit	-	
	655561110.37	**495243323.37**		**655561110.37**	**495243323.37**

Per our report of even date

Date: 24.06.2011
Place: Kolkata

For ROY & BAGCHI
Chartered Accountants

(Amit Mitra)
Partner

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES
BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31.03.2011				
SCHEDULE 1 - CORPUS/CAPITAL FUND:	**Current Year**		**Previous Year**	
	₹	₹	₹	₹
Balance as at the beginning of the year	595334394.38		431381536.24	
Add : Contributions towards Corpus/Capital Fund	149939212.00		182141854.00	
Less:Depreciation for the year	19481910.00		21293601.21	
Add : Surplus during the year	12890371.67		3775006.70	
Add : Adjustment for Depreciation (Last Year)	0		5093064.38	
Less: Adjustment for Last Year (Revenue Items)	0		57,63,465.73	595334394.38
		73,86,82,068.05		
BALANCE AS AT THE YEAR - END		**738682068.05**		**595334394.38**
	Current Year		**Previous Year**	
	₹	₹	₹	₹
SCHEDULE 2 - RESERVES AND SURPLUS:				
1. Capital Reserve:				
As per last Account				
Addition during the year				
Less: Deductions during the year				
2. Revaluation Reserve:				
As per last Account				
Addition during the year				
Less: Deductions during the year				
3. Special Reserves:				
As per last Account				
Addition during the year				
Less: Deductions during the year				
4. General Reserve:				
As per last Account				
Add : Surplus during the year		-		-
TOTAL		-		-

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES
BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31.03.2011

Amount ₹

SCHEDULE 3 - EARMARKED/ ENDOWMENT FUNDS	FUND-WISE BREAK UP				TOTAL	
	Project Fund	Medical fund	Leave Salary	Gratuity Fund	Current Year	Previous Year
a) Opening balance of the funds	54809862.75	1123108.00	17164978.00	14631771.00	87729719.75	79565843.75
b) Additions to the Funds						
I) Donations/grants/ Contributions						
ii) Income from investments made on account of funds	59780345.00	457433.00			60237778.00	51519678.00
iii) Other additions -Provision during the year	792250.00		930759.00	713313.00	2436322.00	2290537.00
			2714826.00	2696630.00	5411456.00	4337749.00
TOTAL (a + b)	**115382457.75**	**1580541.00**	**20810563.00**	**18041714.00**	**155815275.75**	**137713807.75**
c) Utilisation/Expenditure towards objectives of funds						
I) Capital Expenditure	23452984.00				23452984.00	24501215.00
Fixed Assets						
Others						
Total						
ii) Revenue Expenditure						
Salaries, Wages and allowances etc.	16682282.00				16682282.00	9831309.00
Rent						
Other Administrative expenses						
Other Payments	11771533.00		1059230.00	1109309.00	13940072.00	14651564.00
iii) Adjustment (Interest)						1000000.00
TOTAL (c)	**51906799.00**	**-**	**1059230.00**	**1109309.00**	**54075338.00**	**49984088.00**
NET BALANCE AS AT THE YEAR-END (a+b-c)	**63475658.75**	**1580541.00**	**19751333.00**	**16932405.00**	**101739937.75**	**87729719.75**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES
BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31.03.2011				
				Amount ₹
	Current Year		Previous Year	
SCHEDULE 4 - SECURED LOANS AND BORROWINGS:				
1. Central Government				
2. State Government (Specify)				
3. Financial institutions				
a) Term Loans				
b) Interest accrued and due				
4. Banks:				
a) Term Loans				
Interest accrued and due				
b) Other Loans (Specify)				
Interest accrued and due				
5. Other Institutions and Agencies				
6. Debentures and Bonds				
7. Others (Specify)				
TOTAL	Nil	Nil	Nil	Nil

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES
BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31.03.2011				
				(Amount - ₹)
	Current Year		Previous Year	
SCHEDULE 5 - UNSECURED LOANS AND BORROWINGS				
1. Central Government				
2. State Government (Specify)				
3. Financial Institutions				
4. Banks:				
a) Term Loans				
b) Other Loans (Specify)				
5. Other Institutions and Agencies				
6. Debentures and Bonds				
7. Fixed Deposits				
8. Others (Specify)				
TOTAL	**Nil**	**Nil**	**Nil**	**Nil**
SCHEDULE 6 - DEFERRED CREDIT LIABIILTIES:	**Current Year**		**Previous Year**	
a) Acceptances secured by hypothecation of capital equipment and other assets				
b) Others				
TOTAL	**Nil**	**Nil**	**Nil**	**Nil**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES
BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31.03.2011				
				(Amount - ₹)
	Current Year		Previous Year	
SCHEDULE 7 - CURRENT LIABILITIES AND PROVISIONS				
A. CURRENT LIABILITIES				
1. Acceptances				
2. Sundry Creditors:				
a) For Capital expenditure	9260733.00			24576517.00
b) Others - Revenue expend.(including Project Rs.30000.00)	4534687.00			4596388.00
3. Advances Received				
4. Interest accrued but not due on:				
a) Secured Loans/borrowings				
b) Unsecured Loans/borrowings				
5. Statutory Liabilities:				
a) Overdue				
b) Others				
6. Other Current Liabilities	9256770.69			9847636.69
TOTAL (A)	**23052190.69**	**-**		**39020541.69**
B. PROVISIONS				
1. For Taxation				
2. Gratuity				
3. Superannuation/Pension				
4. Accumulated Leave Encashment				
5. Trade Warranties/Claims				
6. Others - Adhoc Bonus	70656.00			70656.00
TOTAL (B)	**70656.00**	**-**		**70656.00**
TOTAL (A + B)	**23122846.69**	**-**		**39091197.69**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES
BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31.03.2011

SCHEDULE 8 - FIXED ASSETS

DESCRIPTION	GROSS BLOCK			
	Cost/valuation As at beginning of the year	Additions during the year	Deductions during the year	
A. FIXED ASSETS:				
1. LAND:				
a) Freehold				
b) Leasehold	10950654.60			
2. BUILDINGS:				
a) On Freehold Land				
b) On Leasehold Land	169961987.86	6736196.00		
c) Ownership Flats/Premises				
d) Superstructures on Land not belonging to the entity				
3. PLANT MACHIENRY & EQUIPMENT	154954334.22	57082509.00		
4. VEHICLES	321013.00			
5. FURNITURE, FIXTURES	23829679.22	2566737.00		
6. OFFICE EQUIPMENT	1621091.29	344414.00		
7. COMPUTER/PERIPHERALS	39992085.44	5243912.00		
8. ELECTRIC INSTALLATIONS	5379058.00			
9. LIBRARY BOOKS	134612232.61	20963454.50		
10. TUBEWELLS & W.SUPPLY				
11. OTHER FIXED ASSETS	84225.55			
TOTAL OF CURRENT YEAR	**541706361.79**	**92937222.50**	**-**	
PREVIOUS YEAR	**487759014.52**	**59710813.00**	**57,63,465.73**	
B. CAPITAL WORK IN PROGRESS	**20976481.00**	**48658602.00**	**20965624.00**	
TOTAL (A + B)	**562682842.79**	**141595824.50**	**20965624.00**	

(Amount - ₹)

		DEPRECIATION			NET BLOCK	
Cost/valuation at the year-end	As at the beginning of the year	Additions during the year	Deductions during the year	Total up to the Year-end	Current year-end	Previous year-end
10950654.60	-			-	10950654.60	10950654.60
176698183.86	20533580.24	2451609.00		22985189.24	153712994.62	149428407.62
212036843.22	20585206.61	7930771.00		28515977.61	183520865.61	134369127.61
321013.00	319655.19	129.00		319784.19	1228.81	1357.81
26396416.22	9520468.53	970430.00		10490898.53	15905517.69	14309210.69
1965505.29	427698.65	69002.28		496700.93	1468804.36	1193392.64
45235997.44	24966393.96	2531241.00		27497634.96	17738362.48	15025691.48
5379058.00	1621093.20	178504.00		1799597.20	3579460.80	3757964.80
155575687.11	28418255.63	5347489.72		33765745.35	121809941.76	106193976.98
					-	
84225.55	26667.01	2734.00		29401.01	54824.54	57558.54
634643584.29	**106419019.02**	**19481910.00**	**-**	**125900929.02**	**508742655.27**	**435287342.77**
541706361.79	**90218482.19**	**21293601.99**	**(50,93,065.16)**	**106419019.02**	**435287342.77**	**397540532.33**
48669459.00					**48669459.00**	**20976481.00**
683313043.29	**106419019.02**	**19481910.00**	**-**	**125900929.02**	**557412114.27**	**456263823.77**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES
BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31.03.2011		
		(Amount - ₹)
SCHEDULE 9 - INVESTMENTS FROM EARMARKED/ENDOWMENT FUNDS	**Current Year**	**Previous Year**
1. In Government Securities		
2. Other approved Securities		
3. Shares		
4. Debentures and Bonds		
5. Subsidiaries and Joint Ventures		
6. Others - Fixed Deposit with Nationalised Banks		
Gratuity Fund Investment	9770433.00	12704930.00
Leave Salary Fund Investment	11815945.00	14658372.00
TOTAL	**21586378.00**	**27363302.00**
SCHEDULE 10 - INVESTMENTS - OTHERS	**Current Year**	**Previous Year**
1. In Government Securities		
2. Other approved Securities		
3. Shares		
4. Debentures and Bonds		
5. Subsidiaries and Joint Ventures		
6. Others - Fixed Deposit with Nationalised Banks	161989592.00	96442875.00
TOTAL	**161989592.00**	**96442875.00**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES
BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31.03.2011

(Amount - ₹)

SCHEDULE 11 - CURRENT ASSETS, LOANS, ADVANCES ETC.	Current Year		Previous Year	
A. CURRENT ASSETS:				
1. Inventories:				
a) Stores and Spares		127984.35		159872.18
b) Loose Tools				
c) Stock-in-trade				
Finished Goods				
Work-in-progress				
Raw Materials				
Stock of Books				
2. Sundry Debtors:				
a) Debts Outstanding for a period exceeding six months				
b) Others				
3) Cash balances in hand		28797.00		12816.00
4) Bank Balances:				
a) With Scheduled Banks:				
On Current Accoutns(including Project A/C Rs. 21332181.73)		39835843.85		33310293.85
On Deposit Accounts for LC&BG (includes Project Rs.3764604)		14524667.00		51523070.00
On Savings Accounts (Project A/C)		34719280.02		23971754.02
b) With non-Scheduled Banks:				
On Current Accounts				
On Deposit Accounts				
On Savings Accounts (includes Project A/C Rs.238599)		2288967.00		1653448
5. Remittance - in - Transit				
6. Post Office-Savings Accounts				
TOTAL (A)		**91525539.22**		**110631254.05**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES
BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

SCHEUDLES FORMING PART OF BALANCE SHEET AS AT 31.03.2011

(Amount - ₹)

SCHEDULE 11 - CURRENT ASSETS, LOANS, ADVANCES ETC. (Contd.)	Current Year		Previous Year	
B. LOANS, ADVACNES AND OTHER ASSETS				
1. Loans:				
a) Staff including HBA ,Vehicle &PC Advance(includes Project A/c Rs. 70000)		2259086.00		3093010.00
b) Other Entitites engaged in activities/objectives similar to that of the Entity				
c) Other - Project A/c		-		
2. Advances and other amounts recoverable in cash or in kind				
or for value to be received:				
a) On Capital Account - CPWD Deposit Account		21296671.00		23140890.00
b) Prepayments				
c) Others (Security Deposits)		500104.00		92218.00
d) Contractors & Suppliers (includes Project A/C Rs 17452)		159817.00		541941.00
3. Income Accrued:				
a) On Investments from Earmarked/Endowment Funds		5574055.00		4200172.00
b) On investmetns - Others		1241496.00		385826.00
c) On Loans and Advances				
d) Others				
4. Claims Receivable - Grant -in- Aid Receivable				-
TOTAL (B)		**31031229.00**		**31454057.00**
TOTAL (A + B)		**122556768.22**		**142085311.05**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES
BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31.03.2011		
		(Amount - ₹)
SCHEDULE 12 - INCOME FROM SALES/SERVICES	**Current Year**	**Previous Year**
1) Income from Sales		
a) Sale of Finished Goods		
b) Sale of Raw Material		
c) Sale of Scraps		
2) Income from Services		
a) Labour and Processing Charges		
b) Professional/Consultancy Services		
c) Agency Commission and Brokerage		
d) Maintenance Services (Equipment/Property)		
e) Others	2275668.50	1871922.50
TOTAL	**2275668.50**	**1871922.50**
SCHEDULE 13 - GRANTS/SUBSIDIES (Irrevocable Grants & Subsidies Received)	**Current Year**	**Previous Year**
1) Central Government	140060788.00	121358146.00
2) State Government(s)		
3) Government Agencies		
4) Institutions/Welfare Bodies		
5) International Organsations		
6) Others		
TOTAL	**140060788.00**	**121358146.00**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES
BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31.03.2011		
		(Amount - ₹)
SCHEDULE 14 - FEES/SUBSCRIPTIONS	**Current Year**	**Previous Year**
1) Entrace Fees 2) Annual Fees/Subscriptions 3) Seminar/Program Fees 4) Consultancy Fees 5) Others		
TOTAL	Nil	Nil
Note: Accounting Policies towards each item are to be disclosed		

				(Amount - ₹)
SCHEDULE 15 - INCOME FROM INVESTMENTS	**Investment from Earmarked Fund**		**Investment - Others**	
(Income on Invest. From Earmarked/Endowment Funds transferred to Funds)	**Current Year**	**Previous Year**	**Currnet Year**	**Previous Year**
1) Interest a) On Govt. Securities b) Other Bonds/Debentures 2) Dividents: a) On Shares b) On Mutual Fund Securities 3) Rents 4) Others				
TOTAL	**Nil**	**Nil**	**Nil**	**Nil**
TRANSFERRED TO EARMARKED/ENDOWMENT FUNDS	**Nil**	**Nil**	**Nil**	**Nil**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES
BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31.03.2011		
		(Amount - ₹)
SCHEDULE 16 - INCOME FROM ROYALTY, PUBLICATION ETC.	**Current Year**	**Previous year**
1. Income from Royalty		
2. Income from Publications		
3. Others		
TOTAL	**Nil**	**Nil**
SCHEDULE 17 - INTEREST EARNED	**Current Year**	**Previous year**
1) On Term Deposits:		
a) With Scheduled Banks	6858859.00	3444309.00
b) With Non-Scheduled Banks	151982.00	54624.00
c) With Institutions		
d) Others		
2) On Savings Accounts:		
a) With Scheduled Banks		
b) With Non-Scheduled Banks	76691.00	19,775.00
c) Post Office Savings Accounts		
d) Others		
3) On Loans:		
a) Employees/Staff	153102.00	1,66,918.00
b) Others		
4) Interest on Debtors and Other Receivables		
TOTAL	**7240634.00**	**3685626.00**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES
BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31.03.2011		
		(Amount - ₹)
SCHEDULE 18 - OTHER INCOME	**Current Year**	**Previous Year**
1) Profit on Sale/disposal of Assets:		
a) Owned assets		
b) Assets acquired out of grants, or received free of cost		
2) Export Incentives realized		
3) Fees for Miscellaneous Services		
4) Miscellaneous Income	1015339.00	1719808.96
TOTAL	**1015339.00**	**1719808.96**
SCHEDULE 19 - INCREASE/(DECREASE) IN STOCK OF FINISHED GOODS & WORK IN PROGRESS	**Current Year**	**Previous Year**
a) Closing stock		
Finished Goods		
Work-in-progress		
b) Less: Opening Stock		
Finished Goods		
Work-in-progress		
NET INCREASE/(DECREASE) [a-b]	**Nil**	**Nil**
SCHEDULE 20 - ESTABLISHMENT EXPENSES	**Current Year**	**Previous Year**
a) Salaries and Wages		
b) Other Allowances and Bonus	49107323.00	54610977.00
c) Contribution to Provident Fund	71625.00	67025.00
d) Contribution to Other Fund - Gratuity Fund , Leave Salary Fund etc	2029073.00	3447432.00
e) Staff Welfare Expenses (Medical)	5560614.00	4260224.00
f) Contribution to NPS	943936.00	1464682.00
f) Others	254899.00	64423.00
	1591881.00	896463.00
TOTAL	**59559351.00**	**64811226.00**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES
BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31.03.2011

(Amount - ₹)

SCHEDULE 21 - OTHER ADMINISTRATIVE EXPENSES ETC.	Current Year	Previous Year
a) Extended Visitors Programme.(Including Seminars & Workshops)	8676153.00	7090182.00
b) Meeting Expenses	9,61,693.00	6,53,634.00
c)Library General Expenses	26883.00	6500.00
d) Electricity and Power	13543185.00	9368324.00
e) Laboratory Expenses	3600703.00	3929824.00
f) Insurance	8248.00	5115.00
g) Repairs and Maintenance	26258474.83	15435540.26
h) TPSC	10,97,179.00	17,71,880.00
i) Rent, Rates and Taxes	14,25,067.00	3,58,263.00
j) Vehicles Hire Charges	781063.00	1036683.00
k) Postage, Telephone and Communication Charges	2109553.00	2221418.00
l) Printing and Stationary	1115980.00	734994.00
m) Travelling and Conveyance Expenses	1628804.00	1683054.00
n) Contingency/consumables to Faculty	1,66,211.00	25,486.00
o) Silver Jubilee Year	4,10,323.00	
p) Auditors' Remuneration	29781.00	29781.00
q) Bank Charges	3,70,551.00	2,32,597.50
r) Professional Charges (Legal Charges)	206781.00	30230.00
s) Provision for Bad and Doubtful Debts/Advances		
t) Irrecoverable Balances Written-off		
u) Integrated Ph.D.	14273737.00	12618488.00
v) Import Clearing Expenses including Custom Duty	143361.00	115891.00
w) Hindi Programme	45,508.00	88,234.00
x) Advertisement and Publicity	1005959.00	1462720.00
y) Others	590369.00	1163609.00
TOTAL	**78475566.83**	**60062447.76**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES
BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31.03.2011		
		(Amount - ₹)
SCHEDULE 22 - EXPENDITURE ON GRANTS, SUBSIDIES ETC.	**Current Year**	**Previous Year**
a) Grants given to Institutions/Organisations b) Subsidies given to Institutions/Organisations		
TOTAL	**Nil**	**Nil**
SCHEDULE 23 - INTEREST	**Current Year**	**Previous Year**
a) On Fixed Loans b) On Other Loans (including Bank Charges) c) Others (specify)		
TOTAL	**Nil**	**Nil**

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES
BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

SCHEDULE 24 (2010-2011)
SIGNIFICANT ACCOUNTING POLICIES

1. ACCOUNTING CONVENTION

The financial statements are prepared on the basis of historical cost convention, unless otherwise stated and on the accrual method of accounting. Interest on interest bearing loans/advances granted to the staff and the interest on Fixed Deposits kept as Lien against LC/BG issued by Bank and Guest House Rent are accounted on cash basis.

2. INVENTORY VALUATION

2.1 Stores and Spares (including machinery spares) are valued at cost.

3. INVESTMENTS

3.1 Investments are valued at cost.

4. FIXED ASSETS

4.1 Fixed assets are stated at cost of acquisition inclusive of inward freight, duties and taxes and incidental and direct expenses related to acquisition, as well as customs duty & clearing charges on imported equipment are also capitalized.

4.2 Fixed Assets received by way of non-monetary grants (other than towards the Corpus Fund), are capitalized at value stated / agreed by corresponding credit to Capital Fund. Incomplete work is shown as Capital-Work- in Progress to be capitalized on completion.

4.3 Library Books are accounted for on receipt basis and Journals are accounted for on payment basis.

5. DEPRECIATION

5.1 Depreciation on capitalization has been charged on the value determined / estimated at the time of take over and as and when on further items were added subsequently to Assets.

5.2 Depreciation is provided on straight-line method as per rates specified in the Companies Act, 1956.

5.3 In respect of additions to / deletion from fixed assets during the year, depreciation is considered on pro-rata basis. Depreciation is provided from the date of acquisition of the assets.

5.4 Depreciation arising on Fixed Assets is deducted from Fixed Assets and also from corpus fund out of which Fixed Assets are created.

5.5 Individual items costing Rs. 5000/- or less is not capitalized but charged in Accounts.

6. FOREIGN CURRENCY TRANSACTIONS

6,1 Transactions denominated in foreign currency are accounted at the exchange rate prevailing at the date of transaction.

7. RETIREMENT BENEFITS

7.1 Liability towards gratuity payable on death/retirement of employees is computed on the assumption that employees are entitled to receive the benefit as at each year end.

7.2 Provision for accumulated leave encashment benefit to the employees is accrued and computed on the assumption that employees are entitled to receive the benefit as at each year end.

7.3 Liabilities under above accounts are invested separately in fixed deposit accounts with nationalized bank.

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES
BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

SCHEDULE 25 (2010-2011)
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS

1. CONTINGENT LIABILITIES

1.1 Claims against the Centre not acknowledged as debts – Rs. Nil (Previous year Rs. Nil).

1.2 In respect of

- Bank guarantees given by/on behalf of the Centre – Rs. 2736063.00 against 100% margin money by way of fixed deposit (Previous year Rs. 1820000.00).

- Letters of Credit opened by Bank on behalf of the Centre – Rs. 8024000.00 (Previous year Rs. 4089360.00) against 100% margin money by way of fixed deposit .

- Bills discounted with banks – Rs. Nil (Previous year Rs.Nil).

1.3 Disputed demands in respect of:

Income-tax	Rs. Nil (Previous year Rs.Nil)
Sales-tax	Rs. Nil (Previous year Rs.Nil)
Municipal Tax	: Amount indeterminate as no demand has come yet.

1.4 In respect of claims from parties for non-execution of orders, but contested by the Centre – Rs. Nil (Previous year Rs.Nil).

2. NOTES ON ACCOUNTS

2.1.1 Capital Commitments:

Estimated value of contracts remaining to be executed on capital account and not provided for Rs.0.02 Crores (Previous year Rs.0.31 Crores).

2.2.1 Physical verification of fixed assets was conducted by an external agency in the previous financial year. However, fixed assets register has not been updated to the extent of location of particular fixed assets and the acquisition of fixed assets during the year.

2.2.2. Rs. 19481910.00 being depreciation on Fixed Assets for the year was not passed through Income & Expenditure Account and instead directly debited to Corpus Fund in terms of accounting policy clause 5.4 of Schedule 24.

2.2.3 Capital work-in-progress as on 1st April, 2010 was Rs.20976481.00, addition during the year is Rs.48658602.00, totaling to Rs.69635083.00, out of which Rs.20965624.00 has been capitalized during the year, leaving balance of Rs.48669459.00 which has been carried forward.

2.2..4 Current Assets, Loans and Advances

In the opinion of the Management, the current assets, loans and advances have a value on realization in the ordinary course of business, equal at least to the aggregate amount shown in the Balance Sheet.

2.4 Taxation

In view of there being no taxable income under Income-tax Act 1961, no provision for Income tax has been considered necessary.

2.5 Foreign Currency Transactions

i) Expenditure in foreign currency:

a) Travel: Nil

b) Remittances and Interest payment to Financial Institutions/Banks in Foreign Currency : Nil

c) Other expenditure: Nil

- Commission on Sales
- Legal and Professional Expenses
- Miscellaneous Expenses
- Bank Charges

ii) Earnings:

Value of Exports on FOB basis: Nil

2.6 Transfer of Fixed Assets from project to general fund upon completion of project has not been done pending approval from DST, Govt. of India.

2.7 In absence of any specific directions from Appropriate Authority, contributions to Medical Fund Rs. 1580541.00 (previous year Rs. 1123108.00) by the employees are appearing under Earmarked & Endowment Fund as on 31-03-2011.

2.8 An amount of Rs. 2720084.00 is receivable from P.F. Account appearing under Current Assets (previous year Rs. 27953.00 was shown under Current Liabilities).

2.9 Corresponding figures for the previous year have been re-grouped/re-arranged, wherever necessary.

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