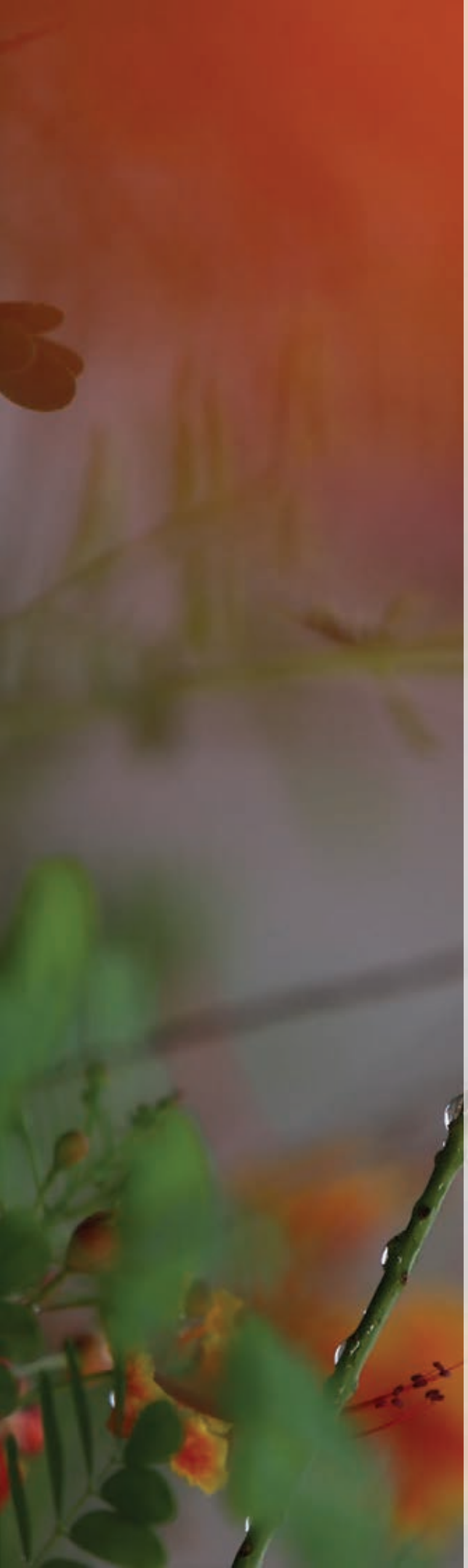
Annual Report

2013-2014

SATYENDRA NATH BOSE NATIONAL CENTRE
FOR BASIC SCIENCES



Annual Report 2013-2014

Satyendra Nath Bose National Centre for Basic Sciences

Publisher

Satyendra Nath Bose National Centre
for Basic Sciences

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Acknowledgement

Annual Report of the 'Satyendra Nath Bose National Centre for Basic Sciences' is a brief representation of its activities of a financial year. The report reflects research activities, administrative activities, academic progress and achievement of young research scholars, development of infrastructure and facilities, and establishment of network with advanced research groups around the world. It's fourth time I have been assigned the job of compilation of Annual Report of the Centre. To prepare the Annual Report, all faculty members and sections of the Centre spent their valuable time to provide respective data. It is a time bound work to be completed within a short span of time. Thanks to the Annual Report Committee members for their suggestions and coordination. I would like to acknowledge the sincere efforts and labour of my Library staff - Mr. Gurudas Ghosh, Ms. Ananya Sarkar and Mr. Amit Roy without whom the work could not be completed within the stipulated time. Finally, I would like to thank all the members of the Centre for their cooperation in preparation of the Annual Report of the Centre.

Saumen Adhikari

Librarian – cum – Information Officer

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MESSAGE FROM THE Director

I am delighted to present to you the annual report of our Centre for the year 2013-2014. The annual report is a chronicle of our growth as well as collective and individual performance.

The primary performance of the Centre, an institution mandated to do basic research, can be judged by publication profile. I feel extremely happy to note that this year the Centre has made more than 189 publications in referred journals. This is significantly larger than what we did last year and is the highest in the history of the Centre. I congratulate the members of the Centre for achieving this. The growth primarily came from the outstanding publication profile of some of my colleagues. My special thanks to them. Collectively we are also publishing in better journals. The total impact factor of journals in which we published the 189 papers is around 570.7 (average = 3.04). Citation of the papers published from the Centre has crossed 2400 last year. The Centre in last few years has made substantial investment in building scientific infrastructure for research. This investment is yielding results.

A part of our institutional mandate is the development of advanced scientific manpower through our PhD programme as well as Post-doctoral Research Associateship (PDRA) programme. The Centre during the year 2013-14 had a total of 148 students (including the Integrated PhD programme). About 20 students have their PhD degree awarded and another 22 students have submitted their thesis. The Centre had during this period 22 PDRA. The growth of the Centre can be seen also in our earnings from extra-mural project support. The year the Centre had about 31 ongoing / new projects with a total receipt of more than Rs. 10 crores, thanks to some high-value projects.

Our achievements in academic front were facilitated by our administration. I would like to thank all sections of the administration for doing an excellent job. Importantly, after long years the Centre now has a permanent Registrar. My sincere thanks to Library, Technical Cell, and Computer Services Cell for providing us with all the needed technical infrastructure support. Both Technical Cell and the Computer Services Cell now have their designated Scientist In-charges.

The extended visitor and linkage programme (EVLP) is an important component of our Center's activity. This year we organized through the EVLP 7 conferences/workshops/symposia in addition to a total of 10 Bose Colloquia, 25 Institute Seminars.

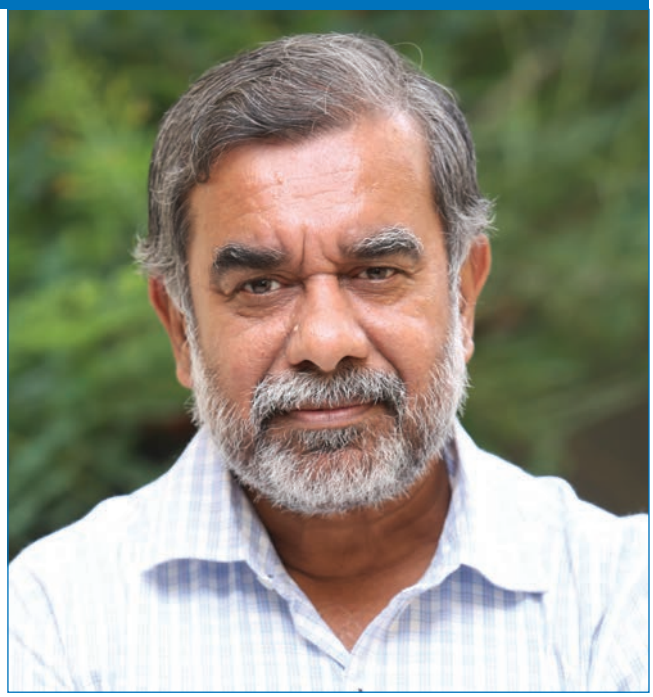
I am deeply indebted to the members of our Governing Body, Academic and Research Programme Advisory Committee, Finance Committee and Building Committee for their advices, proactive policy and guidance. A number of internal committees, in particular Consultative Advisory Committee (CAC) strengthened our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

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

Thanks to the annual report committee for making the report and prepare it on time.

Arup Kumar Raychaudhuri
Director

Dean, Faculty



The year 2013-2014 involved plenty of academic activities related to scientific collaborations, hosting national and international conferences, workshops etc. Compared to the 137 publications during the 2012-2013 fiscal year, this year the publications numbered 189, indicating enhanced academic performance.

All round the year, we had numerous seminars on various topics delivered by scientists ranging from young graduate students to well established ones. Our ongoing collaborations with various countries like UK, Russia, Germany, Sweden etc. in terms of academic visits and exchanged programmes including collaborations in conferences further bolstered the research work at the Centre.

The Centre, apart from running earlier projects to the tune of more than 10 crores, has also succeeded in obtaining another 3.6 crores (approx.).

This year several Post Doctoral Research Associates, three DST INSPIRE Faculty members and two other faculty members joined the Centre.

Rabin Banerjee
Dean, Faculty

Dean, Academic Programme

Training the next generation of scientists is an important part of the activities of the Centre. We have a vibrant PhD programme which students join after an M.Sc. in Physics, Chemistry and occasionally also Biology or Applied Mathematics. Students qualify through an interview, after being screened by nationally administered written tests such as CSIR-NET, JEST (Joint Entrance Screening Test, held for admission to 27 research institutes) or the Centre's own admission test called Bose Test. We also have an integrated PhD programme in Physics called IPhD, conducted in collaboration with the University of Calcutta, which accepts students after their B.Sc. Students qualify for the IPhD programme through the JEST or the Bose Test and an interview.

In the academic year 2013-14, 17 students joined the PhD programme. Of these, 01 joined Astrophysics & Cosmology, 08 joined Condensed Matter Physics and Material Science, 05 joined Chemical, Biological and Macromolecular Sciences and 03 joined Theoretical Sciences. In addition, 10 students joined the IPhD programme.

The Centre currently has 119 (as on 31st March 2014) students in the PhD programme, and another 19 in the IPhD programme. In the 2013-14 academic year, 20 students received their PhD degrees, and another 21 submitted their PhD thesis. There were 05 more students working as research assistants or fellows in various projects.

In addition 27 students came to the Centre on short term visits, including 22 in the summer research programme.

The Bose Test for admission in the Academic Year 2013-14 was held on 7th April 2013 in 11 cities around the country. 576 students appeared for the entrance tests to the PhD programmes in Physical (324) and Chemical Sciences (252), and another 374 for the entrance test to the IPhD programme.

This year the Bose Test is scheduled to be held on 6th April 2014 in 13 cities across the country for admission in different courses of the Centre.

Courses Offered in 2013-14

Integrated Ph.D. Programme in Physical Sciences (IPhD-Ph)

1st Semester:

- PHY 101, *Classical Dynamics*, Partha Guha;
- PHY 102, *Mathematical Methods*, Amitabha Lahiri;

- PHY 103, *Quantum Mechanics I*, Priya Mahadevan;
- PHY 104, *Computational Methods in Physics I,* Soumendu Datta;
- PHY 191, *Basic Laboratory I*, Samir Kumar Pal & Ranjit Biswas.

2nd Semester:

- PHY 201, *Statistical Mechanics*, Punyabrata Pradhan;
- PHY 202, *Quantum Mechanics II*, M Sanjay Kumar;
- PHY 203, *Electromagnetic Theory*, Subodh K Sharma;
- PHY 204, *Computational Methods in Physics II*, Amlan Dutta;
- PHY 291, *Basic Laboratory II*, Kalyan Mandal & Chhayabrita Biswas.

3rd Semester:

- PHY 301, *Atomic & Molecular Physics*, Subhra Jana & Anjan Barman;
- PHY 302, *Condensed Matter Physics*, Prosenjit Singha Deo & Manoranjan Kumar;
- PHY 303, *Nuclear & Particle Physics*, Ramkrishna Das & Archan S Majumdar;
- PHY 304, *Project Research II*, Faculty Supervisors;
- PHY 391, *Methods of Experimental Physics*, Kalyan Mandal, Barnali Ghosh & Madhuri Mandal.

4th Semester:

- PHY 401, *Project Research III*, Faculty Supervisors;
- PHY 402, *Seminar Course*, Faculty Experts;
- PHY 403, *Astrophysics & Cosmology*, Sandip K Chakrabarti & Soumen Mondal;
- PHY 404, *Chemical Physics*, Gautam Gangopadhyay;
- PHY 406, *Advanced Mathematical Methods,* Rabin Banerjee;
- PHY 409, *Magnetism & Superconductivity*, Arup K Raychaudhuri & Kalyan Mandal;
- PHY 412, *Physics of Materials*, Sugata Mukherjee & Tanusri Saha Dasgupta;

Ph.D. Programme

Course Work Programme

Common to all the departments:

- PHY 501, *Research Methodology*, Part A: Sandip Kumar Chakrabarti, Pratip Kumar Mukhopadhyay, Kinsuk Acharyya; Part B (TS): M Sanjay Kumar, Samir Kumar Paul, Punyabrata Pradhan, Biswajit Chakraborty, Part B (CMPMS): Arup K Raychaudhuri, Kalyan Mandal, Ranjan Chaudhury, Sugata Mukherjee, Tanusri Saha Dasgupta, Part B (CBMS): Gautam Gangopadhyay, Manik Pradhan, Subhra Jana, Jaydeb Chakrabarti, Rajib Kumar Mitra, Part B (CBMS): Sandip K Chakrabarti, Soumen Mondal.
- PHY 502, *Review of the Topical Research*, Faculty Supervisors;
- PHY/CB 591, *Project Research*, Faculty Supervisors.

Department of Astrophysics & Cosmology:

- PHY 510, *Astrophysics*, Sandip Kumar Chakrabarti & Soumen Mondal.

Department of Chemical, Biological and Macromolecular Sciences:

- CB 528, *Stochastic Processes in Physics & Chemistry*, Gautam Gangopadhyay;
- PHY 525, *Instrumental Methods of Analysis*, Samir Kumar Pal;
- CB 540, *Study of Bio-macromolecules*, Mahua Ghosh.
- CB 527, *Molecular Physics & Spectroscopy,* Subhra Jana & Anjan Barman.

Department of Condensed Matter Physics & Material Sciences:

- PHY 601, *Advanced Condensed Matter Physics - Magnetism & Superconductivity*, Arup K Raychaudhuri & Kalyan Mandal;
- PHY 602, *Advanced Condensed Matter Physics - Electronic Structure & Physics of Materials*, Sugata Mukherjee & Tanusri Saha Dasgupta.

Department of Theoretical Sciences:

- PHY 506, *Quantum Physics*, Rabin Banerjee;
- PHY 507, *Mathematical Methods*, Rabin Banerjee.

Project Research

M. Tech. / M. Sc. Projects

Noncommutative Quantum Mechanics and Noncommutative Geometry, Shivraj Prajapat, Indian Institute of Science Education and Research, Pune, Supervisor: Biswajit Chakraborty

Graphite Oxide as Gate Dielectric for Thin Film Transistors, Kalyan Jyoti Sarkar, Indian Institute of Technology, Kharagpur, Supervisor: Arup Kumar Raychaudhuri

Growth and Characterization of Silicon One Dimensional Heterojunction Devices, Mohd Zeeshan, Indian Institute of Technology, Kharagpur, Supervisor: Arup Kumar Raychaudhuri

Ph.D. Awards

Theoretical Studies on the Nonadiabetic effects in Molecular Aggregates, Kinshuk Banerjee, Supervisors: Gautam Gangopadhyay, in University of Calcutta, on May 17, 2013

Study of Electronic Structure of Disordered Systems, Prashant Singh, Supervisor: Abhijit Mookerjee, University of Calcutta, on June 7, 2013

Stochastic approaches to heterogeneous and complex reaction kinetics, Biswajit Das, Supervisor: Gautam Gangopadhyay, in University of Calcutta, on June 24, 2013

Pairing and Condensation in Ultracold Quantum Gases, Raka Dasgupta, Supervisor: Jayanta K Bhattacharjee, in Jadavpur University, on June 27, 2013

Heat Transport and Related Thermal Properties in Nanofluids and Nanostructured Materials, Rajesh Kumar Neogy, Supervisor: Arup K Raychaudhuri, in Jadavpur University, on June 27, 2013

Numerical Simulation of Viscous Accretion Flows around Black Holes which include Shocks, Kinsuk Giri, Supervisor: Sandip K Chakrabarti, in Jadavpur University, on June 27, 2013

First Principles Study of Silicate Minerals, Swastika Chatterjee, Supervisor: Tanusri Saha Dasgupta, in University of Calcutta, on August 2, 2013

Studies on Biomolecular Recognition Using Ultrafast Laser Spectroscopic Techniques, Tanumoy Mondol, Supervisor: Samir Kumar Pal, in University of Calcutta, on September 17, 2013

Study of Nanostructured Iron Oxides, Arka Chaudhuri, Supervisor: Kalyan Mandal, in University of Calcutta, on October 3, 2013

Electronic, Magnetic and Structural Properties of Transition Metal Oxides, Kapil Gupta, Supervisor: Priya Mahadevan, in Jadavpur University, on October 8, 2013

First Principle study of Novel Materials, Sudipta Kanungo, Supervisor: Tanusri Saha Dasgupta, in University of Calcutta, on December 5, 2013

Electronic and Magnetic Properties of Systems without Periodicity, Rudra Banerjee, Supervisor: Abhijit Mookerjee, in University of Calcutta, on December 11, 2013

Spectroscopic Studies of Molten Electrolyte Mixtures, Binary Polar Solvent Mixtures and Solvents under Confinement, Biswajit Guchhait, Supervisor: Ranjit Biswas, in Jadavpur University, on December 2013

Spectroscopic Studies on Photoreactivity of Inorganic Nanocrystals and Medicinally Important Organic Dyes, Soumik Sarkar, Supervisor: Samir Kumar Pal, in Jadavpur University, on December 2013

Numerical Modeling of VLF Radio Wave Propagation through Earth-Ionosphere Wave guide and its application to Sudden Ionospheric Disturbances, Sujay Pal, Supervisor: Sandip K Chakrabarti, in University of Calcutta, on January 2, 2014

Phase Transition in Black Holes, Dibakar Roychowdhury, Supervisor: Rabin Banerjee, in University of Calcutta, on January 7, 2014

Dynamics of Neat Ionic Liquid, Binary mixtures and Liquids under Confinement: Theoretical and Simulation study, Snehasis Daschakraborty, Supervisor: Ranjit Biswas, in Jadavpur University, on February 20, 2014

A Study of Certain Properties of Nonlinear Ordinary Differential Equations, Barun Khanra, Supervisors: Partha Guha & Anindya Ghose Choudhury (Surendranath College), in West Bengal State University, on February 21, 2014

Study of Planar models in Quantum Mechanics, Field theory and Gravity, Sarmishtha Kumar, Supervisor: Rabin Banerjee, in University of Calcutta, on March 26, 2014

Synthesis and Characterization of Multifunctional Nanoparticles and their Interaction with Biological Macromolecules, Anupam Giri, Supervisor: Samir Kumar Pal, in Jadavpur University, on March 26, 2014

Ph.D. Theses Submitted

Vibrational Properties and Phase Stability of Disordered Alloy, Rajiv Kumar Chouhan, Supervisor: Abhijit Mookerjee, in University of Calcutta, on April 26, 2013

Magnetic and Optical Studies of Wide Band-Gap Oxide Semiconductors, Shyamsundar Ghosh, Supervisor: Kalyan Mandal, in University of Calcutta, on May 17, 2013

Synthesis of transition metal based magnetic nanostructures and their characterization for suitable applications, Debasish Sarkar, Supervisor: Kalyan Mandal, in University of Calcutta, on May 27, 2013

Some Applications of Quantum Entanglement, Tanumoy Pramanik, Supervisor: Archan S Majumdar, in University of Calcutta, on July 24, 2013

Numerical Simulation of Spectral and Timing Properties of Galactic Black Holes, Sudip Kumar Garain, Supervisor: Sandip K Chakrabarti, in University of Calcutta, on July 25, 2013

A Study of Dark Energy from Various Approaches, Nilok Bose, Supervisor: Archan S Majumdar, in University of Calcutta, on July 25, 2013

Mean Field Theory and Computer Simulations on Non-Equilibrium Phenomena in Complex Chemical Systems, Amit Das, Supervisor: Jaydeb Chakrabarti, in University of Calcutta, on July 26, 2013

Study of the Effects on Lower Ionosphere Due to Solar Phenomena Using Very Low Frequency Radio Wave Propagation, Tamal Basak, Supervisor: Sandip K Chakrabarti, in University of Calcutta, on July 30, 2013

Prepotential Formulation of Lattice Gauge Theories, Indrakshi Raychowdhury, Supervisor: Manu Mathur, in University of Calcutta, on July 30, 2013

Chern Simons theory in the context of 2+1 and 3+1 quantum gravity, Rudranil Basu, Supervisors: Samir Kumar Paul & Parthasarathi Majumdar (RKMVU), in University of Calcutta, on July 30, 2013

Quasistatic and Ultrafast Magnetization Dynamics in Magnetic Nanostructures, Bivas Rana, Supervisor: Anjan Barman, in University of Calcutta, on August 16, 2013

Magnetism in dilute magnetic semiconductors and oxides, Hirak Kumar Chandra, Supervisor: Priya Mahadevan, in Jadavpur University, on August 29, 2013

Study of Magnetocaloric and Magnetotransport Properties of Transition Metal Based Materials, Debabrata Pal, Supervisor: Kalyan Mandal, in University of Calcutta, on September 4, 2013

Study of Magnetic, Ferroelectric and Magnetoelectric properties in Bulk and Nanostructured Multiferroics, Rajasree Das, Supervisor: Kalyan Mandal, in University of Calcutta, on September 26, 2013

Spectroscopic Studies on Structure, Function and Dynamics of Biomolecules in Presence of Other Biologically Relevant Macromolecules, Surajit Rakshit, Supervisor: Samir Kumar Pal, in Jadavpur University, on October 1, 2013

Biomolecule-assisted synthesis of nanoparticles and their characterization for potential application in biophysical studies, Nirmal Goswami, Supervisor: Samir Kumar Pal, in Jadavpur University, on October 1, 2013

Effects of curvature and gravity from flat spacetime, Debraj Roy, Supervisor: Rabin Banerjee, in University of Calcutta, on October 22, 2013

Spectroscopic Studies on the Interactions of Biomimetics with Biological Macromolecules, Ranajay Saha, Supervisor: Samir Kumar Pal, in University of Calcutta, on November 13, 2013

Spectroscopic Studies on the Biomolecular Recognition of Medicinally Important Ligands, Soma Banerjee, Supervisor: Samir Kumar Pal, in Jadavpur University, on January 7, 2014

Magnetotransport Properties of Some Disordered Binary and Ternary Alloys, Pampa Pal, Supervisor: Alak Kumar Majumdar & Abhijit Mookerjee, in University of Calcutta, on January 28, 2014

Spectroscopic Investigation on Fluorescent Probes in Biologically Relevant and Engineered Environments, Subrata Batabyal, Supervisor: Samir Kumar Pal, in Jadavpur University, on March 10, 2014

Development of Nanoscale Systems for Spin-Wave Propagation, Dheeraj Kumar, Supervisor: Anjan Barman, in University of Calcutta, on March 24, 2014

Ph.D. Thesis Colloquia

Investigations of complex systems: from Granular to cognitive systems, Dattatreya P Shinde, Supervisor: Anita Mehta, on March 24, 2014

Research Scholars - Ph.D. Programme (by Year of Joining)

EXTENDED SENIOR RESEARCH FELLOW

2007–2008:

- Biswajit Das (SNB) (till 16-10-2013)
- Biswajit Guchhait (CSIR) (till 17-10-2013)
- Kinshuk Banerjee (SNB) (till 10-04-2013)
- Kinsuk Giri (SNB) (till 08-11-2013)

2008–2009:

- Amit Das (CSIR) (till 26-08-2013)
- Shyamsundar Ghosh (CSIR) (till 01-10-2013)
- Snehasish Daschakraborty (CSIR) (till 26-10-2013)
- Tanumoy Pramanik (UGC) (till 07-01-2014)

2009–2010:

- Anupam Giri (UGC)
- Bivas Rana (UGC) (till 28-02-2014)
- Debasish Sarkar (CSIR) (till 04-01-2014)
- Nirmal Goswami (CSIR)
- Rajasree Das (CSIR) (till 15-12-2013)
- Ranajay Saha (SNB)
- Soma Banerjee (UGC) (till 27-02-2014)
- Soumik Sarkar (UGC) (till 06-09-2013)
- Subrata Batabyal (SNB)
- Surajit Rakshit (CSIR)
- Tamal Basak (CSIR)
- Tanumoy Mondol (SNB) (till 23-09-2013)

SENIOR RESEARCH FELLOW

2007–2008:

- Ambika Prasad Jena (CSIR) (till January, 2014)
- Debraj Roy (SNB) (till 01-10-2013)

2008–2009:

- Abhijit Chakraborty (SNB)
- Debmalya Mukhopadhyay (SNB)
- Manotosh Chakravorty (CSIR) (till 26-12-2013)
- Rajib Nath (SNB)
- Sandeep Agarwal (SNB)
- Sandeep Singh (SNB)
- Shahnewaz Mondal (CSIR) (till 11-01-2014)
- Sudipta Kanungo (SNB) (till 30-06-2013)
- Swarnakamal Mukherjee (CSIR) (till 01-02-2014)

2009–2010:

- Dibakar Roychowdhury (CSIR) (till 25-05-2013)
- Dheeraj Kumar (CSIR)
- Md. Injamamul Arief (CSIR)
- Putul Malla Chowdhury (CSIR) (till 12-01-2014)
- Rabaya Basori (SNB)
- Ruma Das (CSIR)
- Saikat Debnath (CSIR)
- Santu Baidya (SNB)
- Semanti Pal (UGC)
- Soumi Roy Chowdhury (SNB)
- Sreemoyee Mukherjee (SNB)
- Sumit Ghosh (CSIR) (till 03-06-2013)
- Tamisra Pal (SNB)
- Urbashi Satpathi (INSPIRE)
- Wasim Iqbal (SNB)

2010-2011:

- Animesh Patra (SNB)
- Anirban Karmakar (SNB)
- Anuradha Das (UGC)

- Arindam Lala (CSIR)
- Bipul Kumar Mahato (CSIR)
- Biswajit Paul (CSIR)
- Dattatreya P Shinde (CSIR)
- Priyanka Chowdhury (UGC)
- Sabyasachi Ghosh (SNB) (till 29-11-2013)
- Sandipa Indra (UGC)
- Sreeraj T. P (CSIR)
- Subhajit Sarkar (CSIR)
- Susmita Saha (UGC)
- Tanmoy Ghosh (SNB)
- Yendrembam Chaoba Devi (SNB)

2011-2012:

- Arindam Das (UGC)
- Arup Ghosh (SNB)
- Basudeb Mandal (CSIR)
- Ishita Dutta Choudhury (SNB)
- Kallol Mukherjee (CSIR)
- Paramita Saha (SNB)
- Pratik Tarafdar (UGC)
- Rishi Ram Ghimire (TWAS- BOSE)
- Samapan Sikdar (UGC)
- Sayani Chatterjee (CSIR)
- Siddhi Chaudhuri (CSIR)
- Suman Das (CSIR)
- Victor U J Nwankwo (TWAS- BOSE)

2012-2013:

- Ashutosh Rai (SNB) (till 26-06-2013)
- Shiladitya Mal (SNB)
- Subhadipa Das (SNB)

JUNIOR RESEARCH FELLOW

2011–2012:

- Sanjoy Kumar Routh (CSIR) (till 11-10-2013)

2012-2013:

- Abhijit Maity (INSPIRE)
- Abhishek Roy (SNB)
- Ambalika Biswas (SNB)
- Anindita Mondal (SNB)
- Arnab Deb (SNB)
- Arpita Mitra (SNB)
- Arpita Nandi (SNB) (till 23-12-2013)
- Aslam Parvej (SNB)
- Chandrima Banerjee (CSIR)
- Chiranjit Ghosh (SNB)
- Gourab Dutta Banik (INSPIRE)
- Hrishit Banerjee (SNB)
- Karan Savio Fernandes (SNB)
- Kartik Samanta (SNB)
- Krishnendu Pal (SNB)
- Md Azaharuddin Ahmed (SNB) (till 02-12-2013)
- Monalisa Pal (SNB)
- Nabarun Polley (INSPIRE)
- Nirnay Samanta (SNB)
- Poulami Chakraborty (SNB)
- Rupali Rakshit (SNB)
- Sagar Sarkar (CSIR)
- Samim Sardar (SNB)
- Shirsendu Dey (SNB)
- Somnath Dutta (SNB)
- Subarna Datta (SNB)

- Subrata Dev (SNB)
- Suman Aich (SNB)
- Suman Som (SNB)
- Sumanto Chanda (SNB)
- Supriyo Ghosh (SNB)
- Susobhan Choudhury (CSIR)

2013-2014:

- Abir Deogharia (SNB)
- Arindam Ghosh (SNB)
- Avrajit Bandyopadhyay (SNB) (till August, 2013)
- Jagabandhu Kumar (SNB)
- Md Hasanujjaman (SNB) (till 10-09-2013)
- Poonam Kumari (SNB)
- Prasenjit Kar (SNB)
- Raj Kumar Sadhu (SNB)
- Rakesh Das (SNB)
- Ransell Richard Dsouza (SNB)
- Ravindra Singh Bisht (SNB)
- Sankar Das (SNB)
- Shaili Sett (SNB)
- Snehasish Rana (SNB)
- Souvanik Talukdar (SNB)
- Subhadip Chakraborti (SNB)
- Sutapa Dutta (SNB)

PROJECT FELLOWS / ASSISTANTS / TRAINEES

2010-2011:

- Ruma Mandal (PROJECT) (till 28-02-2014)

2011-2012:

- Shishir Kumar Pandey (PROJECT)

2013-2014:

- Camelia Manna (PROJECT)
- Debal Kanti Singha (PROJECT)
- Dipanjan Samanta (PROJECT)
- Suvankar Das (PROJECT)

Research Scholars - Integrated Ph.D. Programme

EXTENDED SENIOR RESEARCH FELLOW

2006–2007:

- Indrakshi Roychowdhury (SNB) (till 30-08-2013)
- Nilok Bose (SNB)
- Rudranil Basu (CSIR) (till 31-08-2013)
- Sudip Kumar Garain (A&C)

SENIOR RESEARCH FELLOW

2006–2007:

- Oindrila Ganguly (SNB)
- Rajiv Kumar Chouhan (SNB) (till May, 2013)

2007–2008:

- Arghya Dutta (CSIR)

2008-2009:

- Soumyadipta Pal (SNB)
- Sukla Pal (SNB)

2009–2010:

- Arnab Ganguly (SNB)
- Ashutosh Kumar Singh (SNB)
- Biplab Bhattacherjee (SNB)
- Debanjan Polley (SNB)
- Subhasish Chakrabarty (SNB)

JUNIOR RESEARCH FELLOW

2007-2008:

- Ansuman Dey (SNB)

2009–2010:

- Arghya Das (SNB)
- Kumar Jang Bahadur Ghosh (SNB) (till 02-10-2013)

2010–2011:

- Ankita Chakraborty (SNB) (till 26-07-2013)
- Arpan Krishna Mitra (SNB)
- Soumyakanti Bose (SNB)
- Suman Dutta (SNB)
- Tejas Rathod (SNB) (till 22-07-2013)

2011–2012:

- Anita Halder (SNB)
- Chandreyee Roy (SNB)
- Debasish Das Mahanta (SNB)
- Dilip Sao (SNB)
- Shauri Chakrabarty (SNB)
- Sumanta Kundu (SNB)

Integrated Ph.D. Programme

2011–2012:

- Debolina Basu (SNB) (till 31-07-2013)
- Saheli Banerjee (SNB) (till 20-07-2013)
- Somnath Mukhopadhyay (SNB) (till 14-09-2013)
- Souvik Mondal (SNB) (till 31-07-2013)

2012–2013:

- Arkadev Roy (SNB)
- Ayan Bhattacharjee (SNB)
- Bhavya Tiwari (SNB) (till August, 2013)
- Kausik Chanda (SNB)
- Monalisa Singh Roy (SNB)
- Samiran Choudhury (SNB)
- Saurav Singha (SNB)
- Subodha Sahoo (SNB)
- Sudhanshu Ranjan (SNB)
- Vibhuti Narayan Rai (SNB)

2013–2014:

- Amal Garai (SNB)
- Ankan Pandey (SNB)
- Avinash Kumar Chaurasiya (SNB)
- Debalina Banerjee (SNB)
- Kumar Neeraj (SNB)
- Riddhi Chatterjee (SNB)
- Ritam Basu (SNB)
- Sanchi Maithani (SNB)
- Santanu Mandal (SNB)
- Sourav Kumar Misra (SNB)

Research Scholars - Part Time Ph.D. Programme

Ambika Prasad Jena, Condensed Matter Physics & Material Sciences, under Abhijit Mookerjee

Arpita Nandi, Astrophysics and Cosmology, under Ramkrishna Das and Soumen Mondal, Current Affiliation: Itachuna Sree Narayan Institution, Hooghly

Asit Kumar Chaudhury, Astrophysics & Cosmology, under Sandip Kumar Chakrabarti, Current Affiliation: LMSM High School, Malda Town.

Manotosh Chakravorty, Condensed Matter Physics and Material Sciences, under Arup Kumar Raychaudhuri, Current Affiliation: School Service, WB

Nirman Ganguly, Astrophysics & Cosmology, under Archan S Majumdar, Current Affiliation: Heritage Institute of Technology, Kolkata.

Putul Chakravorty (Malla Chowdhury), Condensed Matter Physics and Material Sciences, under Arup Kumar Raychaudhuri, Current Affiliation: School Service, WB

Samik Roy Moulik, Condensed Matter Physics & Material Sciences, under Barnali Ghosh (Saha), Current Affiliation: Icon Analytical Equipment Pvt. Ltd., Mumbai

Soumendra Singh, Chemical, Biological & Macro-Molecular Sciences, under Samir Kumar Pal, Current Affiliation: Bose Institute, Salt Lake

Sovik Roy, Astrophysics & Cosmology, under Archan S. Majumdar, Current Affiliation: Techno India, Kolkata.

Shahnewaz Mondal, Condensed Matter Physics and Material Sciences, under Arup Kumar Raychaudhuri, Current Affiliation: School Service, WB

Swarnakamal Mukherjee, Condensed Matter Physics & Material Sciences, under Tanusri Saha Dasgupta

Amitabha Lahiri

Dean, Academic Programme

Bose Fest

Extended Visitors' Linkage Programme

Extended Visitors' Linkage Programme

The S. N. Bose National Centre for Basic Sciences fosters, encourages and promotes the growth of advanced studies and original research in basic sciences. One of the important mandates of the Centre is to have a vigorous Programme that would enhance the scientific activities and expand the science base in the country. The Centre's Visitor's Programme and its associated activities are coordinated by the EVLP Office.

Seminar & Colloquia Programme (SCOLP)

BOSE Colloquium

Speaker: Dr. Suresh Das

Affiliation: Director, Photosciences and Photonics Section, Chemical Sciences and Technology Division, National Institute for Interdisciplinary Science and Technology, (CSIR), Trivandrum

Title of the Colloquium: Photoresponsive Materials

Date: 03.05.2013

Speaker: Dr. R. Chidambaram

Affiliation: Principal Scientific Adviser to the Govt. of India & Chairman, Scientific Advisory Committee to the Cabinet (Former Chairman, Atomic Energy Commission)

Title of the Colloquium: The Research & Innovation Ecosystem

Date: 28.06.2013

Speaker: Prof. Ravindra E. Amritkar

Affiliation: Institute of Infrastructure, Technology, Research and Management (IITRAM) & Physical Research Laboratory, Ahmedabad

Title of the Colloquium: Extreme events on complex networks

Date: 01.11.2013

Speaker: Prof. Debashish Chowdhury

Affiliation: Dr. Jag Mohan Garg Chair Professor, J.C. Bose National Fellow,

Department of Physics, IIT, Kanpur

Title of the Colloquium: Molecular motors: a multi-disciplinary enterprise

Date: 13.12.13

Speaker: Prof. Abhishek Dhar

Affiliation: ICTS, TIFR, Bangalore

Title of the Colloquium: Puzzles in the theory of heat conduction in low-dimensional systems

Date: 27.12.13

Speaker: Prof. G. Baskaran

Affiliation: The Institute of Mathematical Sciences, Chennai

Title of the Colloquium: Magic Electronic Carpets

Date: 21.1.14

Speaker: Prof. Amalendu Chandra

Affiliation: Sajani Kumar Roy Memorial Chair Professor, Dept of Chemistry, IIT Kanpur

Title of the Colloquium: Theoretical studies of chemical dynamics in aqueous systems from first principles simulations

Date: 3.1.14

Speaker: Prof. Mark Maroncelli

Affiliation: Penn State Department of Chemistry

Title of the Colloquium: Solvation and Solute Dynamics in Ionic Liquids

Date: 11.2.14

Speaker: Prof. Amitabha Chattopadhyay

Affiliation: J.C. Bose Fellow, Outstanding Scientist (Director Level), Centre for Cellular & Molecular Biology, Hyderabad,

Extended Visitors' Linkage Programme

Associates Day, 20 December 2013

Conference on Physics and Chemistry of Materials Computation and Experiments, 24 - 25 February 2014

Bose Fest, 30 - 31 January 2014

Workshop on Light Scattering Techniques and Application to Astronomy and other areas, 19 - 21 November 2013

Conference on Current Trends in Biochemical and Biophysical Modelling, 7 - 8 October 2013

Workshop on Quantum Integrable Systems, 2 - 6 December 2013

Professor & Dean, Biological Sciences, Academy of Scientific and Innovative Research

Title of the Colloquium: Current Excitements and Challenges in Membrane Biology

Date: 14.02.14

Speaker: Prof. Ayyappanpillai Ajayaghosh

Affiliation: National Institute for Interdisciplinary Science and Technology (NIIST), CSIR, Trivandrum

Title of the Seminar: Excited State Properties of Fluorescent Molecular Assemblies and Gels

Date: 21.3.14

Institute Seminar

Speaker: Dr. Bibhas Ranjan Majhi

Affiliation: IUCAA - Pune

Title of the Seminar: Noether charge, Virasoro algebra and horizon entropy

Date: 01.04.13

Speaker: Prof. Aibing Yu

Affiliation: Scientia Professor and Federation Fellow Laboratory for Simulation and Modelling of Particulate Systems (Simpas) School of Materials Science and Engineering, The University of New South Wales Sydney, Australia

Title of the Seminar: Small Particles, Big Science: A Personal Perspective

Date: 16.04.13

Speaker: Dr. Jak Chakhalian

Affiliation: Charles and Claudine Scharlau Professor of Physics Director, Laboratory for Artificial Quantum Matter Physics Department, University of Arkansas, USA

Title of the Seminar: That strange copper oxide

Date: 22.05.2013

Speaker: Dr. John W. Freeland

Affiliation: Physicist, Advanced Photon Source, Argonne National Laboratory, Argonne

Title of the Seminar: Understanding Interfaces as a Route to Control the Orbital Degree of Freedom in Cuprates

Date: 27.05.2013

Speaker: Dr. G. Narahari Sastry

Affiliation: Centre for Molecular Modeling, Indian Institute of Chemical Technology, Hyderabad, India

Title of the Seminar: Modulating Non-Bonded Interactions: The Causes and Consequences

Date: 17.06.2013

Speaker: Dr. Tapas Chakraborty,

Affiliation: Sr. Professor and Head, Dept. of. Physical Chemistry, Indian Association for the Cultivation of Science, Jadavpur, Kolkata

Title of the Seminar: Methyl rotor in chemistry and spectroscopy

Date: 05.07.2013

Speaker: Dr. Jahur Alam Mondal

Affiliation: Scientific Officer (E), Radiation & Photochemistry Division, Bhabha Atomic Research Centre, Mumbai

Title of the Seminar: Structure and Orientation of Water at Model Membrane Interfaces: A Heterodyne-Detected Vibrational Sum frequency Generation Study

Date: 26.07.2013

Speaker: Dr. Nilmoni Sarkar

Affiliation: Professor, Dept. of Chemistry, IIT-Kharagpur, W.B.

Title of the Seminar: Chemistry in Microheterogeneous Media: Investigation of Various Photophysical and Dynamical Phenomena

Date: 30.08.2013

Speaker: Dr. Cyril Branciard

Affiliation: Centre for Engineered Quantum Systems and School of Mathematics and Physics, Queensland, Australia

Title of the Seminar: Uncertainty relations for approximate joint measurements

Date: 05.09.2013

Speaker: Denis Rosset

Affiliation: University of Geneva, Switzerland

Title of the Seminar: Trust in devices and entanglement characterization

Date: 05.09.2013

Speaker: Dr. D. Atkinson

Affiliation: Department of Physics, Durham University, U K

Title of the Seminar: Local Control of Nanoscale Magnetic Properties by Interfacial Modification in Bilayer Magnetic Systems Induced by Ga+Ion Irradiation

Date: 24.09.2013

Speaker: Dr. A. T. Hindmarch

Affiliation: Centre for Materials Physics, Department of Physics, Durham University, UK

Title of the Seminar: Novel magnetic interactions in amorphous alloy thin films

Date: 26.09.2013

Speaker: Dr. Anjan Barman

Affiliation: Thematic Unit of Excellence on Nanodevice Technology, Department of Condensed Matter Physics and Material Sciences, S. N. Bose National Centre for Basic Sciences

Title of the Seminar: Spin Waves at the Nanoscale: A New Paradigm towards On- Chip Microwave Communications

Date: 03.10.2013

Speaker: Dr. Ramaprosad Mukhopadhyay

Affiliation: Professor, HBNI, DAE & Head, Solid State Physics Division, Bhabha Atomic Research Centre, Mumbai

Title of the Seminar: Stochastic Dynamics in Condensed Matter-Neutron Scattering Study

Date: 30.10.2013

Speaker: Dr. Sarika Jalan

Affiliation: Assistant Professor, Complex Systems Lab - Indian Institute of Technology, Indore

Title of the Seminar: Randomness in random networks: A random matrix theory approach

Date: 15.11.2013

Speaker: Dr. N. D. Hari Dass

Affiliation: Professor, Chennai Mathematical Institute & CQIQC, IISc, Bangalore

Title of the Seminar: The Superposition Principle in Quantum Mechanics - did the rock enter the foundation surreptitiously?

Date: 18.11.2013

Speaker: Dr. N.D.Hari Dass

Affiliation: Professor, Chennai Mathematical Institute & CQIQC, IISc, Bangalore

Title of the Seminar: Varieties of Quantum Measurements

Date: 20.11.2013

Speaker: Dr. Jayvardhan Sinha

Affiliation: Post Doctoral Fellow, Magnetic Materials Unit NIMS Tsukuba, Japan

Title of the Seminar: Tuning interface anisotropy in Ta|CoFeB|MgO

Date: 28.11.2013

Speaker: Dr. Kavita Jain

Affiliation: Professor, JNCASR Bangalore

Title of the Seminar: Adaptation and distribution of beneficial fitness effects

Date: 29.11.2013

Speaker: Dr. Dinshaw Balsara

Affiliation: Associate Professor, University of Notre Dame, USA

Title of the Seminar: Simulating and Analyzing Two-Fluid Turbulence in Molecular Clouds

Date: 8.1.14

Speaker: Dr. Sarbarish Chakravarty

Affiliation: University of Boulder, Colorado

Title of the Seminar: Beach waves and Line-solitons of the KP equation

Date: 9.1.14

Speaker: Dr. Sanjib Sabhapandit

Affiliation: Raman Research Institute, Bangalore

Title of the Seminar: Fluctuations and large deviations in nonequilibrium systems

Date: 17.1.14

Speaker: Dr. Pushan Ayyub

Affiliation: Department of Condensed Matter Physics & Materials Science Tata Institute of Fundamental Research, Mumbai

Title of the Seminar: Looking for Complexity in Elementary Systems

Date: 7.2.14

Speaker: Dr. R. Rajesh

Affiliation: The Institute of Mathematical Sciences, Chennai

Title of the Seminar: Microstructural Characteristics of the Mammalian Cortical Bone

Date: 21.2.14

Speaker: Dr. Arijit K.De

Affiliation: Postdoctoral Fellow, Physical Biosciences Division, Lawrence Berkeley National Laboratory and Department of Chemistry, University of California at Berkeley

Title of the Seminar: Probing ultra fast coherent dynamics by incoherent fluorescence detection: Towards a spatiotemporal approach

Date: 31.3.14

SPECIAL LECTURE

Speaker: Dr. Bharat L. Newalkar

Affiliation: Corporate R&D Centre, Bharat Petroleum Corporation Limited, Greater Noida

Title of the Seminar: Use of zeolites in petroleum refining and petrochemical processes – Recent advances

Date: 28.02.14

Bose Colloquium – 10, Institute Seminar – 25, Special Lecture – 1

Bose Fest

Bose Fest showcased the spirit of creativity and science through a 2-day long festival held within the Center's premises during 30- 31 January 2014.

- All academic colleagues were invited for spontaneous participation in the yearly science celebration under SCOLP, EVLP.
- The programme was inaugurated by Prof. A.K Raychaudhuri, Director at the Silver Jubilee Hall.
- All students belonging to 3rd and 4th years delivered oral presentations while the rest made poster presentations. All talks were of 15 (12 + 3) minutes duration. The talk sessions were divided into 4 Sessions corresponding to the 4 Departments at the Centre. This year there were 38 Talks and 40 Posters presented by the students of the Centre.
- The Condensed Matter Physics and Material Sciences session were chaired by Prof. Priya Mahadevan (SNBNBS), Dr. Sujit Bandyopadhyay (VECC, Kolkata), Dr. Manoranjan Kumar (SNBNBS), and Dr. D. Das (UGC DAEF, Kolkata). The Chemical, Biological and Macro-Molecular Sciences sessions were chaired by Prof. Tapas Chakraborty (IACS, Kolkata) and Prof. Pradip K.Ghorai (IISER- Kolkata). Prof. A.S. Majumder (SNBNCBS) chaired the session on Astrophysics & Cosmology. The session on Theoretical Sciences were chaired by Dr. Shraddha Mishra (SNBNBS), and Prof. Biswajit Chakraborty (SNBNBS).
- Cultural performance by Muktangan followed by Family dinner was held on 30.01.14.
- The curtains fell with the Prize distribution ceremony for the best talk and Poster presentation on 31.01.14.

Visitor, Associates and Student's Programme (VASP)

Associates & Short Term Visitors

Associate: Dr. B. Rajini Kanth

Affiliation: Associate Professor, T. K. R. College of Engineering and Technology, Hyderabad

Duration of Visit: 18.05.2013 to 31.05.2013 & 22.01.2014 to 05.02.2014

Host Faculty: Prof. P. K Mukhopadhyay

Associate: Dr. Nilotpal Ghosh

Affiliation: Associate Professor, VIT University, Vellore

Duration of Visit: 31.05.2013 to 26.06.2013 & 20.12.2013 to 30.12.2013

Host Faculty: Prof. A. K. Raychaudhuri & Dr. Barnali Ghosh Saha

Student Associate: Sanchayita Rajkhowa

Affiliation: Research Scholar, NEHU, Shillong

Duration of Visit: 17.12.2013 to 27.12.2013

Host Faculty: Prof. Ranjit Biswas

Short Term visitor: Shyamashis Das

Affiliation: Student, IISc. Bangalore

Duration of Visit: 21.05.2013 to 29.05.2013

Host Faculty: Dr. Priya Mahadevan

Short Term Visitor: Dr. Shradha Mishra

Affiliation: INSPIRE Faculty, Dept. of Physics and Meteorology, IIT, Kharagpur

Duration of Visit: 27.05.2013 to 28.07.2013

Host Faculty: Dr. Sakuntala Chatterjee

Short Term Visitor: Dr. Rukmini Dey

Affiliation: Reader 'F', School of Mathematics, Harish-Chandra Research Institute, Allahabad

Duration of Visit: 30.05.2013 to 21.06.2013

Host Faculty: Dr. Samir Kumar Paul

Short Term Visitor: Mr. Rahul Kumar Singh

Affiliation: JRF, School of Mathematics, Harish-Chandra Research Institute, Allahabad

Duration of Visit: 30.05.2013 to 21.06.2013

Host Faculty: Dr. Samir Kumar Paul

Short Term Visitor: Dr. Dibakar Roychowdhury

Affiliation: Post Doctoral Fellow, IISER, Bhopal

Duration of Visit: 20.06.2013 to 06.07.2013

Host Faculty: Prof. Rabin Banerjee

Short Term Visitor: Dr. Bikash Chandra Paul

Affiliation: Associate Professor, North Bengal University, Siliguri

Duration of Visit: 22.10.2013 to 31.10.2013

Host Faculty: Prof. Archan S. Majumdar

Short Term Visitor: Dr. Raju Roychowdhury

Affiliation: Postdoctoral Researcher CAA, Department of Physics and Astronomy, Shanghai Jiao Tong University

Duration of Visit: 18.11.2013 to 29.11.2013

Host Faculty: Prof. Partha Guha

Short Term Visitor: Dr. Kuldeep Kumar

Affiliation: Assistant Professor, Department of Physics, Panjab University, Chandigarh

Duration of Visit: 15.12.2013 to 10.01.2014

Host Faculty: Prof. Rabin Banerjee

Short Term Visitor: Dr. Santabrata Das

Affiliation: Assistant Professor, Department of Physics, IIT Guwahati

Duration of Visit: 16.12.2013 to 26.12.2013

Host Faculty: Prof. Sandip K Chakrabarti

Short Term Visitor: Dr. Manabendra Nath Bera

Affiliation: Postdoctoral Fellow, HRI Allahabad

Duration of Visit: 10.2.2014 to 15.2.2014

Host Faculty: Prof. Archan S. Majumdar

Short Term Visitor: Prof. Peter Leach

Affiliation: University of Natal, Durban, South Africa

Duration of Visit: 10.2.2014 to 9.03.2014

Host Faculty: Prof. Partha Guha

Summer Research Programme 2013 – (May, JUNE, JULY)

The Summer Research Programme is designed for students in first /second year of M.Sc in Physical, Chemical (including Biophysics and Chemical Biology) and Mathematical Sciences for a period of eight weeks (with no break) under the supervision of a Faculty Member of SNBNCBS in an area of mutual interest.

Sl. No	Supervisor	Selected Candidate	Affiliation
1	Dr. Jaydeb Chakrabarti	Rajarshi Bhattacharyya	IISER - Kolkata
2	Dr. Sugata Mukherjee	Manash Kumar Jha	Central University, Rajasthan
3	Dr. Biswajit Chakraborty	Kaushlendra Kumar	IIT - Varanasi
4	Dr. Anjan Barman	Pranav Nimgade	IIT - Delhi
5	Dr. T. Saha-Dasgupta	Shashank S. Harivyasi	Amity Institute of Nanotechnology, UP
6	Dr. A. S. Majumder	Abinas Pradhan	NIT - Rourkela
7	Dr. Gautam Gangopadhyay	Jayanta Ghosh	IIT - Bombay
8	Dr. A. K. Raychaudhuri	Mukul Bhattacharya	IISc - Bangalore
9	Dr. P.K. Mukhopadhyay	Sandipan Haldar	IIT - Bombay
10	Dr. B.B.Bhattacharya	Arka Das	ISM - Dhanbad
11	Dr. S.K.Pal	Vivekananda Mahato	ISM - Dhanbad
12	Dr. Soumen Mondal	Riya Sebait	Visva-Bharati, Santiniketan
13	Dr. Manoranjan Kumar	Adyasha Aparimita	NIT - Rourkela
14	Dr. Madhuri Mondal	Deblina Majumder	Scottish Church College, Kolkata
15	Dr. Rajib Kr. Mitra	Pratibha Verma	IIT - Delhi
16	Dr. Kalyan Mandal	Archana	Central University, Rajasthan
17	Dr. Saswati Barman	Anamika Patra	Calcutta University
18	Dr. Ranjan Chaudhury	Poonam Bhincher	Delhi University
19	Dr. Priya Mahadevan	Govind Chhabra	Delhi University
20	Dr. Punyabrata Pradhan	Anusuya Pal	University of Hyderabad
21	Dr. Ranjit Biswas	Prabhat Prakash	Banaras Hindu University
22	Dr. Mahua Ghosh	Jagriti Banerjee	IISER, Bhopal

- 22 students enrolled for the 8 weeks in-house programme.
- 10 funded students (Fellowships from KVPY, INSPIRE & Indian Academy of Science). The rest were funded by SNBNCBS.
- On completion of 8 weeks, students deliver an Open Talk and submit 3 copies of their project work for the Library, EVLP office and their respective Supervisor.
- Certificate & stipend are given to students on completion of the programme.

Associates' Day

The 'Associates Day' was held on 20 December 2013 at the Centre. All current Associates and PDRAs under the Extended Visitors & Linkage Programme delivered an 'open talk' showcasing the work done in collaboration with the Centre. The one day programme hosted 10 talks and was inaugurated by Director, Prof. A. K Raychaudhuri. All faculty members and students were invited to participate in the programme.

Conference, Workshop & Extension Programme (CWEP)

Science, Technology and Innovation Policy 2013 15th May 2013

The Centre organized a one-day brainstorming conference on behalf of the Department of Science and Technology, Govt. of India. This conference on the Science, Technology and Innovation Policy 2013 was one of a series of 10 regional conferences planned by the DST, which is primarily responsible for implementation of the Policy. The policy was announced by the Honourable Prime Minister during the inauguration of the 100th session of the Indian Science Congress in January 2013.

Purpose of the Conference–

To elicit inputs of diverse stakeholders for implementation and operationalising the specific measures and mechanism enunciated in the Policy. The Conference helped to identify best practices and come up with new ideas in the areas of research, technology and innovation that will help frame specific schemes, missions, programmes, mechanisms, instruments and procedures for implementation of the STI Policy.

Participation included scientists, social scientists, technologists and engineers, representatives of industry and senior persons involved in governance and policy making.

Session topics –

- Nurturing and Promoting Excellence and Relevance in Science Education, Research & Development
- Crafting the dream Innovation ecosystem
- Enhancing Private Sector Investments in R&D, Technology and Innovation
- Development & Resources for an aspirational Indian Society

C.K Majumdar Memorial Summer Workshop in Physics
1 – 12 July 2013

The workshop jointly organized by Indian Association of Physics Teachers (Regional Council- 15) and SNBNCBS was designed for outgoing 3rd year B.Sc Physics students.

Convener – Dr. Saswati Dasgupta (Teacher – in – charge, Rammohan College, Kolkata

Co - Convener – Prof. Archan S. Majumdar (SNBNCBS)

Purpose of the Workshop –

To give exposure to different fields of research (both theoretical and experimental) to a group of outgoing final year B.Sc students in Physics. The programme has been conducted by IAPT since 1999 without a break. It has been observed that students who join this programme get an orientation towards future research.

About the Workshop –

- 31 undergraduate students from different colleges of West Bengal enrolled for the Summer Workshop.
- Prof. A.K Raychaudhuri, Director, SNBNCBS inaugurated the programme.
- Eminent scientists delivered lectures and the students enjoyed an interactive session with the speakers.
- The morning session consisted of three lectures and the afternoon session was devoted to laboratory work.
- Students worked on innovative experiments set up and designed by IAPT and other faculty members from several colleges of West Bengal.
- The programme ended with an interactive feedback session with the students.

Current Trend in Biochemical and Biophysical Modelling
7 - 8 Oct, 2013

Conveners – Prof. Jaydeb Chakrabarti, Prof. Gautam Gangopadhyay, and Dr. Mahua Ghosh

Purpose of the Meeting –

The activities in the area of biochemical and biophysical modelling and computation are gaining momentum with the advent of new theoretical and computational techniques. The major purpose of the meeting was to bring together people working in these areas. This would also help in making a nation-wide network of such newly emerging research activities.

Total number of participants – Total – 45, Students - 20

Light Scattering Techniques and Application to Astronomy and Other Areas
19 - 21 Nov, 2013

Conveners Professor Subodh Kumar Sharma, SNBNCBS, Kolkata, Professor Ranjan Gupta, IUCAA, Pune

Purpose of the Meeting –

Over past few decades, the light scattering techniques have improved due to various advances in computational power as well as improvement in mathematical abilities. The most common techniques use Mie Theory, T-matrix approach, discrete dipole approximation, eikonal methods and many other approximation and numerical methods. These techniques are adapted to suit various applications viz. (i) interpretation of Astrophysical phenomena as a result of light scattered from cosmic dust (ii) laboratory experiments on simulated dust samples (iii) medical and astrophysical applications etc. On international scene multiple conferences are held every year relating with these topics. In India, there

are several interested workers in this field ranging from astronomers, theoreticians and laboratory physicists who found the workshop as an important platform to exchange new ideas and possible inter- disciplinary areas where collaborations can be initiated.

Total number of participants – Total – 35, Students - 10

International Workshop On Quantum Integrable Systems
2 - 7 Dec, 2013

Conveners - Partha Guha (SNBNCBS), Anjan Kundu (SINP) & Prasanta K. Panigrahi (IISER, Kolkata)

Purpose of the Meeting –

An advanced level workshop to stimulate research activities on Quantum Integrable system, which has profound applications in Hamiltonian system, associative algebras and string theory.

Total number of participants – Total – 30, Students - 10

Physics and Chemistry of Materials: Computation and Experiments (PCMCE 2014)
24 - 25 Feb, 2014

Convenor: Tanusri Saha-Dasgupta, SNBNCBS;

Co-Convener: Ranjit Biswas, SNBNCBS

Purpose of the Meeting –

The purpose of this meeting was to bring together young and motivated researchers working in the exotic field of materials science, to discuss its recent trends on experimental and computational aspects. The rapid progress of both experimental, theoretical methods and simulation techniques have made this field a site of intense activities.

Participants included both physicists and chemists and also senior PhD students and post-doctoral fellows working in the field from different Universities and Institutes of India, in and around Kolkata.

Total number of participants – Total – 60, Students - 30

One Day Discussion Meeting on Integrable & Non Integrable Aspects of Dynamical Systems
21 March 2014

Convener - Partha Guha (SNBNCBS)

Purpose of the Meeting –

In continuation with the NMI – IISc. funded workshop on Quantum Integrable Systems held at the S.N. Bose National Centre for Basic Sciences during 2-6 December 2013, this scientific meeting is a one day discussion on Integrable & Non Integrable aspects of Dynamical Systems. The main aim was to bring together people working in Classical & Quantum Integrable systems in a common forum.

Total number of participants – Total – 20, Students - 10

Advanced Post-Doctoral Manpower Programme (APMP)

The Centre runs a programme based on Post-Doctoral Research Associates (PDRA). Candidates possessing Doctorate (PhD degree) (including those who recently submitted thesis or are about to submit thesis in next 3 months) are eligible for appointment as a PDRA in the Centre. The selection procedure is done four times in a year.

The four times 'gather' for PDRA selections are held in **January, April, July and October.**

PDRA Selection 2013 – 14

Total No. of applications – 23

Total shortlisted candidates – 13

Total selected candidates – 4

Dr. Mainak Sadhukhan (April 2013 gather)

Mentor - Prof. Ranjit Biswas

Department of Chemical, Biological and Macromolecular Sciences

Resigned on 24.12.13

Mr. Rohit Kumar (April 2013 gather)

Mentor - Prof. Amitabha Lahiri

Department of Theoretical Sciences

Dr. Sanchari Goswami (July 2013 gather)

Mentor - Dr. Sakuntala Chatterjee

Department of Theoretical Sciences

Dr. Jaivardhan Sinha (January 2014 gather)

Mentor – Prof. Anjan Barman

Department of Condensed Matter Physics and Materials Sciences

Other PDRAs

Dr. Partha Sarathi Pal (July 2012 gather)

Mentor - Prof. Sandip Chakrabarti

Department of Astrophysics & Cosmology

PDRA Review – 30.10.13

Dr. Bipul Das (July 2012 gather)

Mentor - Prof. A.K. Raychaudhuri

Department of Condensed Matter Physics and Materials Sciences

PDRA Review – 30.10.13

Mr. Sudhakar Upadhyay (October 2012 gather)

Mentor - Prof. Rabin Banerjee

Department of Theoretical Sciences

Resigned on 04.03.14

Dr. Tilak Das (January 2013 gather)

Mentor – Prof. Tanusri Saha Dasgupta

Department of Condensed Matter Physics and Materials Sciences

Dr. Suman Ghosh (January 2013 gather)

Mentor - Prof. Amitabha Lahiri

Department of Theoretical Sciences

Total Number of PDRAs supported by the Centre - 9

Networked Projects and Extension Programme (NPEP)

The programme invites researchers and research institutes to take up projects under exchange programmes. Such networked projects are categorized as International Manpower Exchange Programme (IMEP), Joint Advanced Research Programme (JARP), Partnership programme with University and Colleges (PPUC) and Strategic alliance and Knowledge Centers with Industrial partners.

Arka Renewable Energy

The Centre is engaged with Arka Renewable Energy for the Development of Solar Jacket/ Cooling vest for traffic Police and Industrial workers.

The project has been initiated on 31.10.13 and a project review meeting was held on 12.3.14.

Debashree Bhattacharyya

Co-ordinator, EVLP

Theoretical Physics Seminar Circuit

Theoretical Physics Seminar Circuit

I. Details of TPSC visits for the period April 2013 to March 2014 is given below:

Name: Prof. N. D. Hari Dass, IISc, Bangalore & CMI, Chennai

Duration of visit: 17.11.2013 to 01.12.2013

Seminar date: 27.11.2013

Title: From Strings to Strings - the amazing story of strings in Quantum Chromodynamics

Name: Dr. Chirag Kalelkar, IIT-Kharagpur

Duration of visit: 05.09.2013 to 06.09.2013

Seminar date: 06.09.2013

Title: Micro-Extensional Rheometer

Name: Dr. Sumanta Tewari, Clemson University, USA

Duration of visit: 27.06.2013

Seminar date: 27.06.2013

Title: The search for the quirky quantum particle struck gold: The emergence of Majorana Fermions in Condensed Matter Physics and implications

II. Following Topical Research Workshops / Advanced Research Schools were held under TPSC :

"Physics of Advanced Optical Materials & Photonics", in Bhubaneswar, during 26-28 March 2014, jointly organised by Vidyasagar University, Midnapore. About 150 participants attended. A sum of Rs 200000 was disbursed from TPSC.

"Current Trends in Quantum Gases, BEC & Solitons", held in Panjab University, Chandigarh, organised by the Physics Department, PU, during 3-6 March 2014. Over 100 participants attended. A sum of Rs 200000 was disbursed from TPSC.

Sugata Mukherjee

Convener, Theoretical Physics Seminar Circuit

Registrar

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 the year 2013-2014 successful. Staff comprising of strength of approximately 22 in permanent, 12 in temporary and 44 in contractual category as on 31st March 2014, 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 (Bhagirathi), security, EPABX, transport, canteen, electrical maintenance, AC maintenance, campus maintenance etc. has been made possible due to the professional services provided by the various services contract agencies working closely with the administrative sections of the Centre. The administrative employees of the Centre have been encouraged to attend various training programmes and workshops all through the year so that their administrative and technical abilities are enhanced. The Centre has maintained a close communication with the Department of Science and Technology and some other ministries and have replied to their various enquiries and 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 has been reported during the period of 2013-2014. One case under the purview of the Complaints Committee was reported and was successfully disposed off. The Centre has also adhered to the norms of the Right to Information Act and so far has received ten cases under the said Act in the last financial year all of which has been disposed off.

The administration of the Centre also lend its strong support to the DST – Autonomous Bodies Conclave and Young Scientists' Meet which was held in the Centre during 28th and 29th January 2014. This was attended by Secretary and various officials from DST, Directors of all Autonomous Institutes under DST and Young Scientists representing various scientific and research institutes.

Welfare Measures and Language Policy

Official Language Policy

The Centre paid emphasis on implementation of the Official Language in the year 2013-14. 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 were circulated in Hindi also. Many of the internal notings and signing in the Attendance Register (on the first of every month) is done in Hindi. Some of the important policy documents of the Centre have been translated in Hindi and have been uploaded in the Centre's website. The Centre has also carried out some correspondences in Hindi with the ministry and other organisations. The Centre is a member of Calcutta Town Official Language Implementation Committee (CALTOLIC) and has a Hindi Implementation Committee which meets regularly. Almost 100% of the administrative staff now possess working knowledge of Hindi and have been successfully trained 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. It was officially inaugurated on 14th September by Prof. Sandip Kumar Chakrabarti, Acting Director in presence of Shri. R. N. Saroj, Shri.R.A.Choudhury and Shri Vipati of Hindi Teaching Scheme. The hindi mahina was celebrated through screening of Hindi Film "Chhoti Si Baat", staging of an in house Hindi play by staff and students of the Centre "Beti Bachao", Hasya Kavi Sammelan performed by guests and a Hindi Quiz programme.

Welfare Measure

The Centre has the Contributory Medical Scheme (CMS) under which the Centre extends medical facilities (both outdoor and indoor) to all its staff members and their dependents (in case of permanent staff members) and to the students and contractual staff members (as individuals) and reimburses medical bills as per CGHS rates. The Centre has its own medical unit to cater to the requirements of the staff members where Allopathic, Homeopath and Ayurvedic physicians are available for regular consultation. Facilities like oxygen, wheel chair, stretcher, rest bed etc. are readily available apart from First Aid treatments. The Centre also has tie ups under CGHS with some of the renowned hospitals in Kolkata viz. Apollo Gleneagles Hospitals, B.M. Birla Heart Research Centre, Peerless Hospital & B.K.Roy Research Institute, Desun Hospital & Heart Institute etc who provide cash less indoor hospitalisation facility.

The Centre organised a training programme on Basic Life Support (BLS) and First Aid on 21st March 2014 at Silver Jubilee Hall of the Centre. The training was conducted by doctors and experts of Apollo Gleneagles Hospitals, Kolkata. The axiom of the training was to impart knowledge on Basic Life Saving and First Aid support for handling any trauma during emergency conditions.

The Centre has Crèche facilities (Kishlay) for the children of staff and students of the Centre.

The Centre houses a modern Guest House by the name of 'Bhagirathi' comprising of 57 air conditioned rooms (including Single Bed, Double Bed & Transit rooms), 5 air conditioned suites and a fully AC Dining Hall and Kitchen with modern facilities, an ATM and Seminar room. The Centre also has two hostels by the name 'Radhachura' and 'Krishnachura' which provides hostel accommodation to approximately 32 and 122 students respectively. The students residing in the Centre run their own mess and the hostels have facilities like dining rooms, common rooms etc.

The Centre has modernly equipped Lecture Halls / Seminar Halls namely : Silver Jubilee Hall (120 sitting capacity), BOSON (60 sitting capacity) and FERMION (80 sitting capacity) with latest lecture facilities to cater to the various events organised viz. Lectures, Seminars, Colloquiums, Symposiums, Training programmes, Cultural Programmes, etc.

The members of the Bose Centre family have presented a number of creative and recreational activities in past few years. In order to promote these activities, the Centre has formed a recreation club called 'Muktangan' which has identified 5 broad activities viz. Performing Arts, Literary Arts, Visual Arts, Sports Activities, Social Outreach. Each activity has Activity Co-ordinators. 'Muktangan' was formally inaugurated on 1st January 2014, and since then organised several programmes under its aegis.

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

Shohini Majumder

Registrar

Committees

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

Ms Anuradha Mitra *Member*
Joint 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 Sanjay Mitra, IAS *Member*
Chief Secretary, Government of West Bengal
Kolkata

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

Prof. Deb Shankar Ray *Permanent Invitee*
Acting Director
Indian Association for the Cultivation of Science
Kolkata

Ms. Shohini Majumder *Non-Member Secretary*
Registrar
S. N. Bose National Centre for Basic Sciences
Kolkata

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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

Ms Anuradha Mitra *Member*
Joint Secretary & Financial Adviser
Department of Science & Technology
New Delhi

Ms. Shohini Majumder *Member Secretary*
Registrar
S. N. Bose National Centre for Basic Sciences
Kolkata

Academic & Research Programme Advisory Committee

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Director, UGC-DAE Consortium, Indore

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Director, NCRA, Pune

Prof. Sanjay Puri *Member*
Professor, JNU, New Delhi

Prof. Amitabha Raychaudhuri *Member*
Professor, Calcutta University, Kolkata

Prof. Dilip G. Kanhere *Member*
Distinguished Professor, University of Pune

Prof. Amalendu Chandra *Member*
Professor, IIT Kanpur, Kanpur

Prof. Raghavan Varadarajan *Member*
Professor, IISc, Bangalore

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Director, S. N. Bose National Centre
for Basic Sciences, Kolkata

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Dean (Faculty)
S. N. Bose National Centre for Basic Sciences

Prof. Amitabha Lahiri *Member*
Dean (Academic Programme)
S. N. Bose National Centre for Basic Sciences

Ms. Shohini Majumder *Member*
Registrar
S. N. Bose National Centre for Basic Sciences

Prof. S. K. Chakrabarti *Permanent Invitee*
Head, Department of Astrophysics and Cosmology
S. N. Bose National Centre for Basic Sciences

Prof. S. S. Manna *Permanent Invitee*
Head, Department of Theoretical Sciences
S. N. Bose National Centre for Basic Sciences

Prof. P. K. Mukhopadhyay *Permanent Invitee*
Head, Department of Condensed Matter Physics
and Material Sciences
S. N. Bose National Centre for Basic Sciences

Prof. Ranjit Biswas *Permanent Invitee*
Head, Department of Chemical, Biological
and Macromolecular Sciences
S. N. Bose National Centre for Basic Sciences

Mr. Santosh Kumar Singh *Non-Member Secretary*
Deputy Registrar (Academic Programme) [Officiating]
S. N. Bose National Centre for Basic Sciences

Official Language Implementation Committee

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

Ms. Shohini Majumder *Member*
Registrar
S. N. Bose National Centre for Basic Sciences

Prof. Manu Mathur *Member*
Professor
S. N. Bose National Centre for Basic Sciences

Mr. Apurba Kanti Sarkar *Member*
Deputy Registrar (Finance)
S. N. Bose National Centre for Basic Sciences

Dr. Chhayabrita Biswas *Member*
Bose Fellow
S. N. Bose National Centre for Basic Sciences

Mr. Sirsendu Ghosh *Member*
In-charge, Hindi Cell
S. N. Bose National Centre for Basic Sciences

Mr. Santosh Kumar Singh *Member*
AR (Purchase)
S. N. Bose National Centre for Basic Sciences

Mr. Prashant Singh *Member*
Part-time Hindi Officer
S. N. Bose National Centre for Basic Science

Building Committee

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

Ms. Shohini Majumder *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, Shibpur

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
S. N. Bose National Centre for Basic Sciences

Prof. Rabin Banerjee *Member*
Dean (Faculty)
S. N. Bose National Centre for Basic Sciences

Prof. Amitabha Lahiri *Member*
Dean (Academic Programme)
S. N. Bose National Centre for Basic Sciences

Prof. S. S. Manna *Member*
Head, Department of Theoretical Sciences
S. N. Bose National Centre for Basic Sciences

Prof. S. K. Chakrabarti *Member*
Head, Department of Astrophysics and Cosmology
S. N. Bose National Centre for Basic Sciences

Prof. Ranjit Biswas *Member*
Head, Department of Chemical, Biological and Macromolecular Sciences
S. N. Bose National Centre for Basic Sciences

Prof. Pratip Kumar Mukhopadhyay *Member*
Head, Department of Condensed Matter Physics and Material Sciences
S. N. Bose National Centre for Basic Sciences

Ms. Shohini Majumder *Member*
Registrar
S. N. Bose National Centre for Basic Sciences

Mr. Apurba Kanti Sarkar *Member*
Deputy Registrar (Finance)
S. N. Bose National Centre for Basic Sciences

Mr. Santosh Kumar Singh *Member - Secretary*
Deputy Registrar (Academic) [Officiating]
S. N. Bose National Centre for Basic Sciences

PEOPLE AT THE CENTRE

Academic Members

Faculty Members

1	Arup Kumar Raychaudhuri	Director & Distinguished Professor, CMPMS
2	Amitabha Lahiri	Professor & Dean (AP), TS
3	Anita Mehta	Senior Professor, TS
4	Anjan Barman	Professor, CMPMS
5	Archan S. Majumdar	Professor, A&C
6	Barnali Ghosh (Saha)	Scientist-E (Technical Cell), CMPMS
7	Biswajit Chakraborty	Professor, TS
8	Gautam Gangopadhyay	Professor, CBMS
9	Jaydeb Chakrabarti	Professor, CBMS
10	Kalyan Mandal	Professor, CMPMS
11	Manik Pradhan	Assistant Professor, CBMS

12	Manoranjan Kumar	Assistant Professor, CMPMS
13	Manu Mathur	Professor, TS
14	M. Sanjay Kumar	Associate Professor, TS
15	Partha Guha	Professor, TS
16	Pratip Kr. Mukhopadhyay	Professor & HOD, CMPMS
17	Priya Mahadevan	Professor, CMPMS
18	Prosenjit Singha Deo	Professor, CMPMS
19	Punyabrata Pradhan	Assistant Professor, TS
20	Rabin Banerjee	Senior Professor & Dean (Faculty), TS
21	Rajib Kumar Mitra	Assistant Professor, CBMS
22	Ramkrishna Das	Faculty Fellow, A&C
23	Ranjan Chaudhury	Associate Professor, CMPMS
24	Ranjit Biswas	Professor & HOD, CBMS
25	Sakuntala Chatterjee	Assistant Professor, TS
26	Samir K. Pal	Professor, CBMS
27	Samir K. Paul	Associate Professor, TS
28	Sandip K. Chakrabarti	Senior Professor & HOD, A&C
29	Sanjoy Choudhury	Scientist-C (Computer Services Cell)
30	Soumen Mondal	Assistant Professor, A&C
31	Subhrangshu Sekhar Manna	Senior Professor & HOD, TS
32	Sugata Mukherjee	Associate Professor, CMPMS
33	Tanusri Saha Dasgupta	Professor & Associate Dean (Faculty), CMPMS

Emeritus Professors

1	Abhijit Mookerjee	CMPMS
2	Subodh Kumar Sharma	TS

Senior Visiting Scientist

1	B. B. Bhattacharya	TS

Research Scientist

1	Mahua Ghosh	CBMS

Bose Fellows

1	Chhayabrita Biswas	CMPMS
2	Kinsuk Acharyya	A&C

Scientist-D

1	Amitava Moitra	TUECMS
2	Biswaroop Mukherjee	TUECMS
3	Chacko Sajeev Sakai	TUECMS
4	Kaustuv Das	TUENDT
5	Saswati Barman	UNANST

Scientist-C

1	Arabinda Halder	TUENDT
2	Sudeshna Samanta	UNANST

DST Inspire Faculty Members

1	Amlan Dutta	CMPMS
2	Partha Mahata	CMPMS
3	Shradha Mishra	TS
4	Soumendu Datta	CMPMS
5	Subhra Jana	CBMS

Post Doctoral Research Associates

1	Bipul Das	CMPMS
2	Bipul Rakshit	CMPMS
3	Madhuri Mandal	CMPMS
4	Mainak Sadhukhan	CBMS
5	Pabitra Mandal	CMPMS
6	Partha Sarathi Pal	A&C
7	Pinaki Laha	CMPMS
8	Ponraj Sabareesan	CMPMS
9	Prasanna Kumar Mondal	CBMS
10	Prashant Singh	CMPMS
11	Rohit Kumar	TS
12	Sanchari Goswami	TS
13	Sudhaker Upadhyay	TS
14	Suman Ghosh	TS
15	Sunita Mohanty	CMPMS
16	Swastika Bhattacharya Chatterjee	CMPMS
17	Tilak Das	CMPMS
18	V. V. Ravi Kishore	CMPMS

A&C : Department of Astrophysics & Cosmology

CBMS : Department of Chemical, Biological & Macro-Molecular Sciences

CMPMS : Department of Condensed Matter Physics and Material Sciences

TS : Department of Theoretical Sciences

TUECMS : Thematic Unit of Excellence on Computational Materials Science

TUENDT : Thematic Unit of Excellence on Nanodevice Technology

UNANST : Unit for Nanoscience and Technology

Administrative and Technical Staff Members

1	Ranjan Chaudhury	Acting Registrar (till 29th August 2013)
2	Shohini Majumder	Registrar (w.e.f. 30th August 2013)
3	Sugata Mukherjee	Vigilance Officer
4	Saumen Adhikari	Public Information Officer

Other Members

1	Apurba Kanti Sarkar	Deputy Registrar(Finance)
2	Avijit Ganguly	Campus Engineer cum Estate Officer
3	Saumen Adhikari	Librarian cum Information Officer
4	Sukanta Mukherjee	Assistant Registrar (Projects)
5	Santosh Kumar Singh	Assistant Registrar (Purchase) & Officiating as Deputy Registrar (Academic) w.e.f. 01.03.2013 to 31.03.2014
6	Sirsendu Ghosh	Programme Coordinating Officer
7	Tapan Kumar Sen	Senior Programme Assistant
8	Achyut Saha	Personal Assistant to Director w.e.f. 5th March 2014 (A/N)
9	Jaydeep Kar	Programme Assistant
10	Prosenjit Talukdar	Programme Assistant
11	Shiba Prasad Nayak	Pump Operator
12	Aditya Pal Choudhury	Project Assistant
13	Bijoy Kumar Pramanik	Junior Assistant (Guest House)
14	Bhupati Naskar	Library Stack Assistant
15	Arun Kumar Bhattacharya	Library Stack Attendant
16	Sushanta Kumar Biswas	Driver
17	Pradip Kumar Bose	Tradesman 'A'
18	Partha Chakraborty	Attendant
19	Partha Mitra	Attendant
20	Ratan Acharya	Attendant
21	Swapan Ghosh	Attendant

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	Cleaner
12	Nimai Naskar	Cleaner

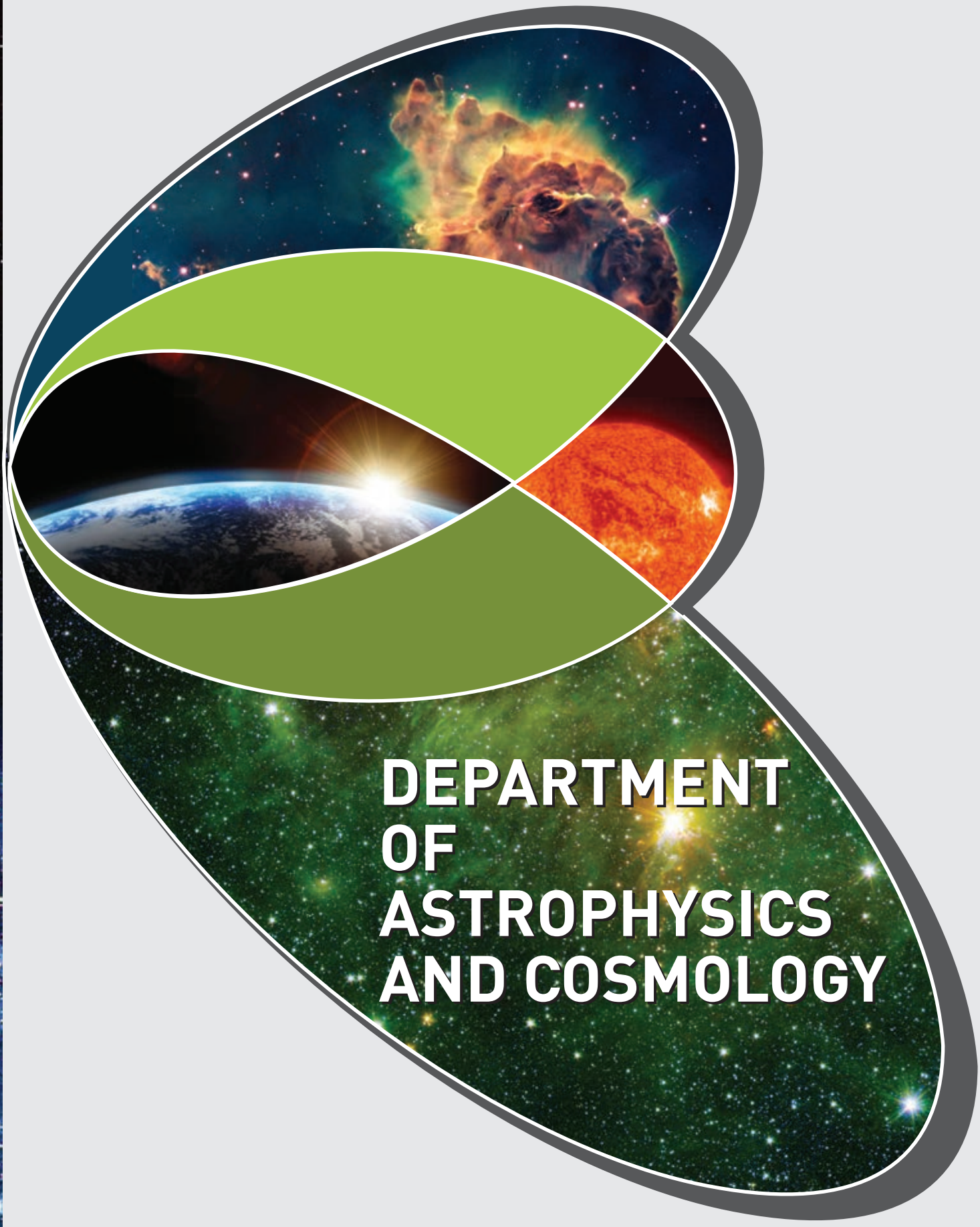
Personnel on Contractual Appointment

1	Sukumar Sarkar	Consultant (Administration)

2	Sunish Kumar Deb	Consultant (Liaison)
3	Dipankar Mukhopadhyay	Project (Advisor)
4	Jnanada Ranjan Bhattacharya	Superintending Engineer
5	Debashree Bhattacharyya	EVLP Co-ordinator
6	Achyut Saha	PS to Director (till 05.03.2014 F/N)
7	Sutapa Basu	PS to Registrar
8	Mahua Mitra (Ghosh)	Executive Assistant (Admin.) (till 30th June 2013)
9	Abhijit Ghosh	Junior Computer Engineer
10	Abhijit Roy	Junior Computer Engineer
11	Prosenjit Lahiri	Junior Computer Engineer
12	Sagar Samrat De	Junior Computer Engineer
13	Amit Roy	Technical Assistant (Library)
14	Gurudas Ghosh	Technical Assistant (Library)
15	Ananya Sarkar	Technical Assistant (Library)
16	Dipankar Roy	Technical Assistant
17	Shakti Nath Das	Technical Assistant
18	Surajit Mukherjee	Technical Assistant
19	Urmi Chakraborty	Technical Assistant
20	Amit Kumar Chanda	Technical Assistant
21	Ganesh Gupta	Jr. Engg (Electrical)
22	Supriyo Ganguly	Jr. Engg (Electrical)
23	Amitava Palit	Jr. Engg (Civil)
24	Asish Nandy	Jr. Engg (Civil)
25	Lakshmi Chattopadhyay	Jr. Engg (Civil)
26	Chandrakana Chatterjee	Office Assistant
27	Rupam Porel	Office Assistant
28	Mitali Bose	Office Assistant
29	Suvodip Mukherjee	Office Assistant
30	Swarup Dutta	Office Assistant
31	Moumita Banik	Office Assistant
32	Dipanjan Dey	Office Assistant
33	Suvendu Dutta	Office Assistant
34	Ritomoy Bhattacharya	Office Assistant (till 31st May 2013)
35	Siddhartha Chatterjee	Office Assistant (w.e.f. 2nd September 2013)
36	Sonali Sen	Office Assistant
37	Lina Mukherjee	Junior Office Assistant
38	Debasish Mitra	Telephone Operator
39	Jinia Deb	Telephone Operator
40	Siddhartha Chatterjee	Telephone Operator (till 1st September 2013)
41	Amit Kumar Ghosh	Mechanic
42	Sani Amed Ali Molla	Technician (AC & Refrigeration)
43	Babulal Sardar	Technician (AC & Refrigeration)
44	Arvind Paswan	Driver
45	Gobinda Das	Driver
46	Kalyani Ghosh	Caretaker (Creche)
47	Suranjan Deb	Telephone Technician
48	Prashant Tiwari	Hindi Officer (Part-time)
49	Harishikesh Nandi	Glass Blower (Part-time)

Consultant Physician

1	Dr. Swapan Kumar Bhattacharyya	Authorised Medical Officer
2	Dr. Tridib Kumar Sarkar	Doctor of Homeopathy
3	Dr. Gopal Chandra Sengupta	Doctor of Ayurvedic



DEPARTMENT OF ASTROPHYSICS AND COSMOLOGY

Department of Astrophysics and Cosmology

Prof. Sandip Kumar Chakrabarti

Head of the Department

Department Profile Indicators

Table A: Manpower and Resources

Number of faculties	4 Regular and 1 Bose Fellow
Number of Post–doctoral research associate (centre+project)(1+1)	1
Number of Ph.D students	19
Number of other project staff	0
Number of summer students	2
Projects (ongoing)	2

Table B: Research Activities Indicators

Number of research papers in Journals	24
Number of Book-chapters/books	1
Number of other publications	18
Number of Ph.D students graduated (submitted+degree awarded)	9
Number of M.Tech/M.Sc projects	0

Table C: Academic Activities and Linkage

Number of courses taught by faculties	7	
Number of Visitors (non –associates)	0	
Number of associates	0	
Number of Seminars organized	0	
Number of Conference/Symposia/ Advanced Schools organized	5	
Number of talks delivered by members of department in Conferences/Symposia	National	14
	International	9

Most Important Research Highlights

- Viscous and radiative accretion flow around black holes.
- Reproduction of ionospheric responses by VLF of solar flare perturbations and time lag using GEANT4 simulations
- Study of Deuterated species in interstellar medium
- Carried out temperature programmed desorption (TPD) experiment of H_2 using a custom built laboratory set-up for simulating star forming regions

- Deep observations of O_2 toward a deeply embedded solar-mass protostar using Herschel Space Observatory
- Effects of back reaction due to inhomogeneities on evolution of universe
- Study of teleportation through two-qubit noisy channels
- Study of Photometric variability in Young Star Forming Regions
- Near-infrared spectroscopic and photometric evolution of Nova V476 Scuti

Summary of Research Activities

Viscous accretion with radiative transfer was studied using numerical simulation. Quasi-periodic oscillations were found to occur only in certain accretion rate range. Viscous transonic flow which desegregated in Chakrabarti-Titarchuk configuration was found to have spectral and timing properties in agreement with observations.

Time lag between solar X-ray flares and their ionospheric response was computed theoretically using Monte-Carlo method. Injection of high energy radiation from the sun was made on ionosphere. GEANT4 simulation satisfactorily track photons in ionosphere and change electron density at different heights.

Using a custom built laboratory set-up for simulating star forming regions, temperature programmed desorption (TPD) experiment of H_2 was carried out and its binding energy on a silicate substrate was determined. Lower limit of sticking coefficient was estimated by comparing gas load at room temperature and at low temperature ranging from 7 K to 14 K. TPD experiment of CO in presence of H_2 was also performed.

Deep observations of O_2 toward a deeply embedded solar-mass proto-star using Herschel Space Observatory were made. Complementary data of the chemically related NO and CO molecules were obtained as well. Data were analyzed using radiative transfer models to infer column densities and abundances, and were tested directly against full gas-grain chemical models.

Effects of back reaction due to inhomogeneities on the evolution of the universe is investigated within the Buchert framework. The observed present acceleration of the universe was used as an essential input. The back reaction from inhomogeneities was found to cause acceleration to slow down in the future for a range of initial configurations and model parameters.

The problem of teleportation through two-qubit noisy channels with the aid of weak measurement to preserve fidelity of teleportation was investigated and it was shown that application of weak measurement and subsequent reverse measurement at suitable stages of the protocol leads to fidelity greater than classical for any value of the decoherence parameter. The steerability of continuous variable non-Gaussian entangled states is also investigated.

We initiated establishment of an Astronomical observing facility at Panchet Hill and process of land procurement is nearly complete. We detected an optically thin dust shell, possibly due to clumpiness or non-coverage of entire solid angle along the line of sight, around nova V476 Scuti (2005). The fraction of such novae in which optically thin dust formation is detected is quite low which makes such observations very significant.

Photometric variability in Young Star Forming Regions (e. g. NGC 2282, Cyg 0B7, NGC 2264 etc.) are studied using CCD/Near-IR camera and spectrograph on 1.2m Mt. Abu telescope (PRL), 2m Himalayan Chandra Telescope (HCT,IIA) and the 1.3m Devasthal Fast Optical Telescope (DFOT, ARIES). Photometric variability studies in young clusters allow us to study the pre-main-sequence (PMS) stars, and estimate the rotation rates for PMS objects at a variety of masses and ages.

Optical/near-infrared (near-IR) photometric and spectroscopic observations of a bright optical transient J212444.87+321738.3 using the 2m Himalayan Chandra Telescope (HCT) at Hanle and 1.2m IR telescope at Mt. Abu shows strong molecular features of TiO, VO bands in optical wavelengths and strong first overtone bands of ^{12}CO in the H and K band between 1.55 to 2.3 micron. Absorption due to water in the source's atmosphere is indicated in these spectra of typical cool M type star. Long monitoring of the object using a small telescope through International collaborative program shows variability of more than 400 days and variability amplitude more than 3.5 magnitude in optical I-band, which is the typical nature of only M-type Mira variable.

We studied near-Infrared spectroscopic and photometric evolution of nova V5558 Sgr (2007). Key results include detection of long (~ 60 days) pre-maximum halt and multi-outbursts. Detection of He/N and FeII lines indicates that this might be a hybrid nova.

Sandip Kumar Chakrabarti

Head, Department of Astrophysics and Cosmology

Archan Subhra Majumdar

Professor

Department of
Astrophysics and Cosmology

- Quantum Information Science: uncertainty relations, nonlocality, witnesses
- Cosmology: dark energy and cosmological inhomogeneities

Quantum Information Science: We consider optical beams with topological singularities which possess Schmidt decomposition and show that such classical beams share many features of two mode entanglement in quantum optics. We demonstrate the coherence properties of such beams through the violations of Bell inequality for continuous variables using the Wigner function. The Bell violation for the Laguerre-Gaussian beams is shown to increase with higher orbital angular momenta of the vortex beam. In view of the increasing importance of non-Gaussian entangled states in quantum information protocols like teleportation and violations of Bell inequalities, the steering of continuous variable non-Gaussian entangled states is investigated. We examine several classes of currently important non-Gaussian entangled states, such as the two-dimensional harmonic oscillator, the photon-subtracted two-mode squeezed vacuum, and the NOON state, in order to demonstrate the steering property of such states. A comparative study of the violation of the Bell inequality for these states shows that the entanglement present is more easily revealed through steering compared to Bell violation for several such states.

We investigate the problem of teleportation through two-qubit noisy channels with the aid of weak measurement to preserve the fidelity of teleportation. In particular, we consider a shared two qubit maximally entangled state as resource for teleportation, allowing one or both qubits to interact with the environment via the amplitude damping channel. We show that application of weak measurement and subsequent reverse measurement at suitable stages of the protocol lead to fidelity greater than classical for any value of the decoherence parameter when only one of the qubits interact with the environment. In the case when both qubits interact with the environment, the above-mentioned technique of weak measurement and its reversal enables one to achieve the fidelity greater than classical for all magnitudes of decoherence for a sub-class of maximally entangled channels. The success probability of the protocol decreases with the strength of weak measurement, and is lower when both the qubits are affected by decoherence.

Absolutely separable states form a special subset of the set of all separable states, as they remain separable under any global unitary transformation unlike other separable states. We consider the set of absolutely separable bipartite states and show that it is convex and compact in any arbitrary dimensional Hilbert space. Through a generic approach of construction of suitable Hermitian operators we prove the completeness of the separation axiom for identifying any separable state that is not absolutely separable. We demonstrate the action of such witness operators in different qudit systems. Examples of mixed separable systems are provided, pointing out the utility of the witness in entanglement creation using quantum gates. Decomposition of witnesses in terms of spin operators or photon polarizations facilitates their measurability for qubit states.

Cosmology: We investigate the effect of backreaction due to inhomogeneities on the evolution of the present universe by considering a two-scale model within the Buchert framework. Taking the observed present acceleration of the universe as an essential input, we study the effect of inhomogeneities in the future evolution. We find that the backreaction from inhomogeneities causes the acceleration to slow down in the future for a range of initial configurations and model parameters. The present acceleration ensures formation of the cosmic event horizon, and our analysis brings out how the effect of the event horizon could further

curtail the global acceleration, and even lead in certain cases to the emergence of a future decelerating epoch.

Publications in Journals

1. T. Pramanik and **A. S. Majumdar,** *Improving the fidelity of teleportation through noisy channels using weak measurement*, Phys. Lett. A, **377**, 3209 (2013).
2. Priyanka Chowdhury, **A. S. Majumdar**, and G. S. Agarwal, *Nonlocal continuous-variable correlations and violation of Bell's inequality for light beams with topological singularities*, Phys. Rev. A, **88**, 013830 (2013).
3. N. Bose and **A. S. Majumdar**, *Effect of cosmic backreaction on future evolution of an accelerating universe*, Gen. Rel. Grav., **45**, 1971 (2013).
4. S. Roy, N. Ganguly, A. Kumar, S. Adhikari, **A. S. Majumdar**, *A cloned qutrit and its utility in information processing tasks*, Quantum Inf. Process., **13**, 629 (2014).
5. Priyanka Chowdhury, Tanumoy Pramanik, **A. S. Majumdar**, and G. S. Agarwal, *Einstein-Podolsky-Rosen steering using quantum correlations in non-Gaussian entangled states*, Phys. Rev. A, **89**, 012104 (2014).
6. N. Ganguly, J. Chatterjee and **A. S. Majumdar**, *Witness of mixed separable states useful for entanglement creation*, Phys. Rev. A, **89**, 052304 (2014).

Supervision of Students

Ph.D. Students: Ashutosh Rai (Ph.D awarded), Nilok Bose (Thesis submitted), Tanumoy Pramanik (Thesis submitted), Nirman Ganguly (external), Priyanka Chowdhury, Subhadipa Das, Siladitya Mal, Sovik Ghose (external), Ansuman Dey, Pratik Tarafdar; Project Students: Pratik Tarafdar- "Acoustic surface gravity in Schwarzschild metric" and Abinas Pradhan- "The bending of light in gravitational field: analysis with modified gravity".

Students' Publications

Subhadipa Das, Manik Banik, Md. Rajjak Gazi, Ashutosh Rai, Samir Kunkri, Ramij Rahaman, *Bound on tri-partite Hardy's nonlocality respecting all bi-partite principles*, Quantum Inf Process, **12**, 3033 (2013).

Lectures Delivered

1. "Quantum information processing" INSPIRE Internship Science Camp, RKGEC Ghaziabad, May 2013
2. "Quantum Information Science", C.K.Majumdar Memorial Summer Workshop, SNBNCBS Kolkata, June 2013
3. "EPR Paradox and steering", Discussion Meeting on recent trends in Optics", IISER Kolkata, July 2013
4. "Optimal lower bound of uncertainty in the presence of quantum memory", Asian Quantum Information Science Satellite Workshop, ISI Kolkata, August 2013
5. "Quantum Information Science", Workshop on Current Trends in Physics, Tata College, Chaibasa, November 2013
6. "Fixing the lower limit of quantum uncertainty using fine-graining", Quantum Information Processing and Applications", HRI Allahabad, December 2013
7. EPR-steering by continuous variable non-Gaussian states, International Meet on Quantum Correlations, IIT Rajasthan, Jodhpur, December 2013
8. "Quantum information science and applications" DST Inspire Camp, RKGIT Ghaziabad, January 2014
9. "Nonlocality of non-Gaussian resources", International Program on Quantum Information, IOP Bhubaneswar, February 2014
10. "Quantum uncertainty relations and their applications", Quantum correlations: foundations and applications", ISI Kolkata, March 2014

Academic Visits

Oklahoma State University, Physics Department, Oklahoma, USA, April-May 2013

Courses Taught

Nuclear and Particle Physics, Fall

Participation In Committees

Internal: Library Committee, CWEP (Convener)

Meetings Organized

1. C. K. Majumdar Memorial Summer Workshop, June 2013, SNBNCBS Kolkata
2. Workshop in Remote Areas, "Current trends in Physics", November 2013, Tata College, Chaibasa
3. DST Young Scientists' Meet, January 2014, SNBNCBS Kolkata

Kinsuk Acharyya

Bose Fellow

Department of
Astrophysics and Cosmology

- Study of gas-grain interaction on a laboratory analog of interstellar dust grain.
- Studied desorption of H_2 from a olivine substrate with more than 90 % forsterite content.
- Studied effect of grain size distribution on molecular hydrogen formation in diffuse molecular clouds.
- Studied O_2 formation towards a deeply embedded solar-mass protostar.

Using a custom built laboratory set-up for simulating star forming regions, temperature programmed desorption (TPD) experiment of H_2 was carried out and its binding energy on a silicate substrate was determined. Then lower limit of sticking coefficient was estimated by comparing gas load at room temperature and at low temperature ranging from 7 K to 14 K and its astrophysical significance was studied using a gas-grain chemical network.

TPD experiment of CO was performed in presence of H_2 and its binding energy on the olivine substrate was found out. It was observed that in presence of H_2, a small amount of H_2CO was formed below 15 K.

Deep observations of O_2 toward a deeply embedded solar-mass protostar using Herschel Space Observatory were made. Complementary data of the chemically related NO and CO molecules were obtained as well. Data were analyzed using radiative transfer models to infer column densities and abundances, and were tested directly against full gas-grain chemical models. It was concluded that the low O_2 abundance in the collapsing envelope around a low-mass protostar suggests that the gas and ice entering protoplanetary disks is very poor in O_2.

In addition, H_2 Formation in diffuse Clouds using a parallel computation code developed by us was also studied. We also calculated the H_2 formation efficiency in presence of the stochastic heating of grain due ultra violet photos.

Publications in Journals

1. Umut A. Yldz, **Kinsuk Acharyya**, Paul F. Goldsmith, Ewine F. van Dishoeck, Gary Melnick, and et al., *Deep observations of O_2 toward a low-mass protostar with Herschel-HIFI*, Astronomy & Astrophysics, **558**, 58 (2013).

2. W. Iqbal, **K Acharyya**, and E. Herbst, *H_2 Formation in Diffuse Clouds: A new Kinetic Monte Carlo Study*, ApJ, **784**, 139 (2014).

Other Publications

1. Kinsuk Acharyya, "Effect of size distribution and Grain Growth on the Formation of Molecules in Star Forming Regions" in the proceedings of International Conference on "Chemical Evolution of Star Forming Regions and Origin of Life", Published by AIP, 2013 Volume 1543.

2. Kinsuk Acharyya, "Thermal Desorption Study of Air on Laboratory Analog of Interstellar Dusts" in the proceedings of International Conference on "Chemical Evolution of Star Forming Regions and Origin of Life" published by AIP, 2013, Volume 1543.

3. Yildiz U., Acharyya K., Goldsmith P., van Dishoeck E. & Melnick G. et al., "Deep O_2 observations toward a lowmass protostar with Herschel-HIFI", 2013, in the

Protostars and Planets VI, bibliographic code: 2013prpl.conf1B065Y.

4. Yildiz, Umut., Acharyya, K., Goldsmith, P., van Dishoeck, E., HOP (Herschel Oxygen Project) Team, "Stringent Limits of O_2 Abundance Toward a Low-mass Protostar with Herschel-HIFI", American Astronomical Society Meeting, 2014, AAS, 223, 244.18.

Books Published

Co-edited an 'Edited Volume' on "Chemical Evolution of Star Forming Region and Origin of Life" published by AIP, Volume - 1543, 2013

Supervision of Students

Ph.D. Students: Wasim Iqbal.

Participation in Committees

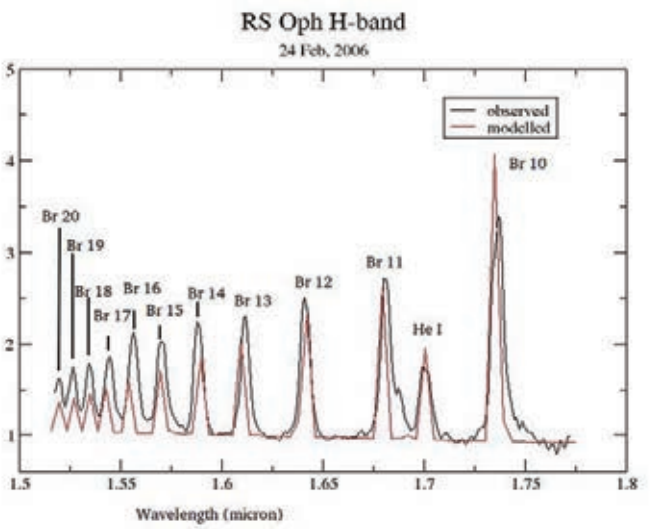
Internal: Newsletter Committee

Ramkrishna Das

Faculty Fellow

Department of
Astrophysics and Cosmology

- Spectroscopic and photometric studies of novae.
- Spectroscopic and photometric studies of suspected Mira J212444.87 +321738.3.
- Photometric observations of star forming regions.
- Upcoming Telescope Project of S N Bose Centre.



1. Studied near-Infrared spectroscopic and photometric evolution of nova V476 Scuti (2005). The key result concerns detection of optically thin dust shell around the nova. The SED's (spectral energy distributions) have been fitted with black body curves to study the time evolution of dust. Not many evidences of such kind of studies have been found (Das, Banerjee, Ashok et al., 2013, BASI, 41, 195).

2. Continuing observations of the suspected Mira variable (MASTER OT J212444.87 +321738.3) which was detected by us (Mondal, Das, Ashok et al., 2013, ATel 4931) to generate the light curve which is required to determine several parameters of the object.

3. Studied near-Infrared spectroscopic and photometric evolution of nova V5558 Sgr (2007). The key result concerns detection of long (~ 60 days) pre-maximum halt and multi-outbursts. Detection of He/N and FeII lines indicates that this might be a hybrid nova (Das, Banerjee, Ashok et al., 2014, under communication).

4. We successfully ran the code CLOUDY to investigate the photoionization process inside nova ejecta. The

generated synthetic spectra matched with the observed spectra from which we estimated several parameters (paper under preparation).

5. Upcoming Telescope facility of S N Bose Centre: We are pursuing the process for acquisition of land at Panchet hill-top for establishing our centre's first astronomical observatory. The survey work was conducted in March 2013 in our presence. We prepared and submitted necessary documents to the DFO, Purulia. Part II – V have been filled in, duly signed in and sent to the Regional Forest Office, Bhuwaneshwar. We have received a reply from the above mentioned office asking for GPS data and FRA certificate. Already we have completed GPS measurements. We are following it up regularly to complete the remaining processes.

Publications in Journals

R. K. Das, D. P. K. Banerjee, N. M. Ashok & S. Mondal, *Near-Infrared spectroscopic and photometric evolution of nova V476 Scuti – a nova that formed optically thin dust*, Bulletin of Astronomical Society of India, **41**, 195 (2013).

Supervision of Students

Ph.D. Students: Anindita Mondal; **Project Students:** "Observational Techniques in Astronomy" by Sourav Singh. Project Research – III (PHY 401)

Lectures Delivered

"Formation and Evolution of Dust in Novae Environment" at "Light Scattering Techniques and Application to Astronomy", SNBNCBS, Kolkata, November 19-21, 2013.

Courses Taught

PH 303 Nuclear Physics 3rd Semester (July – December 2013)

Participation in Committees

Internal: Committee for land acquisition and construction activities at the proposed site for setting up of astronomical observatory and installation of telescope

Sandip Kumar Chakrabarti

Senior Professor and Head of the Department

Department of
Astrophysics and Cosmology

- Study of accretion flows including viscosity and radiative cooling effects. Modeling ionospheric changes in presence of solar flares. Study of reaction cross-sections for several key bio-molecules in interstellar space. Observing X-rays from celestial objects using balloon borne experiments

Hydrodynamic simulations of accretion flows which include viscosities show that the Chakrabarti-Titarchuk solution of two component flow is stable and the Keplelian disk, thick accretion disks, ADAFs are all special cases of Chakrabarti solution of Transonic flow. Study of radiative transfer through Comptonization using Monte-Carlo code of this flow shows formation of QPOs in stellar mass black hole light curve.

Modeling propagation of very low frequency radio waves indicates that VLF signal amplitudes obtained during last two solar eclipses depend on interferences among different modes along the transmitter-receiver path. VLF amplitudes during solar flares are seen to lag behind X-ray observation by satellite and the lag depends on flux of radiation in the flare. This lag was quantified. We have shown that treating earth's ionosphere as a detector, GEANT4 code reproduces the observed VLF signal variation when the ionosphere is bombarded with solar X-rays. We also reproduce theoretically observed time lags.

In Astrobiology/Astrochemistry, reaction pathways and cross-sections to form several bio-molecules have been found. Their abundances in molecular clouds have been computed. We compute abundances of pre-cursors of bio-molecules so that observations of them may indicate creation of bio-molecules in star forming regions.

In collaboration with Indian Centre for Space Physics, balloon borne experiments have been carried out. Various payloads (Photomultiplier and proportional counter based) were flown along with accelerometer, gyroscopes, magnetometer) to obtain light curve and spectra of both quiet and active solar radiation.

Publications in Journals

1. P. S. Pal, **S. K. Chakrabarti**, A. Nandi, *Comptonization efficiencies of the variability classes of GRS 1915 + 105*, Advances in Space Research, **52**, 740 (2013).

2. D. Debnath, **S. K. Chakrabarti**, A. Nandi, *Evolution of the temporal and the Spectral Properties in 2010 and 2011 outbursts of H 1743-322*, Advances in Space Research, **52**, 2143 (2013).

3. K. Giri, **S. K. Chakrabarti**, *Hydrodynamic simulation of two-component advective flows around black holes*, MNRAS, **430**, 2836 (2013).

4. L. Majumdar, A. Das, **S. K. Chakrabarti**, S. Chakrabarti, *Study of the chemical evolution and spectral signatures of some interstellar precursor molecules of adenine, glycine & alanine*, New Astronomy, **20**, 15 (2013).

5. S. Mondal, **S. K. Chakrabarti**, *Spectral properties of two-component advective flows with standing shocks in the presence of Comptonization*, MNRAS, **431**, 2716 (2013).

6. A. Das, L. Majumdar, **S. K. Chakrabarti**, S. Chakrabarti, *Chemical evolution during the process of proto-star formation by considering a two dimensional hydrodynamic model*, New Astronomy, **23**, 118 (2013).

7. T. Basak and **S. K. Chakrabarti**, *Effective recombination coefficient and solar zenith angle effects on low-latitude D-region ionosphere evaluated from VLF signal amplitude and its time delay during X-ray solar flares*, Astrophys Space Sci, **348**, 315 (2013).

8. A. Das, L. Majumdar, **S. K. Chakrabarti**, R. Saha and S. Chakrabarti, *Formation of cyanoformaldehyde in the interstellar space*, MNRAS, **433**, 3152 (2013).

9. S. Palit, T. Basak, S. K. Mondal, S. Pal, **S. K. Chakrabarti**, *Modeling of Very Low Frequency (VLF) radio wave signal profile due to solar flares using the GEANT4 Monte Carlo simulation coupled with ionospheric chemistry*, Atmospheric Chemistry and Physics, **13**, 9159 (2013).

10. R. Kumar, C.B. Singh, I. Chattopadhyay, **S. K. Chakrabarti**, *Effect of the flow composition on outflow rates from accretion discs around black holes*, MNRAS, **436**, 2864 (2013).

11. L. Majumdar, A. Das, **S. K. Chakrabarti**, *Formation of different isotopomers of chloronium in the interstellar medium*, Astrophysical Journal, **782**, 73 (2014).

12. S. K. Garain, H. Ghosh, **S. K. Chakrabarti**, *Quasi-periodic Oscillations in a Radiative Transonic Flow: Results of a Coupled Monte Carlo-TVD Simulation*, MNRAS, **437**, 1329 (2014).

13. P. S. Pal & **S. K. Chakrabarti**, *A Study of the Variation of Geometry of Accretion Flows of Compact Objects through Timing and Spectral Analysis of Their Outbursts*, MNRAS, **440**, 672 (2014).

14 L. Majumdar, A. Das, **S. K. Chakrabarti**, *Spectroscopic characteristics of the cyanomethyl anion and its deuterated derivatives*, Astronomy & Astrophysics, **562**, 56 (2014).

Other Publications

1. S. K. Chakrabarti, 2013, Golden Jubilee Year of Stanley Miller Experiment and Chemical Evolution and Origin of Life, AIP conference proceedings No. 1543 on 'Chemical Evolution of Star Forming Regions and Progin of Life' (AIP: New York)

2. A. Das, S. K. Chakrabarti, 2013, Monte Carlo Simulation for the formation of Interstellar Grain Mantle, AIP conference proceedings No. 1543 on 'Chemical Evolution of Star Forming Regions and Progin of Life' (AIP: New York)

3. A. Das, S. K. Chakrabarti, K. Acharyya, S. Chakrabarti, 2013, Methanol formation around the star forming region, AIP conference proceedings No. 1543 on 'Chemical Evolution of Star Forming Regions and Progin of Life' (AIP: New York)

4. A. Das, S. K. Chakrabarti, K. Acharyya, S. Chakrabarti, 2013, Monte Carlo Simulation of the Production of Hydrogen Molecules on Grain Surfaces, AIP conference proceedings No. 1543 on 'Chemical Evolution of Star Forming Regions and Progin of Life' (AIP: New York)

5. D. Sahu, A. Das, S. K. Chakrabarti, 2013, Role of Ambipolar Diffusion towards the chemical evolution of molecular cloud, AIP conference proceedings No. 1543 on 'Chemical Evolution of Star Forming Regions and Progin of Life' (AIP: New York)

6. L. Majumdar, A. Das, S. K. Chakrabarti, S. Chakrabarti, 2013, A 2D hydrodynamic simulation coupled to chemical evolution around star forming region: A time dependent study AIP conference proceedings No. 1543 on 'Chemical Evolution of Star Forming Regions and Origin of Life' (AIP: New York)

7. R. Saha, L. Majumdar, A. Das, S. K. Chakrabarti, S. Chakrabarti, 2013, Formation of the nucleobases around the Star forming region, AIP conference proceedings No. 1543 on 'Chemical Evolution of Star Forming Regions and Origin of Life' (AIP: New York)

8. L. Majumdar, A. Das, S. K. Chakrabarti, S. Chakrabarti, 2013, Quantum Chemical approach to study the spectral properties of some important precursor of bio-molecules, AIP conference proceedings No. 1543 on 'Chemical Evolution of Star Forming Regions and Origin of Life' (AIP: New York)

9. S.K. Chakrabarti, 2013, Status of the accretion flow solution in the Golden Jubilee year of the discovery of extra-solar X-ray sources, in "Recent Trends in The Study Of Compact Objects: Theory and Observation", S. Das, A. Nandi and I. Chattopadhyay (Eds.), p. 1

10. D. Debnath, S. K. Chakrabarti, S. Mondal, 2013, Extracting flow parameters of H 1743-322 during early phase of its 2010 outburst using two component advective flow model, 2013 in Recent Trends in The Study Of Compact Objects: Theory and Observation", S. Das, A. Nandi and I. Chattopadhyay (Eds.), p. 85

11. S. Mondal, S. K. Chakrabarti, 2013, Spectral properties of two component advective flows around black holes with standing shock in presence of Comptonization in "Recent Trends in The Study Of Compact Objects: Theory and Observation", S. Das, A. Nandi and I. Chattopadhyay (Eds.), p. 59

12. P. S. Pal & S. K. Chakrabarti, 2013, Geometry variation of accretion disks of compact objects in "Recent Trends in The Study Of Compact Objects: Theory and Observation", S. Das, A. Nandi and I. Chattopadhyay (Eds.), p. 55

13. H. Ghosh, S. K. Garain and S. K. Chakrabarti, Compton cooling and its effects on spectral and hydrodynamic properties of an accretion flow around a black hole: results of a coupled monte carlo TVD simulation, 2013, in "Recent Trends in The Study Of Compact Objects: Theory and Observation", S. Das, A. Nandi and I. Chattopadhyay (Eds.), p. 51

14. K. Giri and S. K. Chakrabarti, 2013, Role of viscosity and cooling in hydrodynamic simulation of Two Component Accretion Flow (TCAF) around black holes in "Recent Trends in The Study Of Compact Objects: Theory and Observation", S. Das, A. Nandi and I. Chattopadhyay (Eds.), p. 15

15. S. K. Garain, H. Ghosh and S. K. Chakrabarti, 2013, Numerical simulation of spectral and timing properties of a two component advective flow around a black hole, in "Recent Trends in The Study Of Compact Objects: Theory and Observation", S. Das, A. Nandi and I. Chattopadhyay (Eds.), p. 11.

Books Published

AIP Proceedings "First International Conference on Chemical Evolution of Star Forming Region and Origin of Life", S. K. Chakrabarti, K. Acharyya and A. Das (Eds.), AIP Publication No. 1543 (New York).

Supervision of Students

Ph.D. Students: K. Giri, S. Sasmal, S. Palit, S. Pal, received PhD degrees. S. Mondal, T. Basak, and S. Ray, submitted thesis. Supervising: S. Garain, V. Nwankwo, A. Bhattacharyya, A. Deb, A. Ghosh, L. Majumdar, S. Chakraborty, A. Chowdhury, T. Katoch

Post Doctoral Researchers

Partha Sarathi Pal

Lectures Delivered

1. "Latest Developments of the Black Hole Accretion Flow Dynamics" Two Lectures at ICRANET, Pescara, Italy (June, 2013)

2. "Low Cost Balloon flight programme of Indian Centre for Space Physics", at 21st conference on the European balloon and rocket programme, Thun, Switzerland (June, 2013)

3. "Predictability of Two Component Advective Flow Solution" An Invited Talk at the conference on 'Accretion of Black Holes' at International Centre, Goa (Sept. 2013)

4. 'Earth as a Gigantic detector: GEANT4/LWPC simulation of X-ray detection and comparison with observation' and 'Propagation Effects of VLF signals in Earth-Ionosphere waveguide during the eclipses of July 2009 and January, 2010': oral contributions and 'Effective recombination coefficient and solar zenith angle effects on low-latitude D-region ionosphere evaluated from VLF signal amplitude and its time delay during X-ray solar flares' and 'Study of Precursors of Earthquakes from Indian Centre for Space Phsyics' poster contributions at VERSIM-6 conference in University of Otago, New Zealand (January, 2014)

5. 'Comptonization in black hole accretion flows and contribution of Zeldovich', at National Academy of Science of Belarus at Minsk, Belarus (March, 2014)

Academic Visits

National Academy of Sciences, Belarus (March, 2013); International Centre for Relativistic Astrophysics, Pescara (June, 2013).

Courses Taught

1. Research Methodology (Jointly with K. Acharyya, P.K. Mukhopadhyay)

2. Astrophysics (Jointly with S. Mondal)

Participation in Committees

External: International Organizing Committee member of Zeldovich-100 Meeting, March 10-14, 2014, Minsk, Belarus; In Charge, Academic Affairs and General Secretary of the Governing Body of Indian Centre for Space Physics; Editorial Board member: Indian Journal of Physics; Bulletin of Astronomical Society of India;

Internal: Head of the Dept. (Astrophysics and Cosmology); Academic and Research Advisory Committee (ARPAC); Departmental Research Committee (DRC); Consultative Advisory Committee (CAC); Students' Curriculum and Research Evaluation Committee (SCREC); Library and several other committees

Soumen Mondal

Assistant Professor

Department of
Astrophysics and Cosmology

- Extra-solar planets
- Brown dwarfs and low-mass stars in star-forming regions
- M-Giants and Mira variables
- Small solar system objects
- Astronomical Instrumentation

My major research interest is broadly in observational Astronomy. I am working on few research problems that include detection of Extra-solar planets using transit search, photometric variability in star-forming regions and star-cluster, late M-giants and Mira variables, atmosphere of brown dwarfs, small solar system objects and optical/Near-IR Astronomical instrumentation.

Photometric variability in a L3.5 brown dwarf 2MASSW J0036159+1821102 : Evidence of Evolving Weather Patterns or Binarity ?

We present here the result of long time baseline photometric monitoring in the optical I-band of a L3.5 Brown Dwarf (BD) 2MASSW J0036159+1821102 (hereafter, 2M0036+18) on seven epochs over a period of five years from 2005 November to 2010 November. Such kind of long time photometric monitoring on a particular BD is quite rare in the literature. Interestingly, previously reported period of about 3-hrs is recovered here in two epochs with significant variability amplitude (rms) of 60-30 millimagnitude (mmag), while on other epochs the source did not show any statistical significant variability. Possible reasons for such kind of variability in BDs were attributed due to inhomogeneous dust clouds or magnetic field induced spots on their surfaces. Complimentary binarity data reveals that in fact 2M0036+18 is a (L4 + L5 V) binary BD having almost equal masses in a close binary system, the separation estimated on two epochs of observations to be 0.4 and 0.78 AU respectively. We propose that the binary BD might be in a elliptical orbit, and the orbital period to be 57 2- 3 yrs. The observed significant variability might be due to one component, which is a spotted BD spinning with 57 3 hrs about it's own axis, the hour-scale period what we are detecting here, while other component is a non-variable BD. As the orbital configuration changes, the spotted BD might be partially or completely eclipsed by the non-variable BD, the line-of-sight alignment between them might cause such changing in variability amplitude over the orbital time-scale of few yrs.

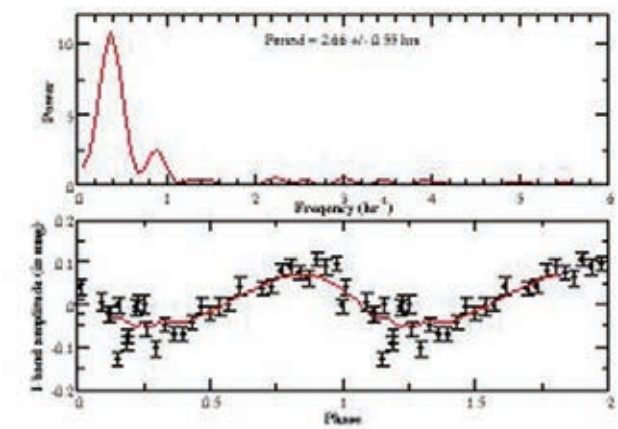


Fig. 1.: Periodiograms of BD 2M0036+18 using the Lomb-Scargle method is shown in the top panels, and the phase light curve in I-band of 2M0036+18 observed on 2007 December 06 in the bottom panels using the period, P=2.66 hrs.

Publications In Journals

R. K. Das, D. P. K. Banerjee, N. M. Ashok & **S. Mondal**, *Near-Infrared spectroscopic and photometric evolution of nova V476 Scuti – a nova that formed optically thin dust*, Bulletin of Astronomical Society of India, **41**, 195 (2013).

Other Publications

1. Mondal, Soumen, Das, Ramkrishna and Chakrabarti, Sandip Kumar - "A New Photometric Survey Design for Detection of Extra-solar planets by Transit technique" - American Institute of Physics (AIP) Conference Proceedings, 2013 vol. 1543, pp.187-193.

2. Das, Ramkrishna and Mondal, Soumen- "Observations of Dust and Molecules in Novae Environment"- American Institute of Physics (AIP) Conference Proceedings, 2013, vol. 1543, pp.157-176.

Supervision of Students

Ph.D. Students: Supriyo Ghosh, Somnath Dutta, Arpita Nandi (Co-Supervisor with Dr. R. K. Das); **Project Students:** Monalisa Singharoy (IPhD student - 2nd Sem project), Riya Sebait from Visva-Bharati (Summer project)

Lectures Delivered

1. Invited talk on "Mira variable stars: Wonderful objects in the Sky" at C. K Majumdar Memorial Summer Workshop in Physics 2013, held at S.N. Bose National Centre for Basic Sciences, Kolkata during 1 - 12 July 2013

2. Invited talk on " Our Solar system and Extra-solar Planets: at "Recent Trends in Interdisciplinary areas of Physics" organized jointly S. N. Bose Centre and Tata College, Chaibasa during 25-26 November, 2013

3. Invited talk on "Dust in Sub-stellar Objects" at "Light Scattering Techniques and Application to Astronomy and other Areas" organized jointly S. N. Bose Centre and IUCAA, Pune during 19-21 November 2013

4. Attended a working meeting on " TMT-India Science and Instrumentation workshop" held at IIA, Bangalore during January 16 -18, 2014

Courses Taught

1. Course teaching for IPh. D. on Astrophysics (Course No. PHY 403) during Jan - May 2014 (4th Semester)

2. Course teaching for Ph. D. on Astrophysics (Course No. PHY 510) during Jan - May 2014

Participation in Committees

Internal: Member in Students' Curriculum & Research Evaluation Committee (SCREC), Advisory committee of Technical Cell and Computer cell. Member in Project and Patent cell

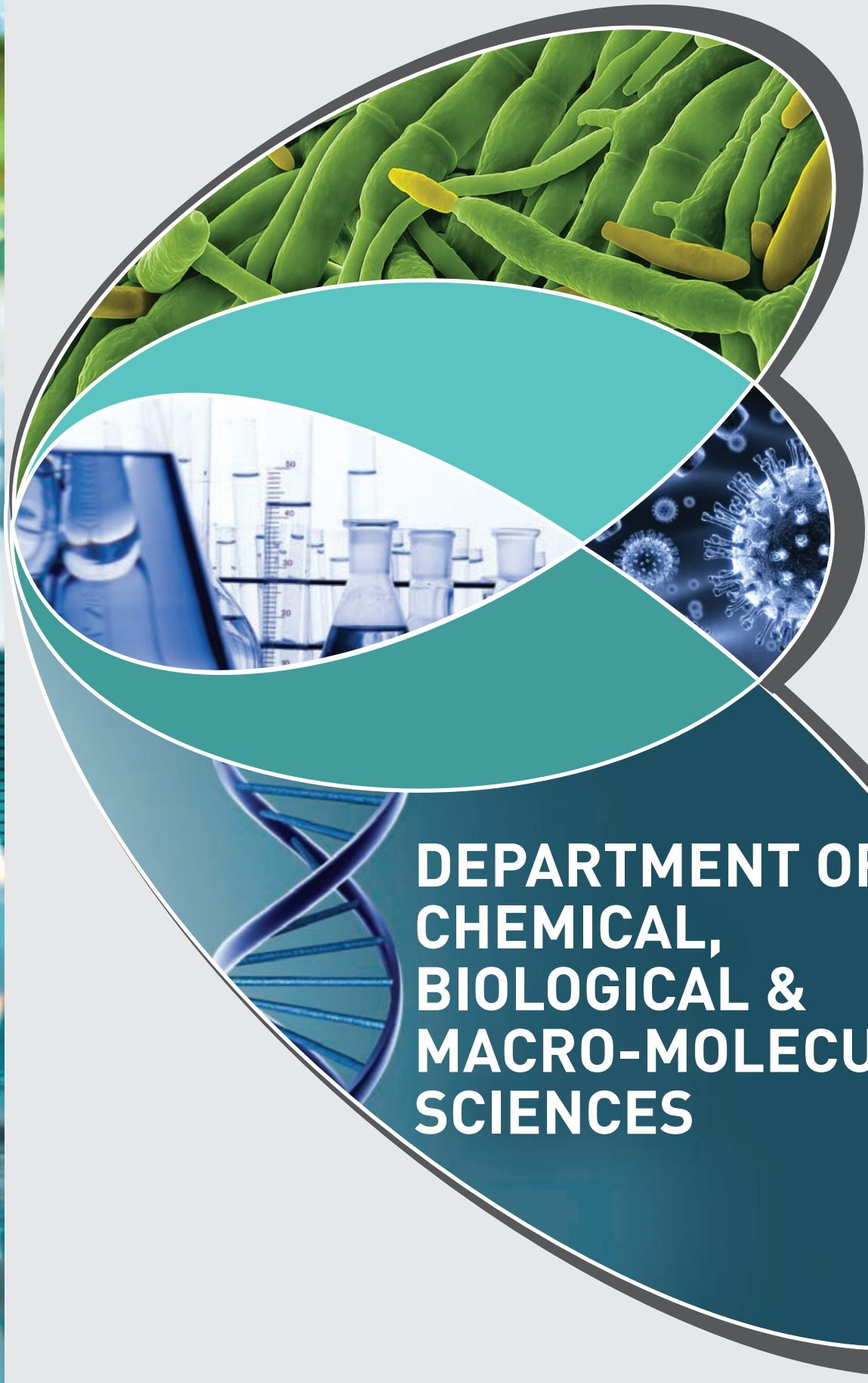
Sponsored Projects

Internal project entitled "Establishment of Astronomical Observing facilities at the Centre and multi-wavelength observations from the National/International telescopes facilities" as a PI

Meetings Organized

Co-organized the National workshop on "Light Scattering Techniques and Application to Astronomy and other Areas", which was organized jointly by S. N. Bose Centre and IUCAA, Pune during 19 - 21 November 2013 and held at S. N. Bose Centre


S. N. BOSE
সত্যেন্দ্রনাথ বসু
1894-1974



DEPARTMENT OF CHEMICAL, BIOLOGICAL & MACRO-MOLECULAR SCIENCES

Department of Chemical, Biological & Macro-Molecular Sciences

Prof. Ranjit Biswas

Head of the Department

Department profile indicators

Table A: Manpower and Resources

Number of faculties	6+2
Number of Post –doctoral research associate (centre+project)	6
Number of Ph.D students	34
Number of other project staff	2
Number of summer students	2
Projects (ongoing)	10+3

Table B: Research Activities Indicators

Number of research papers in Journals	44
Number of Book-chapters/books	1
Number of other publications	0
Number of Ph.D students graduated (submitted+degree awarded)	9
Number of M.Tech/M.Sc projects	2

Table C: Academic Activities and Linkage

Number of courses taught by faculties	9	
Number of Visitors (non – associates)	5	
Number of associates	4	
Number of Seminars organized	17	
Number of Conference/Symposia/ Advanced Schools organized	3	
Number of talks delivered by members of department in Conferences/Symposia	National	14
	International	7

Most Important Research Highlights

- Non-equilibrium thermodynamics of enzyme catalysis
- Quantum transport through conjugated polymer aggregates

- Thermodynamics of ion binding to protein and interfacial changes in protein complex
- Mass spectrometric study of breath to detect Helicobacter pyroli infection
- Laser-spectroscopy assisted breath-analysis for diabetes detection
- Terahertz study showing polarization effects of aligned nanoparticles
- Terahertz study of carbon nanotube-polymer composites
- Development of first molecular theory for dielectric relaxation of Coulomb fluids
- First molecular theory for solvation response in (ionic liquid + polar solvent) mixtures
- Elucidation of structure and dynamics in ionic deep eutectics
- Ultrafast (femtosecond) studies of biological and biomimetic systems
- Fast spectroscopic investigation of nano-bio composites and materials
- Applications of nano-bio composites in therapeutics
- Synthesis of inter-metallic nanoparticles

Summary of Research Activities

Cooperative binding of substrate molecules on the active sites of a single oligomeric enzyme in a chemiostatic condition has been studied via a statistical mechanical theory. The criteria of cooperativity is compared with that of the Hill coefficient of some relevant experimental results. The theory provides a microscopic insight on the mechanism of cooperative binding of substrate on a single oligomeric enzyme. The nonequilibrium thermodynamic response of a voltage gated potassium ion channel using a stochastic master equation has been studied.

Computer simulations have been performed to study dimensional crossover observed in fluids under nanoscale confinements and provide a generic understanding of the crossover as a manifestation of confinement-induced modifications in long-wavelength behaviour of both equilibrium and dynamic density fluctuations. Solvation dynamics in solvophilic and solvophobic confinements have been explored. Thermodynamics of conformational changes arising from the calcium ion binding to Calmodulin protein has been estimated.

Clinical feasibility of a novel residual gas analyzer mass spectrometry (RGA-MS) method for accurate evaluation of the ^{13}C-glucose breath test (^{13}C-GBT) in the diagnosis of pre-diabetes (PD) and type 2 diabetes mellitus (T2D) has been explored. Relevant analyses and results suggest RGA-MS may be a valid method for the 13C-GBT and can serve as a non-invasive point-of-care diagnostic tool for routine clinical practices. A residual gas analyzer (RGA) coupled with a high vacuum (UV) chamber has been developed for noninvasive diagnosis of *Helicobacter pylori* infection through ^{13}C-urea breath analysis.

The collective dynamics of water in native and denatured (both thermally and chemically) proteins are investigated using THz time domain spectroscopy. These studies are further extended to salts having cations and anions of different charge types. Single wall carbon nanotubes dispersed in a poly vinyl alcohol thin film is observed to act as an efficient EMI shielding material in the THz (0.3-2.0 THz) frequency region. THz conductivity of the composite system is described in the light of a.c. hopping conduction. In order to increase the shielding efficacy, a composite of gold nanoparticles with the CNT's are also being investigated.

Molecular theories for studying dielectric relaxation in ionic liquids and Stokes shift dynamics in binary mixtures of dipolar ionic liquid with conventional polar solvents have been developed. All-atom molecular dynamics simulations have been performed to provide molecular level explanations of viscosity decoupling of relaxation rates reflected by time-resolved fluorescence measurements of solute-centred dynamics in (amide + electrolyte) deep eutectics Role of collective low frequency solvent modes in ionic liquid dynamics has been explored via using a semi-molecular theory, and fast fluctuations in deep eutectics are investigated by using multi-probe fluorescence.

Charge migration along DNA molecules is a key factor for DNA-based devices in optoelectronics and biotechnology. A genomic DNA–cetyltrimethyl ammonium chloride (CTMA) complex, a technological important biomaterial, and Hoechest 33258 (H258), a well-known DNA minor groove binder, have been used for solvation studies. The CT dynamics of CdSe/ZnS quantum dots (QDs; 5.2 nm) embedded in the as-prepared and swollen biomaterial

have also been investigated and correlated with that of the timescale of solvation. This study has been extended to temperature-dependent CT dynamics of QDs in a nanoenvironment of an anionic, sodium bis(2-ethylhexyl)-sulfosuccinate reverse micelle (AOT RMs), whereby the number of water molecules and their dynamics can be tuned in a controlled manner.

Intermetallic Ni-Zn nano particles have been synthesized via the chemical conversion of nickel NPs using a zerovalent organometallic zinc precursor. The effective diffusivities of metals and vacancies are on the order of 10^{-20} m^2/s and 10^{-19} m^2/s, respectively. This study represents the first combined experimental-modeling of the formation of hollow nanostructures by the nanoscale Kirkendall effect.

Ranjit Biswas

Head, Department of Chemical, Biological and Macromolecular Sciences

Gautam Gangopadhyay

Professor

Department of
Chemical, Biological & Macro-Molecular Sciences

- We have studied on the characterization of luminescence properties of aggregates of polymeric chains in terms of the nonadiabatic molecular processes.
- Studied kinetics and nonequilibrium thermodynamics of enzyme catalysis in heterogeneous environments. In a similar context we have provided a master equation approach to study kinetics and nonequilibrium thermodynamics of single potassium ion channel. Recently we are working on the cooperativity of ligand binding and ion channel problems from the trajectory entropy estimation.
- To construct the theory of quantum transport through molecular system we have developed the formulation of quantum system coupled to a fermionic bath and the model is applied in various coherent processes.

We have systematically studied the cooperative binding of substrate molecules on the active sites of a single oligomeric enzyme in a chemiostatic condition. We have introduced an index of cooperativity defined in terms of the ratio of the stochastic system entropy associated with the fully bound state of the cooperative and non-cooperative cases. The criteria of cooperativity is compared with that of the Hill coefficient of some relevant experimental result and gives a microscopic insight on the mechanism of cooperative binding of substrate on a single oligomeric enzyme which is usually estimated from the macroscopic reaction rate.

We have studied the nonequilibrium thermodynamic response of a voltage gated Potassium ion channel using a stochastic master equation. Here we have shown quantitatively that although the hysteresis loop area vanishes in low and high frequency domains of the external voltage, they are thermodynamically distinguishable. At very low frequency domain, system remains close to equilibrium whereas at high frequency it goes to a nonequilibrium steady state(NESS) associated with a finite value of dissipation function. At NESS, the efficiency of the ion-conduction can also be related with the nonlinear dependence of the dissipation function on the power of the external field.

Publications in Journals

1. K Banerjee, B Das and **G Gangopadhyay**, *On the estimation of cooperativity in ion channel kinetics: activation free energy and kinetic mechanism of Shaker K^+ channel*, J. Chem. Phys. **138**, 165102 (2013).
2. K. Banerjee and **G. Gangopadhyay**, *Realization of vibronic entanglement in terms of tunneling current in an artificial molecule*, J. Math. Chem. **51**, 2731-2745 (2013).
3. K. Banerjee and **G. Gangopadhyay**, *Emission Rate, Vibronic Entanglement, and Coherence in Aggregates of Conjugated Polymers*, J. Phys. Chem. A **117**, 8642-8650 (2013).
4. B. Das, K. Banerjee and **G. Gangopadhyay**, *Propensity approach to nonequilibrium thermodynamics of a chemical reaction network: Controlling single*

E-coli β-galactosidase enzyme catalysis through the elementary reaction steps, J. Chem. Phys. **139**, 244104 (2013).

5. A. Karmakar and **G. Gangopadhyay**, *A fermionic bath induced antibunching and coherence in Mollow spectra*, Physica Scripta **89**, 045001 (2014).

Supervision of Students

Ph.D. Students: (a) Kinshuk Banerjee obtained PhD from Calcutta University, Kolkata, in the year 2013, with thesis entitled, "Theoretical Studies on the Nonadiabatic Effects in Molecular Aggregates";(b) PhD degree is obtained by Biswajit Das from Calcutta University, Kolkata, in 2013 with thesis title, "Stochastic Approaches to Heterogeneous and Complex Reaction Kinetics";(c) Present PhD students are: Anirban Karmakar(SRF), Krishnendu Pal(JRF), Snehasish Rana(JRF), Souvanik Talukdar(JRF) and Anita Halder(JRF);

Project Students: Msc summer Project student; Jayanta Ghosh

Lectures Delivered

Cooperativity in ligand binding and ion channel kinetics in Current Trends in Theoretical Chemistry conference at BARC, Mumbai, on 26-28th September 2013

Courses Taught

1. Post Msc course on Stochastic Processes in Physics and Chemistry: CB528 Aug-Dec'2013

2. Post Bsc course on Chemical Physics: PHY 404 Jan-May' Spring(2013-2014)

Participation in Committees

Internal: Member, Project Cell; Member, VASP, Visitors programme; Member, SAC

Meetings Organized

Current Trends in biochemical and biophysical modeling Conference on 7-8' Oct' 2013

Jaydeb Chakrabarti

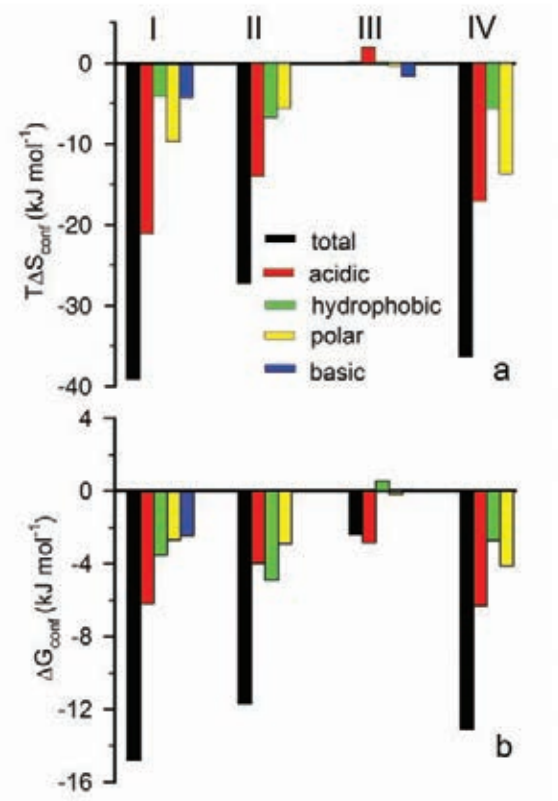
Professor

Department of
Chemical, Biological & Macro-Molecular Sciences

- Statistical Mechanical description of static and dynamic phenomena in complex and soft condensed matter systems, including those of biological interests

1. We have studied the dimensional crossover, observed in fluids under nanoscale confinements, using computer simulations. We provide a generic understanding of the crossover as a manifestation of confinement-induced modifications in long-wavelength behaviour of both equilibrium and dynamic density fluctuations. Exploring the effects of confinement and different confining potentials on non-equilibrium solvation dynamics, we bring out qualitatively different mechanisms of slowing down of solvation dynamics in solvophilic and solvophobic confinements. If the surrounding bulk solvent is subcritical near the liquid-gas coexistence, we show that a competition between wetting by solvophilic solute and drying by solvophobic walls produce dramatic effects.

2. Thermodynamics of conformational changes arising from the calcium ion binding to Calmodulin protein has been estimated. Our results indicate that the conformational changes in all the 4 calcium binding loops are very different, although residue composition of these loops is very similar. Panel (a) shows the conformational entropy costs $T\Delta S_{conf}$ and (b) free energy changes ΔG_{conf} of different types of residues in the 4 loops.



Publications in Journals

1. Amit Das, **J. Chakrabarti** and Mahua Ghosh, *Thermodynamics of interfacial changes in a protein-protein complex,* Molecular BioSystems, **10**, 437 (2014).
2. Amit Das and **J. Chakrabarti**, *Solvation in nanoscale solvophobic confinement near liquid-gas phase coexistence*, under consideration by Chem Phys Lett **592**, 256 (2014).
3. C. Basu Chaudhuri, S. Chakrabarty and **J. Chakrabarti**, *Cross-over between central and non-central conservative effective forces in a modulated colloidal fluid*, J. Chem. Phys., **139**, 204903, DOI: 10.1063/1.4832735 (2013).
4. Amit Das and **J. Chakrabarti**, *Microscopic Mechanisms of Confinement-Induced Slow Solvation*, J. Phys. Chem A, **117**, 10571, (2013).
5. Amit Das, **J. Chakrabarti** and Mahua Ghosh, *Conformational thermodynamics of metal-ion binding to a protein*, Chem Phys Lett, **581**, 91 (2013).

Supervision of Students

Ph.D. Students: Amit Das, Samapan Sikdar, Suman Dutta and Sutapa Dutta; **Project Students:** Deblina Dey (M.Tech, WBUT)

Lectures Delivered

1. Conformational contribution to thermodynamics of binding in protein complexes through microscopic simulation, Department of Chemistry, University of Delhi, March, 2014.
2. Statistical Mechanics of soft matter systems, ANUSANDHAN, Science lecture series of Presidency University, Kolkata, December, 2013
3. Conformational contribution to thermodynamics of binding in protein-peptide complexes through microscopic simulation, Current Trends in Biochemical and Biophysical Modelling, SNBNCBS, October, 2013.
4. Chemical processes in nano meter sized confinement, National Conference on Emerging interfaces at molecular materials, IIT Chennai, August, 2013.

Courses Taught

PHY 501 Research Methodology, 2013

Participation in Committees

Internal: Chief Editor, S. N. Bose Newsletter; Project Cell

Sponsored Projects

1. "Microscopic calculations of metal ion binding to proteins" " in the subject area of Physical Sciences, funded by DST, Government of India.
2. "Computational Material Science-Thematic unit of excellence", (Co-PI), DST funded.
3. "UNANST-II", (Co-PI), DST funded.

Meetings Organized

1. Molecular Architecture, Dynamics and Assembly in Living Systems, Annual meeting of Indian Biophysical Society, February 7-10, 2014
2. Current Trends in Biochemical and Biophysical Modelling, October 7-8, 2013

Mahua Ghosh

Research Scientist

Department of
Chemical, Biological & Macro-Molecular Sciences

- My research interests primarily involve understanding of the molecular basis in biological system driven by the quest of unraveling their structure, biophysical characterization and quantitative measurement of their thermodynamics. I particularly undertake structurally and sometimes even functionally uncharacterized proteins. Expression, biophysical characterization and computer modelling of such proteins and their possible interactions are primary objectives.

1. A state of the art fully functional and self-sufficient "Protein Expression and Purification" facility is developed in the Centre. Many proteins of bacterial origin related to multidrug resistance activity have already been expressed, purified and characterized.

2. Non-specific nucleases can trigger programmed cell death. My earlier crystal structure data (JBC 2007) on such a nuclease, namely NucleaseA-inhibitor complex revealed the interfacial binding residues. Our data suggested that the structural modifications at the interfaces are vital for stability and functioning of such complexes. We quantitatively estimated the contribution of conformational changes in the thermodynamics of the interface in this complex, using our method developed earlier (BioPhys Journal 2013). We show that the basic residues of NucA and acidic residues of NuiA are highly ordered and stabilized via strong electrostatic interactions in agreement to the structural data. Detailed thermodynamic information for every residue may be helpful to modulate the function of these nucleases towards uncontrolled cell growth.

3. We also estimated the thermodynamics of conformational changes arising from the calcium ion binding to Calmodulin protein.

Publications in Journals

1. Amit Das, J. Chakrabarti and **Mahua Ghosh**, *Thermodynamics of interfacial changes in a protein-protein complex,* Molecular BioSystems, **10**, 437 (2014).

2. Amit Das, J. Chakrabarti and **Mahua Ghosh**, *Conformational thermodynamics of metal-ion binding to a protein*, Chem Phys Lett, **581**, 91 (2013).

Supervision of Students

Ph.D. Students: Paramita Saha and Samapan Sikdar; **Project Students:** Deblina Dey (M.Tech WBUT)

Lectures Delivered

1. "Thermodynamics of interfacial changes in a protein-protein complex" Biophysical Society 58th Annual meeting, San Francisco, USA, February 15-19, 2014.

2. "Conformational Thermodynamics from Molecular Simulation", Molecular Architecture, Dynamics and Assembly in Living Systems, Annual meeting of Indian Biophysical Society, February 7-10, 2014

3. "Biophysical Characterization of proteins from *Salmonella* Typhi, Current Trends in Biochemical and Biophysical Modelling, SNBNCBS, October 7-8, 2013.

Courses Taught

CB 540: Study of Bio-macromolecules, Autumn 2013

Sponsored Projects

1. "Structural and Functional Characterization of small Heat Shock Proteins from *Bradyrhizobium japonicum"* in the subject area of Life Sciences, funded by DST, Government of India
2. "Microscopic calculations of metal ion binding to proteins" in the subject area of Physical Sciences, funded by DST, Government of India

Meetings Organized

1. Molecular Architecture, Dynamics and Assembly in Living Systems, Annual meeting of Indian Biophysical Society, February 7-10, 2014
2. Current Trends in Biochemical and Biophysical Modelling, October 7-8, 2013

Manik Pradhan

Assistant Professor

Department of
Chemical, Biological & Macro-Molecular Sciences

- Cavity Ring-Down Laser Spectroscopy
- Noninvasive Detection of Diseases by Exhaled Breath Analysis
- High-Resolution Quantum Cascade Laser Spectroscopy
- Evanescent wave cavity ring-down spectroscopy for studying interfacial dynamics in condensed phase
- Trace Molecule and Isotopic Species Detection in the Atmosphere

(1) We have explored the clinical feasibility of a novel residual gas analyzer mass spectrometry (RGA-MS) method for accurate evaluation of the ^{13}C-glucose breath test (^{13}C-GBT) in the diagnosis of pre-diabetes (PD) and type 2 diabetes mellitus (T2D). In T2D or PD, glucose uptake is impaired and results in blunted isotope enriched $^{13}CO_2$ production in exhaled breath samples. Using the Receiver operating characteristics (ROC) curve analysis, an optimal diagnostic cut-off point of the 13CO2/12CO2 isotope ratios was determined to be 28.81‰ for screening individuals with non-diabetes controls (NDC) and pre-diabetes (PD), corresponding to a sensitivity of 100% and specificity of 94.4%. We also determined another optimal diagnostic cut-off point of 19.88‰ between individuals with PD and T2D, which exhibited 100% sensitivity and 95.5% specificity. Our findings suggest that the RGA-MS is a valid and sufficiently robust method for the 13C-GBT which may serve as an alternative non-invasive point-of-care diagnostic tool for routine clinical practices as well as for large-scale diabetes screening purposes in real-time.

(2) We have developed a residual gas analyzer (RGA) coupled with a high vacuum (UV) chamber for noninvasive diagnosis of *Helicobacter pylori* infection through ^{13}C-urea breath analysis. The present RGA-based mass spectrometry (MS) method is capable of measuring high-precision $^{13}CO_2$ isotope enrichments in exhaled breath samples from individuals harboring *H. pylori* infection. The system exhibited 100% diagnostic sensitivity, 93% specificity alongside positive and negative predictive values of 95% and 100%, respectively compared with the invasive endoscopy-based biopsy tests. A statistically sound diagnostic cut-off value of the RGA-MS system for the presence of *H. pylori* was determined to be 3.0‰ with the aid of a receiver operating characteristics curve analysis. The diagnostic accuracy and the validity of the results are also supported by high-finesse optical cavity-based off-axis integrated cavity output spectroscopy measurements. The RGA-based instrumental setup described here is simple, robust, easy-to-use, more portable and cost-effective compared to currently available all other detection methods. This study demonstrates the clinical efficacy of the RGA-MS technique for accurate evaluation of *H. pylori* infection in real-time, thus making it a new point-of-care medical diagnostics for large-scale screening individuals harboring the infection.

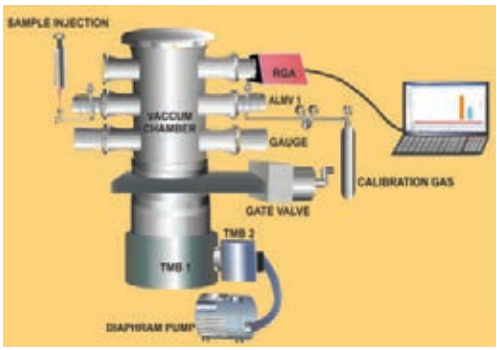


Fig.: Schematic diagram of the residual gas analyzer-mass spectrometry (RGA-MS) system

Publications in Journals

Abhijit Maity, Gourab D Banik, Chiranjit Ghosh, Suman Som, Sujit Chaudhuri, Sunil B Daschakraborty, Shibendu Ghosh, Barnali Ghosh, Arup K Raychaudhuri and **Manik Pradhan**, *Residual gas analyzer mass spectrometry for human breath analysis: a new tool for the non-invasive diagnosis of Helicobacter pylori infection*, Journal of Breath Research, **8**, 016005 (2014).

Supervision of Students

Ph.D. Students: Gourab Dutta Banik, Abhijit Maity, Suman Som and Chiranjit Ghosh

Lectures Delivered

Invited Speaker: DAE-BRNS National Laser Symposium (NLS-22), Manipal University, Karnataka, January 8-11, 2014

Participation in Committees

Internal: Various Thesis, Interview and Technical Cell Committees

Sponsored Projects

1. Ministry of Earth Sciences (MoES): 2013-2017, Title: "Development of a mid-IR Cavity Ring-down Spectrometer for High-Precision Real-Time Continuous Monitoring of Multiple Trace Gases and Stable Isotopic Species in the Atmosphere".

2. Department of Biotechnology (DBT), RGYI Scheme: 2013-2016, Title: "Cavity Ring-Down Spectroscopy for Real-Time Breath Analysis: a Next-Generation Diagnostics in Modern Medicine".

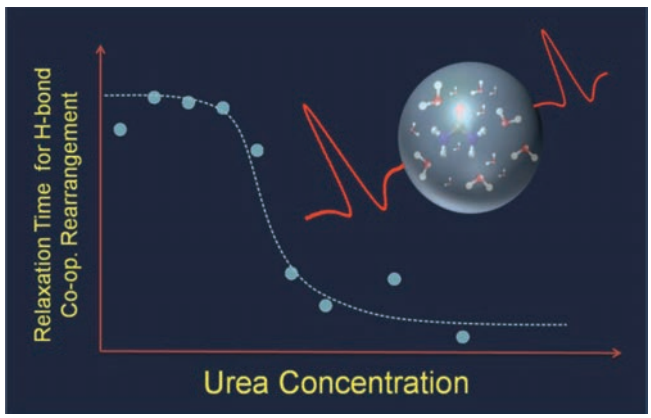
Rajib Kumar Mitra

Assistant Professor

Department of
Chemical, Biological & Macro-Molecular Sciences

- Terahertz Spectroscopy, Time resolved fluorescence spectroscopy, Hydration dynamics, Biophysics, Protein folding, Self-assembled systems (micelles, reverse micelles, lamellae, vesicles etc.), Nanomaterials

1. Dielectric relaxation studies of aqueous solutions of some well known protein denaturant solutes like urea, tetramethyl urea and guadinium hydrochloride in the THz frequency region signify that there occurs substantial perturbation of the collective hydrogen bonded dynamics in water in presence of these solutes, which could possibly correlate the denaturation ability of these solutes. The collective dynamics of water in native and denatured (both thermally and chemically) proteins are investigated using THz time domain spectroscopy. These studies are further extended to salts having cations and anions of different charge types.



2. The thermal unfolding-folding equilibrium of a model protein human serum albumin in presence of crowding agents (small chain polyethylene glycol) has been investigated using circular dichroism, fluorescence and calorimetric measurements. It was concluded that for small chain polymers, both 'excluded volume' as well as 'preferential interaction' are to be taken into consideration to explain the results. The hydration structure of these proteins are investigated using time resolved fluorescence and far infrared FTIR spectroscopic techniques.

3. Single wall carbon nanotubes dispersed in a poly vinyl alcohol thin film is observed to act as an efficient EMI shielding material in the THz (0.3-2.0 THz) frequency region. THz conductivity of the composite system is described in the light of a.c. hopping conduction. In order to increase the shielding efficacy, a composite of gold nanoparticles with the CNT's are also being investigated.

4. The effect of blending of surfactant(s) on the physical and chemical properties of water encapsulated in reverse micelles has been investigated as a function of the charge type as well as the hydrophilic-lipophilic balance of the surfactant(s) used. It was found that the physical properties and dynamics of water indeed depend upon the charge type of the surfactant(s). For potential pharmaceutical applications, special emphasis has been given for biocompatible formulations.

Publications in Journals

1. A. Das, A. Patra, and **R. K. Mitra**, *Do the Physical Properties of Water in Mixed Reverse Micelles Follow a Synergistic Effect: A Spectroscopic Investigation*, J. Phys. Chem. B, **117**, 3593-3602 (2013).

2. D. Polley, A. Ganguly, A. Barman, and **R. K. Mitra**, *Polarizing Effect of Aligned Nanoparticles in Terahertz Frequency Region*, Optics Letters, **38**, 2754-2756 (2013).
3. D. Polley, A. Patra, and **R. K. Mitra**, *Dielectric relaxation of the extended hydration sheathe of DNA in the THz frequency region*, Chem. Phys. Lett., **586**, 143-147 (2013).
4. A. Das and **R. K. Mitra**, *Formulation and Characterization of a Biocompatible Microemulsion Composed of Mixed Surfactants: Lecithin and Triton X-100*, Colloid Polym. Sci., **292**, 635-644 (2014).
5. A. Patra, S. Hazra, G. S. Kumar and **R. K. Mitra**, *Entropy Contribution Toward Micelle-Driven Deintercalation of Drug-DNA Complex*, J. Phys. Chem. B, **118**, 901–908 (2014).
6. D. Polley, A. Barman and **R. K. Mitra**, *EMI Shielding and Conductivity of Carbon Nanotube-Polymer Composites at Terahertz Frequency*, Optics Letters, **39**, 1541-1544 (2014).

Supervision of Students

Ph.D. Students: Animesh Patra, Arindam Das, Nirnay Samanta, Debanjan Polley, Debasis Das Mahanta;

Project Students: Pratibha Verma

Lectures Delivered

1. 'Dynamics of Water around Biomolecules: Dielectric Relaxation Studies' in THz Region in Current Trends in Biochemical and Biophysical Modeling, 7-8 October, 2013, S.N. Bose National centre for Basic Sciences, Kolkata.
2. 'Dynamics of Water Confined in Micro-heterogeneous Nano-confinements' in 5th Asian Conference on Colloid and Interface Science, 20-23 November, 2013, North Bengal University.
3. 'Aligned Nanoparticles can act as a Potential Polarizer in the Terahertz Frequency Region' in International Union of Materials Research Societies – International Conference in Asia – 2013, 16-20 December, 2013, IISc, Bangalore.
4. 'Application of THz Spectroscopy in Material Sciences and Biophysics' in DST Autonomous Bodies Conclave-2014, 28-29 January, S.N. Bose National Centre for Basic Sciences, Kolkata.

Participation in Committees

Internal: Library Committee

Sponsored Projects

1. Water encapsulated in mixed reverse micelles: modulation of its structure, dynamics and activity (funded by CSIR).
2. Real Time Structure and Solvation Dynamics of Proteins during Folding/Unfolding in Crowded Environment (funded by DST).

Ranjit Biswas

Professor

Department of
Chemical, Biological & Macro-Molecular Sciences

- Deep eutectics, Room temperature ionic liquids (RTILs), (RTIL+ molecular solvent) binary mixtures, hydrophobic aggregation in (alcohol + water) mixtures, confined aqueous dynamics, and complex sugars.
- We apply time-resolved fluorescence spectroscopy to explore condensed phase dynamics; employ statistical mechanics to interpret the measurements; use computer simulations to reexamine theoretical predictions for experimental observations.

We have developed molecular theories for studying dielectric relaxation in ionic liquids [*J. Chem. Phys.* **2014**, *140*, 014504], and Stokes shift dynamics in binary mixtures of dipolar ionic liquid with conventional polar solvents [*J. Phys. Chem. B* **2014**, *118*, 1327]. We have employed all-atom molecular dynamics simulations to provide molecular level explanations of viscosity decoupling of relaxation rates reflected by our own time-resolved fluorescence measurements of solute-centred dynamics in (amide + electrolyte) deep eutectics [*J. Chem. Phys.* **2014**, *140*, 104514]. Role of collective low frequency solvent modes in ionic liquid dynamics has been explored via using a semi-molecular theory [*J. Chem. Phys.* **2013**, *139*, 164503], and fast fluctuations in deep eutectics are investigated by using multi-probe fluorescence [*Chem. Phys. Lett*. **2013**, *581*, 47].

Publications in Journals

1. Biswajit Guchhait, Suman Das, Snehasis Daschakraborty, and **Ranjit Biswas**, *Interaction and Dynamics of (Alkylamide + Electrolyte) Deep Eutectics: Dependence on Alkyl Chain Length, Temperature, and Anion Identity*, Journal of Chemical Physics, **140**, 104514 (2014).
2. Biswajit Guchhait, Tuhin Pradhan and **Ranjit Biswas**, *Effects of Acid Concentration on Intramolecular Charge Transfer Reaction of 4-(azetidinyl) benzonitrile in Solution*, Journal of Chemical Sciences, **126**, 55-63 (2014).
3. Snehasis Daschakraborty and **Ranjit Biswas**, *Dielectric Relaxation in Ionic Liquids: Role of Ion-Ion and Ion-Dipole Interactions, and Effects of Heterogeneity*, Journal of Chemical Physics, **140**, 014504 (2014).
4. Snehasis Daschakraborty and **Ranjit Biswas**, *Composition Dependent Stokes Shift Dynamics in Binary Mixtures of 1-Butyl-3-methylimidazolium Tetrafluoroborate with Water and Acetonitrile: Quantitative Comparison between Theory and Complete Measurements*, Journal of Physical Chemistry B, **118**, 1327-1339 (2014).
5. Snehasis Daschakraborty, Tamisra Pal and **Ranjit Biswas**, *Stokes Shift Dynamics of Ionic Liquids: Solute Probe Dependence, and Effects of Self-Motion, Dielectric Relaxation Frequency Window and Collective Intermolecular Solvent Modes*, Journal of Chemical Physics, **139**, 164503 (2013).
6. Snehasis Daschakraborty and **Ranjit Biswas**, *Asymmetric Binary Mixtures Under Cylindrical Confinement: A Molecular Dynamics Simulation Study*, ISRAPS Bulletin, **25**, 84-91 (2013).
7. Anuradha Das, Suman Das and **Ranjit Biswas**, *Fast Fluctuations in Deep Eutectic Melts: Multi-Probe Fluorescence Measurements and All-Atom Molecular Dynamics Simulation Study*, Chemical Physics Letters, **581**, 47-51 (2013).

Supervision of Students

Ph.D. Students: Tamisra Pal, Anuradha Das, Sandipa Indra, Suman De, and Kallol Mukherji (jointly with Prof. A. Barman)

Lectures Delivered

1. Invited Talk at the UGC-sponsored refreshers' course at the Jadavpur University on January 22, 2014 entitled "Decoding Deep Eutectics: Fluorescence Measurements and Molecular Dynamics Simulations".
2. Invited Talk at the International Symposium on Fragility, JNCASR, Bangalore during January 05-08, 2014 entitled "Decoupling of Dynamics at Temperatures Much Above Glass Transition Temperature: Measurements & Simulations",
3. Invited Talk at the Department of Chemistry, IISER-K on Dec 30, 2013, entitled "Decoding (Alkylamide + Electrolyte) Deep Eutectics: Experiments & Simulations".
4. Invited Talk under DBT-STAR College Program at the Lady Brabourne College, Kolkata on Dec 13, 2013 entitled "Aqueous Dynamics of Biomimetic Systems: Insights from Fluorescence Measurements & All-Atom Molecular Dynamics Simulations".
5. Invited Talk in the Department of Chemistry at the Manipur University on October 10, 2013 entitled "Slow Solvation in Ionic Liquids: Understanding from Computer Simulations"
6. Invited Talk at the International Conference in BARC, Mumbai during September 26-28, 2013 entitled "Slow Solvation in Ionic Liquids: Multipoint Correlations and Non-Gaussian Moves"
7. Invited Talk in Thematic Unit of Excellence-Computational Materials Science (TUE-CMS) at the S. N. Bose National Centre for Basic Sciences on May 07, 2013 entitled "Decoding Deep Eutectics: Fluorescence and All-Atom Simulations".

Courses Taught

PHY 191 (Jointly with Prof. Samir K. Pal)

Participation In Committees

Internal: SCOLP (Convener); SCRE (Member); HoD (CBMS)

Samir Kumar Pal

Professor

Department of
Chemical, Biological & Macro-Molecular Sciences

- In S.N. Bose National Centre our research activities on the fundamental and application-driven spectroscopic studies mainly in the fields of (1) experimental Biological Physics, (2) Bio-Nano Interface, (3) Biomimetics and (4) biomedical instrumentation..

Charge migration along DNA molecules is a key factor for DNA-based devices in optoelectronics and biotechnology. The association of a significant amount of water molecules in DNA-based materials for the intactness of the DNA structure and their dynamic role in the charge-transfer (CT) dynamics is less documented in contemporary literature. In one of our studies, we have used a genomic DNA–cetyltrimethyl ammonium chloride (CTMA) complex, a technological important biomaterial, and Hoechest 33258 (H258), a well-known DNA minor groove binder, as fluorogenic probe for the dynamic solvation studies. The CT dynamics of CdSe/ZnS quantum dots (QDs; 5.2 nm) embedded in the as-prepared and swollen biomaterial have also been studied and correlated with that of the timescale of solvation. We have extended our studies on the temperature-dependent CT dynamics of QDs in a nanoenvironment of an anionic, sodium bis(2-ethylhexyl)-sulfosuccinate reverse micelle (AOT RMs), whereby the number of water molecules and their dynamics can be tuned in a controlled manner. A direct correlation of the dynamics of solvation and that of the CT in the nanoenvironments clearly suggests that the hydration barrier within the Arrhenius framework essentially dictates the charge-transfer dynamics .

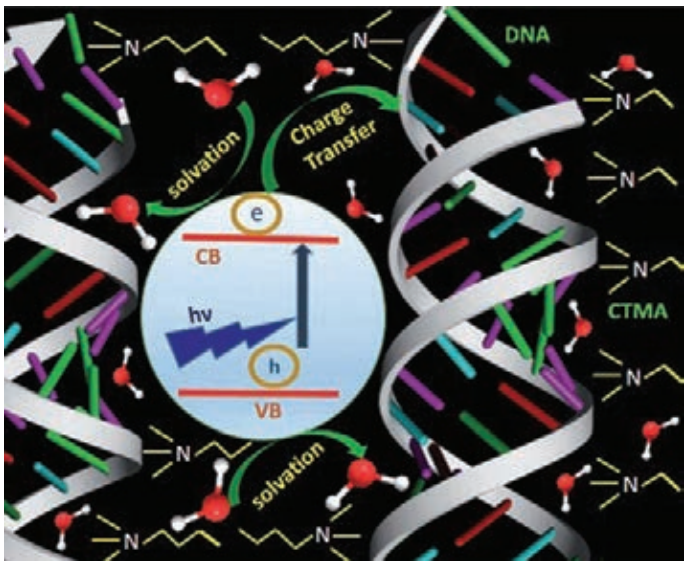


Fig.: Explanation: Representation of DNA–CTMA thin film. Embedded quantum dots (CdSe/ZnS) upon photoexcitation and charge transfer/ solvation are also shown

Publications in Journals

1. S. Batabyal, T. Mondol and **S. K. Pal**, *Picosecond-resolved solvent reorganization and energy transfer in biological and model cavities*, Biochimie, **95**, 1127 (2013).
2. S. Banerjee, S. Sarkar, K. Lakshman, J. Dutta and **S. K. Pal**, *UVA Radiation Induced Ultrafast Electron Transfer from a Food Carcinogen Benzo[α]Pyrene to Organic Molecules*, Biological Macromolecules and Inorganic Nano Structures, J. Phys. Chem. B, **117**, 3726 (2013).
3. R. Saha, P. K. Verma, S. Rakshit, S. Saha, S. Mayor and **S. K. Pal**, *Light driven ultrafast electron transfer in oxidative redding of Green Fluorescent Proteins*, Scientific Reports (Nature Publishing Group) **3**, 1580 (2013).
4. S. Rakshit, R. Saha, A. Singha, Zaki S. A. Seddigi and **S. K. Pal**, *Molecular Interaction, Co-solubilisation of Organic Pollutants and Ecotoxicity of a Potential Carcinogenic Fuel Additive MTBE in Water*, J. Mol. Liquids, **180**, 235 (2013).
5. S. Choudhury, S. Batabyal, T. Mondol, D. Sao, P. Lemmens and **S. K. Pal**, *Ultrafast Dynamics of Solvation and Charge Transfer in a DNA-based Biomaterial*, Chemistry: An Asian Journal **9**, 1395 (2014).
6. S. Banerjee, S. Chaudhuri and **S. K. Pal**, *Ultrafast Spectroscopic Studies on the Interaction of a Potential Food Carcinogen with Biologically Relevant Macromolecules*, International Review of Biophysical Chemistry (IREBIC) **4**, 161 (2013).
7. N. Polley, S. Singh, A. Giri and **S. K. Pal**, *Evanescent Field: A Potential Light-tool for Theranostics Application*, Rev. Sci. Instrum. **85**, 033108 (2014).
8. K. R. Krishnadas, T. Udayabhaskararaoa S. Choudhury, N. Goswami, **S. K. Pal** and T. Pradeep, *Luminescent AgAu alloy clusters derived from Ag nanoparticles: Manifestations of tunable Au(I)-Cu(I) metallophilic interactions*, European J. Inorg. Chem. No. **5**, 908 (2014).
9. S. Batabyal, S. Choudhury, D. Sao, T. Mondol and **S. K. Pal**, *Dynamical perspective of protein DNA interaction*, Biomolecular Concepts **5**, 21 (2014).
10. N. Goswami, A. Baksi, A. Giri, P. L. Xavier, G. Basu, T. Pradeep and **S. K. Pal**, *Luminescent Iron Clusters in Solution*, Nanoscale, **6**, 1848 (2014).
11. A. Giri, N. Goswami, C. Sasmal, N. Polley, D. Majumdar, S. Sarkar, S. N. Bandyopadhyay, A. Singha and **S. K. Pal**, *Unprecedented Catalytic Activity of Mn_3O_4 Nanoparticles: Potential Lead of a Sustainable Therapeutic Agent for Hyperbilirubinemia*, RSC Advances (Communication), **4**, 5075 (2014).
12. S. Sardar, S. Sarkar, M. T. Z. Myint, S. Al-Harthi, J. Dutta and **S. K. Pal**, *Role of Central Metal Ions in Hematoporphyrin-Functionalized Titania in Solar Energy Conversion Dynamics*, Physical Chemistry Chemical Physics, **15**, 18562 (2013).
13. N. Goswami, A. Giri and **S. K. Pal**, MoS_2 *Nanocrystals Confined in a DNA Matrix Exhibiting Energy Transfer*, Langmuir, **29**, 11471 (2013).
14. S. Banerjee, N. Goswami and **S. K. Pal**, *A Potential Carcinogenic Pyrene Derivative under FRET to Various Energy Acceptors in Nanoscopic Environments*, ChemPhysChem, **14**, 3581 (2013).
15. R. Saha, S. Rakshit and **S. K. Pal**, *Molecular Recognition of a Model Globular Protein Apomyoglobin by Synthetic Receptor Cyclodextrin: Effect of Fluorescence Modification of the Protein and Cavity Size of the Receptor in the Interaction*, J. Mol. Recog., **26**, 568 (2013).
16. T. Bora, K. K. Lakshman, S. Sarkar, A. Makhal, S. Sardar, **S. K. Pal** and J. Dutta, *Modulation of defect-mediated energy transfer from ZnO nanoparticles for the photocatalytic degradation of bilirubin*, Beilstein Journal of Nanotechnology, **4**, 714 (2013).
17. S. Rakshit, R. Saha and **S. K. Pal**, *Modulation of Environmental Dynamics at the Active site and Activity of an Enzyme under Nanoscopic Confinement: Subtilisin Carlsberg in Anionic AOT Reverse Micelle*, J. Phys. Chem. B, **117**, 11565 (2013).
18. S. Batabyal, T. Mondol, S. Choudhury, A. Mazumder and **S. K. Pal**, *Ultrafast interfacial solvation dynamics in specific protein DNA recognition*, Biochimie, **95**, 2168 (2013).
19. S. Banerjee and **S. K. Pal**, *Caffeine Mediated Dissociation of a Potential Mutagen from DNA Mimetics, DNA and Cellular Nuclei: Ultrafast Spectroscopic Studies*, Int. Review of Biophysical Chemistry, **3**, 173 (2012).

Books Published

S. Sarkar, S. Sardar, A. Makhal, J. Dutta and S. K. Pal "Engineering FRET-based Solar Cells: Manipulation of Energy and Electron Transfer Processes in a Light Harvesting Assembly", (Book Chapter) in High-Efficiency Solar Cells, Edited by Zhiming M. Wang, SPRINGER, USA 2013, Chapter 10.

Supervision of Students

Ph.D. Students: Ranajay Saha, Soma Banerjee, Subrata Batabyal, Samim Sardar, Susobhan Choudhury, Nabarun Polley, Siddhi Chaudhuri, Prasenjit Kar, Soumendra Singh (External)

Post Doctoral Researchers

Soumik Sarkar, Tanumoy Mondol, Nirmal Goswami, Surajit Rakshit, Anupam Giri, Prasanna Mondol

Lectures Delivered

1. Invited Talk in Emerging Interfaces of Molecular Materials: IIT Madras: August 10, 2013
2. Invited talk in 4th Trilateral Conference on Advances in Nanoscience: Nanyang University, Singapore: 5-7 December 2013
3. Invited Talk in Trombay Symposium of Radiation Physics 2014: BARC, Mumbai, 6-9 January 2014
4. Invited Talk in Indian Science Congress 2014: University of Jammu: 3-7th February 2014-06-09
5. Invited Talk in Light in Chemistry: IIT Kharagpur: 24-25 February 2014
6. Invited Talk in ICONSAT 2014: INST, Maddi, Punjab: 2-5 March 2014

Courses Taught

1. PHY191 Basic Laboratory 1st Sem
2. CH525 Instrumental Methods of Analysis

Participation in Committees

Internal: Pest Control Committee, Chairman

Sponsored Projects

1. SR/SO/BB-15/2007 DST Study of Biomolecular Recognition with Time-resolved Optical Spectroscopy
2. DST/TM/SERI/2k11/103) DST Spectroscopic Studies on Light Harvesting Hybrid Materials Potential Application in Dye-sensitized Solar Cells
3. 2013/37P/73/BRNS BRNS, DAE Science and Application of organic ligand-transition metal oxide hybrids as new functional materials

Subhra Jana

DST INSPIRE Faculty

Department of
Chemical, Biological & Macro-Molecular Sciences

- Colloidal Synthesis of Nanoscale Alloy and Intermetallics
- Chemistry of Inorganic-Organic Hybrid Nanomaterials
- Fabrication of Metal-Semiconductor Nanocomposites
- Low Temperature Chemical Routes to d-d Hollow Intermetallics
- Environmental and Catalytic Applications

Synthesis and modeling of the formation of voids in nanostructured Ni-Zn intermetallic nanoparticles (NPs) have been described and provided estimates of diffusivity for both metals and vacancies that are in good agreement with bulk diffusivity measurements at defects. This is the first report on the synthesis of hollow d-d intermetallic nanoparticles via a nanoscale Kirkendall effect.

Intermetallic Ni-Zn NPs were synthesized via the chemical conversion of nickel NPs using a zerovalent organometallic zinc precursor. After the injection of a diethylzinc solution, Ni NPs progressively transformed from a solid to a hollow Ni-Zn intermetallic structure with time. During the transformation of Ni NPs to intermetallic NI-Zn nanostructures, they retained their overall spherical morphology. The growth mechanism for the solid to hollow NPs transformation is ascribed to the nanoscale Kirkendall effect due to the unequal diffusion rates of Ni and Zn. A diffusion model has also been developed for non-reactive, homogeneous, diffusion-controlled intermetallic hollow NP formation including moving boundaries at the interfaces of void-solid and solid-bulk solutions. The apparent diffusion coefficients obtained in this system compared favorably with results from measurement at grain boundaries in bulk Ni-Zn. The effective diffusivities of metals and vacancies are on the order of 10^{-20} m^2/s and 10^{-19} m^2/s, respectively. This study represents the first combined experimental-modeling of the formation of hollow nanostructures by the nanoscale Kirkendall effect.

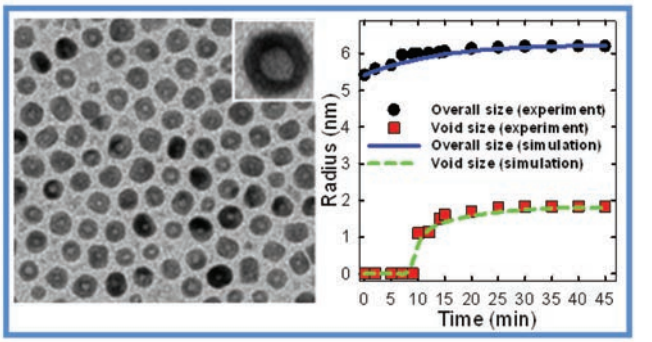


Fig.: TEM images of hollow Ni-Zn nanoparticles and corresponding nanoparticle and void sizes obtained from experiment and simulation.

Publications in Journals

Subhra Jana, Ji Woong Chang, and Robert M. Rioux, *Synthesis and Modeling of Hollow Intermetallic Ni–Zn Nanoparticles Formed by the Kirkendall Effect*, Nano Lett., **13** (8), pp 3618–3625 (2013).

Supervision of Students

Ph.D. Students: Sankar Das; **Project Students:** Hina Badgujar (M. Sc.)

Lectures Delivered

1. International Union of Materials Research Society, International Conference in Asia-2013 (IUMRS ICA-2013), IISc Bangalore, India, December 16-20, 2013.

2. International Conference on Nano Science and Technology, ICONSAT-2014, Chandigarh, India. March 3-5, 2014.

Courses Taught

1. PHY 301: Atomic & Molecular Physics (Integrated Ph.D.)

2. PHY 501: Research Methodology (Ph.D.)

3. CB 527: Molecular Physics and Spectroscopy (Ph.D.)

Awards / Recognitions

DST INSPIRE Faculty Fellowship

Sponsored Projects

Low Temperature Chemical Routes to Alloys, Intermetallics, and Hybrid Nanomaterials, DST INSPIRE Faculty Grant.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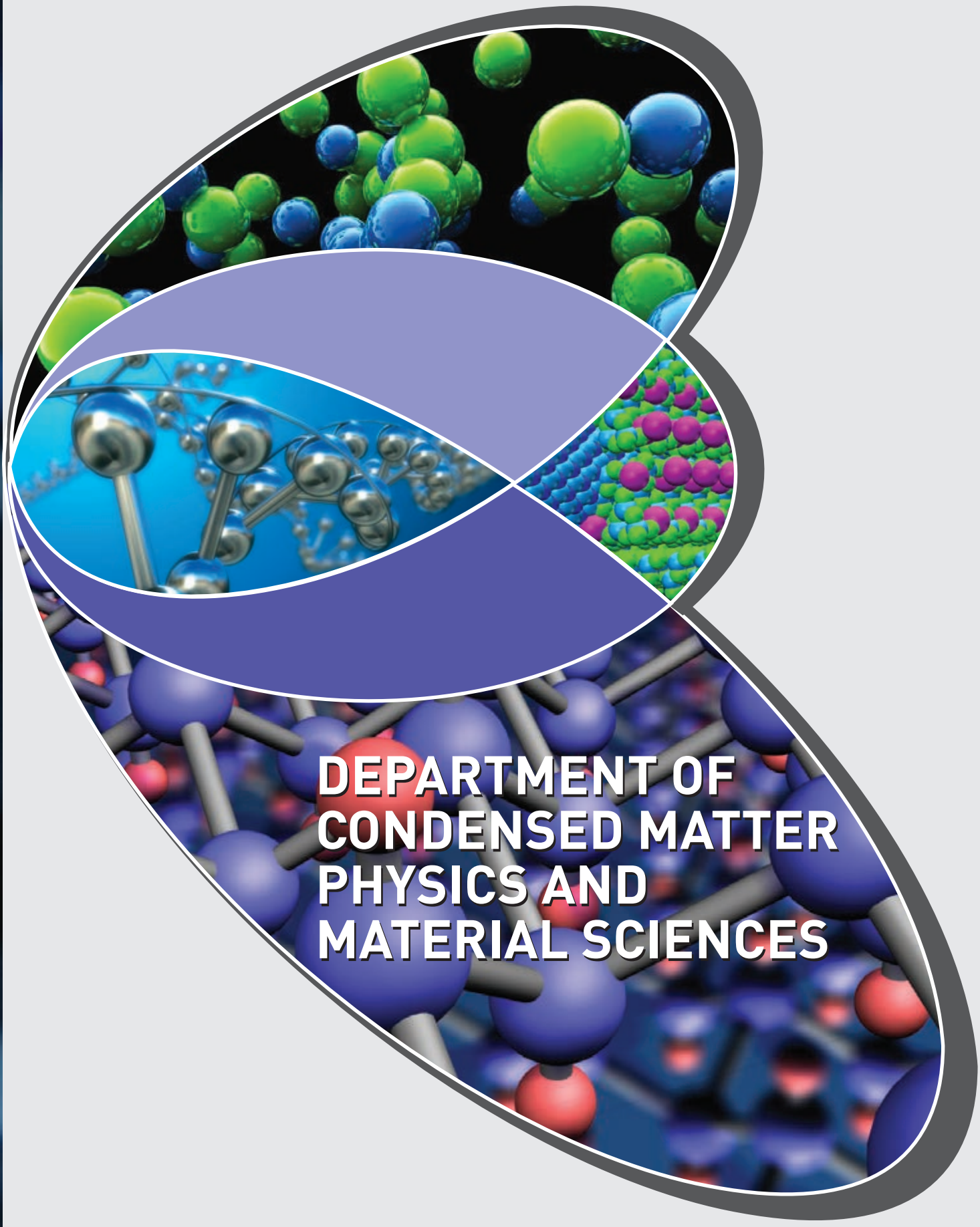


DEPARTMENT OF CONDENSED MATTER PHYSICS AND MATERIAL SCIENCES

Department of Condensed Matter Physics and Material Sciences

Prof. Pratip Kumar Mukhopadhyay

Head of the Department

Department Profile Indicators

Table A: Manpower and Resources

Number of faculties	11
Number of Post–doctoral research associate (centre+project)	4+7
Number of Ph.D students	55
Number of other project staff	5 (students) + 12 (pdf and above)
Number of summer students	11
Projects (ongoing)	19

Table B: Research Activities Indicators

Number of research papers in Journals	93
Number of Book-chapters/books	1
Number of other publications	16
Number of Ph.D students graduated (submitted+degree awarded)	9+7
Number of M.Tech/M.Sc projects	2

Table C: Academic Activities and Linkage

Number of courses taught by faculties	12	
Number of Visitors (non – associates)	1	
Number of associates	3	
Number of Seminars organized	4	
Number of Conference/Symposia/ Advanced Schools organized	1	
Number of talks delivered by members of department in Conferences/Symposia	National	34
	International	30

Most Important Research Highlights

There are two major research areas that may be highlighted –

a) There were a couple of interesting results from band structure calculations in two groups –

   i. Study of effect of ad-atom on bilayer graphene. It was observed that it was possible to switch magnetism of these atoms by external magnetic

fields. This may be useful for controlled nano devices.

ii. Effect of d^n atoms on d^0 based ferroelectric materials. It was observed that by doping V impurity in archaic $BaTiO_3$ ferroelectric material can enhance the ferroelectric properties by a large amount. This finding may become important in search for future multiferroic materials.

b) In case of experiments there are three interesting findings –

i. First time demonstration of magnetic vortex based transistor operations in three isolated nanodots. It was found to be possible to exert control by core polarity and chirality of vortices.

ii. Photoresponse of colossal size was observed in single strand of complex oxide nanowire. This huge amount of enhancement makes the system applicable to device manufacturing

iii. Observation of multicolor fluorescence in surface modified iron oxide nanoparticles. It was found to be due to ligand to metal charge transfer transitions and this was found to be effective for photocatalytically decolor contaminated water.

Summary of Research Activities

This department works on various aspects of condensed matter physics, both in theoretical and experimental methods. These are elaborately dealt with in individual faculty pages, here I present only a bird's eye view of the matter.

In the theoretical side, there were two major lines of work. On one hand, there is a strong group working on band structure based calculations, and on the other there is a microscopic phenomenological work on certain topics. These are elucidated below.

Prof. A Mookerjee and his group worked on electronic band structure calculations of various metal clusters, dilute magnetic alloys with disorder or defects etc.

Prof. P. Mahadevan and her group worked on electronic band structures and related properties of various systems, like layered semiconductors, quantum dots, orbital ordering induced ferroelectricity etc.

Prof T. Saha-Dasgupta and her group calculated electronic band structures for various systems, like complex materials such as bilayer graphene, nanomaterials and also Functional Metalorganics etc.

Dr. M. Kumar and his group worked on broad area of study of electronic properties of low dimensional materials and quantum phase transitions in various systems

Dr. S. Mukherjee and his group calculated electronic properties of Graphene and related Nanomaterials

Dr. S. Dutta worked on electronic structure calculations of nano clusters of metals and fullerenes. He also investigated materials for hydrogen production by photocatalytic water splitting

On a different footing, there are two other groups that worked on

Dr. R. Chaudhury and his group worked on various aspects of superconductivity, as well as theoretical analysis of mutation of DNA

Prof. Singha Deo and his group worked on various aspects of mesoscopic systems, like magnetization, electronic properties etc.

In the experimental side, there are two major branches, one working with nano materials, the other work on ferromagnetic shape memory alloys.

Prof. A.K. Raychaudhuri's group worked on various aspects of nano materials, like nano fabrication, nanolithography, fabrication of nano wires of metals, semiconductors and oxides. Interesting photoresponse was observed in some such systems.

Dr. B. Ghosh Saha and her group worked on various problems of complex oxides of bulk and nanocrystals/nanowires, thin films etc.

Prof. A. Barman and his group worked on ultrafast photoinduced magnetization dynamics of thin films, multilayers and patterned nanostructures. Magnonic band structures of antidote arrays were investigated both experimentally and numerically.

Dr. Mandal and her group worked on synthesis, characterization and engineering of magnetic nanoparticles for Hyperthermia, drug release, biosensor etc.

Prof. K. Mandal's group worked on diverse things, like magnetic nanowires, nanoparticles, defect identification of dilute magnetic semiconductors, as well as magnetic functional properties of some Heusler alloys.

In the line of ferromagnetic shape memory alloys, Dr. C. Biswas and her group worked on various aspects of a series

of Heusler alloys, focusing on martensitic phase transitions, taking into account of effects of disorder.

Prof. P. K. Mukhopadhyay and his group worked on substitution effects, magnetocaloric effects and spin glass nature of a series of such alloys. Band structure calculations were carried out on some interesting binary alloys, along with Prof. A. Mookerjee.

Finally, on experiments of soft matter, magnetic and magnetorheological measurements were done on various fluids prepared in the lab. The magnetic nano particles were either ferrite or alloys of Co, Ni and Fe, and capped with various agents for alterations in functional properties.

Pratip Kumar Mukhopadhyay

Head, Department of Condensed Matter Physics and Material Sciences

Abhijit Mookerjee

Emeritus Professor

Department of
Condensed Matter Physics and Material Sciences

I have worked on four different areas :

- Absorption and catalysis by Pt, Pd and Tb clusters
- Thermal conductivity and entropy in disordered phononic systems
- Electronic structure of systems with extended defects,
- Collaborative work with PKM+AKM (expertiment + theory) of diluted magnetic alloys and study of spin glasses

We found close agreement of theory and experiment for FeAl, FeCr and NiMn alloys. This was even true when we obtained the exchange parameters from first-principles DFT methods.

Fig. : Crinkling at a Stone-Wales defect

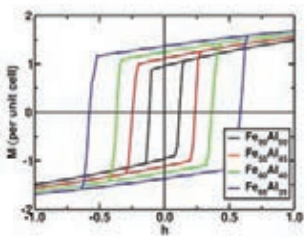


Fig. : Hysterisis in FeAl

The effect of extended, random Stone-Wales defects and defect clusers on the density of states was quite spectacular. Also the local density of states are seen to be very sensitive to defects in their neighbourhood.

Publications in Journals

1. Tanmoy Ghosh, Shreemoyee Ganguly, P.K.Mukhopadhyay, **Abhijit Mookerjee**, *Electronic and magnetic properties of disordered AuCr alloys: A first-principles study*, Journal of Magnetism and Magnetic Materials, **332**, 199–204 (2013).

2. Radhashyam Banerjee, Soumendu Datta, **Abhijit Mookerjee**, *Structure, reactivity and electronic properties of Mn doped Ni_{13} clusters*, Physica B, **419**, 86 (2013).

3. Prashant Singh, Manoj K. Harbola, Biplab Sanyal, and **Abhijit Mookerjee**, *Accurate determination of band gaps within density functional formalism*, Phys. Rev. B **87**, 235110 (2013).

4. Ambika Prasad Jena, Biplab Sanyal, **Abhijit Mookerjee**, *Study of the effect of short ranged ordering on the magnetism in FeCr alloys*, Journal of Magnetism and Magnetic Materials, **349**, 156 (2014).

5. Rajiv K. Chouhan, Aftab Alam, Subhradip Ghosh, and **Abhijit Mookerjee**, *Interplay of force constants in the lattice dynamics of disordered alloys: An ab initio study*, Phys. Rev. B **89**, 060201(R) (2014).

6. Suman Chowdhury, Santu Baidya, Dhani Nafday, Soumyajyoti Halder, Mukul Kabir, Biplab Sanyal, Tanusri Saha-Dasgupta, Debnarayan Jana, **Abhijit Mookerjee**,

A real-space study of random extended defects in solids: Application to disordered Stone–Wales defects in graphene, Physica E, **61**, 191 (2014).

7. Ambika Prasad Jena, Biplab Sanyal, **Abhijit Mookerjee**, *Study of the effect of magnetic ordering on order–disorder transitions in binary alloys*, Journal of Magnetism and Magnetic Materials, **360**, 15 (2014).

8. P. K. Mukhopadhyay, Tanmoy Ghosh, **Abhijit Mookerjee**, *Interesting magnetic behavior of Fe:Al disordered alloys*, Physica B: Condensed Matter, **448**, 226 (2014).

9. Tanmoy Ghosh, Ambika Prasad Jena, Biplab Sanyal, Hirosuke Sonomura, Takashi Fukuda, Tomoyuki Kakeshita, P.K. Mukhopadhyay, **Abhijit Mookerjee**, *Effect of short range ordering on the magnetism in disordered Fe:Al alloy*, Journal of Alloys and Compounds, **613**, 306 (2014).

Supervision of Students

Ph.D. Students: Ph.D. Received – Mitali Banerjee, Rudra Banerjee, Prashant Singh, Rajiv Kumar Chouhan, Gopi Chand Kafle; Doing Ph.D. – Ambika Prosad Jena, Suman Chaudhuri, Banasri Sadhukhan

Lectures Delivered

"Phonons in disordered systems" at the Conference on Phonons in IIT Guwahati, January 9th 2014

Courses Taught

1. 2013 Sem 3 IPHD and PHD half of the special paper on "Condensed Matter Physics" at SNBNCBS
2. 2013 Sem 3 MSc Course on "Advanced Statistical Physics" at Presidency University
3. 2013 Sem 3 MSc Course on "Non-equilibrium Statistical Mechanics" at Lady Brabourne College
4. 2014 Sem 4 MSc half of the course on "Magnetism" (part of Cond Mat Phys) Presidency University
5. 2014 Sem 4 MSc half of the course on "Application of QFT in Solids" Presidency University
6. 2014 Sem 4 course on "Advanced Condensed Matter Physics" at Lady Brabourne College
7. 2014 Three students Subhradeep Banerjee, Somonnita Roy and Shk. Mujaffar Hossein did their term papers on "Extended and topological disorder in allotropes of graphene"

Participation in Committees

External: Member of the Faculty Selection Committee at Presidency University; Member of the Physics Academic Committee at Lady Brabourne College

Sponsored Projects

1. DBT Project : "Non-toxic removal of As from ground water"

Anjan Barman

Professor

Department of
Condensed Matter Physics and Material Sciences

- Magnetic thin films, multilayers and patterned nanostructures
- Ultrafast magnetization dynamics
- Magnonics; spintronics

We have developed several new classes of two dimensional magnonic crystals using ferromagnetic dots and antidots. By using time-resolved magneto-optical Kerr microscope, broadband ferromagnetic resonance spectrometer and Brillouin light scattering spectro-microscopy we studied their spin dynamics in all possible domains (time, frequency and wave-vector). We have observed broadly tunable magnonic spectra by varying the physical structures and material parameters of these magnonic crystals.

We have numerically studied the magnonic band structures in ferromagnetic antidot waveguides. We have shown that the antidot shape, size and lattice constant can be efficiently tuned to control magnonic band gaps by selectively exciting and localizing the spin waves of varying wave-vectors.

We further showed that an intrinsic mirror symmetry of the waveguide can close the magnonic bandgap and this effect can be compensated by an extrinsic factor. This allowed for the recovery of magnonic bandgaps closed due to a fabrication defect. The model developed are extendable for both exchange and dipolar interaction regimes, as well as to other waves in general.

We experimentally investigated spin Hall angle of $Co_{75}Fe_{25}$/Pt bilayer films by means of the spin-torque ferromagnetic resonance and the modulation of damping measurements. We found that the ferromagnetic layer underneath Pt greatly affects the estimation of the spin Hall angle. We also extracted the spin diffusion length of Pt and the ferromagnetic thickness dependence of the Gilbert damping coefficient.

We demonstrated magnetic vortex based transistor operations for the first time in three physically isolated nanodisks by controlling the core polarity and chirality of the vortices. We demonstrated all three conventional operational states of an electronic transistor – *cut-off*, *active*, and *saturation* – using magnetic vortices and interpreted the results by the dynamics of antivortex packets moving through the stray magnetic fields coupling the vortices.

Publications in Journals

1. D. Kumar, S. Barman and **A. Barman**, *Magnetic Vortex Based Transistor Operations*, Scientific Reports (Nature Publishing Group) **4**, 4108 (2014).

2. A. Ganguly, K. Kondou, H. Sukegawa, S. Mitani, S. Kasai, Y. Niimi, Y. Otani, and **A. Barman**, *Thickness Dependence of Spin Torque Ferromagnetic Resonance in $Co_{75}Fe_{25}$/Pt Bilayer Films*, Appl. Phys. Lett. **104**, 072405 (2014).

3. D. Polley, **A. Barman** and R. K. Mitra, *EMI Shielding and Conductivity of Carbon Nanotube-Polymer Composites at Terahertz Frequency*, *Optics Letters* **39**, 1541 (2014).

4. D. Kumar, J. W. Klos, M. Krawczyk and **A. Barman**, *Magnonic Band Structure, Complete Bandgap and Collective Spin Wave Excitation in Nanoscale Two-dimensional Magnonic Crystals*, J. Appl. Phys. **115**, 043917 (2014).

5. J. W. Klos, D. Kumar, M. Krawczyk, and **A. Barman**, *Influence of structural changes in a periodic antidot waveguide on the spin-wave spectra*, Phys. Rev. B **89**, 014406 (2014).

6. A. K. Ghosh, S. Kumar, S. Basu, B. Rana, **A. Barman**, S. Chatterjee, S. N. Jha, and D. Bhattacharyya, *Structural, optical and magnetic properties of sol-gel derived ZnO:Co diluted magnetic semiconductor nanocrystals: an EXAFS study*, J. Mater. Chem. C **2**, 481 (2014).

7. S. Bhardwaj, T. Rana, P. Laha, **A. Barman**, and S. Biswas, *Study of Titanium Dioxide Nanotube Array for the Application in Dye-Sensitized Solar Cells*, Int. J. Mater. Mech. Manufac. **2**, 47 (2014).

8. R. Mandal, P. Laha, K. Das, S. Saha, S. Barman, A. K. Raychaudhuri and **A. Barman**, *Effects of Antidot Shape on the Spin Wave Spectra of Two-Dimensional $Ni_{80}Fe_{20}$ Antidot Lattices*, Appl. Phys. Lett. **103**, 262410 (2013).

9. S. Saha, S. Barman, J. Ding, A. O. Adeyeye, and **A. Barman**, *Tunable Magnetic Anisotropy in Two-Dimensional Arrays of $Ni_{80}Fe_{20}$ Elements*, Appl. Phys. Lett. **103**, 242416 (2013).

10. S. Saha, S. Barman, J. Ding, A. O. Adeyeye and **A. Barman**, *Time-Domain Study of Spin-Wave Dynamics in Two-Dimensional Arrays of Bi-Component Magnetic Structures*, Appl. Phys. Lett. **102**, 242409 (2013).

11. B. K. Mahato, B. Rana, D. Kumar, R. Mandal, S. Barman, Y. Fukuma, Y. Otani, and **A. Barman**, *Configurational Anisotropic Spin waves in Cross-shaped $Ni_{80}Fe_{20}$ nanoelements*, Appl. Phys. Lett. **102**, 192402 (2013).

12. J. W. Kłos, D. Kumar, M. Krawczyk, and **A. Barman**, *Magnonic Band Engineering By Intrinsic and Extrinsic Mirror Symmetry Breaking in Antidot Spin-wave Waveguides*, Scientific Reports (Nature Publishing Group) **3**, 2444 (2013).

13. S. Saha, R. Mandal, S. Barman, D. Kumar, B. Rana, Y. Fukuma, S. Sugimoto, Y. Otani and **A. Barman**, *Tunable Magnonic Spectra in Two-dimensional Magnonic Crystals with Variable Lattice Symmetry*, Adv. Funct. Mater. **23**, 2378 (2013).

14. O. Dmytriiev, U. A. S. Al-Jarah, P. Gangmei, V. V. Kruglyak and R. J. Hicken, B. K. Mahato, B. Rana, M. Agrawal, and **A. Barman**, M. Mátéfi-Tempfli, L. Piraux, and S. Mátéfi-Tempfli, *Static and dynamic magnetic properties of densely packed magnetic nanowire arrays*, Phys. Rev. B **87**, 174429 (2013).

15. D. Polley, A. Ganguly, **A. Barman** and R. K. Mitra, *Polarizing Effect of Aligned Nanoparticles in Terahertz Frequency Region*, Optics Letters **38**, 2754 (2013).

16. S Bedanta, **A. Barman**, W. Kleemann, O. Petracic, and T. Seki, *Magnetic nanoparticles: a subject for both fundamental research and applications* (Review Article), J. Nanomater. **2013**, 952540 (2013).

17. S. Bedanta, **A. Barman**, W. Kleemann, O. Petracic, and T. Seki (Editorial Review), *Synthesis, properties and applications of single- domain magnetic nanoparticles*, J. Nanomater. **2013**, 130180 (2013).

18. D. Kumar, P. Sabareesan, W. Wang, H. Fangohr, and **A. Barman**, *Effect of Hole Shape on Spin-Wave Band Structure in One-Dimensional Magnonic Antidot Waveguide*, J. Appl. Phys. **114**, 023910 (2013).

19. A. K. Ghosh, H. Kevin, B. Rana, G. D. Dwivedi, B. Chatterjee, **A. Barman**, S. Chatterjee and H. D. Yang, *Role of codoping on multiferroic properties at room temperature in $BiFeO_3$ ceramic*, Solid State Commun. **166**, 22 (2013).

20. D. Mahesh, S. K. Mandal, Bipul K. Mahato, Bivas Rana and **Anjan Barman**, *Pronounced multiferroicity in oleic acid stabilized $BiFeO_3$ nanocrystals at room temperature*, J. Nanosci. Nanotechnol. **13**, 4090 (2013).

Supervision of Students

Ph.D. Students: Bivas Rana, Semanti Pal, Dheeraj Kumar, Bipul Kumar Mahato, Sushmita Saha, Ruma Mandal, Arnab Ganguly, Debanjan Polley, Chandrima Banerjee, Kallol Mukherjee;

Project Students: Nikita Porwal (IIT Kgp), Samiran Chowdhury (IPhD), Kaushik Chanda (IPhD), Pranav Nimgade (IIT Delhi), Kingshuk Mallick (IIT Mumbai)

Post Doctoral Researchers

Pinaki Laha

Lectures Delivered

Invited Talks:

1. GHz Frequency Spin Waves At The Nanoscale: A New Paradigm Towards On-Chip Microwave Communications, A. Barman, Institute Colloquium, Shiv Nadar University, Greater Noida, 6 Mar. 2014.
2. Bridging the Gap between Ultrafast Spin Dynamics and Nanoscale Magnonics, A. Barman, ICONSAT2014, Punjab University, Chandigarh, 2-5 Mar., 2014.
3. Spin-Waves in Nanoscale Ferromagnetic Antidot Lattices, A. Barman, Seventh India-Singapore Joint Physics Symposium, IIT Bombay, 24-26 Feb. 2014.
4. Manipulation of Spin Waves in Nanoscale Antidot Magnonic Crystals, A. Barman, Physics and Chemistry of Materials, S. N. Bose National Centre for Basic Sciences, Kolkata, 24-25 Feb. 2014.
5. Nanoscale Magnonic Crystals: A New Paradigm Towards Microwave Communications, A. Barman, IUMRS-ICA 2013, IISc Bangalore, 16-20 Dec. 2013.
6. Optically Induced Ultrafast Spin Dynamics in Ferromagnetic Nanostructures, A. Barman, DAE-BRNS Theme Meeting on Ultrafast Science (UFS-2013), IIT Kharagpur, 25-26 Oct., 2013.
7. Local Control of Nanoscale Magnetic Properties by Interfactal Intermixing in Magnetic/Nonmagnetic Thin Film Bilayers, D. Atkinson, D. M. Burn, T. P. A. Hase, J. A. King, A. T. Hindmarch, A. Barman, S. Pal & A. Ganguly, Amorphous and nanostructured magnetic materials, 1-3 Oct., 2013, Sendai, Japan.
8. Static and dynamic magneto-optic Kerr effect magnetometry for analysis of magnetization processes and fundamental magnetic properties D. Atkinson, D. Burn, J. A. King, M. S. Sultan, A. T. Hindmarch, A. Barman, S. Pal & A. Ganguly, Donostia, International Conference on Nanoscaled Magnetism and Applications (DICNMA), 9-13 Sep., 2013, San Sebastian, Spain.
9. Experimental Studies of Ultrafast Magnetization Dynamics in Magnetic Nanostructures and their Applications, A. Barman, UGC Sponsored National Seminar on Advancement in Modern Physics, R. K. Mission, Narendrapur, Kolkata, August 23 & 24, 2013.
10. Spin waves at the nanoscale - a new paradigm towards on-chip microwave communications, A. Barman, Institute Seminar, S. N. Bose National Centre for Basic Sciences, Kolkata, 3rd Oct. 2013.
11. Magnonic Band Gap Engineering by Intrinsic and Extrinsic Mirror Symmetry Breaking in Magnonic Antidot waveguide, D. Kumar, J. W. Kłos, M. Krawczyk, and **A**. Barman, IUMRS-ICA 2013, IISc Bangalore, 16-20 Dec., 2013.
12. Magnetic Vortex Based Transistor Operations, D. Kumar, S. Barman and A. Barman, IUMRS-ICA 2013, IISc Bangalore, 16-20 Dec., 2013.
13. J. W. Klos, D. Kumar, M. Krawczyk, and A. Barman, Magnonic band gaps in the spectra of symmetric and asymmetric antidots spin wave waveguides, Donostia, International Conference on Nanoscaled Magnetism and Applications (DICNMA), 9-13 Sep., 2013, San Sebastian, Spain.

Courses Taught

1. PHY401: M. Sc. Project Research II
2. PHY301: Atomic and Molecular Physics
3. PHY304: M. Sc. Project Research I
4. PHY292: Summer Research Project

Participation in Committees

External: Program Committee Member of 59th Annual Magnetism and Magnetic Materials Conference 2014 in Hawaii, USA;

Internal: Member of the Technical Cell Advisory Committee, Member of Works Committee, Member of Admission Committee, Member of NPEP committee of EVLP

Awards / Recognitions

Guest Editor in a special issue of Journal of Nanomaterials

Sponsored Projects

1. Nano-Engineered Magnetic Materials for Spintronic Applications, Funding agency: UKIERI DST Thematic Partnership 2012.
2. Advanced computational studies of dynamic phenomena in magnetic nano-materials, Funding agency: DST- European Commission (FP7).
3. Magnonic Crystals: New paradigm towards microwave communications, Funding agency: DST-JST.
4. Development of GHz frequency filters and attenuators using nanoscale magnonic crystals, Funding Agency: Department of Information Technology.
5. Thematic Unit of Excellence on Nanodevice Technology, Funding Agency: Nano Mission, DST.

Arup Kumar Raychaudhuri

Director and Distinguished Professor

Department of
Condensed Matter Physics and Material Sciences

- Nanomaterials, Nanofabrication and Nanolithography, Opto-electronic and Transport properties of single nanowires of metals and semiconductors and correlated oxides
- Specific problems worked on: (a) Physics of size reduction in nanowires and nanocrystals. (b) Ultra-large photoresponse in single nanowire photodetectors and (c) Field effect investigations using electric double layer gates.
- Key words: Nanomaterials, Nanolithography, Correlated electron systems

Ultra-large photo-response approaching 10^5 A/W was obtained in a photo-detector fabricated from a single strand of nanowire (diameter ~30nm, length ~200nm), of charge transfer complex Cu:TCNQ fabricated using vapor phase synthesis and electron beam assisted deposition.

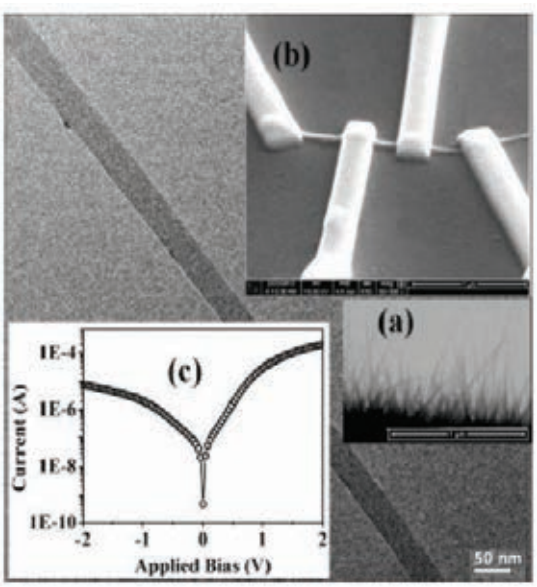
We studied 1/f noise in a single stranded of a Si nanowire and established that size reduction though increases the total noise, when properly normalized by carrier numbers, it may actually show less noise than the bulk.

We investigated a link between the depressions of the melting temperature T_m (ΔT_m (d)) and the Debye Temperature θ_D ($\Delta\theta_D^2$) in Zn nanowires with diameter down to 30nm. We found that both ΔT_m (d) and $\Delta\theta_D^2$ have nearly the same inverse power law dependence on the diameter d.

Neutron scattering investigation of Nanocrystals of $LaMnO_3$ showed that the antiferromagentic insulator in the bulk, gives way to ferromagnetic order with $T_C \approx 260K$, for sizes below 50nm along with a change in structure from orthorhombic (in bulk) to rhombohedral in nanocrystals.

Nanogap capacitance of an electric double layer gates to induce large charge density (> 10^{13} /cm^2) on films (and crystals) of functional oxides like ZnO and manganites and modulated charge transport through them using a gate effect. Particularly in ZnO we could create a synergy between carriers created by illumination and field effect to enhance the photocurrent in a gated photo-detector made from ZnO.

Investigations on nanowires and nanocrystals of manganites showed co-existing phases and in some cases universal entropy changes associated with magneto-caloric effects.



SEM image of a Cu:TCNQ single wire nano device made from nanowires grown by vapor growth method. The Inset shows the I-V curve of the device

Publications in Journals

1. S. Samanta, K. Das and **A. K. Raychaudhuri**, *Low-frequency flicker noise in a MSM device made with single Si nanowire (diameter ≈ 50 nm)*, Nanoscale Research Letters, **8**, 165 (2013).

2. Anis Biswas, Sayan Chandra, Tapas Samanta, Barnali Ghosh, Subarna Datta, M. H. Phan, **A. K. Raychaudhuri**, I. Das, and H. Srikanth, *Universality in the entropy change for the inverse magnetocaloric effect*, Phys. Rev. B **87**, 134420 (2013).

3. Sayan Chandra, Anis Biswas, Subarna Datta, Barnali Ghosh, **A K Raychaudhuri** and Hariharan Srikanth, *Inverse magnetocaloric and exchange bias effects in single crystalline $La_{0.5}Sr_{0.5}MnO_3$ nanowires*, Nanotechnology **24**, 505712 (2013).

4. Sudeshna Samanta, K. Das, and **A. K. Raychaudhuri**, *Junction Effect on Transport Properties of a Single Si Nanowire Metal–Semiconductor–Metal Device*, IEEE Transactions on Nanotechnology, **12**, 1089 (2013).

5. Shahnewaz Mondal, Rishi Ram Ghimire and **A. K. Raychaudhuri**, *Enhancing photoresponse by synergy of gate and illumination in electric double layer field effect transistors fabricated on n-ZnO*, Appl. Phys. Lett. **103**, 231105 (2013).

6. Sabyasachi Ghosh and **A. K. Raychaudhuri**, *Link between depressions of melting temperature and Debye temperature in nanowires and its implication on Lindeman relation*, J. Appl. Phys. **114**, 224313 (2013).

7. R. Mandal, P. Laha, K. Das, S. Saha, S. Barman, **A. K. Raychaudhuri** and A. Barman, *Effects of Antidot Shape on the Spin Wave Spectra of Two-Dimensional $Ni_{80}Fe_{20}$ Antidot Lattices*, Appl. Phys. Lett. **103**, 262410 (2013).

8. Barnali Ghosh, V Siruguri, **A K Raychaudhuri** and Tapan Chatterji, *Effect of size reduction on the structural and magnetic order in $LaMnO_{3+\delta}$ ($\delta \approx 0.03$) nanocrystals: a neutron diffraction study*, J. Phys.: Condens. Matter **26**, 025603 (2014).

9. Rabaya Basori, **A. K. Raychaudhuri**, *Role of Contact and Contact Modification on Photo-response in a Charge Transfer Complex Single Nanowire Device*, Nano-Micro Letters, **6**, 63 (2014).

10. Manotosh Chakravorty and **A. K. Raychaudhuri**, *Low field magnetoresistance of Gadolinium nanowire*, J. Appl. Phys. **115**, 054308 (2014).

11. Rabaya Basori, K. Das, Prashant Kumar, K. S. Narayan, and **A. K. Raychaudhuri**, *Single CuTCNQ charge transfer complex nanowire as ultra high responsivity photo-detector*, Optics Express, **22**, 4944 (2014).

12. Abhijit Maity, Gourab D Banik, Chiranjit Ghosh, Suman Som, Sujit Chaudhuri, Sunil B Daschakraborty, Shibendu Ghosh, Barnali Ghosh, **Arup K Raychaudhuri** and Manik Pradhan, *Residual gas analyzer mass spectrometry for human breath analysis: a new tool for the non-invasive diagnosis of Helicobacter pylori infection*, Journal of Breath Research, **8**, 016005 (2014).

13. Rajib Nath and **A. K. Raychaudhuri**, *Electric double layer (EDL) gate controlled non-linear transport in a nanostructured functional perovskite oxide film*, Appl. Phys. Lett. **104**, 083515 (2014).

Books Published

A. K. Raychaudhuri, Instabilities in Focused Ion Beam-patterned nanostructures in "FIB Nanostructures" editor Z.M.Wang Springer series on Nanoscale Science and Technology Springer. Heidelberg 2013

Supervision of Students

Ph.D. Students: Shanewaz Mandal, Manotosh Chakravorty, Rajib Nath, Rabeya Basori, Putul Malla Chowdhury, Sabyasachi Ghosh, Rishi Ram Ghimire, Shailli Shett, Ravinder A Bisht;

Project Students: M.Tech projects : Kalyan Joyti sarkar (IIT,Kharagpur), Md. Zeeshan (IIT/Kharagpur)

Post Doctoral Researchers

Kaustuv Das, Sudheshna Samanta, Bipul Das and Pabitra Mandal

Lectures Delivered

1. Nanowires and single nanowire optical devices as new generation optical detectors, *Sikksha O Anusandhan,* University Bhubaneswar, PAOMP, March 26, 2014

2. Experiments on single functional nanowires, INST, Mohali, ICONSAT 2014, March 3, 2014

3. Science and Arts of Physics Experiments, Department of Physics, Calcutta University, Lecture Series (3 lectures), March 5-7, 2014

4. Magnetic phases, Phase transition and Spin polarized transport in nano-structured manganites, IIT, Guwahati, MAGMA 2013, December 5, 2013
5. Gating Oxides with solid electrolytes, JNCASR, Bangalore, Winter School on Frontiers in materials science, December 3, 2013
6. Electronic and Opto-electronic measurements in single nanowire devices, Leopoldina, Halle, Germany, Leopoldina-INSA Symposium on nanoscience, November 25-26, 2013
7. A glimpse of research at S.N.Bose National Centre, Institute of Nanoscience, University of Zaragoza, Spain, Colloquium, November 21, 2013
8. Fabrication and electronic measurements of single Nanowires, Institute of Physics, Uni Heidelberg, Germany, Seminar, Nov ember 20, 2013
9. Strain control of Physical Properties in PLD grown films, IIT, Kharagpur, PLD 2013, November 14-15,2013
10. Joy of small things - A brief tour of the world of nano, Xian Xiao Tong University, China, Lecture Series, September 11-15, 2013
11. Integrating top-down and bottom-up fabrication: Experimenting with single nanowires and arrays, Xian Xiao Tong University, China, Institute Colloquia, September 13, 2013
12. FIB as an enabling tool in fabrication of single nanowire devices, Beijing University, China, EMN East 2013, September 7-10, 2013
13. Combining top-down and bottom-up fabrications: Fabrication and experiments on single nanowires and devices, IMMT, Bhubaneswar, EEMR-13, JSPS, August 12-13, 2013
14. The World of Nano: A brief tour, SNBNCBS, Kolkata, CKM memorial Workshop, July 2, 2013

Academic Visits

1. EMN East Workshop , Institute of Semiconductor, Beijing ,China, September, 2013
2. Xian XiTong University, Xian, China, September, 2013
3. Leopoldina, Halle, Germany, November, 2013
4. University of Heidelberg, Heidelberg, Germany, November, 2013
5. University of Zaragoza, Zaragoza, Spain, November, 2013

Courses Taught

1. PHY-203, Electrodynamics, Spring- 2013
2. PHY409/PHY601, Magnetism and Superconductivity, Spring -2014

Participation in Committees

External: Member, Nanosciennce Advisory Group of Nanomission; Member Board of Governors, IIT/Kanpur; Member Executive Council, NEHU,Shillong; Member Governing Council, Bose Institute, Kolkata; Member, Governing Council, Inter-University Accelerator Centre; Visitors nominee in Selection Committee for Faculty and Tripura University; Chairman Project Advisory Group of two projects in Department of Information Technology; Member, PAC Solar Energy Research Initiative;

Internal: Member, Governing Body; Chairman-Finance Committee, Building Committee, Consultative Advisory Committee, Medical Committee, Selections and Assessment committees for Faculties

Patents Submitted

R. Neogy, R. Nath and A. K. Raychaudhuri, Control Synthesis of Micron Sized Gold Network Structure by Assembling Individual Gold Nanoparticles by Laser Ablation, Date of filing 23/05/2013, Ref: 588 /KOL/ 2013 A

Sponsored Projects

1. J.C. Bose Fellowship
2. Unit on Nanoscience at SNBNCBS, Kolkata (UNANST – II)
3. Investigation of strain-dependent magnetization dynamics and electronic transport in magnetic oxides for spintronics and signal processing applications
4. Electroresistance in single crystals and thin films of mixed valence manganites
5. Thematic Unit for Excellence on Nanodevice Technology
6. Nano Breath Application

Barnali Ghosh (Saha)

Scientist-E

Department of
Condensed Matter Physics and Material Sciences

- Synchrotron x-ray study in complex oxides of bulk and nanocrystals/nanowires
- Neutron Diffraction Study on complex oxide nanowires
- Fabrication of single nanowire device of multifunctional perovskite oxide systems and transport measurement
- Cross-sectional TEM and Electron Energy loss spectroscopy (EELS) study in multifunctional oxide nanowires, nanocrystals and thin films
- Study of Photoresponse in binary oxides.

The nature of work has two distinct regions:

a) Academic nature: Research activities along with Ph.D students under CMPMS department

b) Administrative nature: Handling central equipment facilities under Technical Cell as Scientist I/C of the cell

a) Academic Work:

i) *Transport on Single Naowire Device of Functional Oxide System:*

We have done measurement of low frequency resistance noise spectroscopy in a single strand of a nanowire (d ≈ 45nm) of a complex oxide manganite $La_{0:5}Sr_{0:5}MnO_3$, that showed ferromagnetic transition (at T_C) followed by an antiferromagnetic transition (at T_N) and a phase-separated region with co-existing phases below T_N. The phase-coexistence leads to a large noise below T_N. We demonstrated that high precision noise spectroscopy in a single nanowire can cleanly detect the magnetic transition in a single nanowire including the phase-coexistence that may not be possible to do by magnetic measurements on a single nanowire.

ii) *Study of Photoresponse in Binary Oxide thin Films.*

We have observed that the photoresponse behavior can be modified by modifying the surface morphology of two thin films of binary oxide of WO_3.The nanocrystalline film grown on Si shows distinct photo-current (PC) ON/OFF states when light was turned on/off. Whereas the film with needle like structure grown on $SrTiO_3$ exhibits significantly enhanced persistent photo-current (PPC) even in light off condition.

b) Administrative Work:

Work done other than research activities:

As a Scientist in-charge of Technical cell, I have to be actively involved in the instrumental facility management and equipment installation.

Technical cell: All the major instrumental facilities at our centre are under Technical cell, which looks after the overall

running of the facilities. Technical Cell functions as a section and I am Scientist in-charge of the Cell. I/C of Technical Cell act as head of the section. The major activity comes under the sections the following:

i) maintenance of equipments;

ii) purchase and installation of new instruments;

iii) up-gradation of existing instruments under Technical cell;

iv) have to supervise smooth inflow of consumables and supplies that is needed for smooth running of the facility;

v) also involved in the appointment and job allotment of Technical staffs associated with Technical Cell.

As the major instruments are central facility instrument of S.N Bose centre, the users are mainly internal users but we have 20% of the available time for external users also on payment basis.

Publications in Journals

1. **Barnali Ghosh**, V Siruguri, A K Raychaudhuri and Tapan Chatterji, *Effect of size reduction on the structural and magnetic order in $LaMnO_{3+\delta}$ ($\delta \approx 0.03$) nanocrystals: a neutron diffraction study*, J. Phys.: Condens. Matter **26**, 025603 (2014).

2. Anis Biswas, Sayan Chandra, Tapas Samanta, **Barnali Ghosh**, Subarna Datta, M. H. Phan, A. K. Raychaudhuri, I. Das, and H. Srikanth, *Universality in the entropy change for the inverse magnetocaloric effect*, Phys. Rev. B **87**, 134420 (2013).

3. Sayan Chandra, Anis Biswas, Subarna Datta, **Barnali Ghosh**, A K Raychaudhuri and Hariharan Srikanth, *Inverse magnetocaloric and exchange bias effects in single crystalline $La_{0.5}Sr_{0.5}MnO_3$ nanowires*, Nanotechnology **24**, 505712 (2013).

4. Abhijit Maity, Gourab D Banik, Chiranjit Ghosh, Suman Som, Sujit Chaudhuri, Sunil B Daschakraborty, Shibendu Ghosh, **Barnali Ghosh**, Arup K Raychaudhuri and Manik Pradhan, *Residual gas analyzer mass spectrometry for human breath analysis: a new tool for the non-invasive diagnosis of Helicobacter pylori infection*, Journal of Breath Research, **8**, 016005 (2014).

5. Sudipta Goswami, Dipten Bhattacharya, Gail N. Iles, **Barnali Ghosh**, Anastasiia A. Prytuliak, Benoit Malard, Gopes C. Das, B. Ouladdiaf and T. Chatterji, *Anomaly in structural noncentrosymmetry around T_N in bulk and nanoscale $BiFeO_3$*, Powder Diffraction, **28** , No. S2 S94 (2013) DOI: http://dx.doi.org/10.1017/S0885715613001115

Supervision of Students

Ph.D. Students: Subarna Datta, Samik Roy Moulik

Post Doctoral Researchers

Nilotpal Ghosh (Research Associate under EVLP)

Lectures Delivered

1. Growth of complex oxide epitaxial films and nanowires by Pulsed Laser Deposition and tuning of physical properties controlling growth parameters, DAE-BRNS National Symposium on Pulsed laser Deposition on Thin Films and nanostructured Materials (PLD 2013), IIT Kharagpur, India,14-16 Nov, 2013

2. Effect of size reduction on structural and magnetic order of perovskite oxides: A neutron diffraction study, IISER Pune, India, 10-12 Feb, 2014

Academic Visits

Research Proposal No: 2013-IB-020, Accepted for Synchrotron Radiation Experiments at BL-18B, Indian Beamline, Photon Factory (PF), KEK, High Energy Accelerator research Organization, 1-1, Oho, Tsukuba-Shi, Ibaraki-ken, 305-0801, Japan., visit during 16-20 January 2014.

Courses Taught

PHY391

Participation in Committees

External: Member of Editorial Board/Referee: Referee of journals: Journal of Material Science and Engineering B, Journal of Applied Physics, and Solid State Communications;

Internal: Technical cell, and various purchase committees

Sponsored Projects

1. DST sponsored Project: SR/WOS-A/PS/2008

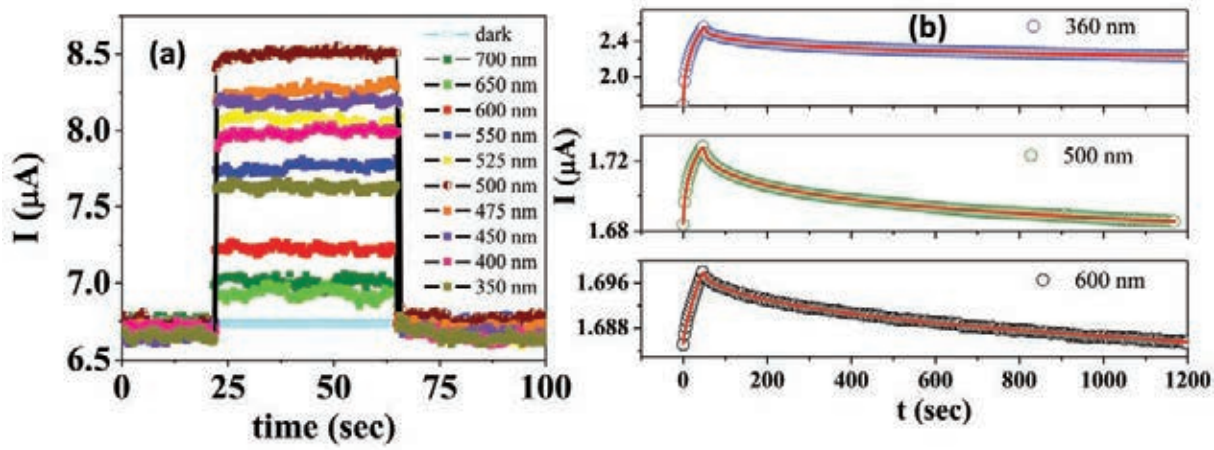


Fig. The time dependent photoresponse of WO_3 film (a) on SiO_2/Si showing distinct photocurrent ON/OFF states when illumination is turned on/off. Where as (b) on $SrTiO_3$ substrate shows persistent photocurrent (PPC) even in light off condition.

Chhayabrita Biswas

Bose Fellow

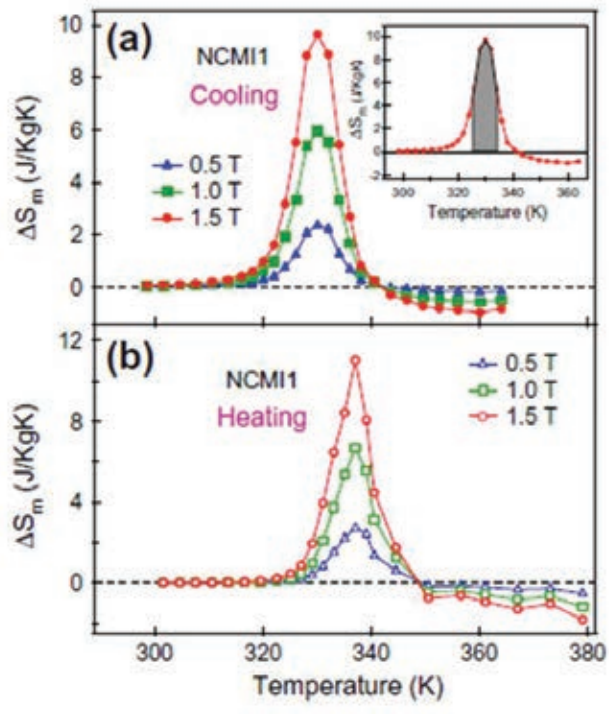
Department of
Condensed Matter Physics and Material Sciences

- Electronic structure investigation (Theoretical) of Ni-Mn-Z (Z=Sn, In) Heusler alloys with martensitic phase transition. The role of coulomb interaction in martensitic transition.
- The experimental investigation of disorder effect on large inverse magnetocaloric effect of Co doped Ni-Mn-In.
- The possible effect of spin-lattice coupling and crystal structure phase fraction on magnetic field induced shift of martensitic transition temperature.

For stoichiometric Ni_2MnSn GGA+U(Mn and Ni) functional works well. For off-stoichiometric Ni-Mn-Sn the GGA+U functional suppress the martensitic transformation. The GGA functional is reliable for calculation over GGA+U functional for off-stoichiometric Ni-Mn-Sn systems.

The large magnetic entropy change (ΔS_m=11 J/Kg K) at low magnetic field (1.5 Tesla) above room temperature in Ni–Co–Mn–In alloys is obtained. The atomic disorder enhances the peak value of ΔS_m while the refrigeration capacity (RC) is unaffected by it. Although peak value ΔS_m can be maximized by inducing more atomic disorder in the system, ΔT_{RC} of disordered system is quite low compared to ordered system. Thus the ordered and disordered system could be utilized for magnetic cooling depending on the requirement of wide temperature and high efficiency applications.

The magnetization behavior changes with the Mn-Mn distance in the martensitic phase of the off-stoichiometric Ni-Mn-Sn compositions that show shift in the martensitic transition. Even much below transition temperature the change in crystal structure phase fraction influences the magnetic property. For the off-stoichiometric Ni-Mn-Sn compositions without shift in martensitic transition, the crystal structure phase fraction remains constant and spin-lattice coupling is absent.



Publications in Journals

Sandeep Singh, Illya Glavatskyy, **C. Biswas**, *The influence of quench atomic disorder on the magnetocaloric properties of Ni–Co–Mn–In alloys*, Journal of Alloys and Compounds, **601**, 108–111 (2014).

Other Publications

Soumyadipta Pal, Sandeep Singh and C. Biswas, Magneto-structural coupling due to martensitic crystal structure evolution in $Ni_2Mn_{1+x}Sn_{1-x}$, "First users' meeting of the Indian Beamline at Photon Factory, KEK, Japan" 7th – 8th October 2013, Saha Institute of Nuclear Physics, Kolkata.

Supervision of Students

Ph.D. Students: Sandeep Singh, Soumyadipta Pal

Courses Taught

PHY 291: Basic Laboratory II 2nd Semester (January to May 2014)

Participation in Committees

Internal: Technical cell, Newsletter, Rajbhasha, Student Advisory Committee

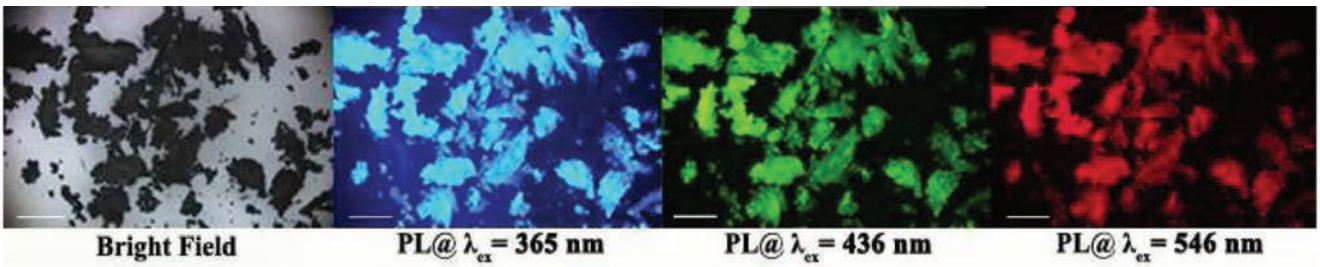
Kalyan Mandal

Professor

Department of
Condensed Matter Physics and Material Sciences

- Surface modification of iron-oxide nanoparticles, Magnetocaloric effect and magnetoresistance in Ni-Mn-Sn Heusler alloys, Defect identification in dilute magnetic semiconductors, Magnetic nanowires

We observed intrinsic multicolour fluorescence in various surface modified iron oxide nanoparticles as shown in Fig.1. Furthermore, we found excellent photocatalytic property of the functionalized nanoparticles in the decolouration of a model water contaminant. Proper investigation through UV–visible absorption and photoluminescence study along with theoretical support from literature reveals that ligand-to-metal charge transfer transition from tartrate ligand to lowest unoccupied energy level of Fe^{3+} of the NPs and d–d transitions centered over Fe^{3+} ions in the NPs play the key role in the generation of multiple fluorescence from the ligand functionalized nanoparticles. Magnetic behaviour of nanoparticles changed considerably after surface modification. We believe that the developed ferromagnetic, multicolour fluorescent nanopaticles would pioneer new opportunities towards diverse applications.



Surface modification also changes magnetic properties to a significant extent. Very high coercivity (0.7 T) was observed when Co-ferrite nanoparticles were coated with TX-100.

The magnetic and magnetocaloric properties of $Ni_{50}Mn_{36.5}Sn_{13.5}$ Heusler alloy has been studied by varying the duration of annealing (0, 6, 12, 18, and 24 h) at 1173 K. The atomic ordering increases, martensitic transition (MT) becomes sharper and exchange bias field increases with increasing annealing time. The sample annealed for 24 h has shown a large magnetic entropy change (ΔS_M) near its MT. But, the net refrigerant capacity at the MT of 12 h annealed sample is larger than the former one. We have discussed these results in the context of structural disorder and the ferro/antiferro correlations present in these alloy systems.

Publications in Journals

1. G. G. Khan, A. K. Singh and **K. Mandal**, *Structure dependent photoluminescence of nanoporous amorphous anodic aluminium oxide membranes: Role of F^+ center defects*, Journal of Luminescence, **134**, 772-777 (2013).

2. G. G. Khan, D. Sarkar, A. K. Singh and **K. Mandal**, *Enhanced band gap emission and ferromagnetism of Au nanoparticle decorated α-Fe_2O_3 nanowires due to surface plasmon and interfacial effects*, RSC Advances, **3**, 1722-1727 (2013).

3. S. Ghosh, G. G. Khan, S. Varma and **K. Mandal**, *Influence of Film Thickness and Oxygen Partial Pressure on Cation-Defect-Induced Intrinsic Ferromagnetic Behavior in Luminescent p-Type Na-Doped ZnO Thin Films*, ACS Applied Materials & Interfaces, **5**, 2455-2461 (2013).

4. S. Ghosh, G. G. Khan, **K. Mandal**, A. Samanta, and P. M. G. Nambissan, *Evolution of Vacancy-Type Defects, Phase Transition, and Intrinsic Ferromagnetism during Annealing of Nanocrystalline TiO_2 Studied by Positron Annihilation Spectroscopy*, Journal of Physical Chemistry C, **117**, 8458-8467 (2013).

5. A. K. Singh, D. Sarkar, G. G. Khan, **K. Mandal**, *Unique hydrogenated Ni/NiO core/shell 1D nano-heterostructures with superior electrochemical performance as supercapacitors*, Journal of Materials Chemistry A, **1**, 12759 – 12767 (2013).

6. S. Ghosh, G. G. Khan, A. Ghosh, S. Verma and **K. Mandal**, *Zinc vacancy-induced high-T_c ferromagnetism and photoluminescence in group-1 alkali-metal substituted p-type ZnO thin films*, Crystal Engineering Communications, **15** , 7748-7755 (2013).

7. D. Sarkar, G. G. Khan, A. K. Singh and **K. Mandal**, *High-Performance Pseudocapacitor Electrodes Based on α-Fe_2O_3/MnO_2 Core-Shell Nanowire Heterostructure Arrays*, Journal of Physical Chemistry C, **117**, 15523 – 15531 (2013).

8. A. Ghosh and **K. Mandal**, *Large inverse magnetocaloric effect in $Ni_{48.5-x}Co_xMn_{37}Sn_{14.5}$ (x=0, 1 and 2) with negligible hysteresis*, Journal of Alloys and Compounds, **579**, 295-299 (2013).

9. A. Ghosh and **K. Mandal**, *Large magnetic entropy change and magnetoresistance associated with a martensitic transition of Mn-rich $Mn_{50.5-x}Ni_{41}Sn_{8.5+x}$ alloys*, Journal of Physics D: Applied Physics, **46,** 435001 (2013).

10. A. Ghosh and **K. Mandal**, *Large magnetoresistance associated with large inverse magnetocaloric effect in Ni-Co-Mn-Sn alloys*, European Physical Journal B, **86,** 378 (2013).

11. R. Das, G. G. Khan, S. Varma, G. Dev Mukherjee and **K. Mandal**, *Effect of Quantum Confinement on Optical and Magnetic Properties of Pr–Cr-Codoped Bismuth Ferrite Nanowires*, Journal of Physical Chemistry C, **117**, 20209–20216 (2013).

12. D. Sarkar, M. Mandal, and **K. Mandal**, *Design and Synthesis of High Performance Multifunctional Ultrathin Hematite Nanoribbons*, ACS Applied Materials and Interfaces, **5**, 11995–12004 (2013).

Other Publications

1. A. Ghosh and K. Mandal, "Tuning of magnetocaloric potential in disordered Ni-Mn-Sn alloy" Proceedings of International Conference on Magnetic Materials and Applications (MagMA-2013), 05-07 December 2013, Department of Physics, Indian Institute of Technology, Guwahati, India.

2. M. Pal, R. Rakshit and K. Mandal, "Surface modification of $MnFe_2O_4$ Nanoparticles to Develop Magnetofluorescent Imaging Probe and Efficient Photocatalyst". Proceedings of 3rd International Conference on Advanced Nanomaterials and Nanotechnology,(ICANN 2013), December 1-3 at IIT Guwahati, India.

3. M. Pal, R. Rakshit and K. Mandal, "Surface Modification of $MnFe_2O_4$ Nanoparticles to Impart Novel Optical and Catalytic Properties", Proceedings of the International Union of Materials Research Societies – International Conference in Asia – 2013 (IUMRS-ICA-2013) , held during December 16-20, 2013 at IISC Bangalore, India.

4. M. Pal, R. Rakshit and K. Mandal, "Surface Modification of Manganese-ferrite Nanoparticles to Impart intrinsic fluorescence and Catalytic Properties", Proceedings of the International Conference on Nano Science and Technology (ICONSAT-2014), held from March 2-5, 2014, in Mohali, India.

5. R. Rakshit, M. Mandal, M. Pal and K. Mandal, "Microscopic origin behind the large tuned ferromagnetism of micelle capped $CoFe_2O_4$ nanoparticles" Proceedings of Proceedings of 3rd International Conference on Advanced Nanomaterials and Nanotechnology,(ICANN 2013), December 1-3 at IIT Guwahati, India.

6. R. Rakshit, M. Mandal, M. Pal and K. Mandal, "Rational surface modification of $CoFe_2O_4$ nanoparticles: tuning of ferrimagnetism & its application as data storage

devices", Proceedings of the International Conference on Nano Science and Technology (ICONSAT-2014), held from March 2-5, 2014, in Mohali, India.

7. Ashutosh K. Singh, Debasish Sarkar, Gobinda Gopal Khan, and Kalyan Mandal, "Nickel oxide based nano-heterostructures as high performance supercapacitor electrodes", Proceedings of the International Conference on Nano Science and Technology (ICONSAT-2014), held from March 2-5, 2014, in Mohali, India.

Supervision of Students

Ph.D. Students: Ph.D. degree received: Arka Chaudhuri; Ph.D. thesis submitted: Shyamsundar Ghosh, Debasish Sarkar, Rajasree Das, Debabrata Pal; Present students working for Ph.D. Arup Ghosh, Ashutosh Singh, Rupali Rakshit and Monalisa Pal;

Project Students: Summer student: Archana: "Effect of A-site doping on magnetic properties of Bismuth ferrite"

Post Doctoral Researchers

Madhuri Mandal

Lectures Delivered

1. K. Mandal, "Nanostructured iron oxides" at Osaka University, Osaka, Japan, on 16 May 2013
2. K. Mandal, "Fe_3O_4 Nanocavities at THz frequency" at Osaka University, Osaka, Japan, on 28 June 2013

Academic Visits

Osaka University, Osaka, Japan, April-July 2013

Courses Taught

1. PHY 291 – Basic Laboratory-II for IPHD programme, 2nd semester
2. PHY 391 – Advanced Laboratory for IPHD programme, 3rd semester
3. PHY 409 – Magnetism and Superconductivity for IPHD programme, 4th semester
4. PHY 601 – Advanced Condensed Matter Physics for PHD programme, 6th semester
5. PHY 501 – Research Methodology for PHD programme, 5th semester

Participation In Committees

External: Executive Committee member, Magnetics Society of India; Ph.D. thesis examiner, Jadavpur University, Calcutta University;

Internal: Chairman, VASP Committee; Member, SCRE Committee; Member, Syllabus review committee; Member Building Committee; Member, PMA Committee; Chairman, Students Admission Committee

Awards / Recognitions

Received "Visiting Professorship" from Osaka University, Japan

Sponsored Projects

1. "Study of magnetocaloric effect" – DRDO sponsored

Meetings Organized

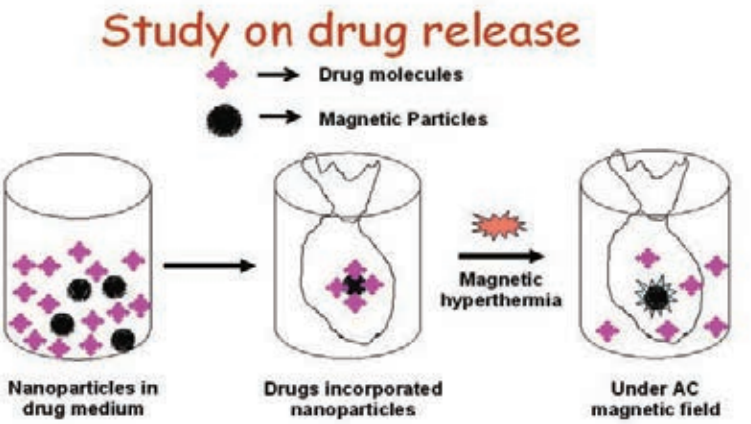
"Associates' Day-2013" on 20 December 2013 at SNBNCBS, Kolkata

Madhuri Mandal

Visiting Faculty Fellow

Department of
Condensed Matter Physics and Material Sciences

- Synthesis, characterization and engineering of magnetic nanoparticles for Hyperthermia, drug release, biosensor etc. Hollow sphere, DNA directed chain like, micelles mediated nanoparticles have been synthesized and analyzed. These analyses show some promising results which give an idea of applicability of these materials in the field of hyperthermia, drug release etc.



Delivering drugs into human body is an extremely important task and also an important field of research. It is very important to deliver the drug in the affected area only without hampering the other body parts and to make the medicine sustained release so that most of it can be utilized purposefully. It is already known that under AC magnetic field, magnetic particles become heated. This heat release depends on magnetic properties of the particles. We have exploited this property to release the drug in a control manner. As the organic molecules attached with magnetic particles can change the magnetic properties, our expectation is that drug release efficiency can be changed by these magnetic particles under magnetic fields. That study is going on. Another advantage is that magnetic particles with attached drug molecules can be sent to a specific region by directing magnetic field towards a fixed direction.

Publications in Journals

1. R Rakshit, **M Mandal**, M Pal, K Mandal, *Tuning of magnetic properties of $CoFe_2O_4$ nanoparticles through charge transfer effect*, Applied Physics Letters, **104**(9), 092412 (2014).

2. B Das, D Sarkar, **M Mandal**, P Das, K Mandal, *DNA Engineered Tri-Functional Ni–Au Nano-Chain: Understanding of Its Formation and Novel Magnetic Properties*, Journal of Nanoscience and Nanotechnology, **14**(3), 2599-2605 (2014).

3. B Das, **M Mandal**, K Mandal, P Sen, *Influence of alumina membrane on magnetic properties for thermally annealed CoPt alloy nanowires*, Colloids and Surfaces A: Physicochemical and Engineering Aspects, **443**, 398-403 (2014).
4. D Sarkar, K Mandal, **M Mandal**, *Detail Study on ac–dc Magnetic and Dye Absorption Properties of Fe_3O_4 Hollow Spheres for Biological and Industrial Application*, Journal of Nanoscience and Nanotechnology, **14**(3), 2307-2316 (2014).
5. D Sarkar, **M Mandal**, K Mandal, *Design and Synthesis of High Performance Multifunctional Ultrathin Hematite Nanoribbons*, ACS applied materials & interfaces, **5** (22), 11995-12004 (2013).

Other Publications

1. M. Mandal, DNA directed chainlike magnetic nanoparticles, CTBBM-2013, SNBNCBS, Kolkata.
2. M. Mandal, Synthesis of Magnetite (Fe_3O_4) Hollow Spheres for Hyperthermia Therapy in Cancer Treatment, WCC-2013, ISI, Kolkata.

Supervision of Students

Ph.D. Students: Debasish Sarkar (submitted his thesis);
Project Students: Deblina Majumder

Lectures Delivered

1. DNA directed chainlike magnetic nanoparticles, CTBBM-2013, SNBNCBS, Kolkata
2. Synthesis of Magnetite (Fe_3O_4) Hollow Spheres for Hyperthermia Therapy in Cancer Treatment, WCC-2013, ISI, Kolkata

Courses Taught

PHY 391, Experimental methods in Physics, 3rd Semester

Participation In Committees

External: Magnetic Society of India, Life member

Sponsored Projects

1. Preparation of magnetic nanoparticles and proper biofunctionalization for their use in drug delivery and release, DST, New Delhi

Manoranjan Kumar

Assistant Professor

Department of
Condensed Matter Physics and Material Sciences

- My broad area of current research interest includes study of electronic properties of low dimensional materials and quantum phase transitions in various systems

1. Twisted ladder spin systems like $Ba_3Cu_3In_4O_{12}$ and $Ba_3Cu_3Sc_4O_{12}$ are very interesting compound it shows ferromagnetic behavior at high temperature and three magnetic dimensional ordering at low temperature. We show that a microscopic 1D model of the paramagnetic (PM) phase combined with a phenomenological model based on sublattice magnetization describes the observed temperature and field dependent magnetism. The model identifies AFM, spin-flop (SF) and PM phases whose boundaries have sharp features in the experimental magnetization M(T,H) and specific heat CP(T,H). Exact diagonalization (ED) of the 1D model, possible for 24 spins due to special structural features of half-twist ladders, yields the magnetization and spin susceptibility of the PM phase.

2. The quantum phases of one-dimensional spin s = 1/2 chains for models with two parameters, frustrating exchange g = J2 > 0 between second neighbors and normalized non-frustrating power-law exchange with exponent and distance dependence r^{-a} is studied. it is shown that with increasing the next nearest neighbor interaction system goes from spin liquid to decoupled phase mediated by bond order phase in small a limit where as in large a limit it goes from long range to order wave phase and finally it leads to decoupled phase.

3. We have shown that three different models are frustrated spin−1/2 chains with variable range exchange, half-filled Hubbard models with spin-independent interactions and modified Hubbard models with site energies for describing organic charge transfer salts have dimer or bond order wave phase. We have also shown that excitation energies crossover can used to determine the boundary.

Publications in Journals

1. **Manoranjan Kumar**, S. E. Dutton, R. J. Cava and Z. G. Soos, *Spin-flop and antiferromagnetic phases of the ferromagnetic half-twist ladder compounds $Ba_3Cu_3In_4O_{12}$ and $Ba_3Cu_3Sc_4O_{12}$*, J. Phys.: Condens. Matter, **25**, 136004 (2013).

2. **Manoranjan Kumar** and Z. G. Soos, *Decoupled phase of frustrated spin-1/2 antiferromagnetic chains with and without long-range order in the ground state*, Phys. Rev. B **88**, 134412 (2013).

3. **Manoranjan Kumar**, S. Ramasesha, Zoltán G. Soos, *Quantum Phase Diagram of One-Dimensional Spin and Hubbard Models with Transitions to Bond Order Wave Phases*, Croat. Chem. Acta, **86** (4), 407 (2013).

Supervision of Students

Ph.D. Students: Aslam Parvej, Hrishit Benerjee (in collaboration with Prof. Tanusri Saha das gupta.), Jagbandhu Kumar, Rakesh Das;

Project Students: Vibhuti narayan Rai (2 semesters), Vibhuti narayan Rai (summer project), Adyasha Aparimita (summer Project)

Lectures Delivered

1. Invited talk in Workshop on Numerical Many Body Methods in Quantum Chemistry and Physics at Coorg.

2. Invited talk in Workshop on Computational Nanoscience under the aegis of the Thematic Unit of Excellence (TUE) in Computational Materials Science, IISc Bangalore.

3. Attend the School and Discussion Meeting on 'Strongly Correlated Systems: From Models to Materials' organised by ICTS Bangalore.

4. Invite talk in workshop for Physics and Chemistry of Materials: Computation and Experiments" (PCMCE-2014), to be held at the S. N. Bose National Centre for Basic Sciences, Kolkata

Academic Visits

IISc Bangalore for a week

Courses Taught

PHY302 Condensed Matter Physics

Participation in Committees

Internal: Computer centre in-charge, members of various selection committees.

Awards / Recognitions

Ramanujan Fellowship

Sponsored Projects

1. Ramanujan fellowship, DST

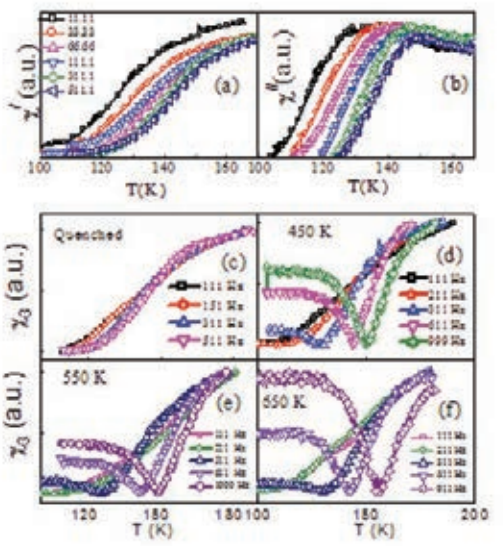
Pratip Kumar Mukhopadhyay
Professor & Head

Department of
Condensed Matter Physics and Material Sciences

- Magnetism is the key aspect that bonds our interest in two diverse fields – in regular solids and in soft materials. This year magnetocaloric effects and magnetorheological effects were studied thoroughly. Band structures calculations were used to explain the data from our own measurements of our own magnetic alloy samples

As stated before, various magnetic materials, in solid or soft form were investigated during this time period. These are summarized as follows –

In the ferromagnetic shape memory alloys, we continued to systematically study the effect of addition of Al and other atoms in a regular Heusler alloy, on the structural and magnetic properties, including magnetocaloric effect. A particularly interesting aspect was to study the spin glass transition effect in these systems inside the martensitic phases. These were studied through non linear susceptibilities. The following graph is the illustrate the findings –



A lot of work on magnetorheological fluids has been carried out. Preparation of various magnetic alloy nano particles and their characterizations continued from the previous year. Various carrier fluids were used to disperse them and the resulting magnetorheological properties were measured. Since this particular measurement is still not available in our centre, we had to spend a lot of time to visit various laboratories in and out of Kolkata for measurements.

We also obtained a project from DRDO for using personal defence material for military and the like. It is to harness the use of the smart materials for offering better protection. The work is in progress and a proof will be arranged in PXE soon.

In the case of the oldest interest of binary alloys, we were busy in consolidating the data and putting them in papers. We found many interesting and novel behavior in these. This work is in progress.

Publications in Journals

1. K. Srinivasarao, G. Srinivasarao, K. V. Madhuri, K. Krishna Murthy, and **P. K. Mukhopadhyay**, *Preparation and Characterization of R.F. Magnetron Sputtered Mo:ZnO Thin Films*, Indian Journal of Materials Science, **2013**, Article ID 684730, 7 pages (2013).

2. Sandeep Agarwal, S. Banerjee, and **P. K. Mukhopadhyay**, *Crossover of spin glass characteristics as a function of field in an NiMnSnAl alloy*, Journal of Applied Physics, **114**, 133904 (2013).

3. Tanmoy Ghosh, Shreemoyee Ganguly, **P. K. Mukhopadhyay**, Abhijit Mookerjee, *Electronic and magnetic properties of disordered AuCr alloys: A first-principles study*, Journal of Magnetism and Magnetic Materials, **332**, 199–204 (2013).

4. Injamamul Arief, **P. K. Mukhopadhyay**, *Fabrication and viscoelastic properties of pvc coated magnetite agglomerates in magneto-rheological suspension*, Magnetohydrodynamics **49**, No. 3-4, pp. 479–483 (2013).

5. **P. K. Mukhopadhyay**, Madhuparna Karmakar, B. RajiniKanth, S. N. Kaul, *Experimental and theoretical investigations of the stress-induced twinning / detwinning in the martensite phase of a FSMA system*, Journal of Alloys and Compounds, **577S**, S119–S122 (2013).

6. Injamamul Arief and **P.K. Mukhopadhyay**, *Synthesis of dimorphic MR fluid containing NiCo nanoflowers by the polymer assisted polyol method and study of its magnetorheological properties*, Physica B: Condensed Matter, **448**, 73 – 76 (2014).

7. **P. K. Mukhopadhyay**, Tanmoy Ghosh, Abhijit Mookerjee, *Interesting magnetic behavior of Fe:Al disordered alloys*, Physica B: Condensed Matter, **448**, 226 (2014).

8. Tanmoy Ghosh, Ambika Prasad Jena, Biplab Sanyal, Hirosuke Sonomura, Takashi Fukuda, Tomoyuki Kakeshita, **P. K. Mukhopadhyay**, Abhijit Mookerjee, *Effect of short range ordering on the magnetism in disordered Fe:Al alloy*, Journal of Alloys and Compounds, **613**, 306 (2014).

Other Publications

1. Spin Glass Behavior of Martensitic Phase in Ni50Mn34Sn8Al8 Ferromagnetic Shape Memory Alloy -Sandeep Agarwal and P. K. Mukhopadhyay, ICFSMA '13, June 2013, USA

2. Anomalous peak of magnetic origin in the martensitic phase in $Ni_{50}Mn_{34}Sn_{10}Al_6$ Ferromagnetic shape memory alloy - Sandeep Agarwal, S. Banerjee and P. K. Mukhopadhyay; ICMAGMA '13, IIT/Guwahati, December 2013

3. Magnetorheological studies of dimorphic MR fluid containing NiCo nanoflowers synthesized by amphiphilic polymer-assisted polyol method - Injamamul Arief, P. K. Mukhopadhyay; ICMAGMA '13, IIT/Guwahati, December 2013

4. Study of elastic properties at different stress levels on CoNiAl Ferromagentic Shapememory Alloy near the Martensitic Transformation Temperature - B. Rajini Kanth and, P. K. Mukhopadhyay, ICFSMA '13, USA

5. Magnetic Field Induced Strain in CoNiAl Ferromagnetic Shapememory Alloy using Strain Gauge - B. Rajini Kanth and P.K. Mukhopadhyay, ICFSMA '13, USA

6. Magnetic Field Effect on CoNiAl Ferromagnetic Shape memory Alloy in the vicinity of Martensitc Transformation Temperature - B. Rajini Kanth and P. K. Mukhopadhyay, ICFSMA '13, USA

7. Discovery of Photo Induced Mechanical Actuation in "NON LIVING" Matter -Tejas Rathod, P. K. Mukhopadhyay, Special Display, ICFSMA '13, USA

8. N. Dutta, S. K. Bandyopadhyay, P. Sen, A. K. Himanshu, P. Y. Naviraj, R. Menon, P. K. Mukhopadhyay, and P. Ray, A simple novel method of developing BFO nanostructures, AIP Conference Proceedings, 1512, 234 (2013).

9. Sandeep Agarwal and P. K. Mukhopadhyay, Role of replacement of Sb with Al in the phase transformation of Ni-Mn-Sb alloys, AIP Conference Proceedings, 1536, 977 (2013).

Supervision of Students

Ph.D. Students: Sandeep Agarwal, Tanmoy Ghosh, Md. Injamaul Arief;

Project Students: Dipanjan Samanta – Project

Post Doctoral Researchers

Visiting associate: Dr. B. Rajinikanth, TKR College, Hyderabad

Lectures Delivered

1. Interesting magnetic behavior of Fe:Al disordered alloys – P. K. Mukhopadhyay, Tanmoy Ghosh, Abhijit Mookerjee, ICMAGMA 2013, IIT/Guwahati

2. CMDays, NIT Rourkela, August 2013

3. Experiments with some Magnetorheological fluids - RDMMTF 13, May 2013, UGC DEAF Indore

Courses Taught

Part A, Phy 501, Error Analysis, SNBNCBS (Fall 2013)

Participation In Committees

External: Member, governing body, Magnetic Society of India; Member, governing council, Indian Physical Society; Founder member, ICFSMA World conference series; **Internal:** Convenor, Project Cell; Incharge, Mechanical Workshop; Convenor, Technical Committee; Convenor, liquid helium plant committee; Convenor and chairman, NPEP, EVLP; Convenor, G+7 users committee; Member of various thesis committees, purchase committees, SCRE committee, CAC, AC and BoS for CU-IPh.D. course, APMP, DPSC, three member committee etc

Awards / Recognitions

1. Referee for various journals, national and international
2. Referee for a project, DST/SERB
3. Ph.D. examiner for a student in Sambalpur University, another in National University in Singapore
4. Chairman for a session in 'National Workshop on "Application of Radiation in Physical, Chemical and Life Sciences", UGC-DAEF/Kolkata Centre and CU, September 2013
5. External expert for PDF intake, IACS, October 2013.

Sponsored Projects

1. Development of synthetic body armour based on smart fluids

Priya Mahadevan

Professor

Department of
Condensed Matter Physics and Material Sciences

- Band gap transitions in layered semiconductors
- Orbital ordering induced ferroelectricity
- B diffusion in MgO and its role in TMR
- Optical properties of Mn doped quantum dots
- Growth of quantum dots
- Mechanism of magnetism in a slater insulator

A major challenge in the search for multiferroic materials among the transition metal compounds has been that ferroelectricity is primarily found in d0 materials while magnetism is found in dn systems. Considering a well-known ferroelectric oxide - $BaTiO_3$, the question we asked within a theoretical study, was whether ferroelectric distortions disappeared for the slightest amount of doping. Surprisingly, in the case of V doped $BaTiO_3$, ferroelectricity was found to be stronger than in the undoped limit. Another surprise was that, the presence of charged impurities rather than free carriers were found to be most detrimental to the presence of ferroelectric distortions. These ideas of the low doping limit were used to design new multiferroics. This appeared in Phys. Rev. B 2013 87, 214110.

In another paper using density functional theory calculations, ultrathin films of $SrVO_3(d^1)$ and $SrCrO_3(d^2)$ on $SrTiO_3$ substrates have been studied as possible multiferroics. Although both are metallic in the bulk limit, they are found to be insulating as a result of orbital ordering driven by lattice distortions at the ultrathin limit. While the distortions in $SrVO_3$ have a first-order Jahn-Teller origin, those in $SrCrO_3$ are ferroelectric in nature. This route to ferroelectricity (FE) results in polarizations comparable with conventional ferroelectrics. This has appeared in Phys. Rev. Lett. 2013 111, 077601

Publications in Journals

1. S. Middey, S. Debnath, **Priya Mahadevan** and D.D. Sarma, *$NaOsO_3$: A high Neel temperature 5d oxide*, Phys. Rev. B, **89**, 134416 (2014).
2. H.K. Chandra and **Priya Mahadevan**, *Boron diffusion in MgO and emergence of magnetic ground states: A first-principles study*, Phys. Rev. B, **89**, 144412 (2014).
3. Ruma Das, Bipul Rakshit, Saikat Debnath and **Priya Mahadevan**, *Microscopic model for the strain-driven direct to indirect band-gap transition in monolayer MoS_2 and ZnO*, Phys. Rev. B, **89**, 115201 (2014).
4. S. Debnath, R. Cherian and **Priya Mahadevan**, *The role of Passivants on the Stoichiometry of CdSe and GaAs Nanocrystals*, J. Phys. Chem. C, **117**, 21981 (2013).
5. Kapil Gupta, **Priya Mahadevan**, Phivos Mavropoulos, Marjana Lezaic,*Orbital-ordering-induced ferroelectricity in $SrCrO_3$*, Phys. Rev. Lett., **111**, 077601 (2013).

6. A. Hazarika, A. Layek, S. De, A. Nag, S. Debnath, **Priya Mahadevan**, A. Chowdhury and D.D. Sarma, *Ultranarrow and widely tunable Mn^{2+} -Induced Photoluminescence from Single Mn-Doped Nanocrystals of ZnS-CdS Alloys*, Phys. Rev. Lett., **110**, 267401 (2013).

7. Hirak Kumar Chandra, Kapil Gupta, Ashis Kumar Nandy and **Priya Mahadevan**, *Ferroelectric distortions in doped ferroelectrics: $BaTiO_3$:M (M=V-Fe)*, Phys. Rev. B, **87**, 214110 (2013).

8. Bipul Rakshit and **Priya Mahadevan**, *Indirect to direct bandgap transition under uniaxial strain in layered ZnO*, Appl. Phys. Lett., **102**, 143116 (2013).

Supervision of Students

Ph.D. Students: Saikat Debnath, Ruma Das, Shishir Kumar Pandey, Basudeb Mandal, Sagar Sarkar, Poonam Kumari; **Project Students:** Arkadev Chaudhuri

Post Doctoral Researchers

Bipul Rakshit, V. Ravi Kishore

Lectures Delivered

1. Invited talk at Physics of Advanced Optical Materials and Photonics, Vidyasagar University, March 2014
2. Invited talk at DST Inspire Camp at Sacred Heart College, Kochi, January 2014
3. Invited talk at Total Energy Workshop, Lausanne, January 2014
4. Invited talk on Novel Oxide Materials and Low-dimensional systems, IISc Bangalore, December 2013
5. Invited talk at Numerical Many Body Methods in Quantum Chemistry and Physics, Orange County, December 2013
6. Talk at Department of Physics, IISER Pune, Pune, October 2013
7. DAE Raja Ramanna prize lecture at JNCASR, Bangalore, September 2013
8. Invited Talk at Workshop on Computational Nanoscience, Indian Institute of Science, Bangalore, August 2013
9. Lectures at National Metallurgical Laborarory, Jamshedpur, February 2014
10. Talk at IISER Kolkata, Mohanpur, February 2014

Academic Visits

1. DST-DAAD project IFF Forchungzentrum Julich June 2013
2. Indo-US project IISc Bangalore January 2014

Courses Taught

PH301 Quantum Mechanics August-Dec 2013

Participation in Committees

Internal: Various thesis committees of students of the centre

Awards / Recognitions

1. Elected fellow Indian Academy of Sciences
2. DAE Raja Ramanna prize lecture in physics

Sponsored Projects

1. DST Nanomission (2011-2014)
2. DST-DAAD (2012 – 2014)
3. IndoUS-STF (2012 – 2015)

Prosenjit Singha Deo

Professor

Department of
Condensed Matter Physics and Material Sciences

- Mesoscopic transport phenomenon, electronic states in mesoscopic systems, correlation effects in mesoscopic systems, magnetization of mesoscopic rings etc.

Spontaneous symmetry breaking in quantum systems is still not understood fully. Recently we have submitted a paper where we have found an analytical way to address the open issues. The basic question is whether a quantum system can at all exhibit spontaneous symmetry breaking? There is a popular way of stating the problem and the statement says that if nuclear orbitals can be deformed why the atomic orbitals cannot be deformed. Earlier several people have tried to address the problem numerically but such a theoretical issue cannot be addressed numerically. Our work addresses the problem analytically and from first principles.

In quantum mechanics evanescent modes have always fascinated physicists as they have no classical analogues. Several issues like time taken by a quantum particle to tunnel through a barrier, what is the current carried by an evanescent state, etc are still open issues. Most theoretical attempts so far are limited to ideal one dimensional systems which makes it difficult to test the results experimentally. There are many technical and conceptual challenges in going from the ideal one dimensional systems to realistic quasi one dimensional systems. We have overcome these challenges and formalized the problem in quasi one dimension. And we have found a huge potential of using such evanescent states to build stable quantum devices as such states can be controlled unlike the propagating states.

Supervision of Students

Ph.D. Students: S. Mukherjee, U. Satpathy, D. Sao

Lectures Delivered

1. Poster presented at ICONSAT in Chandigarh, March 2 to 5, 2014

Courses Taught

Post B.Sc. condensed matter course – 3rd semester – phy302

Ranjan Chaudhury

Associate Professor

Department of
Condensed Matter Physics and Material Sciences

- A detailed theoretical investigation of the possibility of a crossover from magnon-like collective excitations to topological excitations of vortex or meron type in 2d anisotropic quantum Heisenberg ferromagnetic spin model has been carried out in collaboration with Dr. S.K. Paul (SNBS) and S. Sarkar (our Ph.D. student at SNBS) .
- Cooper's pairing instability and its possible role in the emergence of superconductivity in quasi-1d systems have been probed theoretically quite rigorously in collaboration with S. Roy Chowdhury (my Ph.D. student at SNBS).
- My earlier proposed quantum spin model for theoretical analysis of tautomeric mutation of DNA, has been shown by me to completely contain the bosonic model suggested by Professor V. Golo and his group (Moscow State University, Russia).
- A synthesis between the conventional phenomenological and microscopic theories with marginal fermi liquid model has been achieved for type-II superconductors in collaboration with Poonam Bhincher (my summer student at SNBS and M.Sc. student at Delhi University).

(i) The phenomenological evidence for the existence of vortices (merons) and occurrence of Berezinskii- Kosterlitz-Thouless- like transition in layered XY-anisotropic Heisenberg ferromagnet with spin 1/2 and our earlier works on construction of quantum vortices and anti-vortices, motivated us to examine the consequences for the conventional collective spin excitations like magnons in such systems. We have been able to construct quantum vortex (and anti-vortex) states as a linear combination of multi-magnon composite states and show mathematically that these topological excitations are stable quantum mechanically in the thermodynamic limit. This result is expected to play a very important role in the understanding of the detailed magnetic correlations and other thermodynamic properties in the vicinity of the Berezinskii-Kosterlitz-Thouless transition temperature. Further work is in progress.

This work was done in collaboration with S.K. Paul (SNBS) and S. Sarkar (SNBS).

(ii) Our earlier work on Cooper pair formation on 1d lattice , mediated by electronic mechanism of the charge transfer exciton type, has been made use of in investigation of the superconducting phase of the quasi-1d systems. Assuming a combination of s-wave and d-wave pairing, the occurrence of superconductivity is found to be ensured upto a filling factor of about 3/4. The coherence length is found to be in the intermediate regime between momentum-space and real-space pairing even for weak to moderate attractive coupling. The results are consistent with experimental observations from some of the organic superconductors.

This work has been carried out in collaboration with S. Roy Chowdhury (SNBS).

(iii) My earlier proposed quantum spin model of the transverse Ising model type with spin and pseudo-spin degrees of freedom, was used to relate tautomeric mutation rate and the compensation rate in a double-stranded DNA molecule. There was another parallel approach based on the bosonic model, put forward by V.Golo and collaborators (Moscow State University), to describe the propagation of mutation along a

strand. Making use of well known mathematical transformations, I have been able to bosonize my spin model and show that the model suggested by Golo et al appears as the lowest order contributions in the bosonized version of my model which contains many other terms (processes) as well.

(iv) As an extension of my earlier work on the synthesis of marginal fermi liquid model with the conventional phenomenological theories for type I superconductors, we tried out a similar synthesis for type II superconducting systems which are technologically very useful and include the high temperature superconducting cuprates. Our calculational results for the temperature dependences of the upper and lower critical fields are in very good agreement with the experimental observations from $La_{1.85}Sr_{0.15}CuO_4$.

This work has been done in collaboration with P. Bhincher (Delhi University/SNBS).

Publications in Journals

1. **Ranjan Chaudhury** and Samir K. Paul, *Topological Excitations in Quantum Spin Systems*, Advances in Condensed Matter Physics, **2013,** ID 783420 (2013).

2. R. Konno, N. Hatayama and **R. Chaudhury**, *The Pressure Coefficients of the Superconducting Order Parameters at the Ground State of Ferromagnetic Superconductors*, Jour. of Low Temp. Physics, **175**, 508 (2014).

Other Publications

1. Timothy Chibueze and Ranjan Chaudhury "Synthesis of the Conventional Phenomenological Theories of Superconductivity with Marginal Fermi Liquid Model" Cond. Mat. Arxiv. 2013 1308.2870v1

2. Soumi Roychowdhury and Ranjan Chaudhury, "Can Excitonic Mechanism Contribute Significantly to Superconducting Pairing in Quasi-1D systems?" arXiv: 1305.1504v1 (2013).

Supervision of Students

Ph.D. Students: Soumi Roy Chowdhury (SRF), Subhojit Sarkar (SRF), Ankita Chakrabarty (JRF; left in August 2013);

Project Students: Poonam Bhincher (Summer Project student from Delhi University) during May-July, 2013.

Courses Taught

1. PHY 501 Research Methodology (Departmental part corresponding to condensed matter physics, containing linear response theory, correlation functions, Green functions, weakly and strongly interacting electronic systems, Fermi liquid theory and Wigner solid) Fall Semester

2. PHY 601 Advanced Condensed Matter Physics (Magnetism and Superconductivity with excitations in solids) Spring Semester

3. PHY 409 Magnetism and Superconductivity Spring Semester

Participation in Committees

Internal: Member (Secretary) of Finance Committee of SNBS, Member of ARPAC of SNBS etc. till 29th August 2013, Officiated as Acting Registrar of SNBS till 29th August 2013, Chairman of PF Trustee Board of SNBS till 29th August 2013, Member of CAC, EVLP management committee, Medical committee etc. till 29th August 2013.

Soumendu Datta

INSPIRE Faculty

Department of
Condensed Matter Physics and Material Sciences

- Electronic structure calculations of alloyed/pure transition metal nano clusters, endohedral clusterfullerenes. Also investivating layered perovskite oxides and semiconductor heterostructured monolayers as materials for hydrogen production by photocatalytic water splitting

Several bimetallic nano alloyed clusters, consisting of isoelectronic elements, such as PtNi, PdNi, AuAg systems have shown enhanced properties from application viewpoint compared to those of the pure clusters of component elements. There is, therefore, a need for providing microscopic understanding of the structural, electronic and magnetic properties of alloy clusters, when two components from a same column, but different rows of the periodic table are mixed. To achieve an understanding on these issues of bimetallic alloy clusters having atoms of two isoelectronic elements, we performed a comparative study on the structural, electronic and magnetic properties of the Mn_mTc_n , $Mn_m Re_n$ and $Ti_m Zr_n$ alloy clusters with $m+n$ = 13. The Mn_mTc_n and Mn_mRe_n alloy systems form isoelectronic alloy series with electronic configuration $ns2(n-1)d5$, [n = 4 (Mn), 5 (Tc)and 6 (Re)]. On the other hand, $Ti_m Zr_n$ systems form isoelectronic alloy series with electronic configuration *ns2(n -1)d2 , n = 4 (Ti), 5 (Zr)*. The constituents Mn, Tc and Re are late transition metal atoms with half filled *d* shells, while Ti and Zr are early transition metal atoms. In case of Mn_mTc_n , $Mn_m Re_n$ alloy systems, the Mn rich alloy clusters are found to prefer compact icosahedra (ICO) structures and isoelectronic Tc rich or Re rich alloy clusters are found to adapt open hexagonal bilayer (HBL) structures. In contrast, $Ti_m Zr_n$ clusters are all found to stabilize in compact icosahedral structures, irrespective of being Ti-rich or Zr-rich. We found that this change in behavior of stable structural patterns between the two isoelectronic series, is found to be driven by the differences in hybridization effects, due to the differences in evolution of the relative energy positions of the *d* level with respect to *s* and *p* levels upon moving from 3*d* to 4*d* or 5*d* element. This effect further competes with the magnetization effect to decide the overall morphology of the alloy clusters.

An interesting point about the Mn_mTc_n alloyed clusters, is that they show a strong mixing tendency with the cluster of the maximum stability having nearly 50:50 composition. Moreover, the average bondlengths of the alloy clusters, show roughly a linear variation between the average bond lengths of the two pure clusters, in spite of the structural changes from ICO to HBL structures along the concentration variation. Our microscopic analysis reveals that a smooth and continuous interplay between *s-d* hybridization and magnetization effects as shown in the figure, is operative behind such Vegard's law like variation of average bond lengths. Note, such analysis will also be interesting for a broad class of binary transition metal clusters, where bond lengths show a Vegard's law type variation.

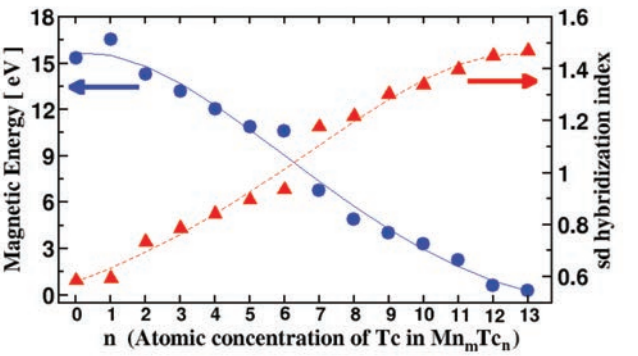


Fig. Variation of magnetic energy and hybridization index of the Mn_mTc_n clusters with the Tc atoms concentrations

Publications in Journals

1. **Soumendu Datta** and Tanusri Saha-Dasgupta, *Structural, electronic and magnetic properties of transition metal binary alloy clusters with isoelectronic components: case study with Mn_mTc_n, Ti_mZr_n and Mn_mRe_n*, J. Phys.: Condens. Matter, **25**, 225302 (2013).

2. Radhashyam Banerjee, **Soumendu Datta**, Abhijit Mookerjee, *Structure, reactivity and electronic properties of Mn doped Ni_{13} clusters*, Physica B, **419**, 86 (2013).

3. **S. Datta** and T. Saha-Dasgupta, *Vegard's law-like behavior for Mn_mTc_n alloy clusters: A first-principles prediction*, J. Phys. : Condensed Matter; **26**, 185004 (2014).

Supervision of Students

Project Students: Mr. Shakti Shankar Ray from Indian School of Mines, Dhanbad is currently doing his summer project with me.

Lectures Delivered

Gave a lecture at a conference on "Theory of Atomic and Molecular Clusters VII"; University of Birmingham, UK; Sept. 15-20, 2013.

Courses Taught

Took a semester course titled "Computational methods in Physics" for the first semester IPhD course (PHY 104)

Participation in Committees

Internal: Included in an interview committee for admission'2013 of IPhD/PhD students. Participated in preparing question paper and grading answer sheets of Bose Test'13.

External: Worked as referee for reviewing three research articles – each for Physics E, J. Molecular Phys. And J. Mag. Mag. Material.

Sugata Mukherjee
Associate Professor

Department of
Condensed Matter Physics and Material Sciences

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

We use DFT based first-principles calculations to investigate the bandstructure and phase stability of Cx(BN)1-x two-dimensional nanomaterial at different concentrations, which have been synthesized recently (Liu et al Nature Nanotech (2013)). Our detail electronic structure calculations performed for both armchair and zigzag interfaces between the Graphene and h-BN domains indicate, that the band gap of this material decreases non-monotonically with the C concentration. The calculated band structure indicates the onset of Dirac-cone like features at high C concentration. From the calculated energy of formation, the phase stability of Cx(BN)1-x was studied using a regular solution model and the system was found to be in ordered phase below a few thousands Kelvin.

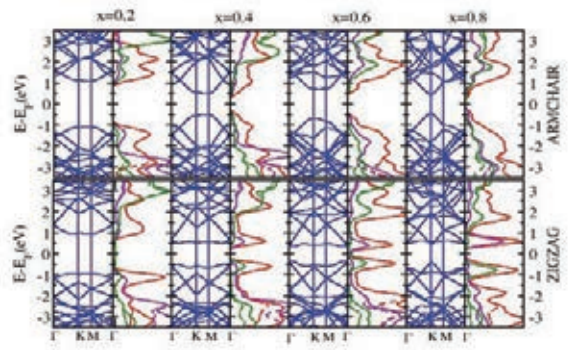


Fig.: The calculated band structure and DOS of Cx(BN)1-x for the armchair and zigzag intrfaces and various concentrations.

Other Publications

Electronic properties of hybrid Cx(BN)1-x two dimensional Nanomaterials, Proc of Puri Conference on Surfaces and Interfaces.

Supervision of Students

Ph.D. Students: Ransell D'Souza;

Project Students: Electronic properties of Graphene – R. D'Souza

Lectures Delivered

1. Chaired a session and discussion session on Graphene at GATI 2014 (from Graphene Analog to Topological Insulators), Vedic Village, Kolkata, Jan 2014.
2. Invited talk on "Electronic properties of hybrid Cx(BN)1-x two dimensional Nanomaterials" at 3rd International Conference on Surfaces and Interfaces, Puri, March 2014.

Courses Taught

Taught Physics of Materials PHY 412 and PHY 602 in winter-semester 2013-14. Introductory course for IPhD and PMSc 2013

Participation in Committees

External: Evaluation committee of JRF in IACS, Kolkata;

Internal: Convener, TPSC Programme Management Board; Vigilance Officer of SNBNCBS

Tanusri Saha-Dasgupta

Professor

Department of
Condensed Matter Physics and Material Sciences

- Electronic Structure of Complex Materials
- Strongly Correlated Electron Materials
- Nanomaterials
- Functional Metalorganics

Magnetism of Adatom on Bilayer Graphene and its Control: A First-principles Perspective

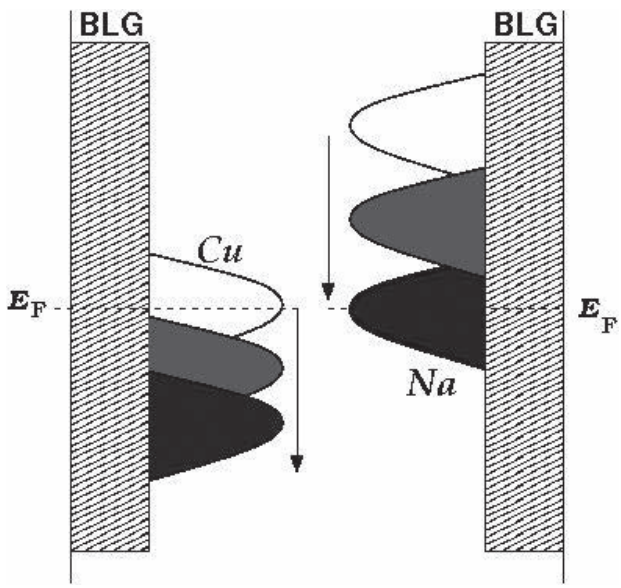


Fig: Schematic diagram showing the movement of Cu s state and Na s state on bilayer graphene, upon application of increasing electric field. The direction of increase of electric field in two cases, are shown with arrows.

We carry out first-principles investigation of the electronic and magnetic properties of adatom on bilayer graphene within the framework of density functional theory and studied the influence of an applied gate-voltage which modifies the electronic states of the bilayer graphene as well as shifts the adatom energy states relative to that of the graphene energy states. Our study carried out for a choice of three different adatoms, Na, Cu and Fe, shows that the nature of adatom-graphene bonding evolves from ionic to covalent, in moving from alkali metal, Na to transition metal, Cu or Fe. This leads to the formation of magnetic moments in the latter cases (Cu, Fe) and its absence in the former (Na). Application of an external electric field to bilayer graphene, completely changes the scenario, switching on a magnetic moment for Na adatom, and switching off the magnetic moments for Cu, and Fe adatoms. Our results have important implications for fundamental studies of controlled adatom magnetism and spintronics application in nanotechnology. *[Dhani Nafday and T.Saha-Dasgupta, Phys. Rev. B 88, 205422 (2013)]*

Publications in Journals

1. **T Saha-Dasgupta**, *Ferroic properties in bi-component perovskites: artificial superlattices and naturally forming compounds*, Journal of Physics: Condensed Matter, (Topical review) **26**, 193201 (2014).

2. Peter S Berdonosov, Elena S Kuznetsova, Valery A Dolgikh, Alexei V Sobolev, Igor A Presniakov, Andrei V Olenev, Badiur Rahaman, **Tanusri Saha-Dasgupta**, Konstantin V Zakharov, Elena A Zvereva, Olga S Volkova, Alexander N Vasiliev, *Crystal Structure, Physical Properties, and Electronic and Magnetic Structure of the Spin S= 5/2 Zigzag Chain Compound* $Bi_2Fe(SeO_3)_2OCl_3$, Inorg. Chem, (2014), Article ASAP DOI: 10.1021/ic500706f

3. S Datta and **T Saha-Dasgupta**, *Vegard's law-like behavior for* Mn_mTc_n *alloy clusters: a first-principles prediction*, Journal of Physics: Condensed Matter **26**, 185004 (2014).

4. P. J. Beldon, S Tominaka, P Singh, **T Saha- Dasgupta**, E G Bithell, AK Cheetham, *Layered structures and nanosheets of pyrimidinethiolate coordination polymers*, Chemical Communications **50**, 3955 (2014).

5. S Kar and **T Saha-Dasgupta**, *Quasi-2D* J_1–J_2 *antiferromagnet* $Zn_2VO(PO_4)_2$ *and its Ti-substituted derivative: A spin-wave analysis*, Physica B: Condensed Matter **432**, 71 (2014).

6. Suman Chowdhury, Santu Baidya, Dhani Nafday, Soumyajyoti Halder, Mukul Kabir, Biplab Sanyal, **Tanusri Saha-Dasgupta**, Debnarayan Jana, Abhijit Mookerjee, *A real-space study of random extended defects in solids: Application to disordered Stone–Wales defects in graphene*, Physica E, **61**, 191 (2014).

7. **Tanusri Saha-Dasgupta**, *Magnetism in Double Perovskites*, J Supercond Nov Magn, **26**, 1991 (2013).

8. S Kanungo, R Datta, S K Panda, **T Saha-Dasgupta**, *Evolution of electronic and magnetic properties in four polytypes of* $BaRuO_3$*: a first-principles study*, Journal of Physics: Condensed Matter **25**, 505503 (2013).

9. Dhani Nafday and **T. Saha-Dasgupta**, *Magnetism of an adatom on bilayer graphene and its control: A first-principles perspective*, Physical Review B **88**, 205422 (2013).

10. J Chakraborty, N Ganguli, **T Saha-Dasgupta**, I Dasgupta, *Role of Te in the low-dimensional multiferroic material* $FeTe_2O_5$ *Br*, Physical Review B **88**, 094409 (2013).

11. P Maldonado, S Kanungo, **T Saha-Dasgupta**, PM Oppeneer, *Two-step spin-switchable tetranuclear Fe (II) molecular solid: Ab initio theory and predictions*, Physical Review B, Rapid Commun, **88**, 020408 (2013).

12. S Datta and **T Saha-Dasgupta**, *Structural, electronic and magnetic properties of transition metal binary alloy clusters with isoelectronic components: case study with* Mn_mTc_n, Ti_mZr_n, Mn_mRe_n, Journal of Physics: Condensed Matter **25**, 225302 (2013).

13. D Meyers, Swarnakamal Mukherjee, J-G Cheng, S Middey, J-S Zhou, JB Goodenough, BA Gray, JW Freeland, **T Saha-Dasgupta**, J Chakhalian, *Zhang-Rice physics and anomalous copper states in A-site ordered perovskites*, Scientific Reports, (Nature Publishing group) **3**, 1834 (2013).

14. S Sarkar, M Kabir, M Greenblatt, **T Saha-Dasgupta**, *The role of an oxometallic complex in OH dissociation during water oxidation: a microscopic insight from DFT study*, Journal of Materials Chemistry A **1**, 10422 (2013).

15. Olga Yakubovich, Galina Kiriukhina, Olga Dimitrova, Anatoly Volkov, Alexey Golovanov, Olga Volkova, Elena Zvereva, Santu Baidya, **Tanusri Saha-Dasgupta**, Alexander Vasiliev, *Crystal structure and magnetic properties of a new layered sodium nickel hydroxide phosphate,* $Na_2Ni_3(OH)_2(PO_4)_2$, Dalton Transactions **42**, 14718 (2013).

16. Larisa Shvanskaya, Olga Yakubovich, Anna Ivanova, Santu Baidya, **Tanusri Saha-Dasgupta**, Elena Zvereva, Alexey Golovanov, Olga Volkova, Alexander Vasiliev, *Copper rubidium diphosphate,* $Rb_2Cu_3(P_2O_7)_2$*: synthesis, crystal structure, thermodynamic and resonant properties*, New Journal of Chemistry **37**, 2743 (2013).

17. Man-Rong Li, David Walker, Maria Retuerto, Tapati Sarkar, Joke Hadermann, Peter W. Stephens, Mark Croft, Alexander Ignatov, Christoph P. Grams, Joachim Hemberger, Israel Nowik, P. Shiv Halasyamani, T. Thao Tran, Swarnakamal Mukherjee, **Tanusri Saha Dasgupta**, Martha Greenblatt, *Polar and Magnetic* Mn_2FeMO_6 *(M=Nb, Ta) with* $LiNbO_3$*-type Structure: High-Pressure Synthesis*, Angewandte Chemie International Edition, **52**, 8406 (2013).

Other Publications

1. Magnetism of Adatom on Bilayer Graphene and its Control: A First-principles Perspective, T Saha-Dasgupta, D Nafday, Bulletin of the American Physical Society, 2014

2. Role of oxometallic complex on OH dissociation during water oxidation: A microscopic insight from DFT study, M Kabir, S Sarkar, M Greenblatt, T Saha-Dasgupta, Bulletin of the American Physical Society

Supervision of Students

Ph.D. Students: Swastika Chatterjee (PhD degree obtained, 2013), Sudipta Kanungo (PhD degree obtained 2013), Santu Baidya (PhD to be submitted in July 2014), Swarnakamal Mukherjee, Kartick Samanta, Hrishit Banerjee, Abir Deogharia, Dhani Nafday (Project student);

Project Students: Subodha Sahu (Post BSc), Vishnu P.K. (summer project)

Post Doctoral Researchers

Tilak Das, Gargi Datta (project)

Lectures Delivered

1. Invited Talk: Ferroic properties of Bi-component superlattices, NTU Singapore, May 2013.
2. Invited Talk: First-principles study of Strongly correlated electron systems, Gottingen, Germany, June 2013.
3. Invited Talk: First-principles study of Strongly correlated electron systems, Telluride, USA, June 2013.
4. Invited Talk: Role of spin-orbit coupling in oxides, Telluride, USA, July 2013.
5. Invited Talk: NMTO Wannier function study, MPI Stuttgart, July 2013.
6. Invited Talk: Low-dimensional Quantum Spin systems, MAGMA, Guwahati, Dec 2013.
7. Invited Talk: Magnetism in low dimensional spin systems, DAE Symposium Dec 2013.
8. Invited Talk: Quantum spin systems, IUMRS Meeting, Bangalore Dec 2013.
9. Invited Talk: First-principles Study of Double perovskites, IIT Guwahati, Jan 2014.
10. Invited Colloquium: Realistic theory of strongly correlated electron systems, IISER Pune, 2014.

Courses Taught

PHY 412, Physics of Materials, 4th Semester

Participation in Committees

External: Member of the committee for IUSSTF-APS Professorships and Student Visitations between India and USA;

Internal: APMP committee, CAC committee

Sponsored Projects

1. Thematic Unit of Excellence on Computational Materials Science. (PI)
2. Unit of Nanoscience and nanotechnology (Member)
3. Indo-Russian project, sanctioned (PI)
4. Indo-Dutch project, sanctioned (Co-PI)

Meetings Organized

ICTS Research School and conference on “STRONGLY CORRELATED SYSTEMS: FROM MODELS TO MATERIALS” at IISc Bangalore, January 2014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2 DIMENSIONAL
QUANTUM FIELD THEORY

DEPARTMENT OF THEORETICAL SCIENCES

Department of **Theoretical Sciences**

Prof. Subhrangshu Sekhar Manna

Head of the Department

Department Profile Indicators

Table A: Manpower and Resources

Number of faculties	11
Number of Post –doctoral research associate (centre+project)	4
Number of Ph.D students	36
Number of other project staff	2
Number of summer students	3
Projects (ongoing)	1

Table B: Research Activities Indicators

Number of research papers in Journals	32
Number of Book-chapters/books	0
Number of other publications	2
Number of Ph.D students graduated (submitted+degree awarded)	7
Number of M.Tech/M.Sc projects	0

Table C: Academic Activities and Linkage

Number of courses taught by faculties	9	
Number of Visitors (non – associates)	7	
Number of associates	0	
Number of Seminars organized	4	
Number of Conference/Symposia/ Advanced Schools organized	3	
Number of talks delivered by members of department in Conferences/Symposia	National	18
	International	3

Most Important Research Highlights

- In conserved-mass transport processes, the steady-state distribution of mass in a subsystem is uniquely determined from the functional dependence of variance of the subsystem mass on its mean, provided that the joint mass distribution of subsystems is factorized

in the thermodynamic limit. [Sayani Chatterjee, **Punyabrata Pradhan**, and P. K. Mohanty, *Gammalike Mass Distributions and Mass Fluctuations in Conserved-Mass Transport Processes*, Physical Review Letters, **112**, 030601 (2014).]

- The origin and significance of topological excitations in quantum spin models in low dimensions (vortices and anti-vortices) were studied in depth highlighting possible experimental consequences and signatures. A bridge was established between field theoretical formalism and well-known statistical mechanical treatment of Berezinskii-Kosterlitz-Thouless transition involving these topological excitations. **[Ranjan Chaudhury** and **Samir K. Paul**, *Topological Excitations in Quantum Spin Systems*, Advances in Condensed Matter Physics, Volume 2013,Article ID 783420, http://dx.doi.org/10.1155/2013/783420.]

- Investigations on anomalous hydrodynamics were continued leading to exact expressions for constitutive relations in anomalous hydrodynamics in two dimensional with gauge and gravitational anomalies. A new relation connecting the response parameters with the anomaly coefficients was obtained. [**Rabin Banerjee**, *Exact results in two-dimensional chiral hydrodynamics with gravitational anomalies*, Eur. Phys. J. C, **74**, 2824 (2014).]

- A new differential geometric structure was developed for principal fiber bundles on path spaces using the tools of category theory. A new notion of decorated bundles was introduced and developed, along with parallel transport for such bundles. **[Saikat Chatterjee**, **Amitabha Lahiri** and Ambar N. Sengupta, *Path space connections and categorical geometry*, Journal of Geometry and Physics **75**, 129 (2014).]

Summary of Research Activities

For the Schwarzschild–de Sitter black hole spacetime in the region between the black hole and the cosmological event horizons a total energy function was constructed. The mass function is local, positive definite, continuous and increases monotonically with the radial distance from the black hole event horizon. The Smarr formula was derived using this mass function, and it was shown that the mass function reproduces the two-temperature Schwarzschild–de Sitter black hole thermodynamics.

(i) Bridge structures in real three-dimensional dry granular packings have been analysed in collaboration with experimentalists in Shanghai. The experiments show striking agreement with independent simulations. (ii) An agent-based approach was used to model gap junction adaptation in Langerhans islets in the pancreas, to predict the onset of diabetes. The analysis reveals that it is nearly impossible to view gap junctions as homogeneous across a tissue. (iii) A model of metaplastic synapses with that of a stochastic and bistable biological switch has been used to explain use-dependent short-term potentiation in experiments on Lymnaea neurons by Canadian neuroscientists. (iv) Spontaneous crystallization was observed and analysed in simulations of shaken granular systems. Although there is typically a competition between hcp and fcc ordering, fcc predominates in general.

The issue of maximal localization, both in position and phase space, through the computation of variance matrix in a symplectic invariant formulation of uncertainty relation, using Hilbert-Schmidt operators has been analyzed. It is shown that in the multi-particle sector, one can extract a “quasi-commutative” basis, enjoying un-deformed Bose / Fermi symmetry and thermal correlation function and thereby restoring Pauli principle, except that the thermal wave-length undergoes a noncommutative deformation in the Voros basis.

Recent work has focused on studying aspects of two-mode entangled states of light generated at the output of a beam splitter under various non-classical input field conditions. In particular we have been interested in studying the dependence of entanglement on input field properties including non-classicality and non-Gaussianity. Specific input states studied include quadrature squeezed states and amplitude squeezed states. Detailed numerical analysis of the results is in progress.

In SU(N) lattice gauge theory Hamiltonian we make certain canonical transformations on the Kogut-Susskind link and electric field operators to rewrite it in terms of SU(N) loop operators and corresponding electric fields which describe SU(N) fluxes on the loops starting and ending at origin. The theory in terms of these SU(N) loop operators has global SU(N) invariance. The final Hamiltonian describing the dynamics of these SU(N) loop fluxes is being studied in terms of gauge invariant orthonormal dual basis.

Li\’enard II equation is mapped into a position dependent mass system. The quantization is carried out using the point canonical transformation method and von Roos ordering technique. It is shown that their eigenfunctions and eigenspectrum can be obtained in terms of associated Laguerre and exceptional Laguerre functions. All the isochronicity conditions for the Liénard type equations are rederived by using the Jacobi last multiplier approach.

Various aspects of the Painleve-Gambier equations are studied. It is shown that, in conserved-mass transport processes, the steady-state distribution of mass in a subsystem is uniquely determined from the functional dependence of variance of the subsystem mass on its mean, provided that the joint mass distribution of subsystems is factorized in the thermodynamic limit. A system of interacting particles in a periodically moving external potential, within the simplest possible description of paradigmatic symmetric exclusion process on a ring is studied. The model, though simple, exhibits remarkably rich features in particle transport, such as polarity reversal and double peaks in particle current upon variation of defect velocity and particle density.

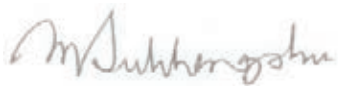
Gauge symmetries in the minisuperspace model of cosmology and reparametrisation invariance is studied. Quantization of this model and obtention of the Wheeler-deWitt equation were carried out by choosing a pair of suitable gauge conditions. Finite coordinate dependent BRST transformations were discussed in the context of the relativistic particle model with curvature. The BRST variables display a novel type of symmetry that is analogous to W_3 – symmetry. Investigations on anomalous hydrodynamics were continued leading to new findings.

An open-chain totally asymmetric exclusion process (TASEP) with stochastic gates present at the two boundaries is studied. The gating dynamics has been modeled keeping the physical system of ion-channel gating in mind. The phase diagram of the system is calculated which shows important, non-trivial differences with the phase diagram of a regular open-chain TASEP. Analytic calculation within mean-field theory captures the main qualitative features of the Monte Carlo simulation results. A refined mean-field calculation has been done where certain important boundary correlations are taken into account. This theory shows significantly better quantitative agreement with the simulation results.

Contributions of multi-magnon composites to the formation of static Quantum vortices corresponding to spin-1/2 XY anisotropic Heisenberg Ferromagnets in two dimensions in the vicinity of T_C = 0 are studies. It is shown that the 1-magnon, 2-magnon, 3-magnon and 4- magnon states participating in the formation of a static elementary vortex(anti-vortex) plaquette (elementary square for our 2-dimensional square lattice) are stable in the thermodynamic limit.

A region of two-dimensional space has been filled randomly with large number of growing circular discs. This model has following properties: (i) The Order Parameter appears to jump discontinuously at a certain critical value of the area coverage; (ii) the width of the window of the area coverage needed to observe a macroscopic jump in the Order Parameter tends to vanish as the growth rate decreases to zero and on the contrary (iii) the cluster size distribution has a power law decaying functional form. While the first two results are the signatures of a discontinuous transition, the third result is indicative of a continuous transition.

Scattering phase function is an important quantity needed as input for solution of multiple scattering problems. A variety of phase functions have been examined and some phase functions have been proposed. A critical review of this topic was undertaken. Resulting review article will appear in "Light Scattering Reviews" later in the year. A method for distinguishing plasmodium falciparum infected red blood cells from normal cells has been studied. Different aspects of this approach are being examined further.



Subhrangshu Sekhar Manna
Head, Department of Theoretical Sciences

Amitabha Lahiri

Professor

Department of
Theoretical Sciences

- Mathematical physics, Application of category theory in physics; Differential geometry of path spaces; Principal fiber bundles and connections on path spaces; Gauge invariant mass for gluons; Properties of de Sitter type black hole solutions.

A total energy function was constructed for the Schwarzschild–de Sitter black hole spacetime in the region between the black hole and the cosmological event horizons. The mass function is local, positive definite, continuous and increases monotonically with the radial distance from the black hole event horizon. The Smarr formula was derived using this mass function, and it was shown that the mass function reproduces the two-temperature Schwarzschild–de Sitter black hole thermodynamics.

In a separate work unrelated to the above, a new differential geometric structure was developed for principal fiber bundles on path spaces using the tools of category theory. A new notion of decorated bundles was introduced and developed, along with parallel transport for such bundles.

Publications in Journals

1. Sourav Bhattacharya and **Amitabha Lahiri**, *Mass function and particle creation in Schwarzschild–de Sitter spacetime*, Eur. Phys. J. C **73**, 2673 (2013).
2. Saikat Chatterjee, **Amitabha Lahiri** and Ambar N. Sengupta, *Path space connections and categorical geometry*, Journal of Geometry and Physics **75**, 129 (2014).

Supervision of Students

Ph.D. Students: Debmalya Mukhopadhyay, Subhasish Chakrabarty, Ishita Dutta Choudhury, Ambalika Biswas, Karan Savio Fernandes

Post Doctoral Researchers

Suman Ghosh, Rohit Kumar

Lectures Delivered

1. BRST and Renormalizability, Benaras Hindu University, July 2013
2. About Nothing – How theorists see the vacuum, Benaras Hindu University, July 2013
3. Conformal scalar in tetrad Palatini formalism, Field theoretic aspects of gravity (FTAG-IX), IIT Gandhinagar, September 2013

Courses Taught

PHY 102 Mathematical Methods, Autumn 2013

Participation in Committees

Internal: Consultative Advisory Committee, Students' Curriculum and Research Evaluation Committee, Students Advisory Committee, Complaints Committee, Computer Services Cell (Working Group & Advisory Committee)

Meetings Organized

Organized the DST Brainstorming Conference on Science, Technology and Innovation Policy 2013 at the S. N. Bose National Centre, 15th May, 2013

Anita Mehta

Senior Professor

Department of
Theoretical Sciences

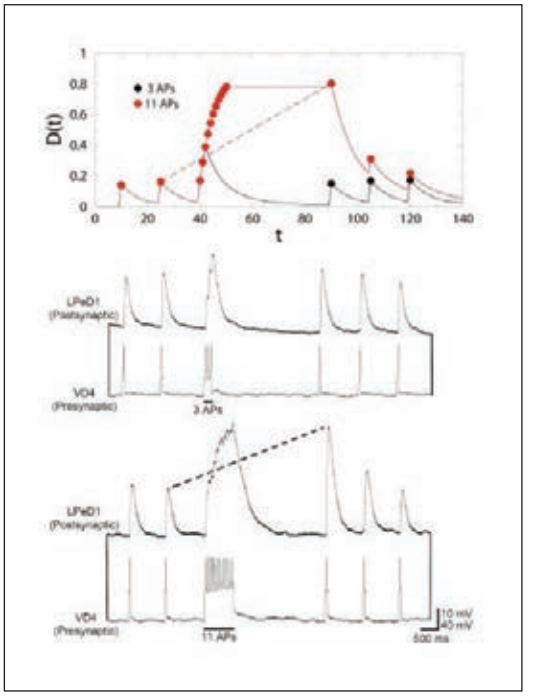
- Synaptic metaplasticity and memory: heterogeneous structures in granular media and their experimental verification: spontaneous crystallization in vibrated granular media: learning-based approaches to gap junction heterogeneity in the pancreas: the application of synaptic metaplasticity theories to real organisms

In joint work with an experimental group at Shanghai Jiao Tong University, we have analysed bridge structures in three-dimensional dry granular packings using X-ray tomography. When bridges are small, they are predominantly linear, and have an exponential size distribution: larger bridges are complex, and have a power-law size distribution. The experimental distributions of sizes, end-to-end lengths, base extensions and orientations show striking agreement with independent simulations.

We have used an agent-based approach to model gap junction adaptation in Langerhans islets in the pancreas, with the view to the prediction of the onset of diabetes. Here, gap junctions are modelled as bonds in a beta-cell network, whose strengths are altered according to homeostatic plasticity rules. Our analysis reveals that it is nearly impossible to view gap junctions as homogeneous across a tissue.

In joint work with Canadian neuroscientists, we explain a novel form of short-term potentiation, which was found to be use-, but not time-, dependent in experiments on Lymnaea neurons. This is done by combining our model of metaplastic synapses with that of a stochastic and bistable biological switch.

We have analysed, using global and local order metrics, the spontaneous crystallization observed in shaken granular systems. End states can be fully or partially ordered, depending on the shaking amplitude. Although there is typically a competition between hcp and fcc ordering, fcc predominates in general. We suggest that 'dislocations' demarcate the interfaces between regions of fully developed hcp and fcc order locally, when these are juxtaposed.



Publications in Journals

1. Y. X. Cao, B. Chakrabortty, G. C. Barker, **Anita Mehta** and Y.J. Wang, *Bridges in three-dimensional granular packings: Experiments and simulations*, Europhysics Letters, **102**, 24004 (2013).

2. Pranay Goel and **Anita Mehta**, *Learning Theories Reveal Loss of Pancreatic Electrical Connectivity in Diabetes as an Adaptive Response*, PLoS ONE, **8(8)**: e70366 (2013).

3. **Anita Mehta**, Jean-Marc Luck, Collin C Luk and Naweed I Syed, *Synaptic metaplasticity underlies tetanic potentiation in Lymnaea: a novel paradigm*, PLoS ONE, **8(10)**:e78056 (2013).

4. D. P. Shinde, **Anita Mehta** and G. C. Barker, *Shaking-induced crystallization of dense sphere packings*, Physical Review E, **89**, 022204 (2014)..

Other Publications

Anita Mehta, The heterogeneous dynamics of sand, Journal of the Physical Society of Japan Conf. Proc., 011004 (2014)

Supervision of Students

Ph.D. Students: Suman Aich and D. P. Shinde;

Project Students: Priyom Adhikari (IISER Kolkata)

Lectures Delivered

Seminars and Colloquiua

1. "From granular to cognitive systems", Seminar at New York University, New York, April 2013.

2. "Using statistical physics to model biological systems", Colloquium at New York University, Abu Dhabi September 2013.

3. "Perceiving, learning and forgetting", Colloquium at Presidency College, Calcutta, November 2013.

4. "Perceiving, learning and forgetting", Colloquium at Indian Institute for Science Education and Research Calcutta, February 2014.

Invited Conference talks

1. "The physics of sand'', Invited plenary talk at 12th Asia Pacific Physics Conference, Chiba, Japan, July 2013.

2. "Sustainable cities -- the science behind the art", Invited speaker at Rotary Club, Calcutta, August 2013.

3. "Perceiving, learning and forgetting", Invited speaker at 8th Conference on Nonlinear Systems and Dynamics, Indore, December 2013.

Academic Visits

Senior Visiting Scientist at the Institut de Physique Theorique, Saclay, France (May-June 2013)

Courses Taught

PHY 591, PHY 502

Awards / Recognitions

1. Member of National Network for Mathematical and Computational Biology, Science and Engineering Research Board, India (2014 -)

2. Member of Working Group for Women in Physics, Asia-Pacific Physics Conferences (2010-)

3. Expert Reviewer at European Research Council Executive Agency (2010-2013)

4. On Editorial Board of Granular Matter and CHAOS

5. Member of Scientific Committee of 'Association pour l'Etude de la Micromécanique des Milieux Granulaires' since its inception

6. Fellow of the American Physical Society

Biswajit Chakraborty
Professor

Department of
Theoretical Sciences

- I continued working on Non-commutative quantum theories during this period. This mainly includes problems on – (i) the breaking of Schwinger's SU(2) and time-reversal symmetries in the harmonic oscillator in Moyal plane and (ii) thermal effective potential in 2D and 3D Moyal spaces and the restoration of Pauli principle, along with rotational symmetries

(i) The very structure of Hilbert-Schmidt operator formulation of non-commutative quantum mechanics in 2D Moyal plane allows one to construct the Schwinger's SU(2) generators. With this the existence of a critical point in the parameter space of mass(μ) and angular frequency(ω) s demonstrated by studying SU(2) symmetry aspect of non-commutative(unphysical) harmonic oscillator. The existence of this critical point is shown to be a novel aspect in non-commutative (unphysical) harmonic oscillator. Then the physical oscillator is considered and the spectrum is obtained by carrying out a Bogoliubov transformation to find that it is of the same form as that of unphysical one (with renormalised parameters), upto an additive Zeeman term which is shown to be solely responsible for both SU(2) and time reversal symmetry breaking.

(ii) The Hilbert-Schmidt operator formulation of non-commutative quantum mechanics is extended to many particles system and eventually to field theory by introducing basis independent field operators. Thermal correlation functions and the associated effective statistical potential in two- and three-dimensional non-commutative space are computed. Although the twisted fermions are found to violate Pauli principle and the SO(3) symmetry in 3D Moyal space, we show the existence of a quasi-commutative basis in momentum space in the multi-particle sector which differs from the twisted one just by a phase factor, enjoying the usual Bose/Fermi symmetry and thereby restoring both Pauli principle and the rotational (SO(2)/SO(3)) symmetries in 2D/3D spaces.

Publications in Journals

Y. Chaoba Devi, K.J.B. Ghosh, **B. Chakraborty** and F.G. Scholtz, *Thermal effective potential in two- and three-dimensional non-commutative spaces*, Journal of Physics A, **47**, 025302 (2014).

Supervision of Students

Ph.D. Students: Yendrenbam Chaoba Devi;

Project Students: Supervised the final year thesis of Mr. Shivraj Prajapat on "Non-commutative quantum mechanics and Non-commutative geometry" required for the partial fulfilment of BS-MS Dual degree of IISER, Pune

Lectures Delivered

A talk on "Emergent Geometry and Statistics in Non-commutative spaces" was given in IISER, Kolkata in the Mini Workshop on "Field theory and Applications" held during 7-8th Aug 2013.

Participation in Committees

Internal: Admission committee, CWEP-EVLP

Makhtedar Sanjay Kumar

Associate Professor

Department of
Theoretical Sciences

- Quantum Optics and Quantum Information: Dependence of entanglement in the output of a beam splitter on the nonclassicality and non-Gaussianity of input fields

Recent work has focussed on studying aspects of two-mode entangled states of light generated at the output of a beam splitter under various nonclassical input field conditions. In particular we have been interested in studying the dependence of entanglement on input field properties including nonclassicality and non-Gaussianity. Specific input states studied include quadrature squeezed states and amplitude squeezed states. Detailed numerical analysis of the results is in progress.

Supervision of Students

Ph.D. Students: Soumyakanti Bose

Courses Taught

1. Gave five lectures in Quantum Mechanics as part of the Ph.D. Course Work Programme [PHY 501 - Research Methodology] of the Theoretical Sciences Department.
2. Taught course PHY202 (Quantum Mechanics II) for II Semester IPhD students.
3. Taught a course (24 lectures) in 'Advanced Optics' at Department of Physics, University of Gour Banga, Malda, West Bengal, during the period 11-16 December, 2013.

Participation in Committees

Internal: Member, Admissions Committee & Admissions Coordinator; Member, EVLP (VASP) Committee

Manu Mathur

Professor

Department of
Theoretical Sciences

- Lattice Field Theory, Duality and Confinement, Coherent States

In SU(N) lattice gauge theory Hamiltonian we make certain canonical transformations on the Kogut-Susskind link and electric field operators to rewrite it in terms of SU(N) loop operators and corresponding electric fields which describe SU(N) fluxes on the loops starting and ending at origin. The theory in terms of these SU(N) loop operators has global SU(N) invariance. The final Hamiltonian describing the dynamics of these SU(N) loop fluxes is being studied in terms of gauge invariant orthonormal dual basis.

The above reformulated Hamiltonian of lattice gauge theory has SU(N) global invariance and can be thought of as describing spin model with SU(N) spins and their conjugate electric fields.

Supervision of Students

Ph.D. Students: Indrakshi Raychowdhury (degree awarded), T. P. Sreeraj

Participation in Committees

Internal: Member of Student Advisory Committee (SAC)

Meetings Organized

School on Quantum Field Theories on Lattice, December 02-06, 2013, Saha Institute of Nuclear Physics

Partha Guha

Professor

Department of
Theoretical Sciences

- Integrable systems, nonlinear dynamics, symmetries of nonlinear ODEs, inverse problem of calculus of variations, isochronous systems

We map the Li\'enard II equation to a position dependent mass system. The quantization of the Li\'enard II equation is then carried outusing the point canonical transformation method together with the von Roos ordering technique. Finally we show how their eigenfunctions and eigenspectrum can be obtained in terms of associated Laguerre and exceptional Laguerre functions. By employing the exceptional Jacobi polynomials we construct three exactly solvable potentials giving rise to bound-state solutions of the Schr\"{o}dinger equation.

We have re-derived all the isochronicity conditions for the Liénard type equations by using the Jacobi last multiplier approach. It provides a justification for the Urabe criterion, besides giving a derivation of the Bolotin-MacKay potential. We have also studied a possible connection between $\ lambda$ symmetries and the property of isochronicity for the Li\'enard type equation.

We have studied various aspects of the Painleve-gambier equations. For example, we have studied the second-order, second-degree systems related to the Painleve equations which possess one and two parameters. In every case we show that by introducing a quantity related to the canonical Hamiltonian variables it is possible to derive such a second-degree equation. We obtain λ-symmetries of some second-order equations of the Painlev\'{e}-Gambier type.

Publications in Journals

1. A. Ghose Choudhury and **Partha Guha**, *Quantization of the Liénard II equation and Jacobi's last multiplier*, J. Phys. A: Math. Theor., **46**, 165202 (2013).

2. B. Bagchi and A. Ghose Choudhury and **Partha Guha**, *Comments on the structural features of the Pais–Uhlenbeck oscillator*, Modern Physics Letters A **28**, 1375001 (2013).

3. **Partha Guha** and A. Ghose Choudhury, *Singular Lagrangian, Hamiltonization and Jacobi Last Multiplier for Certain Biological Systems*, European Physical Journal ST **222**, 615 (2013).

4. A. Ghose Choudhury and **Partha Guha**, *On Commuting Vector Fields and Darboux Functions for Planar Differential Equations*, Lobachevskii Journal of Mathematics, **34**, 212 (2013).

5. **Partha Guha**, A. Ghose Choudhury and B. Khanra, *λ-symmetries, Isochronicity and Integrating factors of Nonlinear ordinary differential equations*, Journal of Engineering Mathematics (Springer) **82**, 85 (2013).

6. S. V. Meleshko, S. Moyo, C. Muriel, J. L. Romero, **Partha Guha** and A. Ghose Choudhury, *On first integrals of second-order ordinary differential equations*, J. Eng. Math., **82**, 17 (2013).

7. **Partha Guha** and A. Ghose Choudhury, *The Jacobi Last Multiplier and isochronicity of Li´enard type systems*, Reviews in Mathematical Physics, **25**, 1330009 (2013).

8. Basil Grammaticos, Alfred Ramani and **Partha Guha**, *Contiguity relations for linearisable systems of Gambier type*, Journal of Nonlinear Mathematical Physics, **20**, 565 (2013).

9. **Partha Guha** and A. Ghose Choudhury, *Application of the Jacobi last multiplier for construction of Lagrangians and Hamiltonians of dynamical systems in population biology*, Review of the Calcutta Mathematical Society, **21** (1), 109 (2013).

10 A. Ghose Choudhury and **Partha Guha**, *Damped equations of Mathieu type*, Applied Mathematics and Computation, **229**, 85 (2014).

11. Basil Grammaticos, Alfred Ramani and **Partha Guha**, *Second-degree Painlevé equations and their contiguity relations*, Regular and Chaotic Dynamics, **19**, 37 (2014).

Other Publications

First Integrals and Hamiltonian structure for a system of ordinary differential equations occurring in magnetohydrodynamics (with A. Ghose Choudhury), AIP Proceedings 1582, 116 (2014).

Supervision of Students

Ph.D. Students: Barun Khanra (degree obtained in February 2014), Sumanto Chando (current student)

Lectures Delivered

1. Invited speaker at StatPhys satellite meeting Perspective of Nonlinear Dynamics, July 18-22, 2013 at University of Hyderabad, Title: Generalized Virial Theorem for the Lienard Type Systems
2. Talk given at Frontiers in Physics (FIP)-2013, Hyderabad Central University, 20-22 September, 2013, Title: Superintegrability
3. Talk given at Geometric Mechanics and Control theory meeting at IISC Bangalore 2-10 January 2014, Title: Nonholonomic deformation of coupled and supersymmetric KdV equation and Euler-Poincare-Suslov method
4. Talk given at Recent Perspectives on Nonlinear Mathematics and its Applications, VISVA-BHARATI, Santiniketan, 25-26 March, 2014, Title: Searching for integrable dynamics in parametric oscillators

Academic Visits

IHES, Bures sur Yvett, France March -June 2013

Courses Taught

PHY 101 Classical Dynamics, Fall Semester 2013

Participation in Committees

External: Organizer of the National Mathematics Initiative Thematic Year (2013-2014) in Classical Integrable Systems

Meetings Organized

1. Workshop on Quantum Integrable Systems, 2-6 December 2013 at SNBNCBS
2. Workshop on Geometry of Mechanics and Control Theory, 2-10 January 2014 at IISC, Bangalore
3. One day discussion meeting on integrable and non integrable aspects of dynamical systems, 21 March, 2014

Punyabrata Pradhan

Assistant Professor

Department of
Theoretical Sciences

- Characterization of nonequilibrium steady state in terms of intensive thermodynamic variables
- Particle transport in systems driven by localized potential

We show that, in conserved-mass transport processes, the steady-state distribution of mass in a subsystem is uniquely determined from the functional dependence of variance of the subsystem mass on its mean, provided that the joint mass distribution of subsystems is factorized in the thermodynamic limit.

We study a system of interacting particles in a periodically moving external potential, within the simplest possible description of paradigmatic symmetric exclusion process on a ring. The model, though simple, exhibits remarkably rich features in particle transport, such as polarity reversal and double peaks in particle current upon variation of defect velocity and particle density. By tuning these variables, the most efficient transport can be achieved in either direction along the ring.

Zeroth law is the cornerstone of equilibrium thermodynamics and leads to a well defined thermodynamic structure. We ask whether there could be a similar thermodynamic characterization for systems having a nonequilibrium steady state. We find an affirmative answer in this direction, which can lead to an extraordinary thermodynamic structure where a wide varieties of systems having a nonequilibrium steady state, all equilibrium systems of course included, form equivalence classes specified by an intensive thermodynamic variable.

Publications in Journals

1. Sayani Chatterjee, **Punyabrata Pradhan**, and P. K. Mohanty, *Gammalike Mass Distributions and Mass Fluctuations in Conserved-Mass Transport Processes*, Physical Review Letters, **112**, 030601 (2014).

2. Rakesh Chatterjee, Sakuntala Chatterjee, **Punyabrata Pradhan**, and S. S. Manna, *Interacting particles in a periodically moving potential: Traveling wave and transport*, Physical Review E, **89**, 022138 (2014).

Supervision of Students

Ph.D. Students: Sayani Chatterjee, Arghya Das and Subhadip Chakraborti

Post Doctoral Researchers

Sanchari Goswami

Lectures Delivered

1. *Gammalike mass distributions and mass fluctuations in conserved-mass* transport processes, IISER - Kolkata, Mohanpur Campus, December, 2013.

2. *Gammalike mass distributions and mass fluctuations in conserved-mass transport processes*, Indian Institute of Science, Bangalore February, 2014.

Courses Taught

1. Research Methodology (Part B), Scaling Theory and Renormalization Group, 5th semester

2. PHY 201, Statistical Mechanics, 2nd semester

Participation in Committees

Internal: Computer Services Cell

Sponsored Projects

Thematic Unit of Excellence funded by Nano Mission of Department of Science and Technology

Rabin Banerjee

Senior Professor

Department of
Theoretical Sciences

- Minisuperspace cosmological models, anomalous hydrodynamics, generalised BRST symmetry in point particles and sigma models, localisation of Galilean symmetry and nonrelativistic diffeomorphism invariance

Gauge symmetries in the minisuperspace model of cosmology were studied. Reparametrisation invariance was exhibited. Quantisation of this model and obtention of the Wheeler-deWitt equation were carried out by choosing a pair of suitable gauge conditions.

Finite coordinate dependent BRST transformations were discussed in the context of the relativistic particle model with curvature. The BRST variables display a novel type of symmetry that is analogous to W_3 – symmetry.

A method was developed where the above generalized BRST symmetry could be applied for supersymmetric field theory. It was shown that the Jacobian of such transformations reproduced the well-known actions for sypersymmetric sigma models.

Investigations on anomalous hydrodynamics were continued leading to new findings. Exact expressions for constitutive relations in two dimensional hydrodynamics with gauge and gravitational anomalies were found. While the expressions for the gravity sector reproduced the results from a derivative expansion approach, those from the gauge sector were new. Also, a new relation connecting the response parameters with the anomaly coefficients was obtained.

Publications in Journals

1. **Rabin Banerjee**, Sunandan Gangopadhyay, Dibakar Roychowdhury, and Arindam Lala, *Holographic s-wave condensate with nonlinear electrodynamics: A nontrivial boundary value problem*, Phys. Rev. D, 2013, **87**, 104001.

2. **Rabin Banerjee**, *Exact results in two-dimensional chiral hydrodynamics with gravitational anomalies*, Eur. Phys. J. C, **74**, 2824 (2014).

3. **Rabin Banerjee**, Biswajit Paul, Sudhaker Upadhyay, *BRST symmetry and W-algebra in higher derivative models*, Phys. Rev. D **88**, 065019 (2013).

4. **Rabin Banerjee**, Pradip Mukherjee, Biswajit Paul, *New Hamiltonian analysis of Regge-Teitelboim minisuperspace cosmology*, Phys. Rev. D, **89**, 043508 (2014).

Supervision of Students

Ph.D. Students: Dibakar Raychaudhury (degree awarded), Sarmishtha Kumar (degree awarded), Debraj Roy (degree awarded), Biswajit Paul, Arindam Lala, Shirsendu De, Arpan Krishna Mitra, Arpita Mitra

Post Doctoral Researchers

Sudhaker Upadhyay

Students' Publications

Arindam Lala, *Critical phenomena in higher curvature charged AdS black holes*, Adv.High Energy Phys, **2013**, 918490 (2013).

LECTURES DELIVERED

Exact results in two dimensional chiral hydrodynamics with gauge and gravitational anomalies, IISER Kolkata, July, 2013

Courses Taught

PHY 406 Advanced mathematical physics, 4th semester

Participation in Committees

Internal: Various committees, either as Chairperson in my capacity as Dean (Faculty) or as a member.

Sakuntala Chatterjee

Assistant Professor

Department of
Theoretical Sciences

- Nonequilibrium Statistical Physics: Phase separation in interacting particle systems, Non-equilibrium steady state with time-periodic drive, Boundary induced phase-transition
- Biological Physics: Chemotaxis of E.coli bacteria, Actin-based cell motility, Ion-channel transport

Boundary induced phase transition with stochastic entrance and exit: We study an open-chain totally asymmetric exclusion process (TASEP) with stochastic gates present at the two boundaries. These gates can randomly switch between an open state and a closed state. In the open state, the gates are highly permeable such that any particle arriving at the gate immediately passes through. In the closed state, a particle gets trapped at the gate and cannot pass through until the gate switches open again. We calculate the phase-diagram of the system and find important and non- trivial differences with the phase-diagram of a regular open-chain TASEP. In particular, depending on switching rates of the two gates, the system may or may not admit a maximal current phase. Our analytic calculations within mean-field theory captures the main qualitative features of our Monte Carlo simulation results. We also perform a refined mean-field calculation where the correlations at the boundaries are taken into account. This theory shows significantly better quantitative agreement with our simulation results.

Interacting particles in a periodically moving potential: Traveling wave and transport: We study a system of interacting particles in a periodically moving external potential, within the simplest possible description of paradigmatic symmetric exclusion process on a ring. The model describes diffusion of hardcore particles where the diffusion dynamics is locally modified at a uniformly moving defect site, mimicking the effect of the periodically moving external potential. The model, though simple, exhibits remarkably rich features in particle transport, such as polarity reversal and double peaks in particle current upon variation of defect velocity and particle density. By tuning these variables, the most efficient transport can be achieved in either direction along the ring. These features can be understood in terms of a traveling density wave propagating in the system. Our results could be experimentally tested, e.g., in a system of colloidal particles driven by a moving optical tweezer.

Publications in Journals

1. Rakesh Chatterjee, **Sakuntala Chatterjee**, Punyabrata Pradhan, and S. S. Manna, *Interacting particles in a periodically moving potential: Traveling wave and transport*, Physical Review E, **89**, 022138 (2014).

2. **Sakuntala Chatterjee**, Ramanna Harish and Gunter M. Schütz, *Strong Reactivity Enhancement through Molecular Traffic Control in Zeolites*, Chemie Ingenieur Technik, **85**, page 1671 (2013).

Supervision of Students

Ph.D. Students: Subrata Dev, Rajkumar Sadhu, Shauri Chakraborty, Sukla Pal (Jointly with Jayanta K Bhattacherjee)

Post Doctoral Researchers

Sanchari Goswami

Lectures Delivered

Interacting particles in a periodically moving potential: traveling wave and transport , Jawaharlal Nehru University, New Delhi, March, 2014

Samir Kumar Paul

Associate Professor

Department of
Theoretical Sciences

1) Contributions of multi-magnon composites to the formation of static Quantum vortices corresponding to spin-1/2 XY anisotropic Heisenberg Ferromagnets in two dimensions in the vicinity of T_C = 0 and below T_{BKT} (BKT = Berezinskii-Kosterlitz-Thouless).

2) Invariance of some special class of solutions of SU(2) Yang-Mills theories under scale and conformal transformations

1) The 1-magnon, 2-magnon, 3-magnon and 4-magnon states participating in the formation of a static elementary vortex(anti-vortex) plaquette (elementary square for our 2-dimensional square lattice) turn out to be quantum mechanically stable.

2) The monopole sector behaves in a very special fashion in the sense that the BPS monopole respects scaling symmetry whereas conformal invariance seems to be violated at a first glance (not to be confused with the common scenario that a system having massive fields breaks full conformal invariance).

Works 1) and 2) described above are done in collaboration with Subhajit Sarkar and Ranjan Chaudhury (SNBNCBS).

Publications in Journals

Ranjan Chaudhury and **Samir K. Paul**, *Topological Excitations in Quantum Spin Systems*, Advances in Condensed Matter Physics, **2013,** ID 783420 (2013).

Supervision of Students

Ph.D. Students: Rudranil Basu (Thesis submitted in July, 2013), Subhajit Sarkar (jointly with Ranjan Chaudhury, CMPMS)

Courses Taught

PHY 501, Research Methodology (five talks on Ising models as a part of the course)

Participation in Committees

Internal: SCRE committee, Syllabus Modification committee

Subhrangshu Sekhar Manna

Senior Professor

Department of
Theoretical Sciences

- Percolation Phenomena, Particles moving under symmetric exclusion process, Collective behavior, Disease spreading models, Fiber bundle model, Information sharing and sorting process

A region of two-dimensional space has been filled randomly with large number of growing circular discs. This model has following properties: (i) The Order Parameter appears to jump discontinuously at a certain critical value of the area coverage; (ii) the width of the window of the area coverage needed to observe a macroscopic jump in the Order Parameter tends to vanish as $\delta \to 0$ and on the contrary (iii) the cluster size distribution has a power law decaying functional form. While the first two results are the signatures of a discontinuous transition, the third result is indicative of a continuous transition.

A simple model of the two dimensional collective motion of a group of mobile agents have been studied. Like birds, these agents travel in open free space where each of them interacts with the first n neighbors determined by the topological distance with a free boundary condition. Using the same prescription for interactions used in the Vicsek model with scalar noise it has been observed that the flock, in absence of the noise, arrives at a number of interesting stationary states. One of the two most prominent states is the `single sink state' where the entire flock travels along the same direction maintaining perfect cohesion and coherence. The other state is the `cyclic state' where every individual agent executes a uniform circular motion, and the correlation among the agents guarantees that the entire flock executes a pulsating dynamics i.e., expands and contracts periodically between a minimum and a maximum size of the flock. We have studied another limiting situation when refreshing rate of the interaction zone is the fastest. In this case the entire flock gets fragmented into smaller clusters of different sizes.

A model for the sharing and sorting of informations in a community consisting of a large number of agents has been stidied. The information gathering takes place in a sequence of mutual bipartite interactions where randomly selected pairs of agents communicate with each other to enhance their knowledge and sort out the common information. Though our model is less restricted compared to the well established naming game, yet the numerical results strongly indicate that the whole set of exponents characterizing this model are different from those of the naming game and they assume non-trivial values. Finally it appears that in analogy to the emergence of clusters in the phenomenon of percolation, one can define clusters of agents here having the same information. We have studied in detail the growth of the largest cluster in this article and performed its finite-size scaling analysis.

Publications in Journals

1. Abhijit Chakraborty and **S S Manna**, *Space-filling percolation*, Phys. Rev. E, **89**, 032103 (2014).
2. B. Bhattacherjee, K. Bhattacharya and **S. S. Manna**, *Cyclic and Coherent States in Flocks with Topological Distance*, Frontiers in Physics, **1**, 35 (2014).
3. Abhijit Chakraborty and **S. S. Manna**, *Disease spreading model with partial isolation*, Fractals, **21**, 1350015 (2013).
4. Chandreyee Roy, Sumanata Kundu, and **S. S. Manna**, *Scaling forms for relaxation times of the fiber bundle model*, Phys. Rev. E , **87**, 062137 (2013).
5. Biplab Bhattacherjee, **S. S. Manna** and Animesh Mukherjee, Information sharing and sorting in a community, Phy. Rev. E., **87**, 062808 (2013).

Supervision of Students

Ph.D. Students: Abhijit Chakraborty, Biplab Bhattacherjee, Chandreyee Roy, Sumanata Kundu;

Project Students: Monalisa Singh Roy

Subodh Kumar Sharma

Emeritus Professor

Department of
Theoretical Sciences

- Applications of Light Scattering Technique to biomedical tissue and interstellar dust characterization

Scattering phase function is an important quantity needed as input for solution of multiple scattering problems. We have examined a variety of phase functions and proposed some phase function ourselves. This work has been done over last 15 years. A critical review of this topic was undertaken. Resulting review article will appear in "Light Scattering Reviews" later in the year.

In the context of light scattering from biomedical tissues, we suggested in 2012 a method for distinguishing plasmodium falciparum infected red blood cells from normal cells. Different aspects of this approach are being examined further.

Supervision of Students

Ph.D. Students: Pritesh Ranadive at IUCAA, Pune;

Project Students: S Samaddar - Application of Physics in Non-invasive Medical Dignosis with the help of Tomography (R K Mission, Narendrapur, Kolkata)

Lectures Delivered

1. Soft tissue characterization via anular scattering and diffuse reflectance measurements, and
2. Analytic formulas for extinction of major components of interstellar dust,

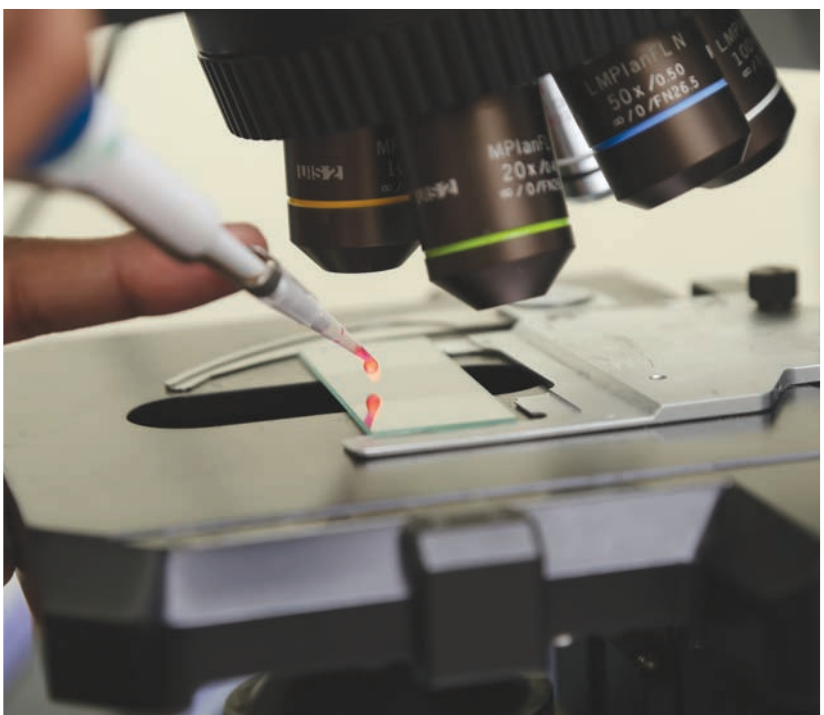
in Workshop on "Light scattering techniques and applications in astrophysics" and other areas held during 19-21 November 2013.

Courses Taught

PHY 203. Electromagnetic Theory, 2nd Semester

Meetings Organized

Light Scattering Techniques and Applications to Astronomy and other Areas, 19-21 November 2013, SNBNCBS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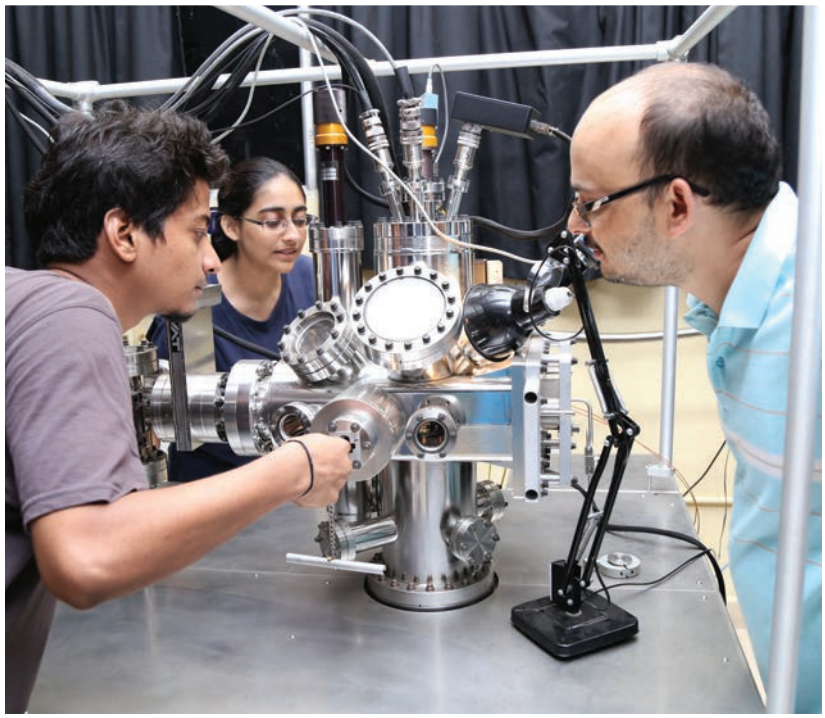

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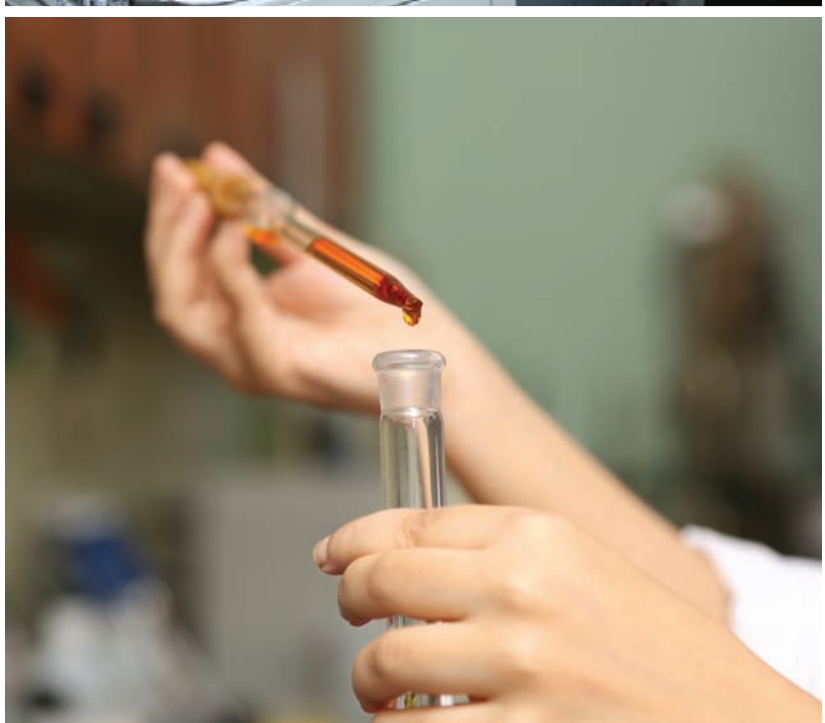


Library

About Library

Library of the Centre is the hub of learning and research activities. Since inception of the Centre in 1986, library has been playing an important role in providing information and various academic services to its users; the library also provides service to outside students, researchers and professionals working throughout the country and abroad in all possible ways.

Collection

The Library has a good and useful collection of documents. Presently library possesses more than 13685 books and 8000 bound volume journals. The Library subscribes many useful journals published by reputed publishers mostly in electronic version. In addition, being a member of National Knowledge Resource Consortium (NKRC), library gets access to a wide range of online journals. The library is also equipped with databases like web of Science, SciFinder Scholar, Mathscinet, ICSD, Indiastat etc. Library has a Fiction Section with popular books on English, Hindi and Bengali literature. It includes novels, short stories, biographies, dramas, and books on general interests aiming to satisfy all type of readers. Library has a good collection of audio-visual materials. In the magazine and newspaper reading section, 17 popular magazines and 13 daily newspapers in different languages are subscribed regularly. The library is enriched with a valuable archive of S N Bose. This archive includes some personal belongings of S N Bose and his personal book collections.

Library Hours

The Library is open from morning 9.00 AM to Night 12.00 AM. During examination Library is open for whole night. Saturday 9.00 AM to 8.00 PM. However, circulation counter is open from 9:00 AM to 5:30 PM. Library is closed on Sundays and national holidays

Library Users

On an average 50 users visit the library per day. Online journals and databases are accessible within the campus through campus LAN and outside the campus through VPAN. Therefore users may use those online resources from their convenient places.

Services

1. **Reading Facility:** Library provides reading facility to its members as well as outside visitors. All the books including reference collections are classified and are open-accessed.

2. **Document Lending service:** Each member is entitled to issue 6 books and 2 bound volumes of journals at a time.

3. **Reference Service:** Reference service is provided via e-mail, telephone or personal interaction with the help of different reference tools like encyclopedias, directories, dictionaries, yearbooks, web of science, annual report etc.

4. **OPAC:** Library offers Online Public Access Catalogue (OPAC) which allows user to browse library collection by author, title, subject, classification number, etc. through web OPAC.

5. **E-resources and Internet Facility:** Library is well equipped with sufficient number of computers with internet connectivity 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 subscribed e-resources.

6. **Reprographic Services:** Library has printer cum copier, good colour printer, photocopy machine and poster printer for providing extensive reprographic service.

7. **Audio-visual Room:** Library has a separate Audio-Visual Room for showing multimedia presentation, video lectures, documentaries etc. The room is equipped with projector, screen, white board and sitting arrangements. The room is used as a discussion room for teachers and students.

8. **Bibliometric Services:** Library helps to prepare various bibliometric reports specially usage statistics, citation analysis, h-index, Impact factor of Journals etc. as per users' request.

9. **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 libraries under DST and CSIR. SNB library has institutional membership in the British Council Library (BCL), Kolkata.

10. **Library is for leisure:** Library has a separate section for Bengali, Hindi, and English literature, fiction, classic literature, novel, history, and books on general interest.

11. **Institutional Repository:** Library has an institutional digital repository with search engine facility. It is enriched with pre-published version of the published research papers of the S.N. Bose Centre. Library has also developed the S.N. Bose Archive containing photographs and scanned documents related to S. N. Bose. Library has repository of Ph.D. thesis of the Centre.

Resources and Services Added in the F.Y. 2013-14

1. Approximately 615 new books and some new journals have been added in the library collection during the last financial year.

2. Library has developed an institutional digital repository with multiple way search facility. It is enriched with pre-published version of the published research papers of the S.N. Bose Centre. In this financial year retrospective papers for the years 2012, 2009 and 2008 have been uploaded in the repository.

3. In the Financial Year 2013-14, the special Fiction Section has been enriched by procuring 372 books of classic literature, novel, short story, biography and books of general interests.

4. Library has also developed the S.N. Bose Archive containing photographs and scanned documents related to S. N. Bose. The archive is linked to the Centre's website.

5. Library created a map section containing 5 large wall fixed maps .i.e. map of World, India, West Bengal, North 24 Parganas and Salt Lake City.

6. Library has been compiling the Annual Report, Annual Research Profile, Diary, and Calendar of the Centre and coordinated the process of printing.

7. New arrival section has been made inside the Library, where, every month, newly processed books are displayed for the user. Same list has been uploaded in the website on the first week of every month.

8. Every month Library is preparing pictorial research publication status of the Centre and it is uploaded in the website on regular basis.

9. To reduce the dependency of paid proprietary Library Management Software Libsys, Library has customized an open source software KOHA. And it is working in the online environment, so far 6000 bibliographic records has been fed in the KOHA database.

Saumen Adhikari

Librarian – cum – Information Officer

Engineering Section

The functions of Engineering Section of the Centre can be broadly divided into three categories:

- New works & Creation of New Facilities
- Maintenance, Repair & Renovation
- Estate Management

A spirited team of engineers and staff worked untiringly to uphold the Centre's objective. Other sections, students and faculties cooperated generously in execution of various works. A brief account of the Engg Section's annual activities is given below.

New Works / Facilities

Building works

- **Construction of Integrated Hostel Building & Transit Quarters Complex (G+5)** - This hostel building will be constructed at present in the same pattern of existing nearby Krishnachura Hostel Building (G+5). Its design of pile foundation has been considered G+11. Necessary soil investigation has been completed. On open tendering method lowest bidder, M/s. Bridge and Roof Co. (India) Ltd. has been selected. Work order has been issued in favour of M/s. Bridge and Roof Co. (India) Ltd.
- **Proposed Construction of G+7 Multi-storied Building** - The Expression of Interest (EOI) of the above mentioned building for empanelment of selection of Architect is approved by the Competent Authority. The purpose of this building is to create space for research laboratories, student and visitors' bay, lecture's room and seminar hall, space for administration works, faculty offices and board room, cafeteria etc. This EOI will be notified in the daily newspapers as well as in the Centre's website very soon.
- **Construction of Liquid Helium Plant Room** – Construction completed.
- **Construction of new 11kV / 440 v substation building** - design engineering, preparation of specification & estimate and tendering completed.
- **Creation of special room for installation of supercomputing facility (CRAY).**
- **Repairing of floor of existing pump-room & extension of pump-house.**
- **Construction of Peripheral Pathway** - design engineering, preparation of specification & estimate and tendering completed.
- **Reconstruction of Main Gate** - design engineering, preparation of specification & estimate and tendering completed.

Electrical works

- Installation of VRF AC system in Library – design and estimation done.
- Power supply work for CRAY facility.
- Replacing HPSV/Metal Halide lamps with solar powered LED lamps – design & estimation.
- Supply, installation, testing & commissioning of AFAS at Library – Estimation, tendering completed.
- Miscellaneous minor electrical works.

Building Maintenance Works

1. **Repairing, Renovation and Restoration of Central Portion of Bhagirathi Guest House:**

Renovation work of the central portion of Bhagirathi Guest House is almost in completion stage except roof treatment work and toilet fixtures for differently abled persons. This two works will also be completed very soon.

2. **Renovation of A and B Wings including Painting of few Rooms and Face Lifting of Rear Portion of Bhagirathi Guest House:**

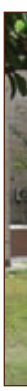
Portions of these two wings will be renovated keeping parity with the already renovated Central Portion in respect of corridors, floors and room painting for which necessary advertisement for selection of Agency has been published.

3. **Repairing and Renovation of Seminar Hall at Ground Floor of Bhagirathi Guest House:**

The existing timber flooring has been damaged by termite insects which will be replaced by vitrified tiles. Necessary wall repairing and its complete painting has been taken up.

Other Maintenance works

Initiating proposal, estimating, open tendering, execution and overall supervision of service, operation & maintenance contracts



- Housekeeping of Main Building & Hostels.
- Water Supply, Sanitary & Plumbing Installations of the Campus.
- Landscaping and Horticulture.
- DG Sets, Substation and Electrical Installation.
- Lifts.

Maintenance of AC and Water-coolers by in house staff.

Estate Management

1. **Looking after cleaning and hygiene of the Centre:**
    - AMC management for housekeeping of Main Building and two Hostels.
    - Annual contract for pest control services - overall supervision and monitoring.
    - Scrap & waste disposal.
2. **Complete maintenance and beautification of the Campus:**
    - AMC management for Landscaping & Horticulture work.
    - Overall supervision and monitoring of performance of the contractor.
    - Providing necessary support and suggestion to gardeners for growing seasonal flowers.
3. **Facilitating the Organizing Committees of academic and cultural programmes of the Centre**. Face-lifting works, Campus cleaning and arrangement of infrastructural facilities for hosting DST-Autonomous Bodies' Conclave.
4. **Furnishing offices, hostels, staff quarters and laboratories** as needed and approved by the appropriate authority.
5. **Arranging office space and accommodation** of faculties, academic and staff-members as per office-order and custodian of keys related to Estate.
6. **Physical movement of assets, furniture etc. Physical verification of assets.**
7. **Fire-Safety Management of the campus.**
8. Liaison with Bidhan Nagar Municipality, State Forest Dept., WBSEDCL, Fire-Service and other local authorities.

A. Ganguly.

Avijit Ganguly
Campus Engineer cum Estate officer

Computer Services Cell

The Computer Services Cell (CSC) enables to extend all computational facilities and computer related services of the centre. The **Computer Services Cell Advisory Committee (CSC-AC)** governs the cell and the **Computer Services Cell Working Group Committee (CSC-WG)** carry out required services. CSC In-charge (Mr. Sanjoy Choudhury), Junior Computer Engineers (Mr. Abhijit Ghosh, Mr. Abhijit Roy, Mr. Prosenjit Lahiri and Mr. Sagar S. De) and Jr. Assistant (Mr. Bijay Pramanik) had supported all kind of day-to-day activities associated to the cell.

At the end of the academic year 2013-14, there were about 500 users including faculty members, administrative staffs and students. The Centre has 100Mbps internal network; 100Mbps and 8Mbps leased line for internet access. Internal backbone is made up with Optical Fiber for high speed connectivity. In the last year Wi-Fi has been reinstall after Bhagirathi Guesthouse repairing. New Web, Intranet servers has been configured with better platform support for name based access, robust performance and better security. Desktops, Printers, UPSes, Xerox machines and other Network devices have been maintained regularly. Activities such as updation of website, tenders, jobs, web-based General Notice Board (where the Centre's general, official, academic, seminar and placement related notices are posted regularly), hall booking of lecture halls are followed regularly. CSC also looks after other centre computational facilities including Serial Computing Clusters and Parallel Computing Clusters built by Super Micro. Project Clusters are also maintained by the cell. New super computer (CRAY) has been installed as a part of TUE-CMS project.

Summary of central computational facilities

Machine Name	Processor Core	Storage	User
Photon	84	NA	55
Phonon	84	NA	27
HPC	344	2.2 TB	72
UNANST (partial)	96	12 TB	--
AMRU1	360	6 TB	31
AMRU2	48	NA	27
PMG	60	NA	10
EDRA2	120	NA	12

Summary of project sponsored computational facilities

Machine Name	Processor Core	Storage	User
ATHENA	320	NA	12
UNANST (partial)	480	12 TB	25
CRAY	7808	250	50

CSC-AC Members: Prof. Tanusri Saha Dasgupta, Prof. Priya Mahadevan, Prof. Amitabha Lahiri, Prof. Ranjit Biswas, Prof. Soumen Mondal, Ms. Shohini Majumder, Mr. A. K. Sarkar, Mr. Avijit Ganguly, Prof. Punyabrata Pradhan, Mr. Sanjoy Choudhury.

CSC-WG Members: Prof. Tanusri Saha Dasgupta, Prof. Amitabha Lahiri, Prof. Manoranjan Kumar, Ms. Shohini Majunder, Mr. S. K. Singh, Mr. Soumen Adhikari, Mr. Sanjoy Choudhury, Mr. Abhijit Ghosh, Mr. Abhijit Roy, Mr. Prosenjit Lahiri, Mr. Sagar S. De.

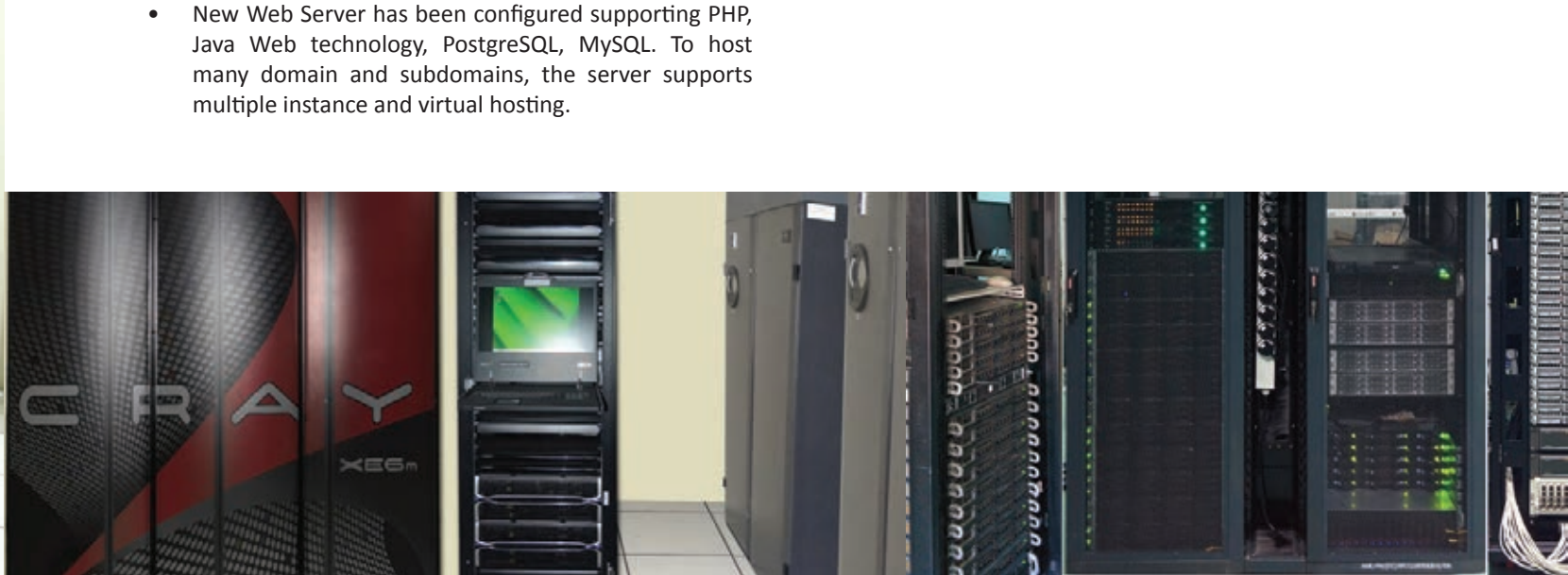
Major achievements (2013-14)

- In the process of reducing dependencies from ISPs and to increase network reliability, CSC step forward towards Multihoming. Therefore CSC has acquired a pool of 256 public IP addresses along with Autonomous System Number (ASN) from Indian Registry for Internet Name and Numbers (IRINN).
- CSC configured linux based personal firewall, gateway for the centre.
- VPN service has been revised and reconfigured in the dedicated gateway firewall supporting LAN as well as Journal access.
- For web and intranet applications, CSC introduced name based access replacing old IP based access.
- New Web Server has been configured supporting PHP, Java Web technology, PostgreSQL, MySQL. To host many domain and subdomains, the server supports multiple instance and virtual hosting.
- To reduce power consumption, space and maintenance, a separate Intranet Server has been configured, suspending all individual desktops for the intranet applications.
- Administration server has been recovered from crash and applications have been restored.
- On October 20, 2013, CSC launched new dynamic Website for the centre. The site supports low and easy maintenance and possible auto update.
- Web applications such as Radhachura booking, Guesthouse Billing, Visitor pass has been developed and deployed in the intranet server.
- Admission application has been modified to fullfil 2014 admission criteria.
- Different complaint tracking system has been introduced.
- BCRC blog has been created.
- Guesthouse Wi-Fi has been re-established after building repair. Entire guest house is now covered by enterprise class Wi-Fi equipment to provide internet facilities.
- Old CO_2 and Dry Powder based fire extinguishers have been replaced with safer clean agent based fire extinguishers in the cell.
- Comprehensive fire safety solution has been proposed for the entire computer centre which is in the due process of being implemented.

Sanjoy Choudhury

Sanjoy Choudhury

In-charge, Computer Services Cell



Project Cell

Like the years before, the project cell - now a mature facility, provided a smooth and streamlined procedure for regular housekeeping for the incumbent projects, channeled itself to any new project grant application and finally was a storehouse for the past projects. The website, http://bose.res.in/~prjcell, for the project cell now has the relevant forms for use of the concerned people.

The following table summarises the details of externally funded projects that were running for the last five years, ending with the concerned financial year.

Year	No. of Projects	Amount Received (Rs.)
2009-2010	39	5,51,44,887=00
2010-2011	40	4,83,19,968=00
2011-2012	41	7,13,74,645=00
2012-2013	36	5,94,78,715=00
2013-2014	31	10,10,54,463=00

The details are listed overleaf –

Ongoing Projects in 2013-14

Project Title	PI / Co – PI	Funding Agency
"J.C. Bose Fellowship"	Prof. A.K. Raychaudhuri	DST SR/S2/JCB-17/2006
DST/MM/09-10/21 – "Synthesis of DNA and Micelles Templated Magnetic Nanoparticles and their Necessary Surface Functionalization for Bio –Medical Applications"	Dr. Madhuri Mandal	DST (SERC Fast Track) SR/FT/CS-090/2009
DRDO/KM/09-10/24 – "Study of magneto caloric effect"	Dr. Kalyan Mandal	DRDO ERIPR/ER/0902182/M/01/1296
DST/KD/09-10/28 – "Investigation of the intrinsic conductivity of undoped single Si nanorod/ nanowire grown by vapor transport and chemical method"	Dr. Kaustuv Das	DST (SERB) SR/FTP/PS-60/2009
CSIR/KM/09-10/29 –"Preparation and study of nanostructured dilute magnetic semiconductors"	Dr. Kalyan Mandal	CSIR 03(1178)/10/EMR-II
DST/AB/09-10/31 – "Magnonic Crystals: New paradigm towards microwave communications"	Dr. Anjan Barman	DST (DST-JST Prog) INT/JP/JST/P.23/2009
SRC/TSD/09-10/38 – "Magnetism in organic materials"	Dr. Tanusri Saha Dasgupta	Swedish Research Council (SRC)
DST/AKR/09-10/40 –"Unit on Nanoscience at SNBNCBS, Kolkata (UNANST – II)	Prof. A.K. Raychaudhuri	DST SR/NM/NS-53/2010
DST/PM/10-11/41 –"Electronic and structural properties of semiconductors at the nanoscale"	Dr. Priya Mahadevan	DST (Nano Mission) SR/NM/NS-91/2010(G)
DST/KA/10-11/43 –"The study of photo-desorption and photo-ionization of Complex Molecules in Star Forming Regions"	Dr. Kinsuk Acharyya	DST (SERC Fast Track) SR/FTP/PS-075/2010(G)
DST/SB/10-11/50 –"Advanced Computational Study of Magnonic crystals"	Dr. Saswati Barman	DST (Women Scientist Scheme – A) SR/WOS-A/PS-27/2010(G)
DIT/AB/10-11/52 –"Development of GHz Frequency Filters and Attenuators using Nanoscale Magnonic Crystals"	Dr. Anjan Barman	DIT 1(7)/2010/M&C
DST/AKR/10-11/53 – "Investigation of strain-dependent magnetization dynamics and electronic transport in magnetic oxides for spintronics and signal processing applications"	Prof. A.K. Raychaudhuri	DST-DAAD (Indo-German) INT/FRG/DAAD/P-210/2011 dated 9-7-2011

Project Title	PI / Co – PI	Funding Agency
DST/AKR/10-11/55 –"Electroresistance in single crystals and thin films of mixed valence manganites"	Prof. A.K. Raychaudhuri	DST (DST-RFBR) (RUSP-1183) INT/RFBR/P-110
DST/BBB/11-12/61 – "Geoelectrical Methods: Theory and Application"	Prof. Bimalendu B. Bhattacharya	DST (SERB) HR/UR/09/2011 dated 13-2-2012
DST(FT)/MG/11-12/62 – "Structural and functional characterization of small heat shock proteins from *Bradyrhizobium japonicum*"	Dr. Mahua Ghosh	SR/FT/LS-94/2011 dated 29-5-2012 (SERB)
DST/AKR/11-12/63 –"Thematic Unit for Excellence on Nanodevice Technology"	Prof. A.K. Raychaudhuri / Dr. Anjan Barman (Coordinator)	DST SR/NM/NS-09/2011
CSIR/RKM/11-12/67 –"Water encapsulated in mixed reverse micelles: modulation of its structure, dynamics and activity"	Dr. Rajib Kumar Mitra	CSIR 01(2573)/132/EMR-II
UKIERI/AKR/11-12/70 – "Nano Breath App"	Prof. A.K. Raychaudhuri	IND/CONT/E/11-12/086
"Thematic Unit of Excellence on Computational Materials Science at the SNBNCBS, Kolkata"	Prof. Tanusri Saha Dasgupta	DST SR/NM/NS-29/2011
DST/SKP/11-12/78 –"Spectroscopic Studies on Light Harvesting Hybrid Materials and Potential Application in Dye-sensitized Solar Cells"	Dr. Samir Kumar Pal	DST DST/TM/SERI/2k11/ 103
DBT(RGYI)/MP/11-12/80 –"Cavity Ring-down Spectroscopy for Real Time Breath Analysis: A Next Generation Diagnostics in Modern Medicine"	Dr. Manik Pradhan	DBT (RGYI) BT/PR6683/GBD/27/ 477/2012
DST/PM/11-12/82 – "Modeling multiferroic materials"	Dr. Priya Mahadevan	DST-DAAD (Indo-German) INT/FRG/DAAD/P-224/2012
MES/MP/11-12/85 -"Development of a mid-IR Cavity Ring-Down Spectrometer for High-Precision Real-Time Continuous Monitoring of Multiple Trace Gases and Stable Isotopic Species in the Atmosphere"	Dr. Manik Pradhan	MoES/16/26/12-RDEAS
DST/JC/12-13/91 – "Microscopic calculations of metal ion binding to proteins"	Dr. Jaydeb Chakrabarti	DST (SERB) SR/S2/CMP-100/2012
DBT/AM/12-13/92 – "Development of nanomaterial based dual mode contrast agent and their surface mediated conjugation study from first principles"	Prof. Abhijit Mookerjee, Dr. Ranjit Biswas (From SNBNCBS)	Biotech Consortium India Ltd. (DBT) BCIL/NER-BPMC/2013-367
DST-UKIERI/AB/12-13/102 – "Nano-Engineered Magnetic Materials for Spintronic Applications"	Dr. Anjan Barman	DST-UKIERI INT/UK/UKIERI/P-44/2013

Project Title	PI / Co – PI	Funding Agency
DST/SKP/12-13/105 – "Study on the role of biomolecular conformation and environmental dynamics in the process of molecular recognition with Time-resolved optical spectroscopy"	Dr. S.K. Pal	DST (SERB) SB/S1/PC-011/2013
DRDO/PKM/12-13/108 –"Development of synthetic body armour based on smart fluids"	Dr. P.K. Mukhopadhyay	(DRDO) PXE/TE/CARS PXE/CARS/01/2013
"Ramanujan Fellowship"	Dr. Manoranjan Kumar	DST SR/S2/RJN-69/2012
"Science and application of organic ligand-transition metal oxide hybrids as new functional materials"	Dr. S.K. Pal	DAE – BRNS 2013/37P/73/BRNS

In addition to the generation of financial assets, the projects attracted a lot of human resources. There were 9 project students in this particular year, 15 PDF/RAs and 5 DST Inspire Faculties.

Pratip Kumar Mukhopadhyay

Convenor, Project Cell

Technical Cell

All the central experimental facilities are maintained by the Technical Cell. The facilities are available to use for free to the Centre's staffs and students and are made available to the external users on payment basis.

Organization of the Technical Cell:

The Cell has 2-tier organization,

(a) broad policy making body called the Technical Cell Advisory Committee and

(b) a management group called the Technical Cell Working Group

The details about the facility is available in the website

http://newweb.bose.res.in/facilities/TechnicalCell/

	Details	
i)	Number of Major equipments	13
ii)	Other equipments	8
iii)	Equipments under AMC (*Non comprehensive)*	14
iv)	UPS under AMC *(Non comprehensive)*	8
v)	Chiller under AMC *(Non comprehensive)*	5
vi)	Main job done:	a) Facility running b) Utilization through a transparent slot booking system (users : internal and external) c) Maintenance d) Up-gradation e) purchase and installation of new equipments
vii)	Number of Internal users	40
viii)	Number of external users From: Institutes/universities/colleges	31

List of External Users:

Our Frequent Users			
1.	Jadavpur University, Kolkata	17	IACS, Kolkata
2	Bardwan University	18	CMERI, Durgapur
3	Presidency University, Kolkata	19	Vellore Institute of Technology
4	Kalyani University	20	BESU, Shibpur, West Bengal
5	Vadodora University	21	WBUT, West Bengal
6	Calcutta University (Science College)	22	Delhi IIT
7	CU (Ballygunge Science College)	23	IISER Kolkata
8	Hyderabad University	24	NIT, Durgapur
9	Tezpur University	25	Central Institute of Technology, Assam
10	Tribhuvan University, Nepal	26	Shree Devi Institute of Technology, Mangalore
11	Vignan University	27	DIT University, Dehradun
12	M S University, Tamil Nadu	28	Asutosh College, Kolkata
13	IFTM University, Moradabad	29	Sammilani College, Kolkata
14	Indian Statistical Institute, Kolkata	30	Reliance Industries Ltd.
15	Bose Institute, Kolkata	31	Botanical Survey of India
16	Saha Institute of Nuclear Physics		

The list of the major equipments falling under technical cell are given below:

- X-ray Diffractometer (XRD)
- Mini X-ray Diffractometer (Mini XRD)
- Environmental Scanning Electron Microscope (ESEM)
- Field Emission Scanning Electron Microscopy (FESEM)
- Energy Dispersive X-Ray Analysis (EDAX)
- High Resolution Transmission Electron Microscope (HRTEM)
- Atomic Force Microscopy (AFM)
- Vibrating Sample Magnetometer (VSM)
- Thermo Gravimetry/Differential Thermal Analyzer (TG/DTA)
- Dynamic Light Scattering (DLS)
- Spectroscopic Ellipsometer
- Pulsed Laser Deposition (PLD) Unit
- DSC / Modulated DSC

Total Equipment utilization time:

A brief monthly report stating up-time of facilities, status of any facility not working, hours utilized and users who utilized, which is being uploaded in the Centre's intranet every month.

Item	Usage time (%)	Up time (%)
XRD (old machine installed in 2005)	30%	42%
FESEM	26%	90%
VSM	65%	82%
AFM	73%	95%
PLD	65%	95%
Sputtering/evaporation	11%	80%
TEM	50%	75%
TG/DTA	36%	90%

Note:

- ✓ The large down time for the XRD machine is due to repair and maintenance.
- ✓ Other equipment, not included in the table: users are less, but uptime is 95%.

A) Major Facilities under Technical cell:

Equipments:

1) X-ray Diffraction #1: *Installed: 2005*

PANalytical X-PERT PRO With solid state detector and Pixel detector

Different measurement modes:

i) Powder diffraction

ii) Thin film reflectivity

iii) high resolution rocking curve analysis

iv) stress/texture analysis

v) Small angle x-ray scattering (SAXS)

Note: Upgraded with high temperature powder Diffraction Facility on 19.04.2009

i)high temperature (1600 °C) attachment ,

ii) pixel detector.

2) X-ray Diffraction #2: *Installed: March, 2011*

Rigaku, model: MiniFLEX II : **Measurement mode:** Powder diffraction

Equipments:

3) Environmental SEM (ESEM) with W-filament: With E-beam lithographic facility

FEI QUANTA 200 ESEM resolution ~ 2.4nm under high vacuum resolution ~3.0nm under low vacuum

Note: Upgraded with FESEM on Jan, 2013: Model: Quanta 250 FEG

For High, low and Environmental mode imaging

Made: FEI, Source: FEG

Electron beam Resolution achievable up to 1.2 nm (approx) at 30 kV

4) Vibrating Sample Magnetometer (VSM): Lakeshore (Model no: 7407) ***Installed: April, 2006***

Temperature range: 77K -400K Magnetic field range: ±1.6 Tesla resolution ~1.25 micro-emu

Note: Upgraded on 17.08.2009: High temperature attachment: ~1273K

5) Atomic Force Microscopy (AFM), ***Installed: 2005:*** Model: Veeco CPII With lithography facility

Note: Upgraded on August 2011: Innova model of Bruker. with added advantages of better precision in Nanolithography and Nanomanipulation

6) Pulsed Laser Deposition (PLD) Unit: Model: Compex Pro 201 made by Coherent Inc. ***Installed: Nov. 2008***

Pulsed Excimer Laser:

Wavelength: 248nm(KrF) &193nm (ArF)

Max^{m} power: 700mJ

Repetition rate:10Hz

Note: Upgraded on 23.3.12.

i) High pressure RHEED system (RHV-KSA) from STAIB Instruments, Germany for in situ analysis of the deposited film by laser ablation.

The electron source energy ~ 35 KeV

7) High Resolution Transmission Electron Microscope (HRTEM): with 200 kV EFG source: ***Installed: April, 2011*****: Model: Technai G^{2} S-Twin (FEI, Netherland)**

i) Resolution 0.2 nm

ii) High resolution HAADF STEM detector with magnification range 200 x to 1M x.

Note: a) Upgraded on 12.8.2011.

i)Electron Energy Loss Spectroscopy (EELS) attachment model: GIF Quantum 963 from Gatan, USA: energy resolution ~ 0.9 eV.

b) **Upgraded on Oct 2012 with Ultra microtome:** Specially designed to prepare cross section of Biological sample for TEM Imaging.

B) Other facilities under Technical cell:

1. Differential Scanning Calorimeter (DSC):	2. TG-DTA:	Dynamic Light Scattering (DLS):	Spectroscopic Ellipsometer:	Sputtering/ evaporation unit:
Model: DSC Q 2000 (TA Instruments) Installed: Jan 2011	Model: Perkin Elmer made system the Temperature range of 50 °C to 1200 °C.	Model: Zetasizer system resolution of < 1nm	Model: WVASE32 system (J. A. Woollam Co. Inc.)	Model: HINDHIVAC dc and rf magnetron sputtering system. With resistive evaporation attachment

C)Up-gradation of Facilities during 2013-14:

i) Helium Leak detector

Barnali Ghosh (Saha)

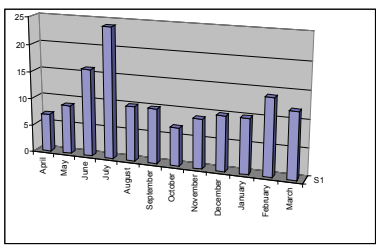
Barnali Ghosh (Saha)
Scientist in-charge,
Technical Cell

Mechanical Workshop

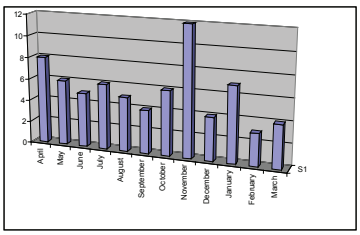
Both the glass blowing and the mechanical workshop sections were operational in this year and gave service to users from inside the centre and a few out of it. The glass blowing facility is used to construct various glass and quartz contraptions, and a major demand is for vacuum or argon flushed quartz ampouling for various atmosphere sensitive samples.

There were 47 outside works done for outside users, generating some revenue also in the process. The number of jobs from the centre was 23.

For the mechanical workshop, it has a small lathe machine, a milling machine, a drilling machine etc. for simple jobs, there were quite a few users from the labs and other departments. It finished 138 jobs in all.



Graph for work done by the mechanical workshop



Graph for work done by the glass blowing section

The mechanical workshop remains open on all working days. The glass blowing section normally works on Tuesdays, but can be operated on other days if the need arises.

Pratip Kumar Mukhopadhyay
In-charge, Mechanical Workshop

Guest House

Bhagirathi – The Guest House

The Centre has its own modern guest house named 'Bhagirathi' and cafeteria located within the premises. In the guest house there are five (5) fully air conditioned suites and three (3) fully air conditioned transit rooms each having attached bath and kitchenette, eight (8) double-bed and forty six (46) single bed, air-conditioned, fully furnished rooms. All rooms are provided with basic amenities like hot water, telephone, television, electric kettle etc. All rooms are equipped with basic furnishings, Cable TV, wi-fi, etc. The third floor of the guest house comprising twenty two (22) single rooms and four (4) double rooms are being presently used for accommodating students. A small seminar room with sitting capacity of twenty (20) 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, Wi fi, laundromat, ATM and car parking facilities. The Central portion of the guest house has recently been renovated and entrance and lobby has got a new look. 'Bhagirathi' is a venue for accommodating guests and visitors of the Centre and also houses guests from government organisations like C-DAC, IGNOU, ICAR labs, CSIR labs, DAE, etc.

Students' Hostel & Essential Staff Quarter

The Centre presently provides residential accommodation to around one hundred and forty three (143) students currently enrolled in various programmes. An integrated hostel – Krishnachura can provide accommodation upto one hundred and twenty-two (122) students. The New Hostel Block – Radhachura provides accommodation for thirty-two (32) students. The third floor of the Bhagirathi guest house comprising twenty two (22) single rooms and four (4) double rooms are used for accommodating students. The Centre also provides rented accommodation located within close proximity to the Centre for accommodating post doctoral fellows etc. The Centre has limited accommodation for outstation post doctoral fellows with families and for single women faculties. The Essential Staff Quarter (Subarnarekha) located within the Centre currently houses several scientists/ post doctoral fellows and permanent staff. At present, 6 students are staying in the Essential Staff Quarter of the Centre.

Shohini Majumder

Shohini Majumder
Registrar

Crèche

'Kishlay' is a home away from home for the children of staff and students of S. N. Bose National Centre for Basic Sciences.

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. At present, there are four children in 'Kishlay'.

Sonajumder

Shohini Majumder

Registrar

Recreation and Cultural Programmes

Throughout the year, the Centre organized a number of recreational and cultural events to ensure that there is all round healthy interactions between the members of the Centre.

- The Centre celebrated Satyendra Nath Bose's 120th birthday on 1st January 2014. The bust of Satyendra Nath Bose was garlanded by the Director and other senior faculties and sweets were distributed. On the same day, the Bose Centre Recreation Club 'MUKTANGAN' was inaugurated.
- On the occasion of 67th Independence Day on 15th August 2013 and to celebrate the 65th Republic Day on 26th January 2014, Prof. Arup Kumar Raychaudhuri, Director hoisted the national flag for both the events. 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 the 100th Anniversary of Kabiguru Rabindranath Tagore's work, Gitanjali, getting the Nobel Prize for literature on 2nd August 2013 by organising in-house Cultural programme of songs, dance and recitation exclusively performed by the students of the Centre. On that day the students of the Centre presented a musical journey through philosophical essence of Gitanjali titled 'Probhu Aamar, Priyo Aamar (My Lord, My Love)".

Like previous years, the Centre organised number of programmes in September to celebrate the Hindi Mahina. As a part of the programme, the following programme was undertaken:

- ✓ Signing of Attendance Register in Hindi.
- ✓ Everyday one new Hindi word with its English meaning is displayed in the Reception area.
- ✓ Showing of Hindi Feature Film (Chhoti Si Baat) for the students of the Centre.
- ✓ In house Hindi Play named 'Beti Bachao' was staged by students and staff of the Centre.
- ✓ A Hasya Kavi Sammelan was organised.
- ✓ A quiz session for all in Hindi

The official inauguration of the Hindi Diwas was made by the Acting Director on 14th September, 2013. The occasion was graced by Shri. R.A.Choudhury, Shri. R.N. Saroj and Shri Vipatti.

- As a part of the DST Autonomous Bodies Conclave and Young Scientists' Meet, a delightful evening of classical ragas with Vocalist Shri Soumyojit Das and pianist Shri Sourendro Mullick was organised by the Centre on 28th January 2014.
- On the occasion of Bose Fest held during 30th January 2014 –31st January 2014, Family Day was celebrated on the evening of 30th January 2014. On 30th January 2014, the staff and students presented an in-house programme comprising of individual and group performances of singing, recitation, a Nityalekha – Dance Programme named 'Aranya Amrita'. On the same day the students arranged a programme depicting the life of 'Sir Charles Spencer "Charlie" Chaplin'. The magazine 'Scipix' was also launched under the aegis of 'Muktangan'. The functions were followed by family dinner. The programmes were attended by friends and family members of staff and students and were a huge success. "Photo Fest" – the photography exhibition cum competition among the staff and students participants of the Centre also took place during this period.
- The Sports Activity Group of 'Muktangan' organised an Inter Institute Badminton Tournament on 21st February 2014 and 22nd February 2014 within the Centre's premises. The event was categorised into i) Men's Doubles ii) Women's Singles iii) Mixed Doubles. Institutes like IICB, SINP, Bose Institute, IACS, VECC etc participated in the said event.

Shohini Majumder

Shohini Majumder

Registrar


Current Science
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Journal of Earth System Science
Journal of Biosciences
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Academy Proceedings in Engineering Sciences

LIST OF PUBLICATIONS

List of Publications

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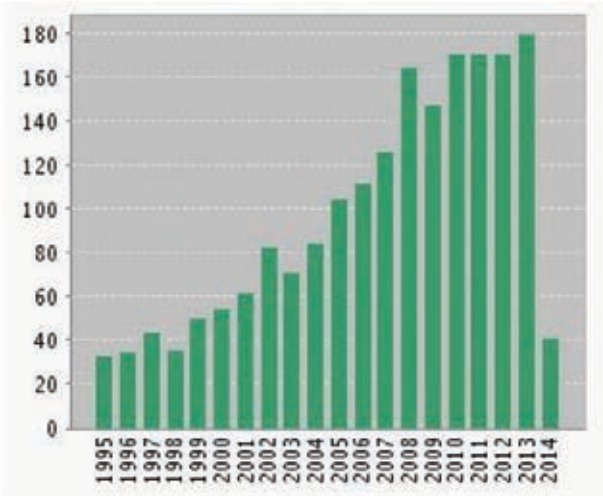

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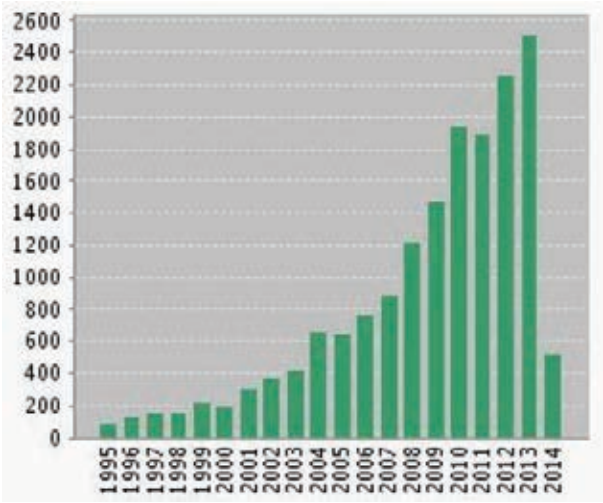

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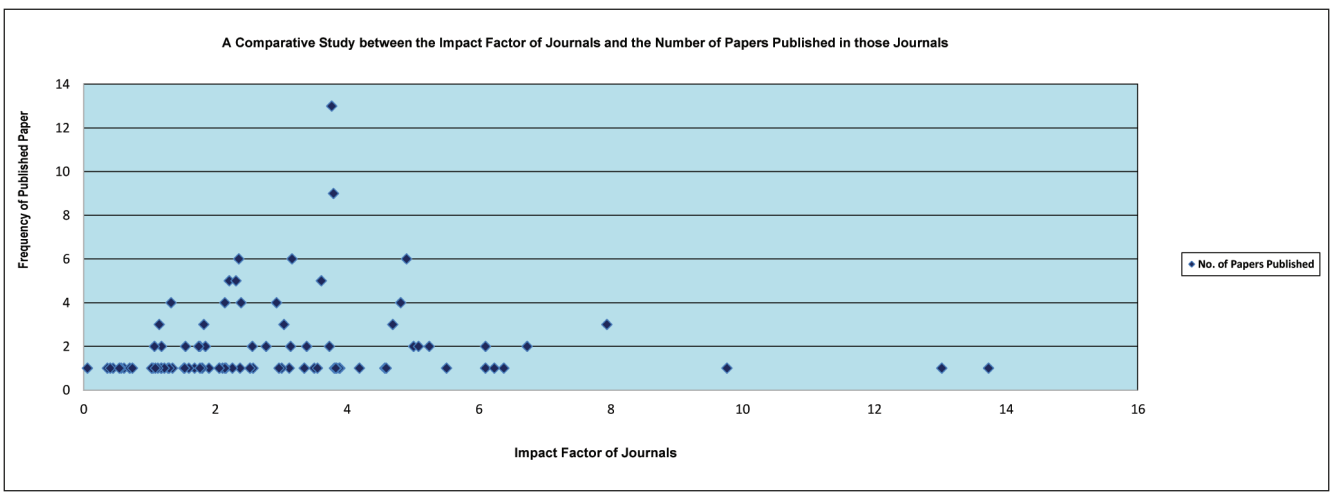
Impact Factor for Publications in the Financial Year 2013-14

Sl No.	Name of Journal	Journal Impact Factor	No. of Papers Published	Total of Impact Factor in the Journal
1	ACS Applied Materials & Interfaces	5.008	2	10.016
2	Advanced Functional Materials	9.765	1	9.765
3	Advances in Condensed Matter Physics	1.175	1	1.175
4	Advances in High Energy Physics	3.5	1	3.5
5	Advances in Space Research	1.183	2	2.366
6	Angewandte Chemie International Edition	13.734	1	13.734
7	Applied Mathematics and Computation	1.349	1	1.349
8	Applied Physics Letters	3.794	9	34.146
9	Astronomy & Astrophysics	5.084	2	10.168
10	Astrophysical Journal	6.733	2	13.466
11	Astrophysics and Space Science	2.064	1	2.064
12	Atmospheric Chemistry and Physics	5.51	1	5.51
13	Beilstein Journal of Nanotechnology	2.374	1	2.374
14	Biochimie	3.142	2	6.284
15	Biomolecular Concepts	New Journal	1	New Journal
16	Bulletin of Astronomical Society of India	3.89	1	3.89
17	Chemical Communications	6.378	1	6.378
18	Chemical Physics Letters	2.145	4	8.58
19	Chemie Ingenieur Technik	0.698	1	0.698
20	Chemistry: An Asian Journal	4.572	1	4.572
21	ChemPhysChem	3.349	1	3.349
22	Colloid and Polymer Science	2.161	1	2.161
23	Colloids and Surfaces A: Physicochemical and Engineering Aspects	2.108	1	2.108
24	Croatica Chemica Acta	0.614	1	0.614
25	CrystEngComm	3.879	1	3.879

Sl No.	Name of Journal	Journal Impact Factor	No. of Papers Published	Total of Impact Factor in the Journal
26	Dalton Transactions	3.806	1	3.806
27	European Journal of Inorganic Chemistry	3.12	1	3.12
28	European Physical Journal B	1.282	1	1.282
29	European Physical Journal C	5.247	2	10.494
30	European Physical Journal Special Topics	1.796	1	1.796
31	Europhysics Letters	2.26	1	2.26
32	Fractals	0.448	1	0.448
33	Frontiers in Physics	New Journal	1	New Journal
34	General Relativity and Gravitation	1.902	1	1.902
35	IEEE Transactions on Nanotechnology	1.8	1	1.8
36	Indian Journal of Materials Science	0.362	1	0.362
37	Inorganic Chemistry	4.593	1	4.593
38	International Journal of Materials, Mechanics and Manufacturing	0.059	1	0.059
39	International Review of Biophysical Chemistry	–	2	–
40	ISRAPS Bulletin	–	1	–
41	Journal of Alloys and Compounds	2.39	4	9.56
42	Journal of Applied Physics	2.21	5	11.05
43	Journal of Breath Research	2.571	1	2.571
44	Journal of Chemical Physics	3.164	6	18.984
45	Journal of Chemical Sciences	1.298	1	1.298
46	Journal of Engineering Mathematics	1.075	2	2.15
47	Journal of Geometry and Physics	1.055	1	1.055
48	Journal of Low Temperature Physics	1.183	1	1.183
49	Journal of Luminescence	2.144	1	2.144
50	Journal of Magnetism and Magnetic Materials	1.826	3	5.478
51	Journal of Materials Chemistry A	6.101	2	12.202
52	Journal of Materials Chemistry C	6.101	1	6.101
53	Journal of Mathematical Chemistry	1.226	1	1.226
54	Journal of Molecular Liquids	1.684	1	1.684
55	Journal of Molecular Recognition	3.006	1	3.006
56	Journal of Nanomaterials	1.547	2	3.094

Sl No.	Name of Journal	Journal Impact Factor	No. of Papers Published	Total of Impact Factor in the Journal
57	Journal of Nanoscience and Nanotechnology	1.149	3	3.447
58	Journal of Nonlinear Mathematical Physics	0.57	1	0.57
59	Journal of Physical Chemistry A	2.771	2	5.542
60	Journal of Physical Chemistry B	3.607	5	18.035
61	Journal of Physical Chemistry C	4.814	4	19.256
62	Journal of Physics A	1.766	2	3.532
63	Journal of Physics D: Applied Physics	2.528	1	2.528
64	Journal of Physics: Condensed Matter	2.355	6	14.13
65	Journal of Superconductivity and Novel Magnetism	0.702	1	0.702
66	Langmuir	4.187	1	4.187
67	Lobachevskii Journal of Mathematics	–	1	–
68	Magnetohydrodynamics	0.404	1	0.404
69	Modern Physics Letters A	1.127	1	1.127
70	Molecular BioSystems	3.35	1	3.35
71	Monthly Notices of the Royal Astronomical Society	4.9	6	29.4
72	Nano Letters	13.025	1	13.025
73	Nano-Micro Letters	2.057	1	2.057
74	Nanoscale	6.233	1	6.233
75	Nanoscale Research Letters	2.524	1	2.524
76	Nanotechnology	3.842	1	3.842
77	New Astronomy	1.85	2	3.7
78	New Journal of Chemistry	2.966	1	2.966
79	Optics Express	3.548	1	3.548
80	Optics Letters	3.385	2	6.77
81	Physica B: Condensed Matter	1.327	4	5.308
82	Physica E	1.522	1	1.522
83	Physica Scripta	1.032	1	1.032
84	Physical Chemistry Chemical Physics	3.829	1	3.829
85	Physical Review A	3.042	3	9.126
86	Physical Review B	3.767	13	48.971
87	Physical Review D	4.691	3	14.073
88	Physical Review E	2.313	5	11.565

Sl No.	Name of Journal	Journal Impact Factor	No. of Papers Published	Total of Impact Factor in the Journal
89	Physical Review Letters	7.943	3	23.829
90	Physics Letters A	1.766	1	1.766
91	PLoS ONE	3.73	2	7.46
92	Powder Diffraction	0.544	1	0.544
93	Quantum Information Processing	1.748	2	3.496
94	Regular and Chaotic Dynamics	0.742	1	0.742
95	Review of the Calcutta Mathematical Society	–	1	–
96	Review of Scientific Instruments	1.598	1	1.598
97	Reviews in Mathematical Physics	1.09	1	1.09
98	RSC Advances (Communication)	2.562	2	5.124
99	Scientific Reports (Nature Publishing Group)	2.927	4	11.708
100	Solid State Communications	1.534	1	1.534
	Total	**280.832**	**189**	**572.046**



ACCOUNTS

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

BUDGET SUMMARY 2013-2014

The funds come from the Department of Science and Technology, New Delhi. The following is the summary of the budget estimates for the year 2013-2014.

Figure in Lakhs (₹.)

	Actuals 2012-2013	Budget Estimate 2013-2014	Revised Estimate 2013-2014
Non-Plan	18.86	18.79	* 19.09
Plan	3222.99	3515.97	* 3185.53
TOTAL	3241.85	3534.76	3204.62

* Sanctioned by DST Plan ₹. 2907.45 lakhs, Non-Plan ₹. 12.75 lakhs and released as under:

Non-Plan

1.	Sanction Letter No. AI/SNB/003/2013/NP dated 23.07.13	₹.	12.75 lakhs
	Total	₹.	12.75 lakhs

B. Plan

1.	Sanction Letter No. AI/SNB/SAL/003/2013/1 dated 25.04.13	₹.	99.18 lakhs
2.	Sanction Letter No. AI/SNB/GEN/003/2013/1 dated 26.04.13	₹.	224.83 lakhs
3.	Sanction Letter No. AI/SNB/CAP/003/2013/1 dated 26.04.13	₹.	208.56 lakhs
4.	Sanction Letter No. AI/SNB/SC/003/2013/1 dated 26.04.13	₹.	3.96 lakhs
5.	Sanction Letter No. AI/SNB/SAL/003/2013/2 dated 23.07.13	₹.	364.32 lakhs
6.	Sanction Letter No. AI/SNB/GEN/003/2013/2 dated 22.07.13	₹.	753.92 lakhs
7.	Sanction Letter No. AI/SNB/SC/003/2013/2 dated 23.07.13	₹.	14.04 lakhs
8.	Sanction Letter No. AI/SNB/CAP/003/2013/2 dated 22.07.13	₹.	578.94 lakhs
9.	Sanction Letter No. AI/SNB/SC/003/2013/3 dated 27.09.13	₹.	3.60 lakhs
10.	Sanction Letter No. AI/SNB/CAP/003/2013/3 dated 27.09.13	₹.	157.50 lakhs
11.	Sanction Letter No. AI/SNB/GEN/003/2013/3 dated 27.08.13	₹.	137.25 lakhs
12.	Sanction Letter No. AI/SNB/SAL/003/2013/3 dated 27.09.13	₹.	92.70 lakhs
13.	Sanction Letter No. AI/SNB/CAP/003/2013/4 dated 07.02.14	₹.	157.45 lakhs
14.	Sanction Letter No. AI/SNB/SAL//003/2013/4 dated 07.02.14	₹.	61.80 lakhs
15.	Sanction Letter No. AI/SNB/GEN//003/2013/4 dated 07.02.14	₹.	47.00 lakhs
16.	Sanction Letter No. AI/SNB/SC/003/2013/4 dated 07.02.14	₹.	2.40 lakhs
		₹.	2907.45 lakhs

	TOTAL	₹.	**2920.20 lakhs**

INDEPENDENT AUDITORS' REPORT

To the Governing Body of Satyendra Nath Bose National Centre for Basic Sciences

1. Report on the Financial Statements

We have audited the accompanying financial statements of **SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES** ("the Centre") which comprise the Balance Sheet as at March 31, 2014, the Income and Expenditure Account and the Receipts and Payments Account for the year then ended, and a summary of Significant Accounting Policies and Notes on Accounts.

2. Management's Responsibility for the Financial Statements

Management of the Centre is responsible for the preparation of these financial statements that give a true and fair view of the financial position, financial performance. This responsibility includes the design, implementation and maintenance of internal control relevant to the preparation and presentation of the financial statements that give a true and fair view and are free from material misstatement, whether due to fraud or error.

3. Auditor's Responsibility

Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with the Standards on Auditing issued by the Institute of Chartered Accountants of India. Those Standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the Company's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of the accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

4. Opinion

In our opinion and to the best of our information and according to the explanations given to us, the financial statements give a true and fair view in conformity with the accounting principles generally accepted in India:

(a) in the case of the Balance Sheet, of the state of affairs of the Centre as at March 31, 2014

(b) in the case of the Income & Expenditure Account, of the surplus for the year ended on that date; and

(c) in the case of the Receipts & Payments Account, of the Receipts & Payments for the year ended on that date.

5. Emphasis of matters

Without qualifying our opinion we draw attention for the following matters:

(a) Note No. 2.2.1 of the Schedule 25 regarding physical verification of Fixed Assets.

(b) Note No. 2.6 of Schedule 25 regarding transfer of Fixed Assets aggregating to Rs. 1,41,76,823.22 from Project to General Fund upon completion of Project pending approval from the appropriate authority. Further Rs. 44,70,366.86 lying in credit in respect of 25 nos. completed Projects should be refunded/adjusted and similarly Rs. 4219993.00 lying in debit in respect of completed projects should be adjusted.

6. a) We have obtained all the information and explanations which to the best of Knowledge and belief were necessary for the purpose of our audit.

6 b) 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.

6 c) The Balance Sheet, Income & Expenditure Account and Receipts & Payments Account dealt with by this Report are in agreement with the books of account.

6 d) In our opinion the Balance Sheet, the Income & Expenditure Account dealt with in this report comply with the appropriate Accounting Standard.

Place: Kolkata

Date: 12th September, 2014

For

Mookherjee Biswas & Pathak
Chartered Accountants
FRN No 301138E

(S.P.Mukherjee)
Partner
Membership No. 10807

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

Amount (₹)

BALANCE SHEET AS AT 31ST MARCH 2014			
	Schedule	Current Year	Previous Year
FUNDS AND LIABILITIES		₹	₹
CAPITAL FUND	1	1012218107.76	953823824.33
RESERVES AND SURPLUS	2	-	
EARMARKED/ENDOWMENT FUNDS	3	217030481.32	149165998.52
SECURED LOANS AND BORROWINGS	4		
UNSECURED LOANS AND BORROWINGS	5		
DEFERRED CREDIT LIABILITIES	6		
CURRENT LIABILITIES AND PROVISIONS	7	32176568.39	42286385.31
TOTAL		**1261425157.47**	**1145276208.16**
ASSETS			
FIXED ASSETS	8	735401225.87	729679670.87
INVESTMENTS-FROM EARMARKED/ENDOWMENT FUNDS	9	112860436.38	121957281.00
INVESTMENTS - OTHERS	10	183743956.00	213947832.00
CURRENT ASSETS, LOANS, ADVANCES ETC.	11	229419539.22	79691424.29
MISCELLANEOUS EXPENDITURE (to the extent not written off or adjusted)			
TOTAL		**1261425157.47**	**1145276208.16**
SIGNIFICANT ACCOUNTING POLICIES	24		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		

Per our report of even date

Date: 12.09.2014
Place: Kolkata

For Mookherjee Biswas & Pathak
Chartered Accountants

S P Mukherjee
Partner
Membership no: 10807

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

Amount (₹)

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH 2014			
	Schedule	Current Year	Previous Year
INCOME		₹	₹
Income from Sales/Services	12	4075736.88	4903598.00
Grants/Subsidies	13	213784065.00	191997789.00
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	19796074.00	16217506.00
Other Income	18	1441773.50	324752.00
Increase/(decrease) in stock of finished goods and works-in-progress	19		
TOTAL (A)		**239097649.38**	**213443645.00**
EXPENDITURE			
Establishment Expenses	20	86160283.00	80823949.00
Other Administrative Expenses etc.	21	129980574.87	112105434.32
Expenditure on Grants, Subsidies etc.	22		
Interest	23		
TOTAL (B)		**216140857.87**	**192929383.32**
Balance being excess of Income over Expenditure(A-B)		22956791.51	20514261.68
Prior period adjustments (Credit)		410070.92	78368.00
Transfer to/from Capital Fund			
BALANCE BEING SURPLUS/(DEFICIT) CARRIED TO CORPUS/CAPITAL FUND		**23366862.43**	**20592629.68**
SIGNIFICANT ACCOUNTING POLICIES	24		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		

Per our report of even date

Date: 12.09.2014
Place: Kolkata

For Mookherjee Biswas & Pathak
Chartered Accountants

S P Mukherjee
Partner
Membership no: 10807

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

Amount (₹)

RECEIPTS AND PAYMENTS ACCOUNTS

For the year ended 31st March 2014

RECEIPTS	Current Year	Previous Year	PAYMENTS	Current Year	Previous Year
I. Opening Balances			**I. Expenses :**		
a) Cash in hand	30582.00	31443.00	a) Establishment Expenses	95348885.00	88761043.00
b) Bank Balances :			b) Administrative Expenses	89124831.65	72875590.00
I. In current accounts (Schd 11A)	22674295.85	20224290.85	c) Maintenance	36280697.00	27171024.00
ii. In deposit accounts			**II. Payments made against funds for various Projects**		
Schedule - 10	213947832.00	181831289.00			
Schedule - 11A	19093882.00	39343983.00			
iii. Savings accounts (Schd 11A)	19868143.41	24797675.02			
iv. Remittance-in-Transit					
II. Grants Received			**III. Investments and deposits made**		
a) From Government of India			a)Out of Earmarked/Endowment	114915635.38	24634312.00
-For the year	370939159.00	365285536.00	b) CPWD Deposit and NBCC Deposit	1705190.00	3354389.00
-For the previous year			c) Bank Guarantee & LC A/C	28833830.00	3211000.00
b) From State Government			d) Out of Own Fund	21149929.00	
c) From Other sources (details)			e) Bridge&Roof Deposit Account	39200000.00	
(Grants for capital & revenue exp. To be shown separately)					
			IV. Expenditure on Fixed Assets & Capital Work-in-Progress		
			a) Purchase of Fixed Assets	54470047.67	127485686.00
			b) Expenditure on Capital Work-in-Progress	3191217.00	44,239.00
III. Income on Investments from					
a) Earmarked/Endow Funds		-			
b) Own Funds (Oth. Investment)		13313965.00	**V. Refund of surplus money/Loans**		
			a) To the Government of India		
IV. Interest Received			b) To the State Government		
a) On Bank deposits	6144769.00	6964203.00	c) To other providers of funds		
			VI. Finance Charges (Interest)		
V. Other Income	3995459.38	4265472.00			

Amount (₹)

RECEIPTS AND PAYMENTS ACCOUNTS					
For the year ended 31st March 2014					
RECEIPTS	**Current Year**	**Previous Year**	**PAYMENTS**	**Current Year**	**Previous Year**
			VII. Other Payments	53427680.39	37973136.61
			VIII. Amount transferred to Current /Savings Account from Deposit Account Encashment of STD(Sch-10) Interest invested(Sch-10)		14,47,523.00
VI. Amount Borrowed	-	-			
			IX. Closing Balances		
VII. Any other receipts	43044163.12	6514821.00	a) Cash in hand	31393.00	30582.00
			b) Bank Balances :		
VIII. Amount transferred to Deposit Account from Current/Savings Account	191075449.00		I. In current accounts(Schd 11A)	26707922.69	22674295.85
			ii. In deposit accounts		
			Schedule - 10	183743956.00	213947832.00
			Schedule - 11A	129128239.00	19093882.00
			iii. Savings accounts(Schd.11A)	13554280.98	19868143.41
			iv. Remittance-in-Transit		
	890813734.76	**662572677.87**		**890813734.76**	**662572677.87**

Per our report of even date

Date: 12.09.2014
Place: Kolkata

For Mookherjee Biswas & Pathak
Chartered Accountants

S P Mukherjee
Partner
Membership no: 10807

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

Amount (₹)

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31.03.2014				
	Current Year		Previous Year	
SCHEDULE 1 -CAPITAL FUND:	₹	₹	₹	₹
Balance as at the beginning of the year	953823824.33		860435783.63	
Add : Contributions towards Corpus/Capital Fund	78235935.00		110022211.00	
Less : Depreciation for the year	43208514.00		37226799.98	
Add : Surplus during the year	23366862.43		20592629.68	
Less : Adjustment for Depreciation (Last Year)				
Less: Adjustment for Last Year (Revenue Items)				953823824.33
		1012218107.76		
BALANCE AS AT THE YEAR - END		**1012218107.76**		**953823824.33**

	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

Amount (₹)

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31.03.2014

SCHEDULE 3 - EARMARKED/ ENDOWMENT FUNDS	FUND-WISE BREAK UP					TOTAL	
	Project Fund	Medical fund	Leave Salary	Gratuity Fund	Corpus Fund	Current Year	Prev. Year
a) Opening balance of the funds	88002896.14	2915122.00	27894547.00	24441850.00	5911583.38	149165998.52	155596109.13
b) Additions to the Funds							
I) Donations/grants/ Contributions	119508423.00	567343.00	2892719.00	1992444.00	744325.00	125705254.00	69893753.00
ii) Income from investments made on account of funds	5164621.00	212313.00	2493055.00	2086256.00	453756.00	10410001.00	11747919.00
iii) Other additions -Provision during the year							7139512.00
TOTAL (a + b)	**212675940.14**	**3694778.00**	**33280321.00**	**28520550.00**	**7109664.38**	**285281253.52**	**244377293.13**
c) Utilisation/Expenditure towards objectives of funds							
i) Capital Expenditure							
Fixed Assets	37597409.67	-	-	-	-	37597409.67	65047029.00
Others							
Total							
ii) Revenue Expenditure							
Salaries, Wages and allowances etc.	18901257.88	-	-	-	-	18901257.88	19678086.00
Rent Other Administrative expenses							
Other Payments	11752104.65	-			-	11752104.65	10486179.61
iii) Adjustment (Interest)							
TOTAL (C)	**68250772.20**	**-**	**0.00**	**0.00**	**-**	**68250772.20**	**95211294.61**
NET BALANCE AS AT THE YEAR-END (a+b-c)	**144425167.94**	**3694778.00**	**33280321.00**	**28520550.00**	**7109664.38**	**217030481.32**	**149165998.52**

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 31.03.2014				
				Amount (₹)
SCHEDULE 4 - SECURED LOANS AND BORROWINGS:	**Current Year**		**Previous Year**	
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 31.03.2014

Amount (₹)

SCHEDULE 5 - UNSECURED LOANS AND BORROWINGS	Current Year		Previous Year	
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 31.03.2014

Amount (₹)

SCHEDULE 7 - CURRENT LIABILITIES AND PROVISIONS	Current Year		Previous Year	
A. CURRENT LIABILITIES				
1. Acceptances				
2. Sundry Creditors:				
a) For Capital expenditure	8220217.00			20195792.00
b) Others - Revenue expend.(including Project Rs. 30000.00)	5194438.00			10430503.00
3. Current Liabilities	2495665.00			2495665.00
4. Deposit from Contractors	5408978.88			2933149.88
5. Other Liabilities	186615.00			250365.00
6. Deposit from Students	914500.00			811500.00
7. Deposit from Contractual Employees	1229561.00			1189731.00
8. Provident Fund Account (Payable)	711340.08			465759.00
9. Project Overhead Fund	4149235.43			3447902.43
10. Project-Loan from General Fund	3600000.00			
TOTAL (A)	**32110550.39**	**0**		**42220367.31**
B. PROVISIONS				
1. For Taxation				
2. Gratuity				
3. Superannuation/Pension				
4. Accumulated Leave Encashment				
5. Trade Warranties/Claims	66018.00			66018.00
6. Others - Adhoc Bonus				
TOTAL (B)	**66018.00**	**-**		**66018.00**
TOTAL (A + B)	**32176568.39**	**0.00**		**42286385.31**

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 31.03.2014

SCHEDULE 8 - FIXED ASSETS

DESCRIPTION	GROSS BLOCK				
	Cost/valuation As at begin. of the year	Additions during the year	Adjustment during the year	Cost/valuation at the year-end	
A. FIXED ASSETS:					
1. LAND:					
a) Freehold					
b) Leasehold	10950654.60	-	-	10950654.60	
2. BUILDINGS:					
a) On Leasehold Land	283566995.86	352593.00		283919588.86	
b) On Freehold Land					
c) Ownership Flats/Premises					
d) Superstructures on Land not belonging to the entity					
3. PLANT MACHIENRY & EQUIPMENT	343072322.22	23646944.00	-	366719266.22	
4. VEHICLES	321013.00	-	-	321013.00	
5. FURNITURE, FIXTURES	34150269.22	2713063.00	-	36863332.22	
6. OFFICE EQUIPMENT	2142485.29	0.00	-	2142485.29	
7. COMPUTER & LAN INSTALLATION	64007501.44	1416896.00	-	65424397.44	
8. ELECTRIC INSTALLATIONS	5393858.00	63,05,182.00	-	11699040.00	
9. LIBRARY BOOKS	187364965.11	10912334.00	-	198277299.11	
10. TUBEWELLS & W.SUPPLY				0.00	
11. OTHER FIXED ASSETS	84225.55	0.00	-	84225.55	
TOTAL OF CURRENT YEAR	**931054290.29**	**45347012.00**	**-**	**976401302.29**	
PREVIOUS YEAR	**732122776.29**	**198931514.00**	**-**	**931054290.29**	
B. CAPITAL WORK IN PROGRESS	**40015.00**	**3623072.00**	**40015.00**	**3623072.00**	
TOTAL (A + B)	**931094305.29**	**48970084.00**	**40015.00**	**980024374.29**	

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

Amount (₹)

	DEPRECIATION				NET BLOCK	
	As at the beginning of the year	Additions during the year	Adjustment during the year	Total up to the Year-end	Current year-end	Previous year-end
	-	-	-	-	10950654.60	10950654.60
	29493553.62	4624641.00		3,41,18,194.62	249801394.24	254073442.24
					0.00	
					0.00	
					0.00	
					0.00	
	55004856.73	16721247.00		71726103.73	294993162.49	288067465.49
	320013.00	0.00		3,20,013.00	1000.00	1000.00
	14891844.30	2191421.00		17083265.30	19780066.92	19258424.92
	713207.53	101768.00		8,14,975.53	1327509.76	1429277.76
	47814784.46	10277595.00		58092379.46	7332017.98	16192716.98
	2231864.02	345116.00		25,76,980.02	9122059.98	3161993.98
	50905841.33	8942725.00		5,98,48,566.33	138428732.78	136459123.78
				-	0.00	-
	38669.43	4001.00		42,670.43	41555.12	45556.12
	201414634.42	**43208514.00**	**-**	**244623148.42**	**731778153.87**	**729639655.87**
	164187834.44	**37226799.98**		**201414634.42**	**729639655.87**	**567934941.85**
	-	**-**	**-**	**-**	**3623072.00**	**40015.00**
	201414634.42	**43208514.00**	**0.00**	**244623148.42**	**735401225.87**	**729679670.87**

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 31.03.2014

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		
Project Fund Investment	50356178.00	66529814.00
Gratuity Fund Investment	25270930.00	21472720.00
Leave Salary Fund Investment	28406623.00	26967164.00
Staff Medical Fund Investment	2915122.00	2197903.00
Corpus Fund Investment	5911583.38	4789680.00
TOTAL	**112860436.38**	**121957281.00**

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 Indian Overseas Bank (including Project Rs. 5886766)	23225685.00	83580500.00
Fixed Deposit with Union Bank Of India (including Project Rs. 44469412)	160518271.00	126367332.00
Fixed Deposit with Bank of India		4000000
TOTAL	**183743956.00**	**213947832.00**

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 31.03.2014

Amount (₹)

SCHEDULE 11 - CURRENT ASSETS, LOANS, ADVANCES ETC.	Current Year		Previous Year	
A. CURRENT ASSETS:				
1. Inventories:				
a) Stores and Spares	61411.55	61411.55		71139.03
2) Cash balances in hand	31393.00	31393.00		30582.00
3) Bank Balances:				
a) With Scheduled Banks:				
On Current Accounts:				
Indian Overseas Bank (CA-089302000000220)	5991227.23		15593207.62	
Indian Overseas Bank (CA-089302000000273)	8643154.96		1544417.73	
Union Bank of India (CA-460901010034252)	12073540.50	26707922.69	5536670.50	22674295.85
On Deposit Accounts for LC&BG:				
Indian Overseas Bank (CA-089302000000220)	43128239.00		14293882.00	
Indian Overseas Bank (CA-089302000000273)	86000000.00	129128239.00	4800000.00	19093882.00
On Savings Accounts:				
Indian Overseas Bank(SB-089301000010662 UNAST)	5565818.62		10600087.62	
Indian Overseas Bank(SB-089301000012029 SYNC.)	1567499.00		389461.00	
Indian Overseas Bank(SB-089301000011479 NANO TECH)	3299726.00		3183985.00	
Union Bank of India (SB-460901110050013)	493389.36		510152.79	
Axis Bank (SB-775010100024408)	1967582.00		3719818.00	
Axis Bank (SB-775010100017860)	660266.00		788049.00	
BOI (SB-424910110004962)		13554280.98	676590.00	19868143.41
5) Remittance - in - Transit				
6) Post Office-Savings Accounts				
TOTAL (A)		**169483247.22**		**61738042.29**

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 31.03.2014

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.73768.00)	1737137.00			4270058.00
b) Other Entities engaged in activities/objectives similar to that of the Entity				
c) Other - Advance to Project A/c	3600000.00			36,00,000.00
2. Advances and other amounts recoverable in cash or in kind or for value to be received:				
a) On Capital Account - NBCC & CPWD Deposit Account	42178830.00			1941016.00
b) Prepayments				
c) Others (Security Deposits)	106018.00			80018.00
d) Contractors & Suppliers	91941.00			91941.00
3. Income Accrued:				
a) On Investments from Earmarked/Endowment Funds(Including Project Rs.88736.00)	10216410.00			6418473.00
b) On investments - Others	2005956.00			1551876.00
c) On Loans and Advances				
d) Others				
4. Claims Receivable - Grant -in- Aid Receivable		-		-
TOTAL (A)		**59936292.00**		**17953382.00**
TOTAL (A + B)		**229419539.22**		**79691424.29**

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 31.03.2014

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) Guest House Rent	1088550.00	1254096.00
b) Hostel Charges (Recovery of HRA)	1183749.88	1970442.00
c) Equipment Utilisation Fees	462400.00	147400.00
d) Hostel Maintenance Fees	874882.00	875343.00
e) Project Overhead	297730.00	295000.00
f) Others		10895.00
g) Income from BSNL	66000.00	199295.00
h) Rent for ATM	87425.00	151127.00
i) Seminar Room Rent	15000.00	
TOTAL	**4075736.88**	**4903598.00**

SCHEDULE 13 - GRANTS/SUBSIDIES	Current Year	Previous Year
(Irrevocable Grants & Subsidies Received)		
1) Central Government	213784065.00	191997789.00
2) State Government(s)		
3) Government Agencies		
4) Institutions/Welfare Bodies		
5) International Organsations		
6) Others		
TOTAL	**213784065.00**	**191997789.00**

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 31.03.2014

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	
	Current Year	Previous Year	Current Year	Previous Year
(Income on Invest. From Earmarked/ Endowment Funds transferred to Funds)				
1) Interest				
a) On Govt. Securities				
b) Other Bonds/Debentures				
2) Dividends:				
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 31.03.2014

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	19432301.00	15961787.00
b) With Institutions		
c) Others		
2) On Savings Accounts:		
a) With Scheduled Banks	105737.00	72811.00
b) Post Office Savings Accounts		
c) Others		
3) On Loans:		
a) Employees/Staff (Interest on HBA etc.)	258036.00	182908.00
b) Others		
4) Interest on Debtors and Other Receivables		
TOTAL	**19796074.00**	**16217506.00**

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 31.03.2014

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	1441773.50	324752.00
TOTAL	**1441773.50**	**324752.00**

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	74724418.00	66996961.00
b) Other Allowances and Bonus	66018.00	66018.00
c) Contribution to Provident Fund	2143221.00	2192375.00
d) Contribution to Other Fund - Gratuity Fund, Leave Salary Fund etc.	4885163.00	7139512.00
e) Staff Welfare Expenses (Medical)	1684635.00	1644224.00
f) Contribution to NPS	783902.00	650096.00
f) Others (LTC, Leave Encashment on LTC, Re-imbursement of Tuition Fees etc.)	1872926.00	2134763.00
TOTAL	**86160283.00**	**80823949.00**

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 31.03.2014

Amount (₹)

SCHEDULE 21 - OTHER ADMINISTRATIVE EXPENSES ETC.	Current Year	Previous Year
a) Extended Visitors Programme.(Including Seminars & Workshops)	6846897.00	8222110.00
b) Meeting Expenses	1177025.00	1083567.00
c) Library General Expenses	106140.00	58789.00
d) Electricity and Power	27774866.00	23248902.00
e) Laboratory Expenses	9195371.00	10844761.00
f) Insurance	9253.00	8611.00
g) Repairs and Maintenance	42444901.48	32702330.82
h) TPSC Programme	1236397.00	1391785.00
i) Student Hostel Rent	445806.00	1608002.00
j) Vehicles Hire Charges	1411956.00	1638470.00
k) Postage, Telephone and Communication Charges	2265768.00	2358845.00
l) Printing and Stationary	1145491.00	1003960.00
m) Travelling and Conveyance Expenses	3587238.00	2496924.00
n) Contingency to Faculty	100295.00	90,928.00
o) Silver Jubilee Year	-	0.00
p) Auditors' Remuneration	40450.00	44944.00
q) Bank Charges	474126.39	719527.50
r) Professional Charges (Legal Charges)	282914.00	395313.00
s) Staff Training	454771.00	210079.00
t) Patent & Trademark	21,950.00	0.00
u) Integrated Ph.D.	28544056.00	21414787.00
v) Import Clearing Expenses including Custom Duty	-	0.00
w) Hindi Programme	45458.00	35,217.00
x) Advertisement and Publicity	1704233.00	1169364.00
y) Others	518244.00	726498.00
z) Municipal Tax	146968.00	631720.00
TOTAL	**129980574.87**	**112105434.32**

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 31.03.2014		
		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

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 Guest House Rent are accounted on cash basis. Interest and Fixed Deposit on lien against BG/LC is 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 Capital 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 Capital Fund out of which Fixed Assets are created and not passed through the Income and Expenditure Account and directly debited to Capital Fund.

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

5.6 No depreciation charged on assets when the W.D.V is Rs.1000.00

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

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.5849409.00 against 100% margin money by way of fixed deposit (Previous year Rs.3448882.00).
- Letters of Credit opened by Bank on behalf of the Centre and Project–Rs. 123278830.00 (Previous year Rs. 15645000.00) 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)

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

2.2.1 Physical verification of fixed assets was conducted by the Centre internally in August, 2013.Pending final reconciliation no adjustment is given in the Accounts in this year. Fixed assets register is in the process of being updated.

2.2.2 Capital work-in-progress as on 1st April, 2013 was Rs.40015.00, addition during the year is Rs.3623072.00, totaling to Rs.3663087.00,an amount of Rs.40015.00 has been capitalized, leaving balance of Rs.3623072.00 which has been carried forward.

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

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 aggregating to Rs.1,41,76,823.22 from project to general fund upon completion of project has not been done pending approval from the appropriate authority.

2.7 In absence of any specific directions from Appropriate Authority balance of Medical Fund Rs.3694778.00 (previous year Rs. 2915122.00) by the employees are appearing under Earmarked & Endowment Fund as on 31-03-2014.

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

Kolkata

Dated: 12th September, 2014

SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

BLOCK JD, SECTOR-III, SALT LAKE, KOLKATA - 700 098

PARA-WISE REPLIES TO THE AUDIT OBSERVATIONS

SL	Audit Observations	Para-wise replies
1.	Note No. 2.2.1 of the Schedule 25 regarding physical verification of Fixed Assets.	Physical verification has been conducted internally by the Centre . Adjustment required for shortage and excess found on such physical verification will be effected after final reconciliation in consultation with the statutory auditor and after getting the approval of the competent authority.
2.	Note No. 2.6 of Schedule 25 regarding transfer of Fixed Assets aggregating to Rs. 1,41,76,823.22 from Project to General Fund upon completion of Project pending approval from the appropriate authority. Further Rs. 44,70,366.86 lying in credit in respect of completed Projects should be refunded/ adjusted and similarly Rs. 42,19,993 lying in debit in respect of completed Projects should be adjusted.	The matter of transferring Fixed Assets of the completed projects to the Centre had been taken up with the funding agencies (mainly DST). However, no response has been received after repeated reminder. The observations regarding refund / adjustment of debit/ credit balance lying in respect of completed projects has been noted for further compliance.