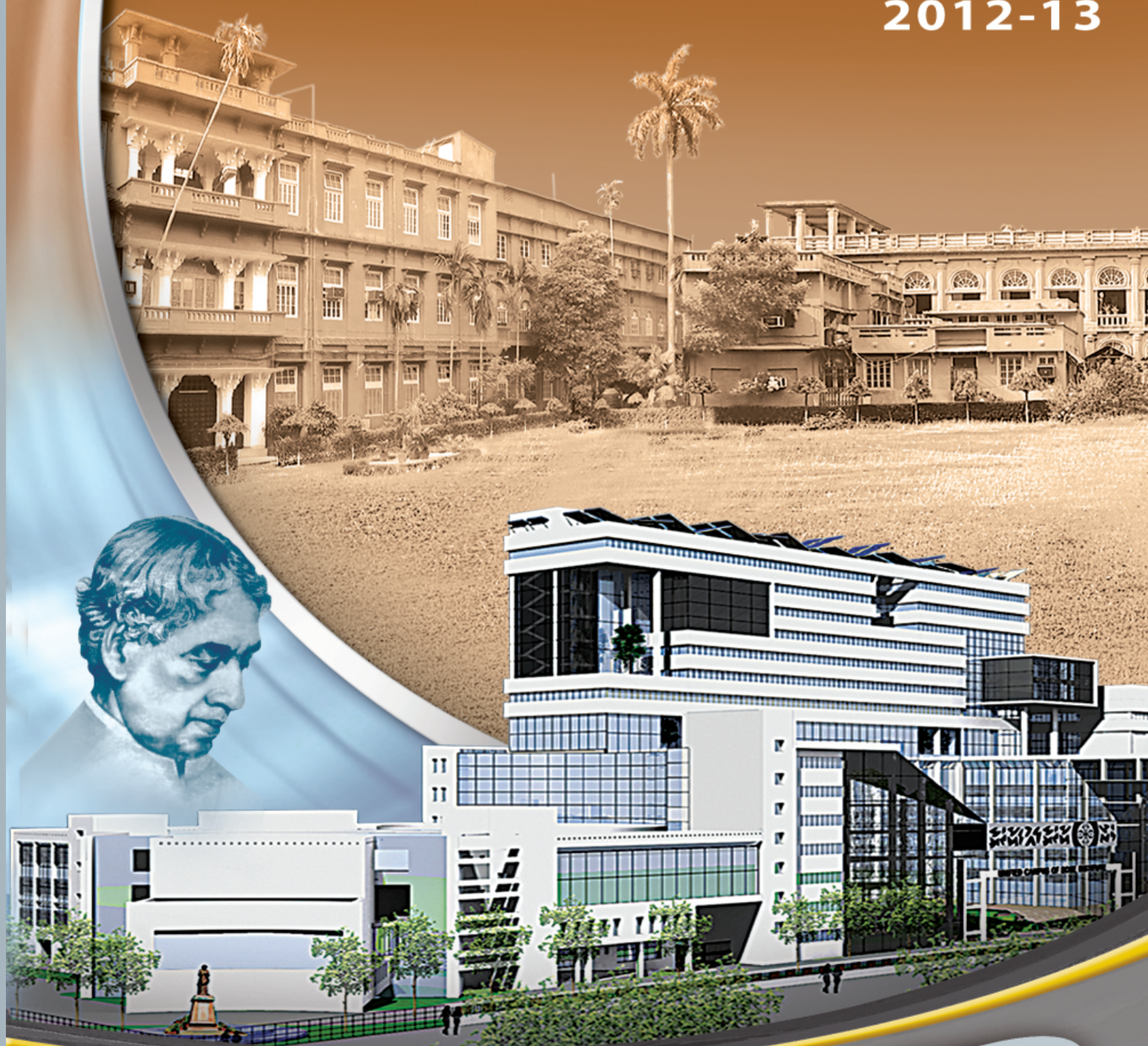


Annual Report

2012-13



BOSE INSTITUTE

ANNUAL REPORT

2012-2013



Bose Institute

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Kolkata -700 009

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*Dr. Rajendra Prasad
President of the Republic of India
is pleased to be the*

*Patron-in-Chief
of the*

Acharya Jagadish Chandra Bose Birth Centenary Committee

By Command of the President of the Republic of India

Military Secretary's Office
The 19 November 1958
Military Secretary to the President

From the Director's Desk



Bose Institute completed its journey of 95 years in the service to the Nation during the year covered by this report. In our pursuit of excellence, as enjoined by our illustrious founder, Acharya Jagadis Chandra Bose, we have been tireless in continuously raising the bar. This, we hope, is reflected in our steady improvement in terms of the usual parameters by which the performance of scientific institutions is measured, like higher impact factor, better publications adding to the sea of scientific knowledge, training of competent manpower and so on.

The Annual Report of the institute is our face to the world, aimed not only at our peers but also, more importantly, to the general people. Bose Institute survives on a grant-in-aid from the Government of India and thus we are answerable to the people of India. We therefore try to give here an easily readable bird's eye view of the various activities that we pursue, both in terms of quest for new knowledge as well as other outreach programmes, including those aimed at bringing about societal benefits. My colleagues of the Publication Committee have been very aware of this rather difficult task and have done an excellent job of it; I take this opportunity to put on record the gratitude of the entire institute to the members of the Publication Committee.

On 2nd June 2012, we had the rare privilege of having the Prime Minister of India, Dr. Manmohan Singh, lay the foundation stone of our new unified academic campus at our Salt Lake site. Dispensing with the formalities, the Prime Minister freely interacted with a number of young members of the faculty and research scholars, encouraging them to keep up their efforts to achieve excellence.

To maintain the competitive edge in scientific research at the international level, the scientific instruments need constant upgrading; the cost of experimental materials have sky-rocketed. In the difficult financial situation at present, we have not succeeded in supporting our scientists at the desired level. Our scientists, however, have always tried very hard to generate the essential resources through extramural funding and I am very happy to note that even our young recruits have followed this path quite aggressively, already achieving remarkable success. I am sure that their efforts will bear fruit in the very near future.

I appeal to all readers of this volume for their continued unstinting support to Bose Institute.

Sibaji Raha
Director
Bose Institute

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128th Birthday Celebration of Prof. Debendra Mohan Bose was celebrated on 26th November 2013 at Main Campus Lecture Hall. **Professor Sushanta Dattagupta** Vice-Chancellor of Visva-Bharati, Santiniketan graced the occasion and delivered the D. M. Bose Memorial Lecture on **The Tagore Model of Inclusive Education – from Grassroots to High Boson**. The lecture was interspersed by live music performed by artists from Sangit Bhavan, led by its Principal Smt. Indrani Mukhopadhyay.



BOSE INSTITUTE

Established: 30th November, 1917

Introduction



Bose Institute was founded by Acharya Sir Jagadis Chandra Bose in 1917 for the advancement of science and dissemination of knowledge. The Institute has served the nation for the past 96 years through its pursuit of advancement of knowledge in science and technology and by developing highly competent and able scientific manpower for the country. The Institute has on its staff highly qualified and experienced scientists devoted to

original and path breaking research in the fields of Plant Sciences, Structural Biology, Molecular Biology, Biomedical Sciences, Biotechnology, Quantum Mechanics, Astrophysics and Condensed Matter Physics. Bose Institute started with three original departments, Botany, Chemistry and Physics. With time more departments were added the Animal Physiology Section (1930), Department of Microbiology (1942), Department of Biochemistry (1974), the Plant Tissue Culture Section (1976, subsequently renamed Plant Molecular & Cellular Genetics Section in 1989), Department of Biophysics (1985), the Environmental Science Section (1992) and the Immunotechnology Section (1992). Very recently, a division of Molecular Medicine has been established, absorbing the sections of Animal Physiology and Immunotechnology, along with the induction of a few scientists from the Departments of Chemistry and Microbiology. In addition, the institute hosts support and service centres like the Central Instruments Facility (CIF), the Distributed Information Centre (DIC), Library, Workshop, J.C. Bose Centre (comprising the Museum and the Publication sections). The wide-ranging and comprehensive base of available scientific infrastructure at Bose Institute also comprises the Acharya J.C. Bose High Altitude Research Centre at Darjeeling and the experimental field stations at Falta, Madhyamgram and Shyamnagar. Recent augmentations include the establishment of a National Facility on Proteomics and Genomics, a National Facility on Astroparticle Physics and Space Sciences, a Centre of Excellence in Bioinformatics, a Rural Biotechnology Training Centre at Falta and the J.C. Bose Biotechnology Innovation Centre based at the Madhyamgram campus. The facilities available in the institute for scientific enquiry and its applications also cater regularly to the scientists from several

universities and research centres in the country. Special efforts have been undertaken to upgrade and modernize the library of Bose Institute during the recent years.

The eminence of Bose Institute scientific research spanning a wide range of disciplines is evident from the large number of research publications in the most competitive peer reviewed international and national journals, the recognition received by the scientists in the form of S.S. Bhatnagar Prize, INSA young scientist award, fellowship of the National Science Academies, fellowship of the Third World Academy of Science, Nehru Fellowship, K.S. Krishnan Fellowship, Rockefeller Foundation fellowship and Homi Bhabha fellowship. The institute has over the years provided yeoman service in manpower development, having trained a large number of Ph.D. students many of whom are now reputed experts in their fields in India and abroad; on an average, 30-40 scholars are awarded Ph.D. degree every year. Over the past decade, scientists of Bose Institute have maintained an enviable record of publication in peer reviewed journals. A number of its scientists and research scholars participate every year in numerous academic activities (seminars, conferences, workshops) in India and abroad as invited speakers, chairpersons and resource persons.

A large number of extramural research projects, with support from various government agencies as well as international funding agencies, are carried out at Bose Institute.

Research Activities

At the time of founding Bose Institute, the illustrious founder, Sir J. C. Bose had unequivocally declared that the objective of Bose Institute would be to practice seamless science, without compartmentalisation on the basis of specialisation. Bose Institute strives to achieve this ideal, encouraging inter-disciplinary research to the fullest. Broadly, the current research activities of our scientists cover the following areas:

Institutional Plan

I. Plant Functional Biology of Stress Responses for Improvement and Exploring Plant Genetic Resources

Since last two decades plant scientists of Bose Institute are working on different fundamental problems of plant biology and special emphasis has given on bioprospecting of novel genes. Identifications of stress-tolerant proteins and genomic resources employing proteomic, genomic and molecular techniques are being continued. Recent initiatives have also been undertaken to understand epigenetic, transcriptional and post transcriptional regulations of selected key genes, upstream regulators and miRNAs. The effective exploitation of these novel genes and regulatory elements are being continued employing functional genomic approach with a view to improve the plant performance in the field; and to combat biotic and abiotic stresses of crop plants.

II. Structural Studies and Biophysical Problems

Resolution of Protein structure is the key criterion to determine functional organization of a protein. Study on the structure-function relation coupled with expression analyses have been undertaken to design therapeutically and other economically important protein molecules.

III. Computational Biology

The institutional plan program Computational Biology aims to understand a plethora of biological processes, molecules and interactions by computational techniques. Some of our broad goals are: i) microRNA networks in stem cells, ii) mechanistic insight into the molecular biology from structural dynamics, integrating therapeutic molecular design, iii) comparative genome analysis towards the understanding of protein evolution, iv) understanding macromolecular recognition from an analysis of known structures of protein complexes, v) development of bioinformatics tools and web-based servers, vi) identification of network biomarkers in Neurodegenerative diseases, vii) structural studies of c-Jun N-terminal kinase 3 (JNK3), and, viii) a combined in silico genomics and proteomics approach for the development of antiparasitic drugs.

IV. Molecular Medicine

The primary focus of the division is to study molecules related to health and diseases and manipulating those molecules to improve diagnosis, prevention and treatment of diseases like Cancer, Diabetes, Cardiovascular problems, Leishmaniasis, Tuberculosis etc. The division has initiated programme for developing drugs, i.e. synthetic, from natural source, protein based etc. specific to one or more of the above diseases. With the induction of a few new faculty members having experiences in one or more of the above mentioned areas it is expected that the division will be able to achieve its mandate more effectively in the coming years.

V. Basic and Applied Microbiology

Genomic approaches have been taken to study the basic biology of microbes leading to useful insights into the mechanisms of their growth, proliferation and cell-cycle regulation. Molecular mechanisms underlying the processes by which some of these microbes cause infectious diseases are being elucidated. Identification of microorganisms with a potential for bioremediation is also under study.

VI. Systems Biology

In this programme scientists are working on various aspects of understanding disease processes and infections using Systems Biology approaches. Specifically, high throughput

approaches have been taken to understand pathogen-tuned signalling networks in host cells. Mathematical modelling has been employed to understand stress responses in mammalian cells and in bacterial pathogens.

VII. Basic & Applied Problems in Physical and Environmental Sciences

The Department of Physics, Centre for Astroparticle Physics & Space Science and the Environmental Sciences Section contribute both to fundamental knowledge as well as applications relevant to industry and society in general. Current research activities in this programme are in the areas of Soft Condensed Matter and Materials Science (including preparation and characterization of dielectric materials), Radiation Physics, Statistical Mechanics and Complex Systems, Foundations of Quantum Mechanics, Quantum Measurement and Entanglement, Quantum Information Theory, Physics and Astrophysics of Strongly Interacting Matter, Detector development for heavy ions in cosmic rays, Detector development for high energy experiment, Nuclear Physics, Cosmology, Atmospheric Physics and Chemistry and Millimetre Waves and Microwaves technology.

The group also participates in the ALICE experiment at the Large Hadron Collider (LHC) at CERN, Geneva and the CBM (Compressed Baryonic Matter) collaboration at the Facility for Antiproton Ion Research (FAIR) at Darmstadt, Germany.

Experimental Stations at Madhyamgram, Shyamnagar and Falta

The experimental field station at Madhyamgram houses the Acharya J. C. Bose Biotechnology Innovation Centre, focussing on translational plant biotechnology. The Central Animal House of Bose Institute is also coming up at this site. The Shyamnagar campus has recently been renovated; in addition to the proposed biological researches there, a vibrant programme of open range millimetre wave measurements has started there. The Falta campus is the seat of the Rural Biotechnology programme of Bose Institute.

Manpower Development (Academic)

In collaboration with the University of Calcutta, Bose Institute has been running integrated M.Sc.-Ph.D. programmes in both Life Sciences and Physical Sciences. Also, a four semester M.Sc. course in Physics is conducted in collaboration with St. Xavier's College, Kolkata.

Science and Society – Rural Biotechnology

A Rural Biotechnology Centre has been developed at the Falta campus of Bose Institute to provide the knowhow of basic biotechnology to the rural people with the aim to help improve their socioeconomic status. The very positive response of the local people, the primary beneficiaries has prompted Bose Institute to take this up as a regular activity with enhanced scope.

Management

Bose Institute is a grant-in-aid autonomous institution under the Department of Science and Technology (DST), Ministry of Science & Technology, Government of India. It has a Governing Body consisting of twelve members including the Director. The management of the Institute is vested in Bose Institute Council that has 18 members including the Secretary, DST, Govt. of India. The Institute also has a Finance Committee responsible for the financial policies and management.

Members of the Governing Body

1. Prof. Debi Chakravarti
2. Prof. S.N. Chatterjee
3. Shri Somnath Sanyal
4. Prof. D. Banerjee
5. Dr. Anutosh Chatterjee
6. Dr. Manish Sekhar Chakraborty
7. Mr. D. Mandal
8. Shri Dilip Bhattacharyya
9. Prof. Parul Chakrabarti
10. Prof. Bikash Sinha
11. Vacant
12. Director, Bose Institute – Secretary

Members of the Council

1. Secretary, Department of Science and Technology, Government of India or his nominee
2. Director General, Council of Scientific and Industrial Research or his nominee
3. Joint Secretary and Financial Adviser, Department of Science and Technology, Govt. of India or his nominee
4. A representative of the Lok Sabha

5. Accountant General (A & E), West Bengal
6. Secretary, Higher Education (Nominee of the Govt. of West Bengal)
7. Municipal Commissioner, Representative of the Calcutta Municipal Corporation
8. Director, Bose Institute Ex-officio
9. Prof. S. S. Hasan, DST nominated Scientist from outside West Bengal
10. Prof. M. Udayakumar, DST nominated Scientist from outside West Bengal
11. Director, Indian Association for the Cultivation of Science, Kolkata - Permanent Invitee
12. Director, SN Bose National Center for Basic Sciences, Kolkata Permanent Invitee
13. Prof. S. N. Chatterjee, Nominee of the Governing Body
14. Prof. Bikash Sinha, Nominee of the Governing Body
15. Registrar, Bose Institute - Secretary

Members of the Finance Committee

1. Secretary, Higher Education Department, Govt. of West Bengal.
2. Shri Somnath Sanyal, Representative of the Governing Body
3. Joint Secretary and Financial Adviser to the Department of Science and Technology, Govt. of India or his nominee
4. Accountant General (A & E), West Bengal
5. Director, Bose Institute
6. Registrar, Bose Institute, Secretary.



Prof. B. B. Biswas, Ex-Director, Bose Institute opening the DBT-Project Laboratory at Acharya J. C. Bose Biotechnology Innovation Centre.

Institutional 12th Plan Participants (2012-2017)

I. Plant Functional Biology of Stress Responses for Improvement and Exploring Plant Genetic Resources:

Dr. Sampa Das (Coordinator), Dr. D. N. Sengupta, Dr. S. R. Sikdar, Dr. T. K. Ghose, Dr. Debabrata Basu, Dr. S. Gupta-Bhattacharya, Dr. Gaurab Gangopadhyay, Dr. Pallob Kundu and Dr. Shubho Chaudhuri.

II. Structural Studies and Biophysical Problems:

Dr. K. P. Das (Coordinator), Dr. Pinakpani Chakrabarti, Dr. Pradeep Parrack, Dr. R. Chattopadhyay, Dr. Gautam Basu, Dr. Jayanta Mukhopadhyay, Dr. Anirban Bhunia, Dr. Ajit Bikram Dutta, Dr. Subhrangsu Chatterjee.

III. Computational Biology:

Dr. Gautam Basu (Coordinator), Dr. Pinakpani Chakrabarti, Dr. Tapas Chandra Ghosh, Dr. R. Chattopadhyaya, Dr. Tapan Dutta, Dr. Debjani Roy, Dr. Shubhra Ghosh Dastidar, Dr. Zhumur Ghosh, Dr. Sudipto Saha.

IV. Molecular Medicine:

Dr. P. C. Sen (Coordinator), Dr. P. C. Sil, Dr. Subrata Majumder, Dr. Tanya Das, Dr. Gaurisankar Sa, Dr. N. N. Mandal, Dr. Atin Mandal, Dr. Kuladip Jana, Dr. Anup Kr. Misra, Dr. Mahadeb Pal, Dr. Kaushik Biswas.

V. Basic and Applied Microbiology:

Dr. Anuradha Lohia (Coordinator), Dr. Pradeep Parrack, Dr. Sujoy Dasgupta, Dr. Subrata Sau, Dr. Tapan Datta, Dr. Wriddhiman Ghosh, Dr. Joyoti Basu, Dr. Manikuntala Kundu, Dr. Srimonti Sarkar.

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V. Basic and Applied Microbiology:

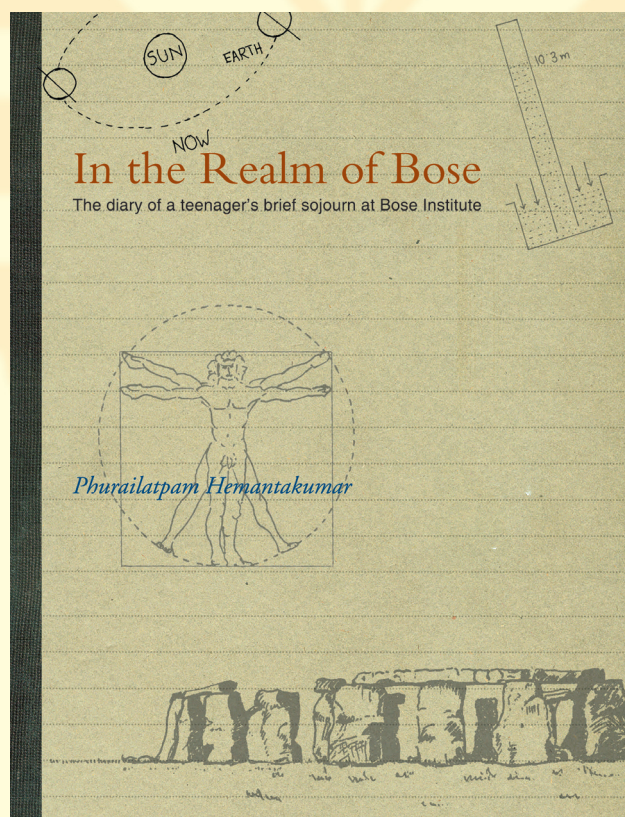
Dr. Anuradha Lohia (Coordinator), Dr. Pradeep Parrack, Dr. Sujoy Dasgupta, Dr. Subrata Sau, Dr. Tapan Datta, Dr. Wriddhiman Ghosh, Dr. Joyoti Basu, Dr. Manikuntala Kundu, Dr. Srimonti Sarkar.

VI. Systems Biology:

Dr. Joyoti Basu (Coordinator), Dr. Indrani Bose, Dr. Manikuntala Kundu, Dr. Soumen Roy, Dr. Jayanta Mukhopadhyay and Dr. Suman Kr. Banik

VII. Basic & Applied Problems in Physical and Environmental Sciences:

Dr. D. Home (Coordinator), Dr. S. Raha, Dr. B. K. Chatterjee, Dr. Indrani Bose, Dr. Sanjay Kr. Ghosh, Dr. S. K. Saha, Dr. T. P. Sinha, Dr. Pradeep Das, Dr. Somsubhro Bandyopadhyay, Dr. Dhruva Gupta, Dr. Rajarshi Roy, Dr. Amitabha Mitra, Dr. Achintya Singha, Dr. Abhijit Chatterjee, Dr. Supriya Das, Dr. P. S. Joardar and Dr. Soumen Roy.



"In the Realm of Bose" (The diary of a teenager's brief sojourn at Bose Institute) written by Phurailatpam Hemantakumar, A new book was published by Bose Institute on 30th November, 2012

Scientific Reports

I. Plant Functional Biology of Stress Responses for Improvement and Exploring Plant Genetic Resources:

***Alternaria brassicicola* mediated hormonal interplay that governs susceptibility to *Brassica juncea* : Dr. Debabrata Basu**

To understand the mechanism of resistance of *Sinapis alba* against fungal pathogen *A. brassicicola*, interplay of hormones like, ABA, SA and JA has been studied. Expression patterns of hormone inducible genes and estimation of hormones through LC-MS/MS indicate a unique combination of ABA and SA responses for expression of resistance against this pathogen. Furthermore, exogenous ABA and SA mediated alteration of the susceptibility and resistivity to *A. brassicicola* in *B. juncea* and *S. alba* respectively confirmed the gene expression profile. Therefore, it is evident from the result that the pathogen is capable of mounting a strong SA response in *B. juncea* to steer the plant towards susceptibility. While the resistant *S. alba* protects itself from the challenge by mounting an ABA response as ABA is antagonistic to SA.

Auxin and ABA crosstalk on resistance against *Alternaria brassicicola* : Dr. Debabrata Basu

Auxin plays a vital role in resistance against necrotrophic pathogens like, *A. brassicicola*. Therefore, expression of some immediate effectors of auxin signaling was monitored after challenging susceptible *B. juncea* and resistant *S. alba* plants with *A. brassicicola*. Upregulation of various auxin responsive genes (AUX-IAA, GH3 and SAUR) which acts as negative regulators of auxin and downregulation of some auxin responsive factors (ARFs) indicate repression of auxin response in susceptible plants. In contrast to that, upregulation of auxin responsive transcription factors like ARF10, ARF16 and ARF17 in resistant *S. alba* at early stage of *A. brassicicola* interaction indicated a pathogen mediate differential auxin response between resistant and susceptible plant. Furthermore, external application of ABA in susceptible *B. juncea* leaves followed by challenge with *A. brassicicola* showed similar trend of expression pattern of auxin responsive genes. This indicates interplay of auxin and ABA on resistance against *A. brassicicola*.

Epigenetic regulations during plants response to different environmental or developmental stimuli : Dr. Shubho Chaudhuri

Understanding the epigenetic regulation involved in the transcription of salt and cold stress induced genes in rice

The rice ortholog of DREB1, OsDREB1b, is transcriptionally induced by cold stress and over-expression of *OsDREB1b* results in increase tolerance towards high salt and freezing stress.

This spatio-temporal expression of *OsDREB1b* is preceded by the change in chromatin structure at the promoter and the upstream region for gene activation. Both the coding and the upstream region of *OsDREB1b* genes appear to be arranged into a nucleosome array. Nucleosome mapping of ~700bp upstream region of *OsDREB1b* shows two positioned nucleosomes between -610 to -258 and a weakly positioned nucleosome at the core promoter and the TSS. Upon cold stress, there is a significant change in the nucleosome arrangement at the upstream region with increase in DNaseI hypersensitivity or MNase digestion in the vicinity of cis elements and TATA box at the core promoter. ChIP assays shows hyper-acetylation of histone H3K9 throughout the locus whereas region specific increase was observed in H3K4me3, H3K14ac and H3K27ac. Moreover, there is an enrichment of RNA PolII occupancy at the promoter region during transcription activation. There is no significant change in the H3 occupancy in *OsDREB1b* locus negating the possibility of nucleosome loss during cold stress. The combined results indicate the existence of closed chromatin conformation at the upstream and promoter region of *OsDREB1b* in the transcription off state. During cold stress, changes in region specific histone modification marks promote the alteration of chromatin structure to facilitate the binding of transcription machinery for proper gene expression. Similar approaches were taken to identify epigenetic regulation involved in the transcription of salt stress induced *OsBZ8* gene.

Investigating the role of ARID/HMG in modulation of chromatin structure in planta

Plants have a novel class of HMG protein known as ARID/HMG. These proteins are characterized by the presence of both AT-rich interaction domain and HMG box in a single polypeptide. It can be hypothesised that the presence of two DNA-binding motifs in ARID/HMG proteins can regulate transcription by either modulating chromatin accessibility or by acting as transcription activators. Till date very less biochemical and physiological information are available about plant ARID/HMGs. Arabidopsis genome has four members of ARID/HMG family. Phylogenetic analysis based on the conserved HMG-box domain indicates that there are considerable divergences present within the group. At1g55650 is close to the canonical AtHMGB1 (At3g51880) whereas At1g04880 (ARID/HMG) is distantly related to AtHMGB1. Biochemical characterization indicates:

- a. ARID/HMG have lower affinity for linear DNA compared to canonical HMGs. However, ARID- domain and HMG- domain of ARID/HMG can bind DNA with higher affinity compared to full length ARID/HMG. ARID4 shows high affinity for the supercoiled plasmid DNA compared to linear DNA.
- b. HMG- domain of ARID/HMG shows DNA topology biased towards supercoiled DNA compared to linear DNA in the DNA-binding assay.

c. ARID/HMGs can bend the DNA backbone and can induce supercoil in relaxed plasmids

**Identification and Expression of insect/pathogen resistant gene(s)/ protein(s) with special emphasis on investigating their mode of action and addressing their biosafety aspects :
Dr. Sampa Das**

Mannose binding monocot Plant lectins namely, AMTL CEA were purified from new sources of *Amorphophalus paenifolius* and *Colocasia esculanta* and their efficacy against a range of sap sucking insects are being monitored (Roy et al 2012 and Das et al 2013)

Antibiotic resistance marker gene free, insect resistant ASAL transgenic rice and mustard plants were developed which are found to be environment friendly as well as biologically safe plant types (Bala et al 2013).

A site directed mutagenesis derived monomeric mASAL generated which is exhibiting significant anti fungal property against a range of plant infesting fungal pathogens. Rice transgenics are being developed with chimeric mASAL gene construct in an aim to develop sheath blight resistance in rice.

Functional Genomic, Microarray based transcriptomic and proteomic techniques were adapted to analyse differentially expressed transcripts and proteins in resistant/ susceptible plant types. Thus, a number of differentially expressed proteins induced in chickpea by challenging with fungal pathogen- *Fusarium oxysporum* are being analysed (Chatterjee et al 2012).

An extensive biochemical and immunochemical analyses of ASAL for monitoring its biosafety were performed following the guide lines framed by FAO and WHO, the results indicate that ASAL does not possess any allergenic feature which could be utilized as an eco friendly component for future pest management programme.

The key residues of Cry 1 Ac toxin involved in binding to the previously identified HaALP, receptor proteins of *Helicoverpa armigera* were mutated. The real time binding analyses of the receptor with native as well as mutated toxins carried out through Surface Plasmon Resonance and other assays. The toxin-receptor complex interplay validated through *in silico* analyses is being carried out in collaboration with Shubhro Ghosh Dastidar (Bioinformatics).

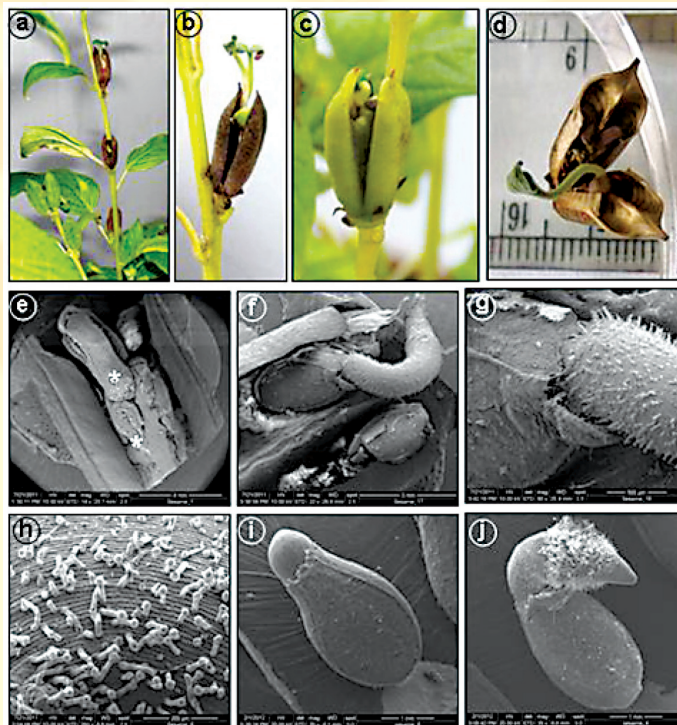
Towards improvement of cultivated sesame varieties : Dr. Gaurab Gangopadhyay

To introgress certain desirable traits (like pod shatter resistance, disease resistance etc. present in wild gene pool) in the cultivated sesame (*Sesamum indicum* L.), hybridization has been initiated and some of the hybrid (F_1) populations are being screened by Marker Assisted Selection approach. Additionally, one unique wild trait (viviparous/ 'precocious' seed

germination) has been reported first time in Turkish and Chinese accession of Sesame in Indian condition. Both the mature and green pods of these accessions showed a peculiar 'within pod' germination of seeds in pot culture. Scanning Electron Microscopy of the placental zone of the immature pod revealed early cotyledon development of different stages, while magnified views of the germinated seedling from the mature pods depicted onset of multicellular trichome and even the stomata. This unique and aberrant phenomenon of seed germination was correlated with environmental fluctuation associated with low dormancy of seeds.

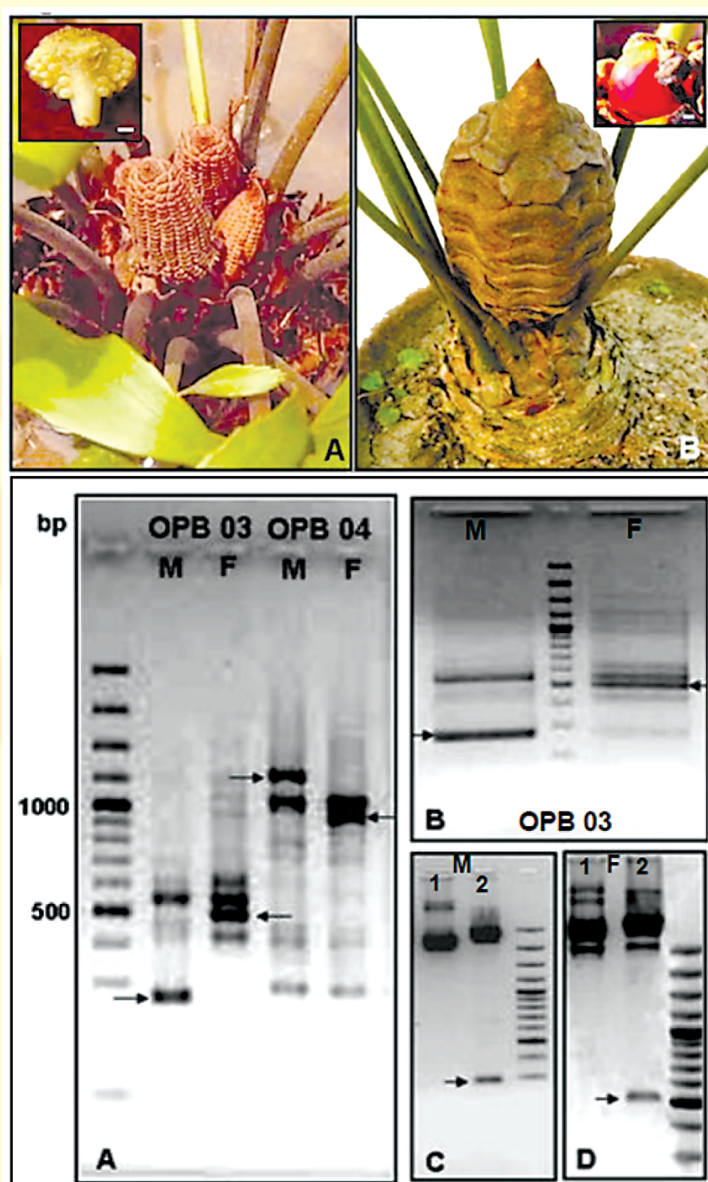
Phenomic analyses of indigenous and exotic accessions of Mulberry (*Morus spp.*) :
Dr. Gaurab Gangopadhyay

Since development of superior genotypes is a continuous process for the Mulberry (*Morus spp.*) breeders to keep parity with the feeding habit of the silkworms, broadening of Mulberry gene pool is also an incessant pre requisite. The diversity of the core collection of Mulberry germplasm (ninety four) of Central Sericulture Research and Training Institute (CSR&TI) at



Unique viviparous seed germination of Sesame; reported first time by Prasad and Gangopadhyay 2013; published in American-Eurasian Journal of Agricultural & Environmental Sciences, 13 (3): 398-401. Figures: a, 'Within pod' seed germination of Sesame; b, Germination within a matured pod; c, Germination within an immature pod; d, Pod split open to excise placental tissue with attached germinating seeds; e - j, SEM photographs: e, Placental tissue within green pod showing two germinating seeds (* marked) of different early developmental stage (14X); f, Developed seedling within matured pod (22X); Hypocotyl showing multi cellular trichomes, g (80X), h (250X); i, Germinated 'control' seed (35X); j, development of root hairs (35X)

Berhampore, West Bengal has been assessed with a phenomic approach to understand the interrelationship between Indigenous/exotic genotypes and also to elucidate the association between traits for identifying future trait based selection strategies for development of further improved Mulberry genotypes.



Sex determination of *Zamia fischeri* Miq., an endangered gymnosperm; reported by Roy, Gangopadhyay and Mukherjee 2012, published in International Journal of Biodiversity and Conservation, 4(7):287-293. Figures: Top - Male (a) and female (b) cone bearing plants; Below: RAPD derived male (M) and female (F) specific bands; (A) polymorphism in RAPD profiles, (B) purified eluted bands of OPB03 primer (M and F); (C, D) purified plasmids (Lane 1) from the clones and their respective restriction enzyme (EcoR1) digested fragments (Lane 2) showing the inserts.

Understanding of molecular factors behind *in vitro* plant morphogenesis : Dr. Gaurab Gangopadhyay

As a prelude to study the molecular factors behind *in vitro* plant morphogenesis, mode of regeneration (direct/indirect, organogenesis/embryogenesis) has been studied by Scanning Electron Microscopy in Tobacco (*Nicotiana tabacum* L.), Indian spinach (*Beta palonga* L.) and Pineapple (*Ananus comosus* (L.) Merr). Tissue harvested at onset of different visible stages of morphogenesis revealed differential isozymic (Peroxidase, Esterase, Acid Phosphatase, α -amylase) profiling.

Genetic Diversity Analysis of Rice Landraces of West Bengal : Dr. T. K. Ghose

In relation to bacterial leaf blight resistance we are now working on the inherent genetic diversity of four copper transporter genes (COPT genes), Xa13 gene and its promoter. Attempts are being made to identify homologues of the rice bacterial leaf blight resistance genes Xa1, Xa5, Xa13, Xa21, Xa26 and Xa27 in other *Xanthomonas* host plants.

Genetic Diversity Analysis of *Carica papaya* : Dr. T. K. Ghose in collaboration with **Dr. P. Acharyya**, CU

A thesis has been submitted and the PhD degree awarded to Samik Sengupta by the Calcutta University. The work involved genetic diversity analysis of 41 papaya genotypes at the DNA level using 20 SSR markers and 16 RGA markers. A total of 134 SSR-derived DNA bands and 24 RGA derived polymorphic bands were sequenced, submitted, and given accession numbers by NCBI

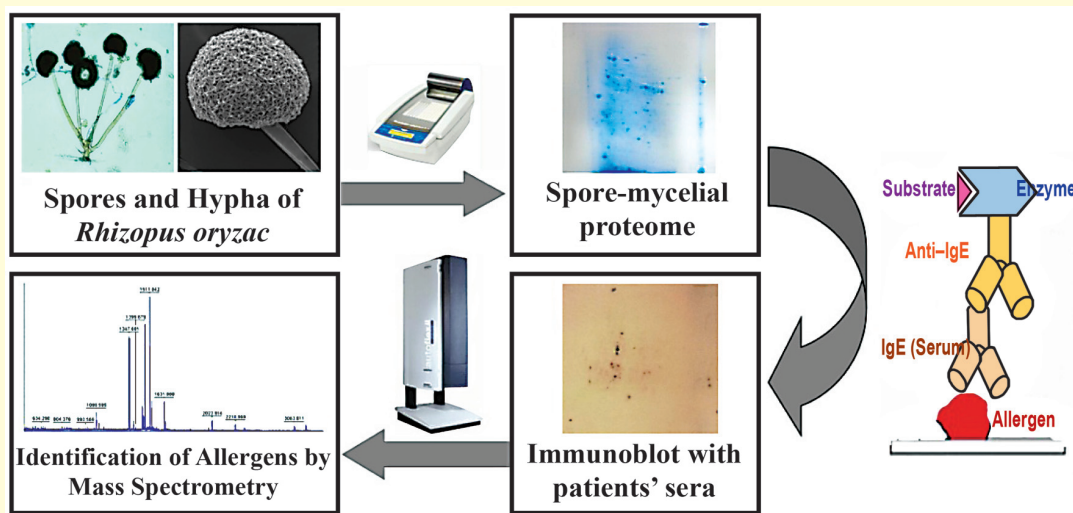
An endeavour towards understanding the host- pathogen interaction for bacterial leaf blight of rice : Dr. T. K. Ghose

Bacterial leaf blight of rice, caused by *Xanthomonas oryzae* pv *oryzae*, is one of the most serious diseases of rice. It is prevalent in all the major rice growing areas of the world. A set of 30 rice landraces including check genotypes, BLB resistant and susceptible, have been selected, grown in the field and in pots. The potted plants inoculated artificially and their reaction to BLB recorded. DNA fingerprinting of this set with SSR markers is in progress. BLB phenotyping of these genotypes for the second time is also in progress.

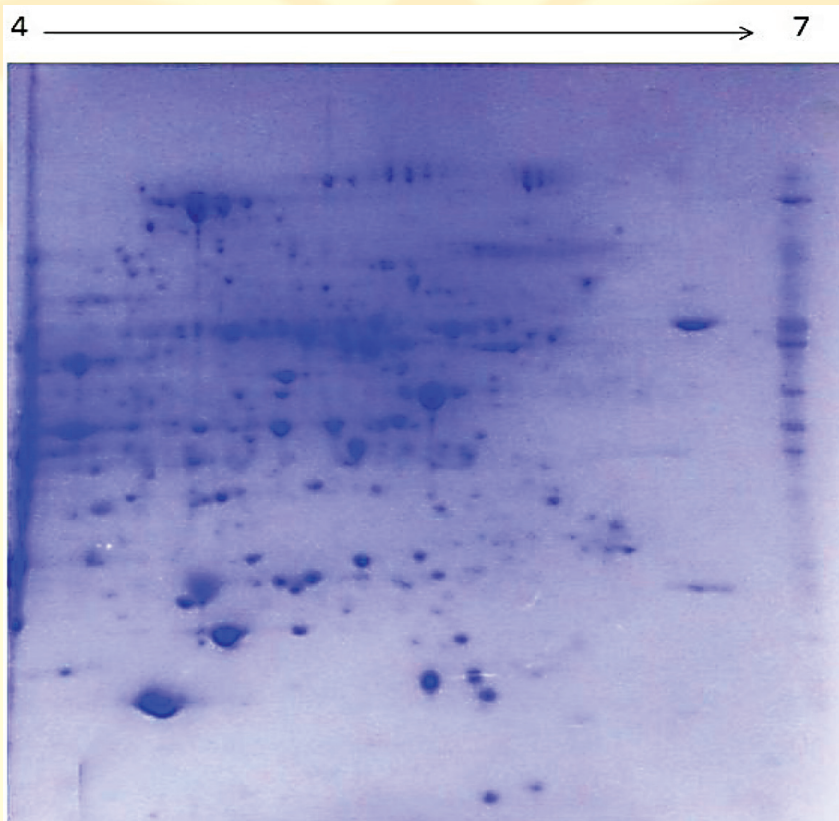
Studies on airborne allergenic pollen grains and spores: Biochemical, clinical and molecular approach : Dr. Swati Gupta-Bhattacharya

Detail proteomic study has been done on allergenic palm pollen grains and airborne pathogenic fungus *Rhizopus oryzae*. The major Allergen from palm pollen has been identified by proteomics tool and currently it is being partially purified using a combination of

Hydrophobic interaction and anion exchange chromatography. Another major 62 kDa allergen has been identified from Phoenix pollen using immunoproteomic tools. Genetic



Schematic representation of identification of allergens from *Rhizopus oryzae*



2D proteome map of *Phoenix* pollen

diversity study of six major palm trees found in and around lower gangetic plains of West Bengal has been initiated with 10 RAPD primers been analysed so far. From *Rhizopus oryzae* the major 44kD aspartyl endopeptidase has been partially purified using a combination of anion exchange and gel filtration chromatography and the full length cDNA encoding this allergen has been amplified and now trying to express it in bacteria.

Detail biomonitoring was conducted in Central Kolkata and suburban gangetic plain near Kolkata. Predominant fungal fragments and pollen grains were recorded, identified and quantitatively correlated with meteorological as well as hospitalization data. Meteorological data of 2 years have also been compared with the data of bio-monitoring by means of statistical analysis using SPSS software. Preliminary immunobiochemical characterization is being carried out to identify the IgE reactive components from certain moulds and pollen grains such as *Trichoderma harzianum*, *Eucalyptus citriodora*, *Curvularia pallescens* and *Lantana camara*.

Transcriptional and post transcriptional regulation of gene expression during plant stress response : Dr. Pallob Kundu

Understanding of the signaling pathway that leads to pathogenesis is prerequisite of designing strategies for resisting a plant pathogen. Using tomato plant and two pathogens tomato leaf curl virus (TLCV) and *Alternaria* fungus we are investigating on the regulatory components of stress signaling pathway. It has been found that TLCV infection correlates with alteration of expression of a cell expansion gene in tomato. To investigate on the mechanism of this regulation promoter of the gene is being analyzed. During *Alternaria* fungus infection tomato plants undergoes a change in its transcriptome and small RNA transcriptome as it has been detected using modern technologies. Analysis of the significance of this alteration of transcriptome is in progress.

Inositol metabolism in relation to plant abiotic stress tolerance : Dr. A.N.Lahiri Majumder

Galactinol synthase (GolS) has been identified as a regulatory step for abiotic stress in higher plants through phylogenetic analysis and expression profile in diverse organisms. Porteresia and rice GolS genes have been identified and completely characterized. Promoters of Ino1 genes from both the sources have been analyzed. Transgenic IR64 rice variety with *PcINO1* (T_4), *PcIMT1* (T_1) individually and both together have been raised. A detailed transcriptome analysis of transgenic *PcINO1* rice has been obtained. In collaboration with Sonali Sengupta, a cross-talk between salinity and mechanical stress has been documented in rice root system showing a convergence in their phenotypic response.

Mechanoreception in sensitive plants using *Mimosa pudica* as a model : Dr. Sonali Sengupta

Three varieties of *Mimosa pudica* with differential touch response have been identified and characterized. In search for a molecular mechanism pertaining to the touch phenomenon, immunoprecipitated protein partners of actin cytoskeleton and calcium-binding proteins have been identified by MALDI-TOF from the touch sensitive *Mimosa pudica* plants.

Search for MYMIV-resistance genes/proteins in *Vigna mungo* : Dr. Amita Pal

An account of genomic resources for the orphan crop *Vigna mungo* has opened with 570 ESTs. Pathogenesis related 317 unigenes were identified, of which 177 were up-regulated during incompatible interaction. Proteomic investigation revealed that the mechanism of MYMIV-resistance involves redirection of carbohydrate flux towards pentose phosphate pathway. Energy pipeline leaf model study of phenomenological fluxes has demonstrated that photosystem II electron transports are the primary targets of MYMIV during pathogenesis. This is also in congruent with present genomics and proteomics data.

Sixty-six miRNA loci, represented by 45 conserved, 8 non-conserved and 13 novel miRNAs in *V. mungo*, were identified by deep sequencing followed by bioinformatics analyses of the small RNA reads; expression patterns of these miRNAs were determined in leaf, stem and root tissues and potential target genes were predicted.

A putative promoter-like sequence (CYR-P) present upstream of the candidate MYMIV-resistance gene that regulates expression of *CYR1* was isolated. Expression analyses of deletion CYR-Ps fused with the GUS reporter in transgenic tobacco plants revealed their differential transcriptional activities. Salicylic acid (SA) induction enhanced CYR-P activity, an upsurge of SA following MYMIV infection has been reported earlier (J. of Proteomics 74:337-349), indicating its regulatory activity under biotic stress.

Resource survey analysis of gene pool with reference to seeds : Dr. Prabir Kumar Saha

Twenty-three accessions of *Sesamum indicum* L. having potential medical and economical importance, were preliminarily categorized by using seed morphological and agro-morphological characters among the accessions. ANOVA showed highly significant differences for quantitative characters. The dendrogram obtained from agro-morphological characters using the same method as above and total 16 representative accessions were selected for the further RAPD analyses. In RAPD analysis, nine primers of OPA and OPM series showed high level of polymorphisms. The results of cluster analysis by using Jaccard's Similarity Coefficients depicted that all the 16 accessions could be well distinguished by RAPD markers. The morphological characterization proved insufficient to distinguish sesame

varieties studied. The primers identified in the present study are robust RAPD markers that explained an average of 80% polymorphism in the banding pattern. The high genetic variability in this set of Indian sesame genotypes suggest that they might have originated from genetically divergent parents or has a long history of adaptation to their respective micro-climatic regions.

Regulation of gene expression in Rice Cultivars as affected by salinity stress : Dr. Dibyendu Narayan Sengupta

Dormancy of the fresh seeds of salt tolerant rice cultivars like Pokkali and Nonabokra generally removed by exposure to sunlight but we found that simply by 1 hr exposure to red light (660nm) the dormancy can be removed. Seeds are equally potential in turning on the genes those are induced during germination after sunlight treatment. By activity gel analysis the DNA Pol λ was found to be enhanced during germination steps and it was further enhanced in rice and maize seeds after the MMS treatment to germinated seedlings. Several T0 IR64 rice plants were generated after infection with *Agrobacterium* and identified by genomic PCR. To identify the transgenes, Hygromycin resistance and SAMdecarboxylase cDNA, Southern blot analysis have been started.

Molecular Documentation and Bioprospecting of Medicinal Potential in Plant of Eastern and North Eastern India : Dr. Swati Sen-Mandi

Zanthoxylum spp.:

A large number of *Zanthoxylum* species growing wild in Asia, Africa and America constitute an important component of traditional folk medicine; these represent many different not well researched genotypes. Through development of AFLP binary matrix based allele tables we have identified Species Specific DNA markers for *Zanthoxylum acanthopodium* and *Zanthoxylum oxyphyllum*. These markers may be used for authentication and molecular documentation of the two species. Distinct Species Specific clustering was observed in the phylogenetic tree.

Zingiber officinale Roscoe:

Trait (6-gingerol, medicinally the most important compound found in *Zingiber officinale*) related DNA marker, useful for bioprospecting of related gene (s), functioning, has been developed in *Zingiber officinale* landraces. This marker may be used as a probe for screening of high 6-gingerol containing genotypes.

Panax spp.:

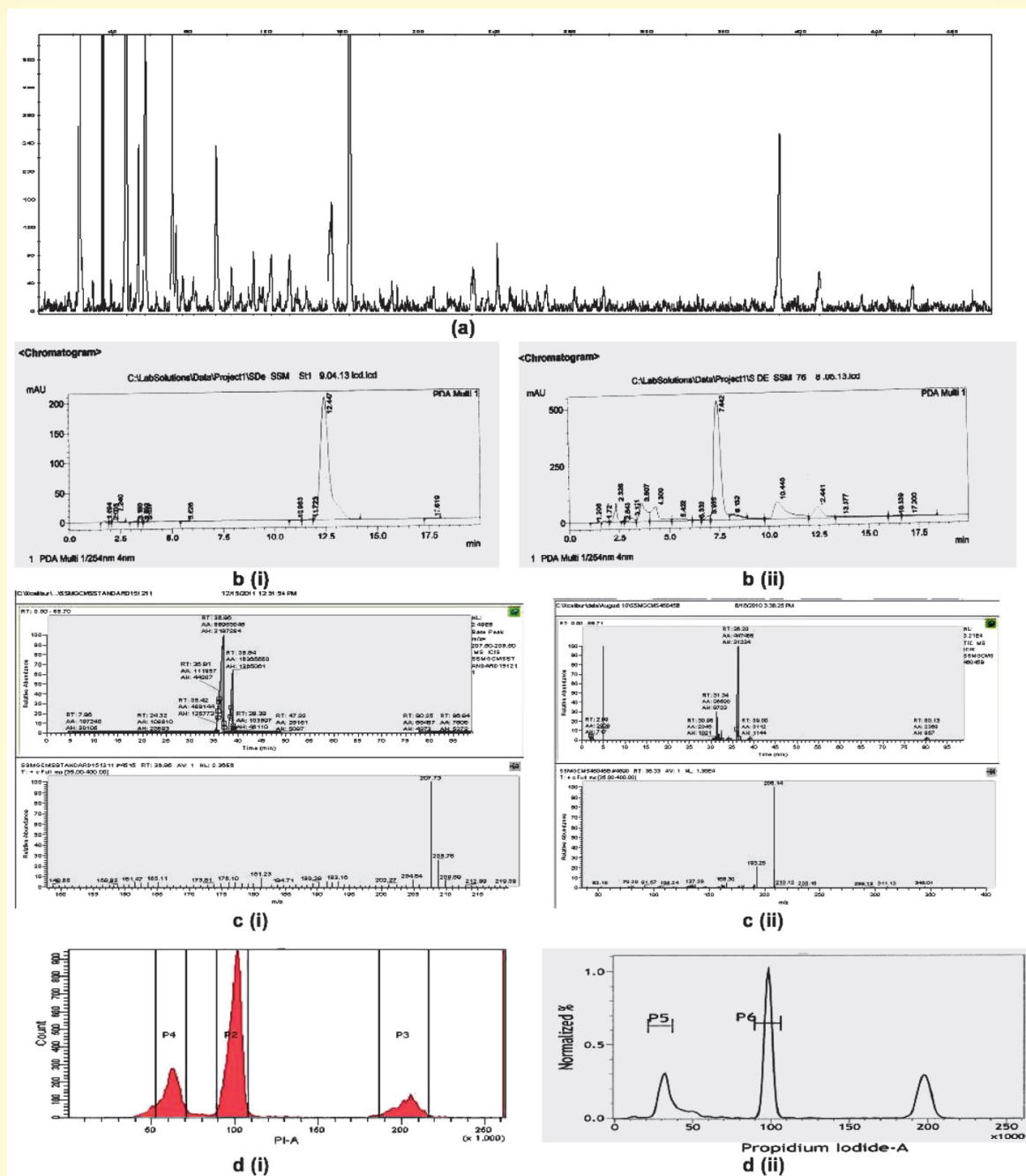
Panax, a genus of medicinal importance particularly known by its species *Panax ginseng* (in China) and *Panax pseudoginseng* (in Nepal), is represented in India reportedly (on morphological characterization) by *Panax assamicus* and *Panax bipinnatifidus*. Our AFLP analysis based DNA Fingerprinting of nuclear DNA indicate that such distinction (morphology based) between *P. bipinnatifidus* and *P. assamicus* does not hold good. This is in agreement with studies on molecular characterization of chloroplast DNA.

Podophyllum aurantiocaule Hand.-Mazz. :

Podophyllotoxin, a non-alkaloid lignan obtained from rhizomes and roots of *Podophyllum* species is useful for production of anticancer drugs viz. etoposide, etopophos and teniposide. In India, Podophyllotoxin is generally obtained from *P. hexandrum* where Podophyllotoxin content varies between 3.02%-9.53% on dry weight basis. However, availability of *P. hexandrum* is becoming limited due to extensive collection and lack of organized cultivation. In view of this, our preliminary study showing that *P. aurantiocaule* collected from lower Dibang Valley, Arunachal Pradesh also contains podophyllotoxin to a considerable extent (2.91%- 4.77% on dry weight basis) provide valuable information. AFLP based Molecular characterization and authentication of this plant (*P. aurantiocaule*) established in our laboratory would be useful for possible exploitation and utilization of this species as an alternative source of podophyllotoxin in the immediate future.

Acorus calamus L.:

Beta asarone, present in *Acorus calamus* is a genotoxic compound known to be effective in treatment of Alzheimer's disease due to its enhancing effect on apoptosis of affected cells. This compound has been reported to vary in content among landraces and a search for genotypes containing high amount of Beta asarone content seems warranted. While most studies in the literature comment on variation in (cytologically determined) ploidy level as being correlated to beta asarone content of the species, these reports do not provide information on proportionality between these parameters. For a clear understanding in this regard we have used FACS method for precise estimation of ploidy level and GC-MS analysis of beta asarone in *A. calamus* land races growing wild in the NE and Eastern region. Our data demonstrates that plants growing in the same plot may show variation in ploidy level. For a clear understanding in this regard, plant to plant assessment of beta asarone content and ploidy level of a plant would have to be undertaken.



Analysis of the candidate defence response gene(s) identified as differentially regulated on aphid challenge in wild crucifer : **Dr. Samir R. Sikdar**

To identify candidate defence response and/or resistance gene(s) against mustard aphid *Lipaphis erysimi* from the aphid resistant wild crucifer *Rorippa indica*, cDNA AFLP and real time RT PCR analysis of aphid challenged *R. indica* transcriptome resulted in the identification of several candidate genes. The study pointed towards complex phytohormonal crosstalk leading to jasmonic acid dependent effective resistance response in the wild crucifer on aphid attack. The transcriptomic identifications have been subjected to detailed analysis aiming for transgenic study. Full length sequencing of one of such induced resistance R genes, HSPRO2, a member of NBS-LRR domain family similar to Arabidopsis; ortholog of sugar beet HS1^{PRO-1} has been done.

Molecular characterization of mushroom somatic hybrid strains and development of hybrid strain-specific SCAR marker : **Dr. Samir R. Sikdar**

The *pfle* (*Pleurotus florida* + *Lentinula edodes*) and *pfls* (*P. florida* + *Lentinus squarrosulus*) hybrid mushroom strains were characterized through RFLP of ribosomal RNA and internal transcribe regions (rRNA-ITS). The ITS1-5.8S rRNA-ITS2 sequence also showed nucleotide polymorphism in both types of hybrid strains compared to their parents. A total of 25 rRNA-ITS sequences of hybrid strains and parents have been submitted to NCBI gene bank. A pair of SCAR marker was developed for *pfle 1rFB* (strain derived through tissue culture of fruit body of *pfle 1r*, the somatic hybrid between *P. florida* + *L. edodes*) which contains important properties like, high yield and high shelf-life.



Prof. A. K. Sharma, opening a laboratory of DBT-Project at Acharya J. C. Bose Biotechnology Innovation Centre.

II. Structural Studies and Biophysical Problems

Domain-domain interactions of *E. coli* GluRS : **Dr. Gautam Basu**

Experimental results obtained from mutant *E. coli* GluRS were analyzed to identify and analyses domain-domain communication. A manuscript is being written that will be communicated soon, to an appropriate journal.

Crystal structure of *E. coli* GluRS : **Dr. Gautam Basu**, in collaboration with **Dr. Ajitbikram Dutta**

Through protein engineering, a suitable mutant of *E. coli* GluRS was produced and successfully crystallized. Preliminary diffraction data have been obtained and analyses are continuing to obtain the 3D structure.

Analysis and design of peptides with cis peptide bonds: Xaa-Pro-Tyr sequence motifs : **Dr. Gautam Basu**

A series of peptides with the general sequence Xaa-Pro-Tyr were synthesized and studied by NMR. The results established Xaa-Pro-Aro to be a new sequence motif. A manuscript has been written and communicated for publication.

Design, Synthesis and High Resolution Structure Determination of Peptides and Oligonucleotides Using Nuclear Magnetic Resonance (NMR) Spectroscopy : **Dr. Anirban Bhunia**

(a) Main aim of my lab is to design new antimicrobial peptides which can significantly bind to the outer membrane of the gram negative bacteria and can penetrate through the bacterial membrane. This special kind of peptides not only ruptures the cell membrane but also alters the DNA folding which leads to stoppage of bacterial replication. Both mechanisms of action are different and a solid platform to generate new antibiotic library for the next generation drugs.

(b) We are also engaged to discover novel type of antifreeze proteins for the commercial and medical use.

© In biology, protein aggregation is a fatal event. Various types of diseases including neuronal disorders happen due to misfolding and aggregation of many important proteins. We have designed some short peptides, structured with a β -hairpin loop significantly binding to the amyloidogenic states of proteins and helps to prolong their high mass aggregated states. The research is under way and we hope to discover some interesting peptide analogs to stop protein aggregation.

Structural studies on proteins from *Vibrio cholerae* : Dr. P. Chakrabarti

Vibrio cholerae is the causative agent of the diarrheal disease cholera, which is usually acquired by oral ingestion of the bacterium with contaminated water or food. *Vibrio cholerae* accessory cholera enterotoxin (Ace) is the third toxin other than cholera toxin (CT) and zonula occludens toxin (Zot) that causes the endemic disease cholera. The ace gene from the strain O395 was cloned, over-expressed and purified. The protein was found to bind virstatin, whose interaction with human serum albumin was also studied. Protein L-isoaspartyl-O-methyltransferase of *V. cholerae* was also over-expressed, and its interaction with cofactors and effect of osmolytes on unfolding studied. Crystals have been grown for the protein and the structure solved.

Protein-nanoparticle interaction : Dr. P. Chakrabarti

For application in drug delivery and as nano-medicines, one needs to understand the nature of the interaction of nanoparticles with well-characterized proteins. In collaboration with Dr. SP Singh of NPL, Delhi we have synthesized ZnO nanoparticles (NPs) and modified the surface using polyethyleneimine (PEI). The binding of PEI-functionalized NP (which was found to be more soluble) with bovine serum albumin was studied. The ZnO nanoparticles have antibacterial and anti-tumor properties – these are very effective against multiple drug resistant bacteria. Similarly, chloroquine-gold nanoparticles were synthesized and were found to have anticancer activity of against MCF-7 breast cancer cells.

Design, synthesis of Novel Aptamers, Peptides, Small molecules selectively bind Telomeric and oncogenic G quadruplexes : Dr. Subhrangsu Chatterjee

(a) Focus of my research is to design new kinds of aptamers (LNA, BNA, ENA), antimicrobial peptides, small molecules which significantly bind to the telomeric and oncogenic G quadruplexes which are essential structures to be investigated and targeted to cause cancer cell death. We also want to investigate the role of POT1 protein and other transcription factors in controlling the telomerase activity. We employ high resolution NMR and other biophysical techniques to unravel molecular interactions.

Understanding misfolding and aggregation of proteins and peptides by high resolution NMR : Dr. Subhrangsu Chatterjee

Protein and peptide aggregation can be very fatal and cause different kinds of neurodegenerative diseases. Our focus is to design and synthesize new kinds of peptides and small molecules which inhibit protein/peptide aggregation and misfolding.

Unfolding and pH- dependent studies of a lectin from the Rhizomes of Turmeric (*Curcuma longa* Lectin): *Dr. Rajagopal Chattopadhyaya*

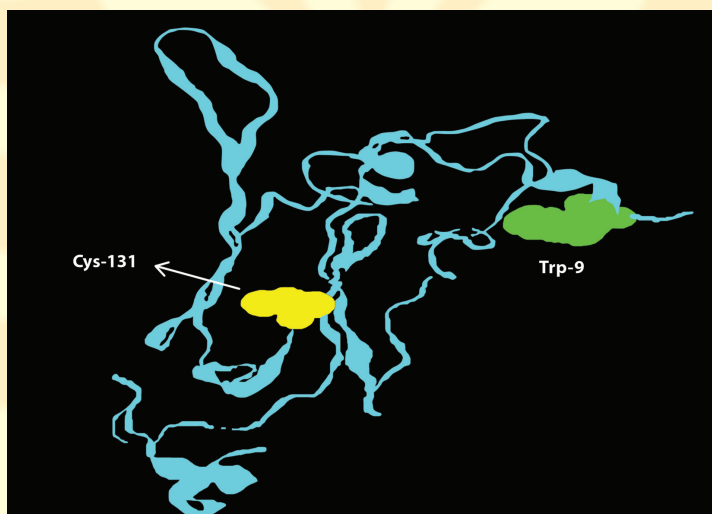
The thermal stability of *Curcuma longa* lectin/agglutinin (CLA), whose purification was described in the previous report, and was studied by circular dichroism and fluorescence spectroscopy, was further investigated by high-sensitivity differential scanning calorimetry (DSC). The DSC endotherm obtained at pH 7.4 consists of two entities with transition temperatures at 349 K, and 354 K. The unfolding process is irreversible and could be described by a three-state model. For the CLA dimer, the $\Delta h_c/\Delta H_v$ ratio is close to 2 for the first transition and 1 for the second transition, suggesting that two and one cooperative units are involved in the first and second transitions, respectively. In the presence of Me- α -mannopyranoside, both transitions shifted to higher temperatures, suggesting that the ligand binds preferentially to the native conformation of CLA. Endotherms recorded as a function of pH indicate that CLA is also stable at lower pH. Chemical unfolding of CLA, induced by Gdn.HCl, was investigated by monitoring the intrinsic fluorescence properties of the protein. The results obtained indicate that chemical denaturation of CLA can be described by a two-state process. These observations suggest that the chemical and thermal unfolding processes are different. The far UV and near UV CD spectra of CLA were nearly identical at different pH values and indicate that its secondary and tertiary structures do not change significantly with pH, suggesting that the structure of the protein is stable over the pH range 2-7.

Influence of Plant Extracts on Fenton-reaction mediated DNA damage : *Dr. Rajagopal Chattopadhyaya*

Transition metals like iron, which is most abundant in our body, can react with H_2O_2 to produce hydroxyl radical ($OH^\cdot$) via the Fenton reaction as follows: $Fe^{2+} + H_2O_2 + H^+ \rightarrow Fe^{3+} + OH^\cdot + H_2O$. The $OH^\cdot$ produced is highly reactive and a major source of oxidative stress in cells, damaging proteins, lipids and DNA. Oxidative DNA damage is implicated in many diseases such as cancer, neurodegenerative and cardiovascular diseases. Thus, considerable attention is being given to research on natural antioxidants because synthetic antioxidants have many harmful side effects. The Indian medicinal plants chosen for our study have well documented antioxidant properties and some of them also possess iron chelating activity. Some of the plant extracts (*Terminalia chebula*, *Terminalia belerica*, and *Embolica officinalis*) have been shown to be selectively cytotoxic to murine tumor cells, inducing apoptosis in those cells. It was mentioned in the last annual report that, Fenton reaction mediated DNA damage is enhanced by the aforesaid plant extracts. *Acacia catechu* has also shown similar results whereas no such effect was significant in the cases of *Dolichos biflorus* and *Hemidesmus indicus*; research to identify the active compounds is in progress. Once the compounds are identified, another future goal is to understand how they interact with the DNA substrates and their mode of action.

Spectroscopic characterization of distinct oligomeric states of α -crystallin in relation to its function : **Dr. K. P. Das** in collaboration with **Dr. K. Bhattacharyya** (IACS) and **Dr. R. Banerjee** (CU)

α -Crystallin in sodium deoxycholate is known to have enhanced autophosphorylation rates. We characterized the oligomeric state of α A-crystallin in deoxycholate by fluorescence correlation spectroscopy (FCS) to have 3.3 nm hydrodynamic radius corresponding to a tetramer. Using acrylodan labeled α A-crystallin and femtosecond solvation dynamics we could show that the deoxycholate binds near the hinge region connecting the α -crystallin domain with the C-terminal region exposing the phosphorylation sites located at the N-terminal and C-terminal region. Interestingly it also explains the lack of involvement of ser-122 in the phosphorylation in the tetrameric state. Spectroscopic characterization of oligomeric states of α -crystallin in different denaturing conditions is being studied.



A-chain of α -crystallin showing the location of the hinge region (cys-131) and N-terminal (trp-9) region.

Inhibition of fibrillation of insulin by small molecules : **Dr. K. P. Das** in collaboration with **Dr. S. Chatterjee** (Biophysics) and **Dr. A. Bhunia** (Biophysics)

A 9-residue peptide, NK9 derived from the sequence of the E-protein of the SARS corona virus was found to delay the fibrillation of insulin. In presence of submolar ratio of insulin to NK9, the lag time for the formation of fibrils more than doubled. NK9 has been found to interfere with the nucleation phase and stabilize the native-like secondary structure of insulin. Binding of NK9 to insulin as measured by fluorescence anisotropy was found to be primarily hydrophobic in nature. STD NMR revealed that several hydrophobic residues interact closely with insulin. In order to obtain further insight into the structure of the NK9-insulin complex and the molecular details of the interactions, docking and MD simulation studies are in progress.

Interaction of proteins with silver nanoparticles (AgNP) : Dr. K. P. Das

We studied the protein concentration dependence of the SPR band profiles of AgNP. We found that with increase in protein concentration, the SPR band intensity displayed a characteristic “dip and rise” pattern. The minimum point of the pattern was related to the isoelectric point of the proteins. Detailed DLS and TEM studies revealed that the SPR profile depended on the size and association state of AgNP. Fluorescence studies showed nano molar binding constants of the proteins with the silver nanoparticles with more than one nanoparticle binding to a protein molecule. Proteins retain native-like structure on AgNP surface except at high molar ratio of AgNP to protein. Our study reveals that 'dip and rise' profile is independent of protein size and structure.

Molecular basis of specificity ubiquitination machinery in eukaryotes : Dr. Ajit Bikram Datta

Post-translational modification of proteins via covalent conjugation of ubiquitin has been established to play myriad of regulatory roles in diverse cellular processes including cell cycle, gene expression, DNA repair and protein degradation. Ubiquitination occurs via a three-step enzymatic cascade requiring the activating enzyme (E1), a conjugating enzyme (E2) and an ubiquitin ligase (E3) that culminates in the formation of a covalent bond between the C-terminal glycine residue of Ubiquitin to a specific lysine in the substrate protein. Ubiquitin E3 ligases “choose” the proper substrate for modification apart from dictating the correct topology of modification by their choice of the E2 partner. Though numerous E3s and their substrates have been identified in all eukaryotes the molecular basis of their specificity is far from being understood.



Crystals of an Ubiquitin E3 ligase complex

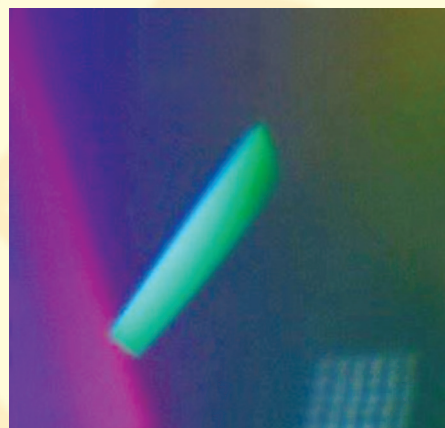
We have recently identified few E3s for detailed study and have successfully purified them in large quantities required for biochemical and structural analyses. These recombinant proteins have also been found to retain their biological activity as evident from their ability to modify cognate substrates in vitro. Crystallization trials for some of these E3s in complex with E2 and the substrate have also been initiated. Initial hits have been obtained for one of these E3 ligases in complex with the E2 and the substrate, however the crystals are not yet ready for structure solution. Thus further optimization is being carried out to obtain diffraction quality crystals. Detailed biochemical and biophysical characterization of these E3s are also being carried out.

Understanding the solution dynamics of Ubiquitin conjugating enzyme(E2) bound to activated ubiquitin : *Dr. Ajit Bikram Datta* in collaboration with *Dr. Shubhra Ghosh Dastidar*, Bioinformatics Center

RING E3 ligases activate the transfer of the ubiquitin from an E2 ~ ubiquitin intermediate. However, this activation does not involve any major conformational change in either the E3, the E2 or the ubiquitin as evident from various crystal structures. Moreover, despite striking structural similarity different ubiquitin E2s are activated to somewhat different extent by RING E3 ligases. We are trying to understand these differences using molecular dynamic simulation studies.

Three dimensional structure of Escherichia coli glutamyl-tRNA synthetase : *Dr. Ajit Bikram Datta* in collaboration with *Dr. Gautam Basu*, Dept. of Biophysics

The *Escherichia coli* Glutamyl-tRNA synthetase, despite being a highly characterized and well –studied protein, had eluded structure determination as all the previous attempts to obtain crystals of this protein failed. To grow crystals of this protein we have engineered two surface mutations that were hypothesized to hinder proper lattice formation. These mutations were confirmed to have no effect on its activity and also yielded diffraction quality crystals. Efforts are now underway to solve the structure.



Crystals of *E. coli*

Crystal structure of the Lambda repressor in complex with O_R2 operator : *Dr. Ajit Bikram Datta* in collaboration with *Prof. Siddhartha Roy*, Indian Institute of Chemical Biology, Kolkata

Temperate coliphage Lambda has served as a model system to study gene regulation for decades. Lambda repressor protein cI is the key regulator that through its interaction with two promoter regions (pR and pL) maintains the lysogenic state of the phage within its host *Escherichia coli*. Recent studies carried out in the laboratory of Prof. Siddhartha Roy indicated that interaction of cI protein with the pL and pR regions are not structurally equivalent rather there exists considerable differences between these complexes. While structures of cI and its complex with pL have already been reported, structure of cI bound to pR is not yet known. We are therefore trying to obtain crystals of lambda repressor protein in complex with a DNA containing pR promoter region.

Understanding the interactions of sigma factors with RNA polymerase in *M. Tuberculosis* and *B. subtilis* : Dr. Jayanta Mukhopadhyay

We have developed a method to purify recombinant Mt RNAP holo enzyme. The methods involve co-expression of genes for α , β , β' , and σ of Mt RNAP core in vivo in *E. coli*. The methods employ two duet vectors: one for expression of β , β' genes and another compatible duet vector for expression of α , σ genes.

We have developed a method to purify recombinant Bs RNAP core enzyme.

We have developed procedures that enable preparation of Bs RNAP core incorporating an intein-CBD tag at either C-terminus of β , or β' subunit, following reaction with Cys-Fluorescein. We have also developed procedures to label principal σ factors *B. subtilis* and *M. tuberculosis* with tetra-methyl-rhodamine (TMR) dye by generating single-cysteine derivatives of σ factors, following reaction with TMR maleimide. We have observed FRET between fluorescein labeled RNAP and TMR labeled sigma in the context of RNAP holoenzyme. We are able to form the elongation complex having 15 nt RNA. Experiments are being performed to determine the composition of elongation complex, hence determine the extent of sigma release upon transition from transcription initiation to elongation.

Crosslinked CRP acts as a transcription regulator even in the absence of cAMP. : Dr. P. Parrack

The CRP protein of *E. coli* is a transcription regulator that is functionally active only in the presence of cAMP. Binding of cAMP brings about several conformational changes in CRP. One such change is that it brings the C178 residues of the two subunits of the homodimeric protein close enough, so that the cys residues can be crosslinked by DTNB.

We prepared such a subunit-crosslinked version of CRP, by treating the protein with DTNB in the presence of appropriate cAMP concentrations. Subsequently, cAMP was completely removed by extensive dialysis. The resulting crosslinked protein (CRP^{cl}) was found to activate transcription from *E. coli* lac and gal promoters, and repress transcription from *E. coli* cya promoter, as ascertained from *in vitro* transcription assays. This result shows that CRP^{cl} was frozen in a conformation that is competent to regulate transcription, and is normally achieved only upon cAMP binding.

Characterization of the DNA and drug binding proteins of bacteria and bacterial virus : Dr. Subrata Sau

Mycobacteriophage L1 employs a repressor protein and two operator sites for maintenance of its lysogenic development. With an aim to create an expression vector for mycobacterial

system, four substitution mutants of mycobacteriophage L1 repressor were characterized and found that two mutants possess appreciable DNA binding activity, whereas, two others have little or very little DNA binding activity at 32 °C. Different mutations also had different effects on the structure, stability and the oligomerization ability of L1 repressor.

E. coli FKBP22, a rapamycin binding peptidyl-prolyl cis-trans isomerase, appears to carry a long α helix (namely α 3) in between its two domains. To find out the role of helix α 3 on the structure, function, and stability of FKBP22, two α 3 deletion and two α 3 insertion mutants of this protein were constructed and studied by various probes. Investigations revealed that structure, stability and the protein folding ability of each mutant protein is different from those of the wild-type protein. In contrast, the drug binding activity of each mutant was similar to that of FKBP22. The length of helix α 3, therefore, contributes considerably to conserve the structure, function, and stability of FKBP22.



Acharya J. C. Bose and
Lady Abala Bose
England, 1900

III. Computational Biology

Electrostatic interactions in protein-protein complexes : Dr. Gautam Basu

Our earlier work on electrostatic control of subunit orientations in protein-protein complexes was written as a manuscript and communicated for publication.

Prediction of aminoacylation rates of mutant tRNA from crystal structure of the wild type tRNA-aminoacyl-tRNA synthetase crystal structures : Dr. Gautam Basu

Using a simple electrostatic model we showed that aminoacylation rates of mutant tRNAs can be predicted from crystal structure of the wild type tRNA-aminoacyl-tRNA synthetase crystal structures. A manuscript was written and would be communicated soon.

Molecular Dynamics simulations of tRNA : Dr. Gautam Basu

MD simulations were performed on tRNA^{Gln} and its mutants to understand the how dynamics controls function.

Glycine-cisProline motifs in proteins : Dr. Gautam Basu

We discovered a novel structural motif in protein, -(Gly_(PR)-cisPro), and showed its functional importance. The results were published in J. Am. Chem. Soc.

Sequence analysis of tRNA^{Glx} from bacterial whole genomes : Dr. Gautam Basu

Based on a large database of bacterial GluRS, GlnRS and gatCAB from bacterial whole genomes, we revisited the evolutionary histories of GluRS and GlnRS in bacteria. Our database and analyses brought out some newer aspects of idiosyncratic evolution of the two functionally related proteins in bacteria and allowed us to confirm or annul some of the prevailing views. A manuscript is being written and would be communicated soon.

Physicochemical features of protein-protein/DNA interfaces : Dr. P. Chakrabarti

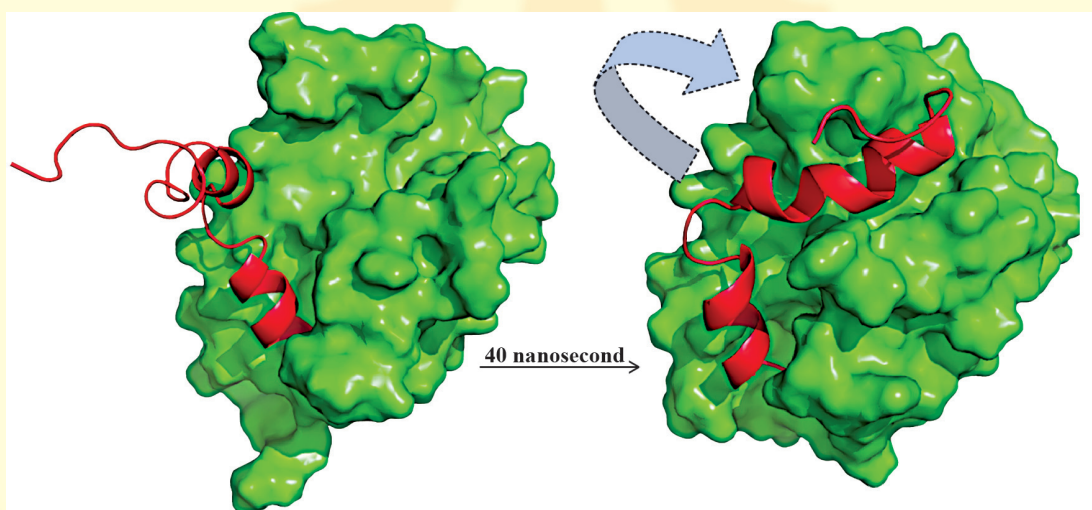
To delineate features that characterize protein-protein interactions is a long-standing theme in our group. Many of the parameters developed for characterizing these interfaces have also been applied to identify protein-DNA interfaces in DNA-binding proteins using support vector machines (SVM). Homology modeling and molecular dynamics simulations were carried out for some proteins which are being studied experimentally in the lab.

Evolutionary studies on bacterial ring-hydroxylating oxygenases : *Dr. Tapan K. Dutta*

Aromatic ring-hydroxylating oxygenases (RHOs) constitute a superfamily of enzymes involved in the oxidative metabolism of a wide variety of aromatic compounds. Dealing with evolutionary studies on bacterial RHOs, we have previously elucidated the evolutionary pathways leading to the evolution of RHOs towards a wide substrate-range based on structural and functional analyses. These observations have been further extended towards understanding the role of selection pressure guiding evolution of nitroarene dioxygenase from naphthalene dioxygenases. Using different maximum-likelihood models of adaptive evolution, signature of natural selective pressures operating across the naphthalene family of dioxygenases were examined. Our analyses revealed that purifying selection pressure dominated the evolutionary history of the enzyme family and that episodic positive Darwinian selection pressure was responsible for the evolution of nitroarene dioxygenases from naphthalene dioxygenase. In addition, a different set of positively selected residues were detected for each nitroarene dioxygenase which are mainly located around the active site, the catalytic pocket and their adjacent regions. A public database of bacterial RHOs is also under construction.

Insight into Structural dynamics of biomolecules, leading to drug design : *Dr. Shubhra Ghosh Dastidar*

The broader area of interest of our 'Structural Dynamics' group is to gain novel insight into the mechanism of functioning of biomolecules from computational modeling and simulations of their structures. The research projects aim for the fundamental understanding of the molecular recognition processes and to use that knowledge for designing novel therapeutic molecules. The more specific interest is to understand the role of protein flexibility to determine the



Dynamics of the 'tail' of Bcl-xL to open and close its binding pocket

protein-protein and protein-ligand associations. p53-pathway, and Bcl2 family are two primary areas of focus, where both are promising areas of cancer therapeutics. For example, investigating the mechanism of conformational transitions (shown in figure) of Bcl2 family of proteins that control the apoptosis has been a primary objective. We use high performance computing (HPC) technology to perform our scientific investigations and work in a truly interdisciplinary manner with active collaborations with experimentalists.

Evolutionary Bioinformatics : *Dr. Tapash C Ghosh*

Understanding the causes of heterogeneous evolutionary rates of proteins is one of the biggest challenges in the field of evolutionary Bioinformatics. My research work is focused on the identification and understanding of the different evolutionary forces by analyzing the genomic and functional data of various organisms.

Regulatory RNA and stem cell biology : *Dr. Zhumur Ghosh*

Elucidating regulatory noncoding RNA (ncRNA) signatures in cancer stem cells followed by setting up experimental infrastructure for validating the ncRNA-mediated regulatory networks in cancer stem cells.

We have been working towards annotating the human and mouse long noncoding RNAs(lncRNAs) as well as human and mouse PIWI interacting RNAs(piRNAs). Further we are looking into their mode of regulation in stem cells specifically cancer stem cells. Further we aim to direct our investigation towards zooming into the role of piRNAs and lncRNAs in reprogramming of cancer stem cells using both dry and wet bench techniques.

Elucidating the oncogenic potential of stem cell derivatives

Another focus of our lab has been towards dissecting the interwoven character of pluripotency and tumorigenicity of stem cell and its derivatives which is acting as the main barrier towards using them for safer regenerative therapy. The result of such investigation will also lead us to understand the key hubs which are responsible for the generation of cancer stem cells.

Analyzing next-generation sequence data needed for the different projects

Further we have successfully designed a computational pipeline for analysing next-generation sequencing data mainly RNA-seq data which is needed for the different projects running in my lab.

I have also been involved with collaborative works on different projects within the Institute as well as with Stanford University School of medicine, USA.

Structural analysis of Ca^{2+} dependent and Ca^{2+} independent type II antifreeze proteins: a comparative molecular dynamics simulation study : **Dr. Debjani Roy**

Comparative molecular dynamics simulations of Ca^{2+} dependent psychrophilic type II antifreeze protein (AFP) from herring (*Clupea harengus*) (hAFP) and Ca^{2+} independent type II antifreeze protein from long snout poacher (*Brachyopsis rostratus*) (lpAFP) have been performed for 10 ns each at five different temperatures. We have tried to investigate whether the Ca^{2+} dependent protein obtains any advantage in nature over the independent one. To this end the dynamic properties of these two proteins have been compared in terms of secondary structure content, molecular flexibility, solvent accessibility, intra molecular hydrogen bonds and protein-solvent interactions. At 298 and 373 K the flexibility of the Ca^{2+} independent molecule is higher which indicates that Ca^{2+} could contribute to stabilize the structure. The thermal unfolding pathways of the two proteins have also been monitored. The rate of unfolding is similar up to 373 K, beyond that hAFP shows faster unfolding than lpAFP. The essential subspaces explored by the simulations of hAFP and lpAFP at different temperatures are significantly different as revealed from principal component analysis. Our results may help in understanding the role of Ca^{2+} for hAFP to express antifreeze activity. Furthermore our study may also help in elucidating the molecular basis of thermostability of two structurally similar proteins, which perform the same function in different manner, one in presence of Ca^{2+} and the other in absence of the same.

Computational proteomics : **Dr. Sudipto Saha**

Identification of novel linear motifs (LMs) that mediate protein protein interactions (PPIs) and characterization of LMs for drug targets.

First, we are developing a comprehensive relational database of LMs. Second, we are developing a computational framework for identifying sequence-signatures that mediate PPIs based on statistical scoring system. We focused on ANK repeats and FH2 domains, which are frequently observed in oncoproteins. Third, we are studying pathogen-host PPIs, focusing on Salmonella and virus as model pathogens. Overall, we are using network based approach to study PPIs and regulatory networks.

IV. Molecular Medicine

Understanding mechanism of carcinogenesis : Role of tumor derived glycosphingolipids in mediating tumor growth, progression and metastasis :

Dr. Kaushik Biswas

Despite various reports existing on the deleterious effects of tumor derived gangliosides in suppressing anti-tumor immunity in tumor bearing host, the role of gangliosides in regulating tumor growth and progression has not been studied with any great detail. Our project aims in defining the role of gangliosides in tumor cell motility, migration, invasiveness and metastatic potential *in vitro*. Based on the expression of either GM2/GD2 synthase message (RT-PCR) or ganglioside GM2 levels, CCF52 (brain tumor), SK-RC-26B and SK-RC-45 (kidney cancer) and NKE (normal kidney epithelial) cell lines were selected for functional studies. siRNA transfection in the cell lines to transiently knockdown expression of GM2/GD2 synthase and hence GM2 expression has been successfully established and confirmed by RT-PCR and immunofluorescent microscopic staining. On a different note, cloning and overexpression of GM2/GD2 synthase in a minimally expressing cell line NKE was successfully initiated using TA cloning strategy. GM2/GD2 synthase knockdown CCF52 as well as SK-RC-26B cells exhibited significantly reduced migration when compared to their respective scrambled siRNA controls, using the modified Boyden chamber assay. Experiments are currently underway to study the functional role of higher order gangliosides including GM2 in regulating other parameters of tumor growth like invasiveness in selected tumor cell lines. Further, studies are in progress to elucidate the mechanism by which GM2 mediates tumor cell migration.

With an aim to translate the *in vitro* role of complex gangliosides including GM2 *in vivo*, mouse tumor cell lines were screened for GM2 as well as GM2/GD2 synthase. Based on the expression profile of GM2, Renca (mouse kidney cancer cell line) expressing negligible levels of GM2 and its GM2 overexpressing variant, Renca-v were chosen for the study. Currently, experiments are under way to generate a specific GM2/GD2 synthase knockout Renca-v, with an objective to study the effect of ganglioside depletion in a syngeneic mouse tumor model in the near future.

Studying the epigenetic regulation of ganglioside synthase genes in cancer : **Dr. Kaushik Biswas**

Although aberrant expression of gangliosides have been reported in various tumors previously, very few studies were performed to find out how these genes are regulated at the transcriptional level. Till date no direct evidence exists on the epigenetic regulation of ganglioside synthase

genes in cancer. We have initiated a study to define the epigenetic role in regulating ganglioside synthase gene activity focusing primarily on two key ganglioside synthases – β -1,4-GalNAcT (β -1,4-N-acetylgalactosaminyltransferase or GM2/GD2 synthase) and ST-II (sialyl transferase/GD3 synthase), since these two enzymes regulate the biosynthesis of higher order gangliosides. The study will also involve identification of the components involved in such an epigenetic regulation and elucidate the underlying mechanism through which ganglioside synthase genes are epigenetically controlled in cancer.

Cancer is not only a genetic disease but a mechanical disease as well: An effort to know the unknown : *Dr. Tanya Das*

One of the key factors that promote cancer cell invasion and metastasis is the physical property of the extracellular matrix (ECM), particularly its compliance, which in turn activates cellular mechano-transductional signaling pathways. Cancer cells, after breaching the basement membrane, invade into stromal matrix, cross endothelial barrier to enter in to the circulatory system, and finally gain access to other organs or tissues. This complex biomechanical phenomena leads to metastasis and is aided by the formation of actin rich dynamic cell membrane protrusions called 'invadopodia' or 'invadosomes'. In the present research work, invasion of breast carcinoma cells MDA-MB-231 has been studied using two dimensional matrix models of various stiffnesses. Results have shown that the process of invasion is governed by many factors, including matrix stiffness, cell-matrix adhesion and proteolysis. β 1-integrin and phosphorylated focal adhesion kinase (p-FAK) promote cell adhesion while, MT1-MMP, a membrane metalloprotease associated with the tips of invadosomes, plays a pivotal role in matrix degradation. The current work has proved that, with increase in matrix stiffness, co-localization of these molecules as well as number of invadopodia formed increase significantly. In cancer cells, the local matrix exerts an unbalanced force and disrupts tissue homeostasis. This force is perceived by the cell receptors (such as integrins) that turn on an intracellular signaling pathway to remodel the cytoskeletal proteins for ensuring of invadopodia formation. Cancer is therefore, not only a genetic disease, but a mechanical disease as well.

Cancer stem cells: Unlocking the secrets of drug resistance and cancer relapse : *Dr. Tanya Das*

Conventional chemotherapies for breast cancer improve survival, yet a substantial number of women remain at risk for late recurrences. Cancer stem cells (CSC) are believed to play a crucial role in cancer recurrence due to their resistance to conventional chemotherapy and capacity for self-renewal. In this study, we determined the role of NF κ B signalling in chemotherapy-induced expansion of CSCs in breast cancer patients and cell lines. We initially discovered enrichment of NF κ B-responsive inflammatory gene signature in chemotherapy-treated primary breast cancers. In primary breast cancers and cell lines, treatment with the chemotherapeutic

agent (doxorubicin, 5-FU or cyclophosphamide) expanded a population with CSC markers and stemness signature. Before any visible sign of tumor burden decrease, genotoxic drug-induced CSC phenotype in non-stem cancer cells (NSCC) was perceived. These effects were abrogated by both NFB inhibitors as well as by I κ B κ -SR-cDNA transfection prior to drug-treatment. Moreover, these effects were mimicked by NF κ B activators. Furthermore, we show that among commonly available non steroidal anti-inflammatory drugs, aspirin or acetyl salicylic acid potently abrogated drug-induced NF κ B activation and thus expansion of the CSCs. The combination of aspirin and chemotherapeutic drugs kills both cancer stem cells and non-stem cancer cells in culture, and reduces mammosphere formation much more effectively than either drug alone. These studies are the first to our knowledge to demonstrate the ability of aspirin, NFB inhibitor, to block the expansion of chemotherapy-resistant CSCs. These observations afford a rationale for why the combination of aspirin and chemotherapeutic drugs might improve treatment of patients with breast (and possibly other) cancers and provide a basis for future clinical studies in breast cancer patients.

To explore the mechanism underneath stemness-retention of breast cancer stem cells: Role of the pluripotency factor Oct-4 : Dr. Tanya Das

Disease recurrence originates from residual treatment-resistant cells, which regenerate the initial breast cancer phenotype. The discovery of normal breast stem cells has re-ignited interest in the identity and properties of breast cancer stem cells (BCSC) and the relationship of these cells to the tumorigenic ability of treatment-resistant cells. While the origin and identity of BCSC are contentious, resistant cells survive and propagate only because of the recruitment of aberrant and potentially drug-able signaling pathways. Survivin, a bifunctional "Inhibitor of Apoptosis" (IAP) that has been implicated in protection from apoptosis and regulation of mitosis, has been found to be highly expressed in BCSC as compared to the non-stem cell tumor population. This indicates that survivin might have some contribution in CSC survival and maintenance. Oct-4, expressed in undifferentiated embryonic stem cells (ESC) and embryonal carcinoma cells, is a well known ESC marker and recently has been reported to activate survivin gene expression by phosphorylation and activation of its transcriptional activator STAT3. Present study showed that the expression of survivin was overall increased through passage/degree of mammosphere (bearing BCSC) formation along with pluripotency marker-Oct-4, both of which were turned down upon re-differentiation. Interestingly, survivin expression was increased in nuclear compartment when compared to its cytoplasmic expression with increase in degree of mammosphere. This altered distribution of survivin pointed towards a different functional significance of survivin in BCSCs. Moreover, down-regulating survivin expression by silencing its transcriptional regulator, STAT-3, or by over-expressing DN-Akt-cDNA, effectively lowers stemness as well as Oct-4 expression. Bioinformatic analysis predicts a binding sequence of Oct-4 on survivin promoter that projects

towards a transcriptional regulation of survivin by Oct-4. Further investigation for the mechanisms underlying the regulation of survivin by Oct-4 and vice versa is in progress. All these findings suggest that survivin may pose a relationship with Oct-4 in maintaining the stemness of BCSC.

Germ cell apoptosis by benzo(a)pyrene: An environmental toxicant : Dr. Kuladip Jana

Testicular toxicity of benzo(a)pyrene have been demonstrated in male and that are mediated by the aryl hydrocarbon receptor (AhR). This study related to testicular steroidogenic acute regulatory gene (StAR) expressions and caspases expressions, glutathione depletion as well as germ cell apoptosis in relation to the benzo(a)pyrene treatment (DST-SERC First Track Young Scientist Project (2012-2013)

Ageing associated testicular gametogenic and steroidogenic disorders: protective functions of Chrysin : Dr. Kuladip Jana

In aged testis, ROS produced by endogenous cellular processes resulting in attenuation of LH receptor signalling to adenylyl cyclase may have a short-term effects on the intracellular transfer of cholesterol to the mitochondria and long-term effects on the metabolism of cholesterol to testosterone. Therefore, my focus of research is to study the steroidogenic processes in aged Leydig cells in relation to the germ cell and Leydig cell apoptosis.

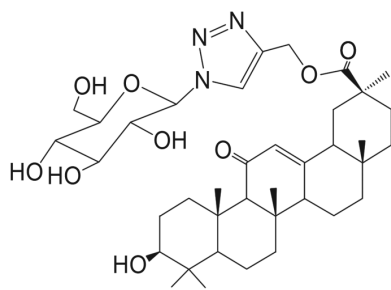
Resveratrol Induced Apoptosis in Cervical Cancer Cells (Hela) : Role of β - catenin. : Dr. Kuladip Jana, in collaboration with Prof. Sanghamitra / Raha, Visva Bharati, Shantineketan

Resveratrol , (Res., trans – 3,4', 5 – trihydroxystilbene) is a phytoalexin which can cause apoptosis in HeLa, the human cervical cancer cell line, in a dose and time – dependent manner. When working with an optimized dose of 60 μ M , we have seen that it can decrease the levels of β – catenin , a major signaling protein of the Wnt pathway, in both the cytoplasm and the nucleus. Apoptosis was verified by a) flow cytometry (the sub - G_0 / G_1 population shifts considerably at ≥ 24 hours of Res. treatment) b) Annexin – V – FITC fluorescent microscopy to study the membrane PS (phosphatidylserine) externalization [with 7-amino actinomycin D (7 – AAD) as viability dye] ; and c) TUNEL assay. The TUNEL positivity was observed from ≥ 24 hours of Res Treatment. We expect to provide further insights about the mode of cell death in HeLa cells after Res. exposure.

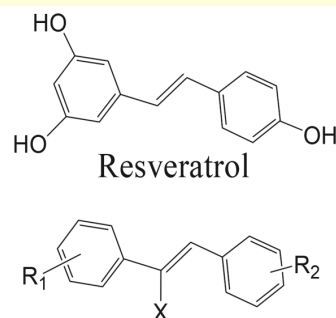
Synthesis and bio-evaluation of natural product analogs for anticancer activity : In collaboration with Dr. A. K. Mishra and Dr. Kuladip Jana

- (a) A series of glycosyl trizolyl terpenoid derivatives were synthesized and anticancer activity of these derivatives are currently ongoing.

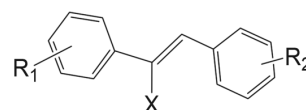
- (b) A series of analogs of Resveratrol, a well known anticancer agent were prepared and their evaluation of biological activity is ongoing.



Glycosyl triazolyl glycyrrhizine derivatives.



Resveratrol



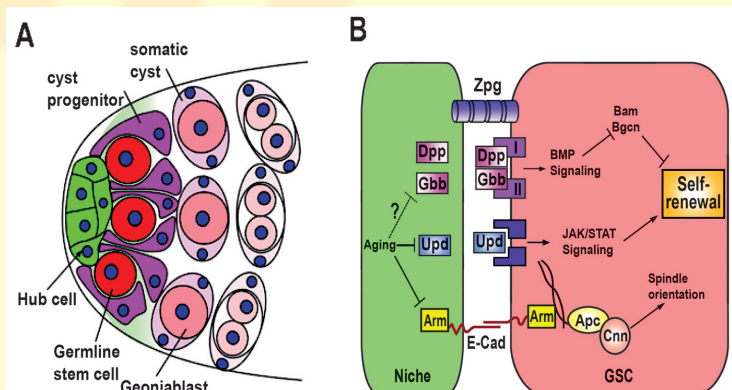
Resveratrol derivatives

Intensive swimming exercise mediated germ cell depletion associated with the alteration of steroidogenesis and generation of pro-oxidants in rat testis : Dr. Kuladip Jana

Intensive strenuous swimming exercise caused dysfunctions in male reproductive system $\Leftrightarrow$ Disruptions of spermatogenesis and sperm DNA damage along with steroidogenesis and steroidogenic acute regulatory protein expression $\Leftrightarrow$ Forced intensive swimming also elevated testicular ROS generation and impairment of the antioxidant status $\Leftrightarrow$ Exhausted swimming resulted impairment of testicular mitochondrial membrane potential ($\Delta\Psi_m$) along with caspase activation $\Leftrightarrow$ Moreover, alpha lipoic acid and N-acetyl cysteine protected the exhaustive swimming exercise mediated testicular abnormalities following diminution of ROS generation.

Molecular Mechanisms of Germ-line Stem Cell Regulation : In collaboration with Dr. Partha Roy, Dept. of Biotechnology, Indian Institute of Technology (IIT), Roorkee, U.T.K. and Dr. Kuladip Jana

Germ-line stem cells (GSCs), which can self-renew and generate differentiated progeny, are unique stem cells in that they are solely dedicated to reproduction and transmit genetic information from generation to generation. Through the use of genetic techniques in *Drosophila*, *Caenorhabditis elegans*, and mouse, exciting progress has been made in understanding molecular mechanisms underlying interactions between stem cells and niches. The knowledge gained from studying GSCs has provided an intellectual framework for defining niches



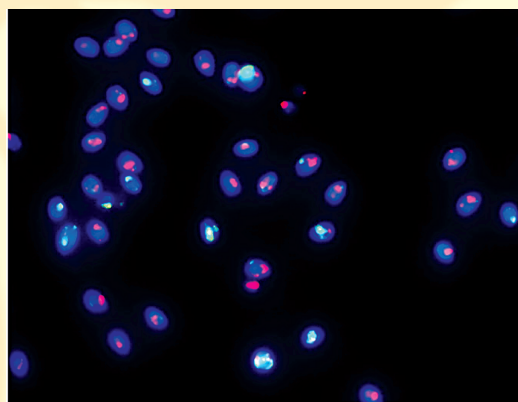
and molecular regulatory mechanisms for other adult stem cells. Our focus is to study the conserved mechanisms underlying GSC self-renewal and differentiation.

Molecular Cues To The Pathogenesis of PCOS: The Role Of Hyperhomocysteinemia : *Dr. Kuladip Jana*; in collaboration with *Prof. Baidyanath Chakravarty*, Institute of Reproductive Medicine

Polycystic Ovary Syndrome (PCOS) is a heterogeneous entity comprised of broad spectra of ovarian disorders and metabolic syndrome (MS) including anovulation, hyperandrogenism with a frequent association of insulin resistance (IR), obesity and dyslipidemia to name a few. Recent studies document that a significant population of PCOS women do also suffer from hyperhomocysteinemia (HHcy), which has been known to be a close associate of IR as well as an independent risk factor of MS. Despite frequent associations between PCOS, IR and HHcy, the cause and effect relationships between these three entities still remain elusive and it remains yet to be resolved if HHcy is a mere co-existence or after-effects of the disease or it has any contributory role in the pathogenesis of the disease. Nevertheless, we have observed that a moderate degree of HHcy induced by oral administration of homocysteine (Hcy) through drinking water replicates the full morphologic and metabolic spectra of PCOS.

Male infertility biomarkers are assessed by a metabolomics platform : *Dr. Kuladip Jana*

Metabolomics is the systematic study of metabolites as small-molecule biomarkers that represent the functional phenotype in a cell, tissue or organism. Detection of crucial disturbances in the concentration of metabolites by metabolomic profiling of key biomarkers can be beneficial in the management of various medical conditions, including male-factor infertility. Recent studies have demonstrated the potential role of this rapid, noninvasive analysis in the investigation of infertile men. Differences in the concentration of oxidative stress biomarkers (-CH, -NH, -OH and ROH) have been found to be uniquely associated with semen plasma of healthy men compared with patients with idiopathic infertility, varicocele and vasectomy reversal. Furthermore, NMR spectra have shown significant differences in citrate, lactate, glycerylphosphorylcholine and glycerylphosphorylethanolamine among semen samples of men with spermatogenesis failure, obstructive azoospermia, oligoasthenoteratozoospermia and healthy donors.



TLR2 and CCR5 cluster in the lipid raft enhances the susceptibility of Leishmania donovani infection in macrophages : *Suchandra Bhattacharyya Majumdar* and *Dr. Subrata Majumdar*

Current study involves the cross-talk between Toll-like receptor 2 and Chemokine receptor 5 on the lipid raft platform of the plasma membrane during early hours of Leishmania donovani

infection in visceral leishmaniasis. Protein kinase C isotypes (-zeta, -delta, -epsilon) have been shown to interact physically with TLR2 of host macrophages during initial host pathogen interaction to provide host defense. CCR5 silencing significantly enhances TLR2-PKC interaction during early hours of infection.

CXCL10 Is Critical for the Generation of Protective CD8 T Cell Response Induced by Antigen Pulsed CpG-ODN Activated Dendritic Cells : Saikat Majumder and Dr. Subrata Majumdar

The visceral form of leishmaniasis is the most severe form of the disease and of particular concern due to the emerging problem of HIV/visceral leishmaniasis (VL) co-infection in the tropics. In the present study, we have used the murine model of leishmaniasis to evaluate the potential role played by soluble leishmanial antigen (SLA) pulsed-CpG-ODN stimulated dendritic cells (SLA-CpG-DCs) in restricting the intracellular leishmanial growth. We found that mice vaccinated with a single dose of SLA-pulsed DC stimulated by CpG-ODN were protected against a subsequent leishmanial challenge and had a dramatic reduction in parasite burden along with the generation of parasite specific cytotoxic T lymphocytes.

Glycyrrhizic acid increases antimony responsiveness in macrophages infected with SAG resistant Leishmania donovani : Amrita Bhattacharjee and Dr. Subrata Majumdar

In the present study we have analysed the immunotherapeutic potential of Glycyrrhizic acid (GA), a triterpene glycoside isolated from the liquorice plant, against visceral leishmaniasis (VL) in combination with Sodium antimony gluconate (SAG). GA could downregulate the expression of Multidrug resistance protein 1 (MRP1) and Permeability glycoprotein (P-gp), two ABC transporters critical for antimony efflux. Coadministration of GA with SAG increased SAG responsiveness in macrophages infected with a highly SAG resistant strain GE1F8R. Further studies in an in vivo murine model exhibited significant parasite clearance by GA and SAG co administration. This strong antileishmanial strategy suggests a potential alternative against SAG monotherapy.

Identification of the host cell factors responsible for survival and death of leishmania : Nihar Ranjan Biswal, Shabina Parveen and Dr. Subrata Majumdar

To identify the components of the host cell signalling machinery those are important for regulating the Leishmania infection, we performed a siRNA screen against all human phosphatases and kinases, in non-adherent human monocyte cell line THP1, infected with a strain of Leishmania donovani Ag83 (MHOM/IN/1983/AG83) promastigotes. Such experiments identified several host molecules that were involved either in facilitating, or suppressing, the intracellular infection. We successfully screened out few genes, out of 252 phosphatases and 89 kinases that are responsible for Leishmania survival or death within the host.

CCR5 is essential For the Establishment of Experimental Murine Tuberculosis: Involvement of IL-10 dependent signaling pathways : Shibali Das and Dr. Subrata Majumdar

In this study we found that Mycobacterium tuberculosis infection significantly increases CCR5 expression in macrophages thereby facilitating nuclear translocation of NF-kBp50 subunit. These events culminated in up-regulation of the immunosuppressive cytokine IL-10 production, which was further associated with the down regulation of macrophage MHCII expression along with the upregulation of CCR5 expression via engagement of STAT-3 in a positive feedback loop. Treatment of macrophages with CCR5 specific siRNA abrogated the IL-10 production and restored MHCII expression. While, in vivo CCR5 silencing was also effective for the restoration of host immune response against tuberculosis. This study demonstrates that CCR5 plays a very critical role for the establishment of this pathogen.

Tumor associated macrophages from B16F10 melanoma induce the differentiation of CD4⁺Foxp3⁺ regulatory T cells : Sayantan Banerjee and Dr. Subrata Majumdar

In this study, we reported that tumor associated macrophages (TAM) are the predominant leukocyte infiltrate within the B16F10 tumors. Moreover, TAM, unlike the tumor infiltrating dendritic cells (TIDC), secrete high level of anti-inflammatory cytokines and exhibit very high level of B7-H4 surface expression. In addition to their well-known T cell suppressive capacity, TAM from B16F10 melanoma induced the differentiation of CD4⁺Foxp3⁺ regulatory T cells from CD4⁺CD25⁺ T cells. Interestingly, TAM induced differentiation of CD4⁺Foxp3⁺ regulatory T cells was found to be MHC-II restricted and B7-H4 and TGF- β dependent, since, blocking of MHC-II, B7-H4 or TGF- β significantly abrogated the TAM induced CD4⁺Foxp3⁺ regulatory T cell differentiation.

Reciprocal roles of PKC and PKC δ in regulation of proliferation and apoptosis of B16F10 melanoma cells : Kuntal Halder and Dr. Subrata Majumdar

Melanoma is a malignant tumor of melanocytes. The molecular mechanisms underlying this transformation have been widely studied, and various signaling pathways including PKC signaling have been found to be altered during this malignant transformation. Various PKC isoforms have been implicated in both proliferation and apoptosis of tumors, but the role of specific PKC isoforms in melanoma tumors remains unresolved. We analyzed the levels of all PKC isoforms in B16F10 melanoma tumor cells, and demonstrated marked variation in the expression and functional aspects of both PKC α and PKC δ isotypes in apoptosis and proliferation of B16F10 tumors. Over-expression of PKC α resulted in enhanced cell proliferation whereas overexpression of PKC δ inhibited cell proliferation and enhanced cell cycle arrest at G0/G1 phase in B16F10 melanoma cells.

Understanding the role of Hsp70 in protein kinase quality control : Dr. Atin Kumar Mandal

Molecular chaperone Hsp70 actively participates in protein quality control by facilitating folding of newly synthesized proteins and targeting immature or misfolded proteins for degradation. We want to address how Hsp70 made the decision to fold or degrade proteins using protein kinase as substrate in yeast system. We found an increased level of Ste11 kinase in temperature sensitive (ts) Hsp70 strain at restrictive temperature compared to its isogenic strain. This result corresponds with reduced turnover of newly synthesized Ste11 at non-permissive temperature or in the presence of geldanamycin, an Hsp90 inhibitor. These results suggest Hsp70's involvement in degradation of Ste11 kinase. We have also observed that Ste11 accumulates in insoluble aggregates upon Hsp70 impairment. Ste11 aggregates are found by fluorescence (GFP-Ste11) study in both Hsp70 ts mutant and in presence of Hsp70 inhibitor. These aggregates are localized mainly in the perivacuolar area of cells as seen by FM4-64 (plasma membrane) and Hoechst 33358 (nucleus) staining. Experiments are currently underway to study the functional role of Hsp70 in stability and maturation of kinases. Further studies are in progress to elucidate how cochaperones modulate the triage decision of Hsp70.

Raf1 quality control and development of pathological condition : Dr. Atin Kumar Mandal

We have initiated studying the quality control mechanism of mammalian Raf1, a MAP3 kinase in RAS-MAP kinase pathway whose mutation attains gain of function in both cancer and hypertrophic cardiomyopathy. We used yeast system since homologous mammalian chaperone network are also present in yeast. We have cloned WT and mutated Raf1 in yeast vector and transformed to different chaperones and cochaperones knockout strains. Our result shows that the steady state level of Raf1 is decreased substantially in Hsp82 knockout, *cdc37^{S14A}* mutant and moderately decreased in cochaperones such as *ydj1*, *aha1*, *sse1* knockout strains. But very little or none effect in *sti1* and *sba1* knock out strains. Pulse chase analysis shows that Raf1 turnover is much faster in *cdc37^{S14A}* mutant strain compared to WT yeast strain. We observed that CDC37 facilitates S621 phosphorylation which is essential for Raf1 stability. We also found that CDC37 is necessary for Raf1 kinase activity. These results suggest that CDC37 protects Raf1 degradation by phosphorylating its conserved S621 residue and also promotes its post-translational maturation. Ongoing works focused in understanding the role of chaperones in Raf1 maturation and activation.

Marine Biotechnology and Medical Biotechnology : Dr. Nripendranath Mandal

Objectives:

Research program in the field of Marine Biotechnology and Medical Biotechnology for disease management in aquatic organism and human system, for welfare of the people with the help of modern science and technology is the main major objective of our laboratory.

Marine Biotechnology research : Dr. Nripendranath Mandal

*DNA markers linked to disease resistance in marine shrimp, *Penaeus monodon**

One of the most aspiring industries of aquaculture with marine species in the world, including India, is with giant black tiger shrimp, *Penaeus monodon*. However, huge economic destruction is continuing by White spot disease caused by white spot syndrome virus (WSSV), without any possible remedy. For the first time the output from the marine biotechnology research has shown that one microsatellite DNA marker (71 bp) and one RAPD-SCAR marker of 457 bp have been developed to identify disease resistant population of shrimp, *P. monodon*. The practical utility of these markers have been tested by WSSV challenge experiment and it was found that $\sim 10^3$ fold higher WSSV propagation among disease susceptible as well as greater survivability among disease resistant population of *P. monodon*. These two DNA markers will be useful to develop Specific Pathogen Resistant (SPR) *P. monodon* through Marker Assisted Selection (MAS) of breeding program and to understand molecular mechanism of disease resistance/susceptibility in shrimp. Moreover, shrimp samples are being collected and used for WSSV and disease resistance prevalence along the entire coastal region of India for prevention from vertical as well as horizontal transmission of this virus.

Medical Biotechnology research : Dr. Nripendranath Mandal

Importance of medicinal plants and development of molecular tools for non-communicable diseases in human system

Research output from the **Medical Biotechnology** program suggested that twelve out of twenty nine medicinal plants would be very useful source for developing orally administrable and cost-effective medicine for amelioration from iron-overloaded toxicity. 70% methanolic extract from various medicinal plants have been screened for their potential antioxidant and free radical scavenging activities which will hopefully serve the purpose of a natural antioxidant. Alongside, seven medicinal plants out of twenty nine have been found to be effective in developing anticancer medicines against lung (A549), breast (MCF-7), cervical (HeLa), liver (HepG2), brain (U87) and blood (K562) cancer cells. Among five purified compounds isolated for the first time from the bark of *Spondias pinnata*, SPE4, SPE3 and SPW1 are the most potent antioxidant and iron chelators, whereas SPE4, SPW1 and SPE2 have potential anticancer activity.

Another **Medical Biotechnology** research has developed various novel biomarkers from the case control study of biochemical, immunological and genetic parameters for early prediction of the risk of coronary heart disease (CHD) among Asian Indians from eastern part of India. These will further be very useful to develop biometric chip for screening the risk of CHD among large number of individuals within very short period of time.

Synthesis and bioevaluation of organic small molecules and complex oligosaccharides of microbial origin : *Dr. Anup Kumar Misra*

(a) Our laboratory is actively involved in the synthesis of medicinally relevant organic small molecules and their biological screening in different drug development program (e.g. cancer, enzyme inhibitors, antioxidant etc.) in collaboration with biologists of Bose Institute and other research institutes (Visva Bharati University, SINP, NICED, CDRI).

(b) Our laboratory has also been engaged in developing concise chemical synthetic strategies for the synthesis of several complex oligosaccharides found in the cell-wall of pathogenic bacteria for their use in the preparation of glycoconjugate derivatives. In the current scenario, glycoconjugates have emerged as successful synthetic vaccine candidates to control microbial infections. In collaboration with biologists, immunochemical studies with the synthetic glycoconjugates are ongoing (sponsored by DST and CSIR, NewDelhi).

Understanding molecular mechanism of action of human heat shock factor 1 (HSF1) in human cancer cells : *Dr. Mahadeb Pal*

Cells normally activate a specialised machinery to neutralise effect of proteotoxic stress induced by variety of stressors including elevated temperature, peroxide, ethanol and heavy metals. Central to this stress response is the activation of transcription activator heat shock factor 1 (HSF1) which drive expression of a group of protein chaperones heat shock proteins (Hsps) to help refold mis-folded proteins and thus dampen the toxicity associated with protein denaturation. HSF1 activation also associates with developmental cues. Although all proteotoxic stressors activate eventually HSF1, signal specific activation mechanism of HSF1 is one of the most interesting aspects still remains to be poorly understood. The significance of understanding of HSF1 function is underscored by its association with cancer and age related pathologies. While HSF1 is functional at basal level in normal cells, proliferative ability of many cancer cells relies on constitutively active state of HSF1. In addition in many neurodegenerative disease conditions HSF1 activity is down regulated. An aim in the lab is to obtain insight to the processes of signal specific activation of HSF1 using proteomic as well as genetic approaches.

Understanding the molecular mechanism of stress induced gene activation in human cells : *Dr. Mahadeb Pal*

It has now been understood that under normal condition the majority of cellular stress-induced genes including the targets of various onco-genes and tumor suppressor genes carry promoter proximally paused but transcriptionally engaged RNA polymerase II (pol II) that are rapidly released into elongation mode soon after an activation signal is encountered. It has been shown in yeast by genomewide mapping that stress inducible genes generally harbour promoter

proximally positioned nucleosomes. By biochemical experiments promoter adjacent nucleosomes have also been implicated in promoter paused pol II stability. A gene activation process normally includes recruitment of nucleosome remodelling activities on the promoter poised complexes. We are interested to determine the extent of specificity if any is conferred by the recruitment of nucleosome remodelers on a stress inducible gene.

Role of DNA-dependent protein kinase in transcription regulation in human cells : Dr. Mahadeb Pal

The role of initiation factors is to engage RNA polymerase (pol II) at a gene promoter. With the help of initiation factors pol II recognise a promoter, determines the transcription start site to initiate transcription, elongate RNA before it clears the promoter or translocates downstream in the coding region of a gene so that another transcription initiation complex can assemble at the promoter. By the time pol II transits into elongation complex basically all initiation factors dissociate to recycle back into subsequent round of transcription event at a gene promoter. Although participation of initiation factors during pre-initiation complex formation at the promoter is well understood, how they disassemble remains to be relatively unexplored. There are evidence indicating that simply it is not structural isomerisation with different states of transcription that drives the release of initiation factors. We are exploring if there are involvement of a specific kinase such as DNA-PK in the dissociation of initiation factors by the time pol II clears the promoter and that represent a regulatory interface.

Novel gain-of-function for transcription factor FoxP3 as co-transcription factor of STAT3 in T_{reg} cells : Dr. Gaurisankar Sa

FoxP3, a lineage-specification factor required for T-regulatory (T_{reg}) cell differentiation and function, executes its multiple activities mostly through transcriptional regulation of its target genes. The molecular bases underlying the phenotypic and functional diversity of Foxp3⁺ T_{reg} cells remain obscure. Our study identifies an IL-10-producing FoxP3⁺ T_{reg} cell population that contributes to IL-10-dependent type-2 cytokine bias in breast cancer patients. Although FoxP3 knock-out inhibits *il10* transcription in these cells, genome-wide analysis rules out its role as a transcription factor for *il10*. An in-depth analysis reveals that FoxP3, in association with HAT1 modify *il10* promoter epigenetically, making a space for pocketing STAT3-FoxP3 complex. A high-throughput docking module with Target Receptor specificity and Exon deletion mutation study showed that STAT3 dimer binds specifically to the Exon-2 beta-sheet region of FOXP3 through its N-terminal floppy domain to form STAT3-FoxP3 complex. Such activity of FoxP3 is extended to other STAT3 target genes, e.g., *il6*, *vegf*, *c-myc*, *bclxl*, *ccnd1*, that lack FoxP3-binding site. These results suggest a 'conditional' gain-of-function of FoxP3, even in absence of mutation, where failing to achieve direct promoter-occupancy, FoxP3 promotes transcription in association with a locus-specific transcription factor, STAT3, in T_{reg} cells.

MEK inhibition prevents tumor-shed TGF β -induced T-regulatory cell augmentation :
Dr. Gaurisankar Sa

Tumor progression is associated with immune-suppressive conditions, which facilitates the escape of tumor cells from the regime of immune cells, subsequently paralyzing the host defense mechanisms. Induction of CD4⁺CD25⁺ FoxP3⁺ T-regulatory (T_{reg}) cells has been implicated in tumor immune escape mechanism, but novel anti-cancer treatment strategies targeting T_{reg} cells remain to be elucidated. The focus of this study is to define the interaction between tumor and immune system, showing how immune tolerance starts gradually and leads to the induction of adaptive T_{reg} cells in tumor microenvironment. Our study identified hyper-activated MEK/ERK-signaling as a potential target for reversing T_{reg} cell augmentation in breast cancer patients. In more mechanistic detail, pharmacological inhibitors of MEK/ERK-signaling inhibited TGF β production in tumor cells that essentially blocked TGF β -SMAD3/SMAD4-mediated induction of CD25/IL2R on CD4⁺ T cell surface. As a result high-affinity binding of IL2 on those cells was prohibited, causing lack of JAK1/JAK3-mediated STAT3/STAT5 activation required for FoxP3 expression. Finally, for more radical approach towards safe MEK inhibitor we validate the potential of multi-kinase inhibitor curcumin, especially the nano-curcumin made out of pure curcumin with greater bioavailability; in repealing tumor-shed TGF β -induced T_{reg} cell augmentation.

Nifetepimine, a dihydropyrimidone, ensures CD4⁺ T cell survival in tumor micro-environment by maneuvering Sarco(endo)plasmic reticulum Ca²⁺ ATPase (SERCA) :
Dr. Parimal C. Sen in collaboration with **Dr. Tanya Das**

Multiple mechanisms have been proposed by which tumors induce T cell apoptosis to circumvent tumor immune-surveillance. Although Sarco/endoplasmic reticulum Ca²⁺-ATPase (SERCA) have long been known to regulate intracellular Ca²⁺ homeostasis, few studies have examined the role of SERCA in processes of T lymphocyte survival and activation. In this context it remains largely unexplored as to how tumors jeopardize SERCA function to disable T cell-mediated anti-tumor immunity. Here, we show that human CD4⁺ T cells in presence of tumor conditions manifested an up-regulation of SERCA3 expression which resulted in development of ER stress leading to CD4⁺ T cell apoptosis. Prostaglandin E₂ produced by the tumor cell plays a critical role in up-regulating SERCA3 by enhancing the binding of its transcription factor Sp1. Gene manipulation and pharmacological approaches further established that increase in SERCA expression also resulted in subsequent inhibition of PKC ϵ and θ and retention of NFB in the cytosol, however, down-modulation of SERCA3 expression by a dihydropyrimidone derivative, ethyl-4-(3-nitro)-phenyl-6-methyl-2-oxo-1, 2, 3, 4-tetrahydropyrimidine-5 carboxylate (Nifetepimine) protected the CD4⁺ T cells from tumor-induced apoptosis. In fact nifetepimine-mediated restoration of PKC activity resulted in

nuclear translocation of p65NFB thereby ensuring its survival. Studies further undertaken in tumor-bearing mice model re-validated the immunoprotective role of nifetepimine. Our present study thus strongly suggest that imbalance in cellular calcium homeostasis is an important factor leading to CD4⁺ T cell death during cancer and holds promise that nifetepimine may have the potential to be used as an immunorestoring agent in cancer bearers.

Stress-mediated alteration in membrane fluidity regulates calcium ATPase activity in plasma membrane of duodenal enterocytes of oophorectomized rats : Dr. Parimal C. Sen in collaboration with **Prof. Chandan Mitra**, Tripura Institute of Paramedical Sciences

In a hypogonadal rat model, calcium ATPase (Ca^{2+} -ATPase) activity and membrane fluidity were examined in plasma membrane of duodenal enterocytes under two different stress conditions induced by chemical change (lipid saturation) and physical change (temperature). Data generated show that under both these stress conditions, calcium ATPase activity was decreased. Membrane fluidity (phase transition temperature) study by fluorescence polarization measurement indicated that compared to corresponding control, enterocyte membranes, differences were seen in the phase transition temperature(T_c) of the oophorectomized rats' enterocyte membrane under both the conditions of stress, which suggested a decrease in membrane fluidity under both the experimental situations. It is proposed that the degree of alteration in calcium ATPase activity in oophorectomized rats' duodenal enterocyte plasma membrane under two different stress conditions was nearly alike, which was influenced by changes in membrane fluidity induced by chemical change (lipid saturation) or physical change (temperature).

Studies on the bio-active molecules in organ pathophysiology : Dr. Parames C Sil

Main objectives:

Research in our laboratory encompasses several major areas of organ pathophysiology: hepatotoxicity, cardiotoxicity, neurotoxicity, reproductive toxicity and nephrotoxicity. However, special emphasis is placed upon:

- Drug and chemical-induced mechanisms of cell injury and cell death in multiple vital target organs both in vivo and in vitro.
- Studies on the signal transduction mechanism of cell death and survival in organ pathophysiology.
- Unraveling the mechanisms and exploring the antitoxic/antioxidant potentials of phytochemicals (natural and man-made antioxidants).

A prospective model of *in vitro* nephrotoxicity study

Differential regulation in respect to heavy metals (e.g., Cd^{2+}) induced oxidative stress mediated cell survival and cell death pathways are being investigated. In this study we mainly focus on

both these pathways and tried to figure out the underlying molecular mechanisms. Cumulatively we found that Cd^{2+} considerably inhibit cell proliferation and induces mitochondria dependent pathway of apoptosis in a concentration–time limited course which also coupled to ROS production and several biochemical as well as morphological events in Human Renal Cell Carcinoma (RCC) SK-RC-45 cells. We have also established that, a milder form of Cd^{2+} stress induces oxidative stress sensitive and highly inducible, Nrf2-HO-1 protective signaling pathway. Cd^{2+} -induced nephrotoxicity assays using the human RCC, SK-RC-45 cells, developed in the present study, would be good for in vitro nephro-toxicological research as the cell line is robust, fast growing and easy to maintain. To the best of our knowledge, for the first time, we are showing both the toxic and protective mechanisms of Cd^{2+} in a single in vitro Human Renal Cell Carcinoma (RCC) cell lines (SK-RC-45). Furthermore, future investigation about the molecular mechanisms of Cd^{2+} induced toxicity, proliferative and anti-proliferative effect and in the search for new potential anti-nephrotoxic and antioxidant agents, the study could be useful.

Diabetes induced organ dysfunction and its reversal by nature derived bioactive molecules

Diabetes has been emerged as an epidemic and it remains to be a major cause of morbidity and mortality due to its complex pathogenesis. It is characterized by a state in which carbohydrate and lipid metabolism is improperly regulated by insulin. A large body of earlier investigations has examined the role of oxidative stress in insulin resistance type I and type II diabetes and its associated complications. In addition, nonenzymatic glycation of protein and glucose autoxidation are also closely associated with the development of hyperglycaemic condition. Antioxidants protect against glycation-derived free radicals and may have therapeutic potential. In addition, recent studies have shown that compounds with combined antioxidant and antiglycation properties are more effective in treating diabetes mellitus. Thus, the screening and development of new compounds with combined antioxidant and antiglycation properties would be beneficial in the treatment of diabetes mellitus. Our aim is to find out easily available, inexpensive therapeutics, having minimum side effects for the better treatment of these diabetic patients.

Role of nanostructures in organ pathophysiology

Nanomaterials, ranging from 1 nm to 100 nm in size, have received enormous attention to create new types of analytical tools for biotechnology and life sciences because of their novel physical (ultra small size, large surface area to mass ratio) and chemical functional properties (extremely high chemical reactivity). In the last decade new directions of modern research, broadly defined as “nano scale science and technology” have emerged. Nanotechnology involves the creation and manipulation of materials at nanoscale levels. The application of nanotechnology to medicine, known as nanomedicine, concerns the use of nanomaterials to

develop novel therapeutic and diagnostic tool. The difference between nanomedicine and conventional drugs is that nanomedicine is entirely based on small molecule chemistry. They not only act as therapeutic agents but also deliver themselves to specific regions or tissues in the body. While benefits of nanotechnology are widely expected, however both academic and public concerns begin to emerge on the potentially adverse effects of these manufactured nanomaterials. Thus, nanotoxicology is emerging as an important sub-discipline of nanotechnology. Exposure to nanostructures occurs in a variety of manners, such as researchers of the manufacturing nanoparticles, patients injected with nanostructures, or people using products containing nanostructures. After exposure and absorption, they enter into the cells of different organs, interact with the macromolecules like protein, DNA etc., and cause organ pathophysiology.

Studies on the protective role of an antioxidant protein molecule from the herb, *Phyllanthus niruri* in pathophysiology: Signal transduction mechanism

Earlier studies from various groups reported that aqueous extracts of this herb possesses protective activity in hepatic and other organ disorders, but the nature of the responsible active principle(s) in its beneficial role has not been well defined. Experimental evidence from our laboratory showed that the soluble protein fraction of this herb possessed more hepatoprotective activity than the non-proteinous fraction against various toxicants and drugs. Recently we also observed that in addition to the hepatoprotective activity, the protein isolate of this herb also possessed free radical scavenging activity in cell free system as well as in hepatocytes.

To achieve this goal, we aim to address the following questions:

- i) What role does this protein (PNP) play in mitochondrial dysfunction?
- ii) Does it release specific second messenger(s) and open a cascade of signaling pathways for its mechanism of action to protect cell death?
- iii) Do the factors like MAP kinases, Bcl2 family proteins, Akt, caspases etc. are involved in the pathophysiological states of our interest, and if so, what role does PNP play on these factors?
- iv) Is the co-existence of apoptosis with necrosis an underlying mechanism of action in cell death under the pathophysiological states of our interest? and if so, does the application of PNP reverse or reduce the phenomenon of death?

We could answer some of the questions recently (during the period of April '12-March '13), and work is still going on to get a complete picture of the beneficial effect of this protein molecule.

Further characterization of the CI-protein from *Cajanus indicus* L : Mechanism of protective action in organ pathophysiology

The 43 kD protein molecule isolated from the herb, *Cajanus indicus* L (the CI protein) still remains one of the molecules of our interest. It has been found to be effective in reducing hepatotoxicity, neurotoxicity and related pathophysiology induced by various environmental toxins and drugs. The neuroprotective and nephroprotective effect of CI protein against doxorubicin (Dox) induced oxidative damage have been carried out in our lab. Administration of Dox significantly enhanced levels of blood urea nitrogen (BUN), creatinine, uric acid, TNF α , urinary γ -glutamyl transpeptidase (γ -GT) activity, total urinary protein and urinary glucose level. Moreover, Dox exposure increased intracellular ROS production, lipid peroxidation, protein carbonylation and ATPases (like Na⁺/K⁺, Mg²⁺.) activities. Post treatment of CI protein provides protection against Dox induced renal pathophysiology through its ROS scavenging and anti-oxidative properties. Moreover, CI protein also acts as an anti apoptotic molecule by down-regulating the activation of phospho-JNK, p38, ERK1/2 and other mitochondrial dependent and independent signaling molecules, as well as by balancing the expression of Bcl-2 family proteins. Administration of Dox increased reactive oxygen species (ROS) production, altered neuro antioxidant status, activities of brain specific coenzymes (like acetyl coenzyme, monoamine oxidase, etc.), ATPases (like Na⁺/K⁺, Ca²⁺, etc.), and brain biogenic amines levels. Signal transduction studies showed that Dox markedly decreased mitochondrial membrane potential, disturbed Bcl-2 family protein balance, enhanced cytochrome c release in the cytosol, increased levels of Apaf1, caspase-9/3, cleaved PARP protein and ultimately led to apoptotic cell death. In addition, Dox markedly increased NF- κ B nuclear translocation in association with IKK α / β phosphorylation and I κ B α degradation. Post treatment with CI protein, however, reduced Dox-induced oxidative stress, attenuated the nuclear translocation of NF- κ B and protects the brain tissue from Dox-induced apoptotic death. These remarkable benefit and absence of any noticeable toxicity with CI protein administration may provide clues in understanding its nephroprotective and neuroprotective mechanism against Dox-induced nephrotoxicity as well as neurotoxicity.

Effect of D-saccharic acid-1,4-lactone in Diabetes and other organ pathophysiology

Recently we have included the beta-glucuronidase inhibitor D-saccharic acid-1,4-lactone (DSL) in our studies as this molecule possesses detoxifying, anticarcinogenic and antioxidative properties. We began to study whether DSL alone can ameliorate the oxidative stress in hepatocytes exposed to TBHP and observed the antioxidant property of DSL. We have also demonstrated that DSL can attenuate alloxan-induced diabetes mellitus in rat model by suppressing the oxidative stress and inhibiting pancreatic beta-cell apoptosis. The role of DSL in reducing the oxidative stress mediated damage in spleen tissue of diabetic rats was also studied.

V. Basic and Applied Microbiology

The mycobacterial protein SepF interacts with FtsZ : Dr. Joyoti Basu in collaboration with Dr. Manikuntala Kundu

The bacterial divisome is a multiprotein complex. In order to understand the cell division machinery in detail, we have characterized the protein Rv2147c of *Mycobacterium tuberculosis* using various biochemical and genetic techniques. Rv2147c (or SepF) interacts with FtsZ through its C-terminus. We have established this using in vitro far-Western assays, and in vivo interaction assays performed in *Mycobacterium smegmatis*. We have identified the key amino acid residues involved in this interaction. Using sedimentation and light scattering assays we have demonstrated that SepF facilitates polymerization of FtsZ. Depolymerization of FtsZ slows down in the presence of SepF. The C-terminus of FtsZ is involved in the interaction with SepF. Expressing a SepF-Cherry fluorescent protein in *M. smegmatis* we have observed that it localizes to mid-cell, whereas the FtsZ-interaction-defective mutant fails to do so. SepF is established as one of the FtsZ interacting partners with a role in cell division.

Mycobacteriophage proliferation under Micro-aerophilic conditions : Dr. Sujoy K. Das Gupta

Members of the genus *Mycobacterium* are known to transit to a dormant state when deprived of O₂. Since Mycobacteriophages infect species belonging to this genus, therefore it is likely that they too may have evolved the capability of adapting to such conditions. Such a possibility was tested using Mycobacteriophage D29 and *Mycobacterium smegmatis* as the phage-host system. The results of the experiments revealed that far from inhibiting, O₂ deficiency stimulated phage growth. Hypoxic conditions were created either by minimizing aeration or pre-treatment of host cells with Vitamin C. In both cases stimulation was observed. Vitamin B12 was found to further enhance phage proliferation particularly when infections were performed under low aeration conditions indicating the possible involvement of a phage encoded class II Ribonucleotide reductase, the product of gene 50, in the process. The increased proliferation activity was not due to increase in adsorption efficiencies, but due to increase in burst size. The stimulatory effects observed involved the hypoxia response regulator *DevR*, as the phenomenon could not be demonstrated in a *devR* mutant. The results presented in this study establish for the first time that bacteriophage growth can be modulated by the redox state of the environment to which their host cells were exposed.

Studies on bacterial catabolic potential in the assimilation of aromatic pollutants : Dr. Tapan K. Dutta

Catabolically versatile bacterial strains belonging to different genus, viz. *Sphingobium*, *Burkholderia*, *Acinetobacter*, *Cupriavidus* and *Gordonia*, capable of mineralizing various recalcitrant aromatic pollutants have previously been isolated and characterized. Complete metabolic pathway(s) for the assimilation of such pollutants in these organisms have been elucidated along with identification of crucial catabolic enzymes. In the degradation of various aromatic hydrocarbons by *Sphingobium* sp. strain PNB, five different dioxygenase gene clusters have been cloned and expressed. Screening of their activities against different aromatic pollutants is in progress to identify potential substrate(s) for each set of dioxygenases. A complex catabolic network has been found to be involved and attempts are being made to understand the complex regulatory mechanism of the catabolic network in strain PNB. On the other hand, the naphthalene degrader, *Burkholderia* sp. strain BC1, have been found to metabolize a structural analogue of naphthalene, i.e., 2-naphthol, a decarboxylated product from 2-hydroxy-1-naphthoic acid via a different gentisic acid route which is distinct to that of the naphthalene pathway. The gene responsible for initializing the 2-hydroxy-1-naphthoic acid metabolic pathway has been identified which encodes a decarboxylase enzyme belonging to the amidohydrolase protein family. The gene has been cloned and overexpressed. Further characterization of the protein and its kinetic studies are underway.

In the field of metagenomics, screening of lipolytic activity from a metagenomic fosmid library constructed from municipal waste-contaminated soil yielded two esterase-positive clones. Transposon mutagenesis lead to the identification of an esterase gene (*estM2*) responsible for the hydrolytic activity of one of the fosmid clones. The gene encodes a 43.12 kDa protein, *EstM2*, belonging to a novel member of the family VIII esterases. The enzyme showed phthalate hydrolase activity and is capable of degrading a wide range of mono- and di-substituted phthalates. Attempts are also being made to characterize different enzymatic activities from fish-gut microbiota following both culture dependent and independent strategies. Some preliminary investigations have lead to the identification of different esterase, cellulase, protease, dehalogenase and α -amylase genes. Further characterization of these enzymes is underway.

Understanding early metabolism : Dr. Wriddhiman Ghosh

The overall aim of my laboratory is to understand the metabolic strategies of early life. Accordingly, we investigate the molecular evolution and interactions of the extant pathways of chemotrophic sulfur oxidation, which, debatably, is the most ancient bioenergetic process. Parallel to these studies, we use metagenomics in tandem with biomarker and

stable isotope analysis to study the community dynamics and palaeontology of microorganisms inhabiting geothermal environments that are allegedly the cradles of early life on Earth.



Geothermal features in the recently-explored Tapovan hot springs of Uttarakhand. Clockwise from top left: a huge deposit of geothermal sinter; sampling thermal fluid amidst intense fumarolic activity; freshly precipitating hydrothermal sediments; active hot mud pool.

A. Recent findings on the interactions of the Sox pathway

Widespread of *sox* gene homologs in *Bacteria* insinuates their ancient and conserved status. However, it is only in certain facultatively lithotrophic alphaproteobacteria that the Sox multienzyme system has been proven functionally fundamental. Outside *Alphaproteobacteria*, inferences regarding the involvement of Sox in sulfur chemotrophy are solely based on genomic data. So we decided to explore whether non-alphaproteobacterial sulfur-oxidizers such as the betaproteobacterium *Tetrathiobacter*

kashmirensis (*Tk*) and the gammaproteobacterium *Thiomicrospira crunogena* (*Tc*) - which exhibit deviant chemotrophic phenotypes despite possessing intact sox loci - do oxidize thiosulfate ($S_2O_3^{2-}$) by mechanisms comparable to the Sox pathway epitomized in *Paracoccus pantotrophus* (*Pp*). *Pp* uses Sox to oxidize $S_2O_3^{2-}$ [but not tetrathionate ($S_4O_6^{2-}$)] to sulfate (SO_4^{2-}) without any intermediate formation. Notably, *Tk* oxidizes $S_4O_6^{2-}$ directly to SO_4^{2-} , but its $S_2O_3^{2-}$ oxidation proceeds via $S_4O_6^{2-}$ formation. *Tc*, in its turn, oxidizes $S_2O_3^{2-}$ to SO_4^{2-} by depositing extra-cellular elemental sulfur under low pH and oxygen. We utilized the stable sulfur isotope discrimination potentials of these chemotrophic systems to test whether they have any mechanistic commonality. Simultaneously, proteomic investigations were aimed at identifying potential involvement of Sox proteins during $S_2O_3^{2-}$ oxidation by *Tk* and *Tc*. *Pp*, *Tk* and *Tc* unanimously rendered atypical reverse fractionation, i.e., enrichment of the heavier isotope ^{34}S , in the end product SO_4^{2-} during chemolithotrophic oxidation of $S_2O_3^{2-}$ or $S_4O_6^{2-}$. With overall fractionation ranging between -4.6‰ and +5.8‰, this was the first report of significant ^{34}S fractionation during chemotrophic oxidation of $S_2O_3^{2-}/S_4O_6^{2-}$ to SO_4^{2-} . In isolation, all the studied processes started with +ve $\Delta^{34}S$ values, subsequent to which, owing to Rayleigh fractionation, $\Delta^{34}S$ approached zero as $\delta^{34}S$ of produced SO_4^{2-} came close to $\delta^{34}S$ of the substrate $S_2O_3^{2-}/S_4O_6^{2-}$. In *Pp* and *Tc*, as the reactions progressed, $\Delta^{34}S$ thiosulfate-sulfate values became -ve owing to continued ^{34}S enrichment in SO_4^{2-} . Interestingly, ^{34}S enrichment rates were almost identical during the peak SO_4^{2-} -producing stage of all the four processes, an observation that insinuated the conserved involvement of identical S-S bond-breaking enzymes. Concurrent proteomic analyses detected the hydrolase SoxB in the actively SO_4^{2-} -producing cells of all three species. Inducible expression of soxB was also observed during $S_4O_6^{2-}$ oxidation by *Tk*, which was particularly interesting because the established Sox pathway has not yet accommodated $S_4O_6^{2-}$ as a substrate. Notably however, no other Sox protein except SoxB was detected in lithotrophically-growing *Tk* cells even after proteomic scanning of its entire peptide map. Instead, several other redox proteins were found over-expressed during $S_2O_3^{2-}/S_4O_6^{2-}$ dependent growth, thereby indicating that there is more to $S_4O_6^{2-}$ oxidation than SoxB alone.

B. A new frontier in the study of early evolution

Although the deepest-rooted branches of *Bacteria* and *Archaea* are occupied by sulfur-oxidizing chemolithotrophs, most of the well-studied sulfur-oxidizers (ancient or recent) are dependent on the respiration of oxygen or nitrate. As such, it is reasonable to believe that their mechanisms of sulfur oxidation can not represent the ancestral state because such terminal electron acceptors could not have appeared in the highly reducing environment of the early Proterozoic, the theoretical era of origin of sulfur chemotrophy. With a long term aim at solving this crucial riddle we have just started focusing our attention to those ill-

defined and ill-studied groups of marine anaerobic bacteria which can oxidize reduced sulfur species by using a wide range of electron acceptors other than oxygen and nitrate (e.g., Fe^{3+} , CO_2 , CO , NO^{2-} , NO , N_2O , SO_4^{2-} , SO_3^{2-} , $\text{S}_2\text{O}_3^{2-}$ and S^0). In order to scout for



Major activities during the research cruise SSK042 onboard CRV Sindhu Sankalp (CSIR-NIO). Clockwise from top left: CTD profiling and water column collection; spade coring operation; gravity core deployment; gravity core recovery; cutting of three meter long cores into two D-halves; sampling and analysis along the length of the sediment cores.

such novel sulfur-chemotrophs and discover cryptic marine sulfur cycles that potentially operate under anaerobic regimes we have forged collaboration with a team of Geological Oceanographers led by Dr. Aninda Mazumdar of CSIR-NIO, Goa. Together we have initiated a comprehensive geomicrobiological investigation of the waters and sediments of the mid-water oxygen minimum zone of the Northern Indian Ocean. An expedition off the Konkan coast of India has already been undertaken between 15th and 23rd December 2012. During that research cruise (SSK042) onboard the CSIR Research Vessel Sindhu Sankalp we collected 75 water samples and 150 sediment samples from eight stations (distributed over water depth ranging from 30 to 1200 m) along the continental slope off Ratnagiri. Conductivity/Temperature/Depth (CTD) profiling of the water column was done before sample collection at various depths. Aliquots of water samples were brought back to the Bose Institute for microbial community characterization, while geochemical analyses were done at the NIO. Similarly, sub-bottom lamination profiles were assessed before sediment core collection. Gravity coring techniques were employed to collect 3 meter long sediment cores, while additional samplings were also done by spade coring techniques. Retrieved cores, in their turn, were sampled at every 10-15 cm vertical depth interval for microbiological as well as geochemical analyses.

Functional analysis of mycobacterial response regulators : Dr. Manikuntala Kundu in collaboration with Dr. Joyoti Basu

Mycobacterium tuberculosis uses two component signal transduction systems for sensing environmental signals and responding to these signals. Two component systems consist of paired histidine kinases and response regulators (RRs). Multiple sequence alignment showed conserved motifs among some of the response regulators of *M. tuberculosis*. We therefore undertook an analysis of the role of these conserved motifs in functions of these RR. Towards this end, we have cloned, expressed and purified the response regulators MprA and MtrA which are cotranscribed with their cognate kinase MprB and MtrB respectively. Attempts were made to understand the function of one particular motif ²⁰²LRRK²⁰⁵ and ²⁰⁰LRAK²⁰² present in predicted DNA binding motifs of MprA and MtrA respectively. We have generated mutants where R and K residues have been mutated to A. We observed that mutation of one or two basic amino acids does not affect DNA binding. However, the mutant containing an LAAA sequence instead of the conserved motif is unable to show DNA binding activity.

Regulation of polyphosphate kinase under stress : Dr. Manikuntala Kundu in collaboration with Dr. Jayanta Mukhopadhyay

In our earlier report, we have demonstrated the role of polyphosphate kinase (PPK1) in the survival of mycobacteria under surface stress. In continuation of our earlier studies, bacteria

was subjected to different kinds of stresses. We observed the involvement of the two component system (TCS), SenX3-RegX3 in regulating *ppk1* expression in mycobacteria subjected to phosphate depletion. The binding of RegX3 to the promoter of *ppk1* was confirmed by electrophoretic mobility shift assay. A mutant of RegX3, defective in phosphorylation by SenX3, showed reduced binding indicating the role of this TCS in the activation of *ppk1* of *M. tuberculosis* under stress. In vitro transcription assays have also confirmed that SigE regulates transcription of *ppk1*. As a negative control, we used other sigma factor (Sig G) which could not support the transcription of *ppk1*.

Regulation of expression of the resuscitation promoting factors (Rpfs) of *Mycobacterium tuberculosis* : Dr. Manikuntala Kundu in collaboration with Dr. Joyoti Basu

In our attempts to understand how the expression of the Rpfs of *M. tuberculosis* are regulated, we have identified putative MtrA binding sites on the promoters of Rpfs A and B, MtrA being the response regulator of the two-component system (TCS) MtrAB. Oligonucleotides have been designed and the binding has been confirmed by EMSAs. The transcriptional start sites of *rpfs* A and B have been determined. Further analysis of the regulation is in progress.

The cell cycle of *Entamoeba histolytica* : Dr. Anuradha Lohia

The genome of *Entamoeba histolytica* encodes several calcium binding proteins and those characterized thus far have been shown to participate predominantly in phagocytosis and endocytosis. Our study showed that EhCaBP6 has two EF-hand domains EFI and EFII; it can bind Ca^{2+} *in vitro* and undergoes conformational transition on binding Ca^{2+} suggesting that it can serve as a calcium sensor. EhCaBP6 is localized in the nucleus, cytoplasm and plasma membrane and is sensitive to heat stress. Unlike other Ca^{2+} binding proteins that have been studied in *E. histolytica*, EhCaBP6 is found at the microtubular ends and at the inter-cellular bridge with the microtubules during cytokinesis. Furthermore, increased expression of EhCaBP6 was correlated with a significant increase in the number of microtubular structures suggesting that this protein may regulate chromosome segregation and cytokinesis in *E. histolytica*.

Studies into the function of *E. coli* HflX : Dr. Pradeep Parrack

- HflX, a highly conserved GTPase whose cellular function is unclear, exhibits autophosphorylation activity. By studying autophosphorylation of several deletion mutants of HflX, we have identified that the autophosphorylation probably occurs at serine 211, which lies within the G1 motif.

- Complementaion of hflX expression via pGEx4T-1 vector (pAX-01) in the mutant $\Delta hflX$ helps it to combat and overcome Mn^{++} stress.
- Confocal microscopy of pAX-01 (*hflX* in $\Delta hflX$) showed that upon complementation, the cells revert back to normal morphology. Unlike $\Delta hflX$ cells, they continue to exhibit normal morphology even in the presence of 1 mM Mn^{++} .
- Unlike wild type cells (MG 1655), there was a significant lag in the growth pattern of $\Delta hflX$ cells when subjected to hydrogen ion concentration stress, both in the acidic (pH 4) and alkaline (pH 10) environments.
- At a high concentration of Mn^{++} (~ 1 mM), both wild type and mutant *E. coli* cells were sensitive to the metal ions, as reflected from their growth curves. Supplementation of the medium by Mg^{++} helped the wild type cells to combat Mn^{++} stress, but the mutant ($\Delta hflX$) could not do so. This difference points to the possibility that Mn^{++} directly perturbs the structural integrity and functional efficiency of the *E.coli* ribosome, autophosphorylation of HflX acting as a sensor to evade the crisis.

Simplified cellular machinery of the protist *Giardia lamblia* : Dr. Srimonti Sarkar

G. lamblia is highly diverged from most eukaryotic lineages and is capable of accomplishing diverse cellular functions with simplified machineries. Members of the laboratory are studying factors involved in protein degradation by the proteasome (Abhishek Sinha and Atrayee Ray) and lysosome (Somnath Dutta, Nabanita Saha and Ananya Jana), SNARE complex disassembly (Shankari Prasad Datta) and also how the ribosome docks onto the Sec61 complex during co-translational protein import into the endoplasmic reticulum (ER) (Abhishek Sinha, in collaboration with Dr. Shubhra Ghosh Dastidar). Immunolocalization with antibody against a proteasomal component shows an atypical distribution of the proteasome in *G. lamblia*. Thus the proteasome may be serving unique functions in this organism and we are in the process of characterizing additional components of this complex to gain further insights. The past year has also enabled us to conclude that a functional ESCRT pathway is present in *G. lamblia*, although its genome encodes only a subset of the ESCRT components that are present in yeast and other higher eukaryotes. The primary location of the ESCRT complex is at the surface of the late endosome, where it is instrumental in facilitating the lysosomal turnover of integral membrane proteins present in the membrane of endosomes. We have functionally characterized several components of the ESCRT pathway and immunolocalization studies indicate that the complex localizes to the peripheral vesicles, which are the functional equivalent of lysosomes in *Giardia*. Another project in the laboratory has focussed on the

Sec61 translocon that forms a protein translocating channel in the ER membrane. A component of the Sec61 translocon, Sec61 α , serves as the docking site for the ribosome and thus enables co-translational protein import into the ER. The mechanism of ribosomal docking onto Sec61 α appears to be unique in *Giardia* as the ribosome-interacting loop of GlSec61 α contains a lysine instead of the arginine residue that is highly conserved amongst all other eukaryotic orthologues. This unique variation may be compensated by another variation (A $\rightarrow$ G) in the stem-loop region of 5.8S rRNA that is known to interact with Sec61 α . Phylogenetic analysis of the GlSec61 α indicates that this amino acid change is likely to have occurred as a result of parasitic lifestyle-driven changes.



Vice President of India, **Dr Sarvapalli Radhakrishnan**, delivering Jagdis Chandra Bose Memorial Lecture

VI. Systems Biology

Temperature mediated molecular switch in *Bordetella pertussis* : Dr. Suman K Banik

Based on the phosphorelay kinetics operative within BvgAS two component system we propose a mathematical framework for signal transduction and gene regulation of phenotypic phases in *Bordetella pertussis*. The proposed model identifies a novel mechanism of transcriptional interference between two promoters present in the bvg locus. To understand the system behavior under elevated temperature, the developed model has been studied in two different ways. First, a quasi-steady state analysis has been carried out for the two component system, comprising of sensor BvgS and response regulator BvgA. The quasi-steady state analysis reveals temperature induced sharp molecular switch, leading to amplification in the output of BvgA. Accumulation of a large pool of BvgA thus results into differential regulation of the downstream genes. Numerical integration of the full network kinetics is then carried out to explore time dependent behavior of different system components, that qualitatively capture the essential features of experimental results performed in vivo. Furthermore, the developed model has been utilized to study mutants that are impaired in their ability to phosphorylate the transcription factor, BvgA, of the signaling network.

MicroRNAs (miRNAs) in *M. tuberculosis* infection : Dr. Joyoti Basu in collaboration with Dr. Manikuntala Kundu and Dr. Zhumur Ghosh

miRNAs play an important role in the immune response including the development and differentiation of immune cells, antibody production, and innate immunity regulation. Network analysis connecting miRNA and mRNA identified the let-7 family of miRNAs among the miRNAs downregulated during *M. tuberculosis* infection. These were densely connected to putative targets which were differentially regulated during infection. We have validated several of these predicted targets which important players in MAP kinase and NF-kappa B signaling. The downregulation of let-7 likely helps in survival of *M. tuberculosis* in macrophages at the early stages of infection. Among these are MAP kinase phosphatases and the deubiquitinase A20. Their role in infection is being investigated.

Systems-level analysis of the role of mannosylated lipoarabinomannan in modulating signaling in host macrophages : Dr. Manikuntala Kundu and Dr. Joyoti Basu

A genome-wide analysis has been carried out to analyze the effect of mannosylated lipoarabinomannan (Man-LAM) on signaling in murine macrophages. As expected, Man-LAM upregulated the expression of a number of host cytokines and chemokines. In

addition, what was striking was that Man- LAM triggered the expression of a number of genes associated with anti-apoptotic effects in RAW264.7 cells. The expression of some of these genes was tested by q-PCR. Striking among the upregulated genes was A1. Man-LAM upregulated the expression of A1 in RAW264.7 and bone marrow-derived macrophages (BMDMs). In order to test the anti-apoptotic effects of Man-LAM, macrophages were treated with *Mycobacterium bovis* BCG alone, or in conjunction with Man-LAM. Mn-LAM suppressed the apoptotic effects of BCG. This effect was abrogated in macrophages where the A1 gene had been silenced, arguing in favor of a role of A1 in the anti-apoptotic effects of Man-LAM.

Interdisciplinary Physics/Systems Biology : Dr. Indrani Bose

Diverse complex dynamical systems are known to exhibit abrupt regime shifts at bifurcation points of the saddle-node type. The dynamics of most of these systems, however, have a stochastic component resulting in noise-driven regime shifts even if the system is away from the bifurcation points. We have proposed a new quantitative measure, namely, the propensity transition point as an indicator of stochastic regime shifts. The concepts and the methodology have been illustrated for the one-variable May model, a well-known model in ecology and the genetic toggle, a two-variable model of a simple genetic circuit. The general applicability and usefulness of the method for the analysis of regime shifts has further been demonstrated in the case of the mycobacterial switch to persistence for which experimental data are available.

Different cell types in a mammalian system are characterized by different gene expression profiles. Recent comprehensive analysis of human expression data has identified a motif which plays a key role in cell fate determination. The motif consists of a genetic toggle switch in which the protein products of two genes repress the expression of each other. The individual genes furthermore autoactivate their own expression. A number of mathematical models have been proposed so far to demonstrate the differentiation of a progenitor cell into specific lineages. We have developed a mathematical model based on experimental cues and shown the existence of a pitchfork bifurcation in an extensive parameter regime. In such a bifurcation, the dynamical system passes from a region of monostability to that of bistability at a critical parameter value. The monostable steady state corresponds to the progenitor state in which the protein products X_1 and X_2 of the two genes are of intermediate concentrations ($X_1 \sim X_2$). The bistable steady states correspond to differentiated cell states with $X_1 \gg X_2$ in one cell type and $X_1 \ll X_2$ in the other cell type. A full analysis of the deterministic dynamics of the two-gene motif has been completed and a stochastic analysis of the model has been initiated.

Micro-regulatory networks in *Mycobacterium tuberculosis* : Dr. Zhumur Ghosh
[Collaborative work with Dr. Joyoti Basu and Dr. Manikuntala Kundu]

We performed an integrated analysis of microRNA and mRNA expression of murine macrophages infected with *Mycobacterium tuberculosis* (M.tb), target prediction and building miRNA-mRNA interaction network by Magia (<http://gencomp.bio.unipd.it/magia2/>) and cytoscape (<http://www.cytoscape.org/>) followed by a functional annotation of the essential genes in the network by Metacore (<http://www.genego.com/metacore.php>). We elucidated 57 potential regulatory networks contributing to the disease aetiology.

From the above study, we speculate that M. tb infection of murine macrophages causes a specific microRNA response and furthermore outlined a regulatory network of potential interactions between microRNAs and mRNAs. This study provides a theoretical concept for unveiling how distinct M.tb might manipulate host cell response.

We have further analyzed the Small RNA sequencing data of Human Monocyte. With our in-house computational pipeline we have screened out the differentially regulated significant miRNA genes in the system.

Modulation of autophagy in gastric epithelial cells by *Helicobacter pylori* infection : Dr. Manikuntala Kundu
in collaboration with Dr. Joyoti Basu

Helicobacter pylori is known to colonize the stomach and is associated with the development of gastric ulcer. In continuation of our earlier studies demonstrating the induction of autophagy by the bacteria, attempts were made to understand the role of autophagy in the network of signaling events elicited when gastric epithelial cells are challenged with the intact bacterium or its effectors. We observed that *H. pylori* induces autophagy at early time points of infection (6 h) in gastric epithelial cells. At later time points, bacteria induces apoptosis by the cleavage of caspase 3. Inhibition of autophagy by silencing *beclin1*, a key player of induction of autophagy, led to increase in apoptosis, suggesting the regulatory role of autophagy in determining the fate of host cells challenged with *H. pylori*. Transcriptional profiling suggests that induction of autophagy may be directly linked to ER stress responsive genes which is under investigation.

Role of alternative sigma factors in global gene regulation of *M. tuberculosis* : Dr. Jayanta Mukhopadhyay

We have initiated efforts to identify the genes regulated by each sigma factor. The method involves two complementary sets of experiments. 1) Genomic SELEX approach to identify promoters for each sigma factor. 2) Microarray analysis of mRNA from *in vitro* transcription assay with each sigma factor, RNA polymerase and *M. tuberculosis* genomic DNA.

For Genomic SELEX approach, we have generated approximately 400 bps random DNA fragments from Mtb Genomic DNA. We have labeled the 400 bps DNA fragments with Cy5 using a Cy5 labeled primer during PCR amplification of the DNA. Upon performing EMSA of the complexes formed with Cy5 labeled DNA fragments and RNAP (containing σ^A), we have observed that a part of the DNA fragments are able to form complex with RNAP. Sequence of the DNA fragments would identify the genes recognized by σ^A .

Using Networks to construct pathway relevant to Endometriosis : *Dr. Soumen Roy*

Endometriosis is classically defined as the growth of endometrial glands and stroma at extra uterine sites, most commonly implanted over visceral and peritoneal surfaces within the female pelvis. From a global perspective, it is a fairly common gynecological disorder affecting almost 10% of women of reproductive age. In India, approximately 1% women undergoing major gynecological surgery, 6–43% who undergo sterilization, 12–32% undergoing laparoscopy for pelvic pain, 21–48% undergoing laparoscopy for infertility are diagnosed with endometriosis. The endometriosis-associated inflammatory response, tissue repair and neovascularization are dependent on the peritoneal fluid (PF) macrophages and their secretory products/cytokines (role of cytokines in endo), which includes interleukins IL-1, IL-4, IL-5, IL-6, IL-8, IL-10, IL-12, IL-13, TNF- α (tumor necrosis factor- α), IFN- γ (interferon- γ), EGF (epidermal growth factor), TGF- β (transforming growth factor- β), CSF (colony-stimulating factor), PDGF (platelet-derived growth factor), and VEGF (vascular endothelial growth factor). Usually, levels correlate with the severity of the disease, with the highest amounts of cytokines being present in advanced stages of endometriosis. Using data gathered from medical practitioners and with the aid of text-mined resources; we have built networks to predict the pathway involved in endometriosis. Many of these predictions from networks have been experimentally validated.

VII. Basic & Applied Problems in Physical and Environmental Sciences

A. Fidelity of Quantum Channels : *Dr. Somshubhro Bandyopadhyay*

To establish an entangled state of optimal fidelity between two distant observers when the available quantum channel is noisy, is a central problem in quantum information theory. A part of our research program is devoted towards this problem, especially characterization of quantum channels through the notion of fidelity or singlet fraction.

1. We consider an instance of this problem for two-qubit systems when only a single use of the channel and local post-processing by trace preserving operations are allowed. We have shown that the optimal fidelity is obtained only when part of an appropriate non-maximally entangled state is transmitted through the channel. The entanglement of this state can be vanishingly small when the channel becomes very noisy. Moreover, in the optimal case no further local processing is required to enhance the fidelity. We have further shown that local post-processing can enhance fidelity if and only if the amount of noise is larger than a critical value and entanglement of the transmitted state is bounded from below. A notable consequence of these results is that the ordering of states under an entanglement monotone can be reversed even when the states undergo the same local interaction via a trace-preserving completely positive map. (with Anindita Ghosh, BARC)

2. We have also made considerable progress towards obtaining an exact expression of optimal fidelity for a generic qubit channel. We have identified a protocol which achieves this optimal value. Furthermore we have been able to completely classify qubit channels based on entanglement of the optimal input state. (with Rajarshi Pal, and Sibasish Ghosh, IMSc., Chennai)

B. Mutually Unbiased Bases and Pauli Classes : *Dr. Somshubhro Bandyopadhyay*

We have provided a construction of sets of $(d/2 + 1)$ mutually unbiased bases (MUBs) in dimensions $d=4,8$ using maximal commuting classes of Pauli operators. We have shown that these incomplete sets cannot be extended further using the operators of the Pauli group. However, specific examples of sets of MUBs obtained using our construction are shown to be strongly unextendible; that is, there does not exist another vector that is unbiased with respect to the elements in the set. We conjecture the existence of such unextendible sets in higher dimensions ($d=2^n$, $n>3$) as well. Furthermore, we note an interesting connection between these unextendible sets and state-independent proofs of the Kochen-Specker Theorem for two-qubit systems. Our construction also leads to a proof of

the tightness of a $H_{\{2\}}$ entropic uncertainty relation for any set of three MUBs constructed from Pauli classes in $d=4$. (with Prabha Mandayam, IMSc., Chennai; Markus Grassl, NUS, Singapore; William. K. Wootters, Williams College, Williamstown)

C. Distinguishability of quantum states under separable measurements : Dr. Somshubhro Bandyopadhyay

One of the many interesting features of quantum nonlocality is that the states of a multipartite quantum system cannot always be distinguished as well by local measurements as they can when all quantum measurements are allowed. In this work, we characterize the distinguishability of sets of multipartite quantum states when restricted to separable measurements – those which contain the class of local measurements but nevertheless are free of entanglement between the component systems. We consider two quantities: The separable fidelity – a truly quantum quantity – which measures how well we can "clone" the input state, and the classical probability of success, which simply gives the optimal probability in identifying the state correctly.

We have obtained lower and upper bounds on the separable fidelity and given several examples in the bipartite and multipartite settings where these bounds are optimal. Moreover the optimal values in these cases were shown to be attained by local measurements. We have further shown that for distinguishing orthogonal states under separable measurements, a strategy that maximizes the probability of success is also optimal for separable fidelity. We have pointed out that the equality of fidelity and success probability does not depend on an using optimal strategy, only on the orthogonality of the states. This fact is illustrated with an example where two sets (one consisting of orthogonal states, and the other non-orthogonal states) were shown to have the same separable fidelity even though the success probabilities are different. (with Michael Nathanson, Saint Mary's College of California, Moraga, CA)

D. Conclusive Exclusion of Quantum States : Dr. Somshubhro Bandyopadhyay

In the task of quantum state exclusion we consider a quantum system, prepared in a state chosen from a known set. The aim is to perform a measurement on the system which can conclusively rule that a subset of the possible preparation procedures can not have taken place. We ask what conditions the set of states must obey in order for this to be possible and how well we can complete the task when it is not. The task of quantum state discrimination forms a subclass of this set of problems. We formulate the general problem as a Semidefinite Program (SDP), enabling us to derive sufficient and necessary conditions for a measurement to be optimal. Furthermore, we obtain a necessary condition on the set of states for exclusion to be achievable with certainty. This task of conclusively excluding

states has gained importance in the context of the foundations of quantum mechanics due to a result of Pusey, Barrett and Rudolph (PBR). Motivated by this, we use our SDP to derive a bound on how well a class of hidden variable models can perform at a particular task, proving an analogue of Tsirelson's bound for the PBR experiment and the optimality of a measurement given by PBR in the process. We also introduce variations of conclusive exclusion, including unambiguous state exclusion, and state exclusion with worst case error. (with Rahul Jain, NUS, Singapore; Jonathan Oppenheim, UCL, London; Christopher Perry, UCL, London)

E. Incompatibility of noncommuting observables : Dr. Somshubhro Bandyopadhyay

Uncertainty relations are often considered to be a measure of incompatibility of noncommuting observables. However, such a consideration is not valid in general, motivating the need for an alternate measure that applies to any set of noncommuting observables. We have presented an operational approach to quantifying incompatibility without invoking uncertainty relations. Our measure aims to capture the incompatibility of noncommuting observables as manifest in the non-orthogonality of their eigenstates. We have proven that this measure has all the desired properties: it is zero when the observables commute, strictly greater than zero when they do not, and is maximum when they are mutually unbiased. We have also obtained tight upper bounds on this measure for any N noncommuting observables and compute it exactly when the observables are mutually unbiased. (with Prabha Mandayam, IMS., Chennai)

Interdisciplinary Physics/Systems Biology : Dr. Indrani Bose

Diverse complex dynamical systems are known to exhibit abrupt regime shifts at bifurcation points of the saddle-node type. The dynamics of most of these systems, however, have a stochastic component resulting in noise-driven regime shifts even if the system is away from the bifurcation points. We have proposed a new quantitative measure, namely, the propensity transition point as an indicator of stochastic regime shifts. The concepts and the methodology have been illustrated for the one-variable May model, a well-known model in ecology and the genetic toggle, a two-variable model of a simple genetic circuit. The general applicability and usefulness of the method for the analysis of regime shifts has further been demonstrated in the case of the mycobacterial switch to persistence for which experimental data are available (the studies have been carried out under the Institutional Programmes VI and VII).

Positive feedback plays an important role in different economic processes, e.g., in the growth of stock market bubbles and subsequent crashes. We have developed a model of growth of income/wealth based on positive feedback and determined the conditions for the

existence of a poverty trap. Some early signatures of the transition to the poverty trap have been proposed which could help in the formulation of appropriate strategies to avoid falling into the trap or coming out of it (the study has been carried out under the Institutional Programme VII).

Quantum spin systems : Dr. Indrani Bose

The phase diagram in a quantum critical point transition contains a quantum critical regime separating two distinct quantum phases. We have initiated studies on the characterization of the different regimes in terms of various quantitative measures of quantum correlations like concurrence, von Neumann entropy, quantum discord and geometric quantum discord. The efficiency of implementing quantum information related tasks like quantum state transfer in the various regimes is under investigation (the studies have been carried out under Institutional Programme VII).

Effective Model studies in the Physics and Astrophysics of strongly interacting matter : Dr. Supriya Das, Dr. Sanjay Ghosh, Dr. Rajarshi Ray, and Subhasis Samanta

In the deconfined phase of QCD the quarks and gluons are liberated to form plasma, whereas, in the confined chiral symmetry broken phase the relevant degrees of freedom are bound states of quarks and gluons, i.e. hadrons and possibly glueballs. This means that it should be expected that physical quantities in this phase admit a representation in terms of hadronic states. This is the idea of the hadron resonance gas model (HRGM). We present temperature (T) and baryonic chemical potential (μ_b) dependency of higher order fluctuations and correlation between conserved charges in excluded volume hadron resonance gas model. Then we show μ_b dependency of moment products (σ^2/M , $S\sigma$, $\kappa\sigma$) at fixed T . Finally we extract chemical freeze-out line from data of moment product ($S\sigma$) at Relativistic Heavy Ion Collider (RHIC) energy.

Dr. Sanjay K. Ghosh, Anirban Lahiri, Sarbani Majumder, Dr. Sibaji Raha and Dr. Rajarshi Ray

Fluctuations of different conserved charges of a system created in Relativistic Heavy Ion Collision provide us the information about the hadron-quark phase transition as they are enhanced during the transition. Study of susceptibilities in QCD is important because of the fact that they can be measured experimentally through the event by event fluctuation in heavy ion collision. Susceptibilities are related with the fluctuations through the fluctuation dissipation theorem. We have found that modification of Fluctuation-Dissipation Theorem is required within the framework of QCD inspired effective mean field models. The effect of implicit chemical potential dependence of thermodynamic pressure through the mean

fields should be considered in order to compute the quark number susceptibility (QNS) perfectly. Incorporating these dependences the modification has been done in a semi-analytic method in NJL model. However due to some insufficiency of the existing formulations, similar modification for PNJL model through Polyakov loop sector only, is done numerically.

Atmospheric Science Studies : *Chirantan Sarkar, Dr. Abhijit Chatterjee, Dr. Ajay K Singh, Dr. Sanjay K Ghosh and Dr. Sibaji Raha*

A detailed study on the characterization of black carbon (BC) aerosols at eastern part of Himalaya in India has been done in order to investigate its temporal variations, identification of potential sources and meteorological impact. The measurement was carried out over a high altitude hill station Darjeeling (27° 01'N, 88°15'E; 2200 m asl) for a period of two years (January 2010 - December 2011). BC exhibited strong seasonal variation with the maximum concentration during Pre-monsoon ($5.02 \mu\text{gm}^{-3}$) followed by winter, post-monsoon and minimum during monsoon ($1.7 \mu\text{gm}^{-3}$). BC varied between $1.1 - 7.8 \mu\text{gm}^{-3}$ with an average of $3.45 \pm 1.19 \mu\text{gm}^{-3}$. BC exhibited strong diurnal heterogeneity with sharp morning and evening peaks. Amongst the long distant sources, higher BC concentration was observed during westerly and north-westerly wind flow. Fossil fuels burning from tourist vehicles during pre-monsoon and biomass burning during winter were the major sources of BC. Relative BC concentrations at 370 nm and 880 nm and wavelength exponent estimated from BC absorption coefficient showed the overall dominance of fossil fuel burning for BC emission throughout the study period. From the context of diurnal and seasonal feature of BC; Darjeeling showed a dual nature representing a typical high altitude hill station as well as a typical urban atmosphere in India. The BC burden over Darjeeling was found to be much higher than any other high altitude stations in India and Nepal and even higher and comparable with some of the metro-cities in India which draws serious attention as it could have significant climatic consequences.

A. Adak, Dr. A. Chatterjee, Dr. A. K. Singh, C. Sarkar, Dr. S. K. Ghosh and Dr. S. Raha

A study on atmospheric fine (less than 2.0 μm) particulate matters were performed for the first time over eastern Himalaya in India in order to investigate the formation and sources in two different seasons, pre-monsoon (Mar – May) and winter (Dec – Feb) for three consecutive years 2008, 2009 and 2010. Fine mode aerosols were further segregated into three modes; ultrafine (less than 0.32 μm), superfine (0.32 – 1.0 μm) and fine mode (1.0 – 2.0 μm). The study was carried out at a high altitude hill station Darjeeling (2200 m asl) at the eastern Himalaya, India using an aerosol spectrometer (GRIMM) to measure aerosol

number concentrations. It was found that the ultrafine and superfine aerosol (less than 1.0 μm) concentrations were higher in pre-monsoon compared to winter whereas fine mode aerosols were comparable in concentrations during these two seasons. Meteorological conditions like sunny/non-cloudy days with higher radiative fluxes and lower humidity favored the formation of ultrafine aerosols from their precursor gases and the initiation of this formation were observed during 0900 – 1000 hours LT. Superfine aerosols were mainly found to be the transported dust aerosols from long distances during pre-monsoon and showed peak during late morning till late afternoon. During winter, it shows higher concentration during night. On the other hand, fine mode aerosols were mainly the locally generated anthropogenic aerosols; emitted mainly from vehicular sources during pre-monsoon and from biomass burning during winter and showed sharp diurnal peaks during morning and evening. Such long-term study on size segregated aerosol concentrations is of paramount importance and can be helpful for the validation of several regional and global aerosol models and for the climate related studies over Himalayan region.

Studying the physics of superheated liquids using superheated drop detectors : Dr. Barun K. Chatterjee

The nucleation threshold temperature of superheated droplets in superheated emulsion detector to spontaneous and gamma-induced nucleation as a function of pressure is studied. The nucleation rate per droplet as a function of temperature is seen to cross for 59.54 keV and 662 keV, gamma-induced nucleation, while it rises abruptly for spontaneous nucleation. The threshold temperature is observed to increase monotonically with pressure.

Mesomorphism in Cholesterol Esters and Membrane Phospholipids: Experiments and Theory : Dr. Pradip Das

Cholesteryl esters of saturated carboxylic acids form monolayer crystals from Acetate to Laurate. Starting from Laurate through Stearate, bilayer crystals are observed. Work in progress attempts to account for this variation of molecular organization in the crystalline state on the basis of molecular models and intermolecular interaction such as dipolar and dispersion. Thermodynamic stability of the mesophases through the homologous series can also be theoretically explored. Another interesting question to address is why monounsaturated esters such as cholesteryl oleate and cholesteryl oleyl carbonate form monolayer crystals despite the long fatty chain. Calorimetry, XRD and NMR of membrane phospholipids such as DPPC, PLPC, DMPC have been carried out. Why nature selects molecules, e.g, DPPC and DMPC, with two palmitoyl or myristoyl chains, instead of 1-palmitoyl phosphatidylcholine is under investigation. Covalently unbound cholesterol plays a significant role in membrane structure/function, which is also under investigation.

**Search for higher excited states of $^8\text{Be}^*$ to study the cosmological ^7Li problem :
Dr. Dhruba Gupta and Dr. Swapan K Saha**

We would like to study the unresolved ^7Li abundance anomaly by carrying out experiments that destroy the rare isotope ^7Be , the main source of ^7Li . Utilizing a 35 MeV ^7Be beam from HIE-ISOLDE at CERN, Geneva, Switzerland, we would like to measure the (d,p) and (d,d) reactions with T-REX. The higher beam energy, for the first time, would allow us to measure higher excitation energies in ^8Be up to about 20 MeV. With a wider angular coverage, we can make improved average cross-section measurement without assuming isotropy done in earlier works. The project CERN-INTC-2012-049, INTC-P-350 has been approved.

**Astrophysical S-factor from nuclear reactions with a rare isotope beam of ^7Be :
Dr. Dhruba Gupta and Dr. Swapan K Saha**

The reaction $^3\text{He} + ^4\text{He} \rightarrow ^7\text{Be} + \gamma$ has immense astrophysical significance. It is the onset of the ^7Be and ^8B branches of the p-p chain of hydrogen burning in the sun. To understand the physical and chemical properties of the sun, the nuclear cross sections need to be known with high accuracy. The above reaction also mediates the ^7Li production at high densities in the standard Big Bang model of the creation of the Universe. The discrepancy in the primordial abundance of the nuclide ^7Li still persists. It is therefore of fundamental importance to know this low-energy reaction rate, or the astrophysical S factor as accurately as possible. In studying nuclear astrophysics, one essentially faces problems due to very low cross sections and the need for rare isotope beams. To deal with the low cross sections, measurements with alternative methods like Coulomb dissociation is employed where the measurement of capture rates are obtained from breakup data on heavy targets. In India at the IUAC Pelletron, New Delhi, the rare isotope beam ^7Be is available. This gives us a good opportunity to study the above mentioned important astrophysical problem. A proposal for funding this project has been submitted and is in the final stages of consideration. An advanced nuclear physics laboratory at Bose Institute is being setup to facilitate the above projects.

Isospectral bound state potential from DDM3Y effective interaction: Dr. Dhruba Gupta and Dr. Swapan K Saha

Theoretical investigation of $5/2^+$ resonance state of ^{11}Be was carried out using Supersymmetric Quantum Mechanics (SQM). The original two-body potential ($^{10}\text{Be} + n$) was constructed microscopically using a DDM3Y effective NN interaction. SQM converted this potential to an isospectral potential which is effective for detecting resonance states in the continuum. The resonance energy of the $5/2^+$ state is in good agreement with the experimental value.

Collaborator: **Dr. S. K. Dutta** (B. G. College, Berhampore, Murshidabad)

Foundations of Quantum Mechanics and Quantum Information : Dr. Dipankar Home

1. An earlier unnoticed implication of quantum indistinguishability is pointed out, namely, a property which we call "Dualism" that characterizes the entanglement of two identical particles (say, two ions of the same species) – a feature which is absent in the entanglement of two nonidentical particles (say, two ions of different species). A crucial application of this property is that it can be used to test quantum indistinguishability without bringing the relevant particles together, thereby avoiding the effects of mutual interaction. This is in contrast to the existing tests of quantum indistinguishability. Such a scheme, being independent of the nature and strength of mutual interactions of the identical particles involved, has potential applications, including the probing of the transition from quantum indistinguishability to classical distinguishability.
2. For a spin-polarized plane wave passing through a spin-rotator containing uniform magnetic field, a detailed analysis for solving the appropriate Schrödinger equation is provided. A modified expression for spin precession is obtained which reduces to the standard Larmor precession relation when kinetic energy is very large compared to the spin-magnetic field interaction. We show that there are experimentally verifiable regimes of departure from the standard Larmor precession formula. The treatment is then extended to the case of a spin-polarized wave packet passing through a uniform magnetic field. The results based on the standard expression for Larmor precession and that obtained from the modified formula are compared in various regimes of the experimental parameters.
3. A careful analysis of the proper significance of Riahi's Comment [*J. Phys. A: Math. Theor.* **46**, 208001 (2013)] in light of our paper (2009 *J. Phys. A: Math. Theor.* **42** 165302) is provided. A fundamental difference between the quantum–classical correspondence scheme considered in our paper and that used in Riahi's Comment is pointed out.
4. Predictive power of the no-signalling condition (NSC) is demonstrated in a testable situation involving a non-ideal Stern–Gerlach (SG) device in one of the two wings of the EPR-Bohm entangled pairs. In this wing, for two types of measurement in the other wing, we consider the spin state of a selected set of particles that are confined to a particular half of the plane while emerging from the SG magnetic field region. Due to non-idealness of the SG setup, this spin state will have superposing components involving a relative phase for which a testable *quantitative constraint* is obtained by invoking NSC, thereby providing a means for precision testing of this fundamentally significant principle.
5. An analytical treatment of a propagating wavepacket incident on a transient barrier reveals an effect in which, for a particular time interval, the time varying transmission

probability exceeds that for the free propagation of the wavepacket. It is pointed out that this effect can be interpreted semiclassically. This effect is also quantified and it is shown that its magnitude is in one-to-one correspondence with the strength of the barrier, a feature that has the potential to be used in a scheme for key generation. It is found that the speed with which the information about the barrier perturbation propagates across the wavepacket can exceed the group velocity of the wavepacket. An application to the speed-up of entanglement generation is also considered.

**Quantum statistical multifragmentation model of astrophysical CFL strangelets :
Mr. Sayan Biswas, Dr. J.N. De, Dr. P.S. Joarder and Dr. Sibaji Raha**

A quantum statistical disassembly model for the warm and excited 'color-flavor locked strange quark matter (CFL SQM)', that is possibly ejected during tidal disruption of a 'CFL star (CFLS)' due to its merger with either a CFLS or an unconverted neutron star (NS) in compact binary stellar systems of the Galaxy, is presented here in their useful limit of massless quarks within a theoretical framework that is analogous to the 'liquid drop model' for ordinary nuclei. The disassembly model is used to determine the rate of injection of baryon number (or mass) distribution of CFL strangelets in the Galaxy. The nature of dependence of such mass distribution on various important physical parameters, such as the 'MIT bag parameter', the '(color superconducting) pairing energy gap' and the temperature of the fragmenting complex at thermodynamic equilibrium at 'freeze-out', is discussed. An order of magnitude estimate for the possible flux of CFL strangelets in primary cosmic rays is also attempted within the framework of a simple diffusion model for the propagation of those strangelets in the inhomogeneous magnetic field of the Galaxy. The derived flux of CFL strangelets is then compared with the estimations obtained either from theoretical model calculations or from the possible upper limit of such fluxes derived in recent observations by high-sensitivity detectors on space-based observing stations by earlier authors. Limitations of the present study are also discussed along with the possible directions for its future improvements.

Project SMS activity :

Development of radar for study of high resolution imaging under outdoor clutter environment at microwaves & millimetewaves through system and appropriate code development : Dr. Amitabha Mitra, Soumendra Singh, Vineet Surana, Ayona Chakravarty, Dr. Sanjay K Ghosh and Dr. Sibaji Raha

Transmitting radio waves through appropriate hardware and its *reception* after being negotiated by different objects is essentially the working principle of radar. The properties

of received radio waves can be considered as the signature of the physical properties of the objects which are being reflected by the radio signals. Characterization of these *objects* from the received radar signal is an important study in the field of Radar Cross Section (RCS) based measurement which finds a number of applications primarily in defence and remote sensing of earth. Electromagnetic characterization of *objects* in this process in outdoor environment, in presence of ambient noise and clutter, is a challenging task.

Indigenously designed radar with state-of-the-art components has been developed with suitable code for automated system control, data acquisition and data processing & display. Suitable hardware as well as software techniques in DSP has been applied to overcome the outdoor noise contribution to extract actual reflected electromagnetic field from various objects. Measured electromagnetic reflectivity of different objects has been calibrated against known objects and the result is highly encouraging.

Project MWS-Phase III activity :

Development of Diagnostic Imaging code at W band under controlled environment Radar Reflectivity Measurement & Diagnostic Imaging at W band : Dr. Amitabha Mitra, Vineet Surana, Soumendra Singh and Dr. Sibaji Raha

A code has been developed for creating 2D & 3D radio image in millimeter wave band (W-band:75-110GHz) in quasi-monostatic path through indigenously developed instrumentation radar hardware with state-of-the-art-components at indoor environment for arbitrary shaped objects. Constant development and improvement of the software code for addition of new features and obtaining better image resolution and granularity is underway.

External Collaboration:

Study of air pollution and detection of suspended particulate matter in the gaseous phase through indigenously developed low cost spectroscopic system : Soumendra Singh, Dr. Amitabha Mitra and Samir Kr. Pal*

* S N Bose National Centre for Basic Sciences

An indigenously designed, low cost instrumentation for detecting air pollution has been developed and tested. The design utilizes the principle of high voltage spark and optical emission spectroscopy. The light emitted by high voltage spark, in presence of suspended particulate matter, is collected through collimation and convergence optics by a CCD photo

sensitive detector. This design is extremely compact and reasonably sensitive to detect gaseous elements; e.g., NO_x , atomic oxygen, K ion, etc. The low cost CMOS detector has been utilized to acquire data for live online monitoring of the pollutant gaseous species. This instrument may be used as a potential probe for the detection of unknown and hazardous gas present in environment which is bio-hazardous.

Controllability of Complex Systems : Dr. Soumen Roy

Controllability is definitely a prime objective in complex systems research. It is a measure of how one can drive a complex system methodically in finite time from an initial state to any preferred final state, with a suitable choice of inputs. In a complex system, individual components of the system interact with each other in a highly non-trivial manner to generate interesting emergent properties. Very often, these complex systems can be viewed as networks, which can capture interactions present in these systems. It is therefore natural to think that the network topology should have a non-trivial bearing on the controllability of such complex systems. Hence, it is important to understand how the topology of complex networks, quantified by network metrics, influences the controllability of complex networks. We propose a new metric with the aim of influencing structural controllability in networks. We show that without using the computationally expensive practice of maximum matching, this metric helps us to ascertain, whether the controllability of a network can be changed and to what extent.

Efficient scheduling using complex networks : Dr. Soumen Roy

Developing an automated method to schedule the production of goods in a manufacturing plant is of immense importance and of long-standing interest to production houses and industrial concerns. Furthermore, there are many deep mathematical problems at the core of developing such as schedule. Here we consider the problem of efficiently scheduling the production of goods for a model steel-manufacturing company. We propose a new approach for solving this classic problem, using techniques from the statistical physics of complex networks in conjunction with depth-first search to generate a successful, flexible, schedule. The schedule generated by our algorithm is more efficient and outperforms schedules selected at random from those observed in real steel-manufacturing processes. Finally, we explore whether the proposed approach could be beneficial for long term planning and show that several standard network measures are not related to the existence of efficient scheduling solutions.

DNA Templated Clusters of Silver Nanoparticles: an Ultrasensitive SERS Substrate : Ms. Dipanwita Majumdar and Dr. Achintya Singha

Stable metal nanocluster (NC) with uniform interior nanogap reproducibly offer a highly robust substrate for surface enhanced Raman scattering (SERS) due to the presence of plenty of hot-spots on their surface. Synthesis of such SERS substrate by a simple route is challenging. Here, highly stable wire-like clusters of silver nanoparticles (Ag-NPs) with an inter-particle gap of ~ 1.7 have been synthesized using DNA as template by exploiting an easy and inexpensive chemical route and the SERS performance of the substrate is investigated. The measurements reveal that the uniform, reproducible, and strong Raman signals have been observed in single molecule level and the enhancement is not highly dependent of the polarization of the excitation laser. We provide detailed theoretical simulation to discuss our experimental realizations.

Study of one dimensional semiconductor nanostructures : Dr. Achintya Singha

We have demonstrated that the enhancement of phonon mode intensity in InAs nanowires is due to the increase of internal electric field in the nanowires originated from the coupling of light with the nanowires. In Germanium nanowires we have shown that the defects within the nanowires can be tuned by changing the synthesis parameters and we have studied the defects using XRD and Raman measurements. In another work we have shown that the Hematoporphyrin conjugated zinc oxide nanorod acts as a potential light-harvesting material.

External collaborators: *Prof. Anushree Roy* (IIT Kharagpur), *Prof. Justin D. Holmes* (University College Cork, Ireland) and *Prof. Samir Kumar Pal* (SNBNCBS, Kolkata)

Electrical transport mechanism of perovskite oxides : Dr. T. P. Sinha

The structure of synthesized complex perovskite oxides ($\text{Sr}_2\text{CeSbO}_6$, $\text{Ba}(\text{Zr}_{0.25}\text{Ti}_{0.75})\text{O}_3$, $\text{Y}_{1-x}\text{Dy}_x\text{FeO}_3$, $x = 0, 0.5$ etc.) have been established by Rietveld refinement technique. The frequency dependent dielectric relaxation (a conduction process) of these synthesized perovskite oxides has been investigated by impedance spectroscopy at different temperatures. The activation energy of the system is obtained and the transport mechanism for the conduction process has been proposed.

Photophysical behaviour and phonon modes of perovskite oxides : *Dr. T. P. Sinha*

The first principles calculation has been employed to investigate the optical and vibrational properties of strongly correlated electron systems such as $A_2\text{CrSbO}_6$ ($A = \text{Sr, Ca}$) etc. The calculated eigen vectors have been used to assign the origin of phonon modes in these materials obtained by Raman spectroscopy. The interband contributions to the optical properties of simple and double perovskite oxides have been explored. The calculated density of states have been substantiated by the X-ray photoemission spectra.

Mega Science Projects : Participation at FAIR

The Facility for Anti-proton and Ion research (FAIR) is a global facility being created at Darmstadt, Germany under an international convention. The FAIR project is managed by the FAIR GmbH. This will be one of the largest accelerator facilities in the world; India's participation in this endeavour is in the ambit of the mega science projects recommended by the Screening Committee on Science & Technology set up by the Planning Commission, Government of India. The FAIR project is a joint venture of the Department of Science & Technology, Government of India and the Department of Atomic Energy, Government of India on equal partnership basis.

India is the third largest shareholder, after Germany and Russia, in FAIR. Prof. Sibaji Raha, Director, Bose Institute, is currently the Vice-Chair of the International Council of FAIR.

Bose Institute has been designated the Indian shareholder of FAIR as well as the nodal institution for the co-ordination and management of the FAIR programme in India. The Indo-FAIR co-ordination centre (IFCC) has been established by the DAE and DST jointly at Bose Institute to co-ordinate all FAIR related activities in India. IFCC is guided by an Executive Council jointly chaired by the Secretary, DST and the Secretary, DAE (Chairman, AEC). IFCC is responsible for identifying various hardware items for supply to FAIR as in-kind Indian contribution. It also has the task of co-ordinating India's participation as the FAIR experiments. During the year under report, substantial progress has been made in assigning the work of fabrication of ultra stable power converters to ECIL, India. Efforts are on for the fabrication of Beam Stopper, Vacuum Chambers and Superconducting Magnets. Three international Symposia, **NUSTAR and CBM** at Kolkata and **PANDA** at Goa, have been organized during the year.

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1. Sarkar R, Mondal P K and Chatterjee B K (2012). Gamma ray sensitivity of R-12 superheated emulsion detector at higher pressure using ^{241}Am and ^{137}Cs gamma sources; *Proc. DAE Symposium on Nuclear Physics* (Delhi University), 3-7 December 2012, 948.
2. Sarkar R, Mondal P K and Chatterjee B K (2012). Study of neutron flux from a ^{241}Am -Be neutron source using superheated emulsion detector (SED); *Proc. of Nineteenth National Symposium on Radiation Physics* (Mamallapuram), 12-14 December 2012, 329.
3. Biswas S, De J N, Joarder P S, Raha S and Syam D (2013) Quantum statistical multifragmentation model for the production of astrophysical strangelets: Poster paper icrc2013-0619 at the 33rd *International Cosmic Ray Conference (ICRC)*, 2013, RIO DE JANEIRO, BRAZIL, 2013, available online at: <http://www.cbpf.br/icrc2013/papers/icrc2013-0619.pdf>.

Library

1. Chakraborty A K and Chakraborty A (2013). Cloud Computing for knowledge Resource Centre: copyright issue. In *Academic Library Services through cloud computing : moving libraries to the web*, Pre-conference Volume, 2nd International conference on Academic Libraries, 12-15 February, 2013 *Indo-American Books, Delhi, In association with Guru Gobind Singh Indraprastha University, New Delhi*, 68-81.
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Students Awarded with Ph.D. Degree

**Name of the Student
(University/Year)**

Title of thesis

Supervisor

Biochemistry Department

Jaspreet Singh Grewal
(J.U. 2013)

Novel Proteins that regulate chromosome Segregation and cell division in *Entamoeba histolytica*

Dr. A. Lohia

Debadrita Mukherjee
(J.U. 2012)

Studies on *Vibrio cholerae* Transcription Activators, HlyT and HlyU

Dr. P. Chakrabarti

Amitava Bandhu
(C.U., 2012)

Studies on the operator DNA binding capacity of the repressor of temperate mycobacteriophage L1.

Dr. S. Sau

Division of Molecular Medicine

Goutam Guchhait
(J.U. 2013)

Synthesis of oligosaccharides corresponding to the bacterial cell wall polysaccharides

Dr. Anup
Kumar Misra

Parna Bhattacharya
(J.U. 2013)

Arabinosylated lipoarabinomannan (ARA-LAM) induced protection against visceral leishmaniasis (VL): Involvement of signaling parameters in the disease process

Dr. Subrata Majumdar

Division of Plant Biology

Madhuvanti Chatterjee
(J. U., 2012)

Towards characterization and understanding of mechanism of induction of some promising gene(s) of *Sinapis alba* L. on infection with the fungal pathogen *Alternaria brassicicola*

Dr. D. Basu

Ramdeep Kaur Grewal
(J.U. 2012)

An endeavour towards understanding the host- pathogen interaction for bacterial leaf blight of rice.

Dr. Sampa Das

Basabdatta Das
(J. U., 2012)

Genetic Diversity Analysis of a Set of Rice Landraces using DNA markers

Dr. Tapas Kumar Ghose

Samik Sengupta (J.U., 2012)	Genetic Diversity Analysis in Papaya (<i>Carica papaya</i> L.) using DNA markers	Dr. Tapas Kumar Ghose (Co-Supervisor)
Subrata Kundu (C.U., 2012)	Identification and characterization of proteins implicated in Mungbean Yellow Mosaic India Virus resistance in <i>Vigna mungo</i> through proteomic approach.	Dr. Amita Pal
Jayadri Sekhar Ghosh (J.U. 2012)	Molecular characterization of a genotype specific marker in <i>Bambusa balcooa</i> and phylogenetic relationships assessment of tropical bamboo species based on <i>ITS</i> sequences of nuclear ribosomal <i>DNA</i> .	Dr. Amita Pal
Lekha Bandopadhyay (J.U., 2012)	Exploring the defence response of <i>Rorippa</i> sp., the wild crucifer challenged by the mustard aphid <i>Lipaphis erysimi</i> through functional genomics	Dr. S. R. Sikdar
Suranjana Roy (C.U. 2013)	Assessment of phenotypic and genotypic diversity of Indian Sesame (<i>Sesamum indicum</i> L)	Dr. P. K. Saha Dr. D. Basu (Co-Supervisor)

Microbiology Department

Shri Arnab Basu (C.U., 2012)	An investigation into the structure function relationship and evolution of a novel class of replication proteins represented by the Mycobacterial plasmid pAL5000 replication protein RepB	Dr. Sujoy K. Das Gupta
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Grants-in-aid Schemes

Investigator/
Co-Investigator

Title of the Scheme

Name of the
Dept./Section

Schemes funded by Aeronautical Development Agency(ADA), Ministry of Defence

Dr. S. Raha Principal Coordinator Dr. A. Mitra Investigator-in-Charge	Millimeterwave Scattering(MWS-Phase-III)- Development of Radar Reflectivity Measurement & Diagnostic Imaging Facility at Multifrequency Band	CAPSS/ Physics
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Schemes funded by CSIR

Dr. S. K. Datta	Dehydration of flowers and foliage and floral craft & their commercialization	Acharya J.C. Bose Biotechnology Innovation Centre
Dr. Srimonti Sarkar	Functional characterization of the lipid-binding FYVE protein from <i>Giardia lamblia</i>	Biochemistry
Dr. Subrata Sau	Isolation of the conditional lethal mutants of mycobacteriophage L1 repressor possessing high operator binding affinities and development of an expression vector for mycobacterial systems (started 01-06-2011)	Biochemistry
Dr. A Bhunia	Structural Study of De Novo Designed Novel Antifreeze Peptides From <i>Leucosporidium Antarcticum</i> Antifreeze Protein-1 (Afp-1).	Biophysics
Dr. G. Basu	Theoretical and experimental analyses of bacterial GlxRS/tRNA-Glx/gatCAB co-evolution and the molecular basis of their interaction	Biophysics
Dr. J. Basu (PI) Dr. M Kundu (Co-PI)	Role of microRNAs in the immune response to mycobacterial infection (1.7.2011-31.6.2014)	Chemistry

Dr. Kaushik Biswas	Molecular mechanisms of tumor progression : role of tumor derived products in mediating tumor cell growth, motility and metastasis	Division of Molecular Medicine
Dr. Subrata Majumdar	Mechanistic insights into dendritic cell maturation and its role in <i>Leishmania donovani</i> : Emphasis on dendritic cell cased anti- leishmanial therapy	Division of Molecular Medicine
Dr. N. Mandal	Isolation and Identification of natural antioxidant and anticancer product in <i>Spondias pinnata</i>	Division of Molecular Medicine
Dr. A. K. Misra	Synthesis of oligosaccharides corresponding to Shigella dysenteriae for the preparation of glycoconjugates to treat Shigelosis	Division of Molecular Medicine
Dr. G. Sa (PI) Dr. T. Das (Co-PI)	Molecular mechanisms of immune evasion by tumor: Role of curcumin in ameliorating dendritic and T-regulator cell-mediated immune dysfunction	Division of Molecular Medicine
Dr. Amita Pal	Understanding molecular mechanism of MYMIV-resistance in <i>Vigna mungo</i> through genomic approach	Division of Plant Biology
Dr. S. R. Sikdar	Towards identification of aphid resistance gene(s) from wild crucifer <i>Rorippa indica</i> through differential transcriptomic approach.	Division of Plant Biology
Dr. W. Ghosh	Understanding the origin(s), evolution and interaction(s) of different molecular mechanisms of chemotrophic sulfur oxidation: Elucidating the metabolic strategies of early Life	Microbiology

Scheme funded by CSIR (NMITLI)

Dr. Sampa Das (PI)	Novel approaches for production of hybrid seeds with characterization of improved insect resistance and higher yield.	Division of Plant Biology
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Scheme funded by CCRH

Dr. T. Das Dr. G. Sa	Role of homeopathic medicine in cancer regression and rejuvenation of depressed immune system: A mechanistic study	Division of Molecular Medicine
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Schemes funded by DAE

Dr. P. C. Sen Dr. T. Das	Remodeling the cellular calcium ethyl-4-(3-nitro)-phenyl-6-methyl-2-oxo-1,2,3,4-tetra-pyrimidine-5-carboxylate (Nifetepimine): A mechanistic approach towards cancer regression and immune-rejuvenation.	Division of Molecular Medicine
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Schemes funded by DBT

Dr. S. K. Datta	Employment Generation Utilizing Unutilized Rural Flora for Preparation of Value Added Products Using Dehydration Technique	Acharya J.C. Bose Biotechnology Innovation Centre
Dr. A. Lohia	Regulation of phagocytosis, cell division and motility in <i>Entamoeba histolytica</i>	Biochemistry
Dr. S. Ghosh Dastidar	Mechanistic insight into the role of conformational Modulations in driving BCL2s apoptotic network: Structural dynamics to therapeutic design	Bioinformatic Centre
Dr. Srimonti Sarkar	Identification and characterization of a 19S proteasomal component of the early diverging eukaryote <i>Giardia lamblia</i>	Biochemistry
Dr. T. C. Ghosh	Role of protein complexes and protein protein interaction network in eukaryotic protein evolution	Bioinformatics centre
Dr. Z. Ghosh	Microregulatory Networks in Leukaemia Stem Cells	Bioinformatic Centre

Dr. Sudipto Saha	Ramalingaswami Re-entry Fellow (No.BT/RLF/Re-entry/11/2011) for a period of five years	Bioinformatic Centre
Dr. G. Basu	Setting up of a State-of-the-art 600 MHz FT-NMR with Cryoprobe facility at Bose Institute	Biophysics
Dr. A. Bhunia / Dr. Subhrangsu Chatterjee	Biophysical and Structural Aspects of Oncogenic G-Quartets Bound to Drugs: Screening, High Resolution NMR and Low Resolution Spectroscopy.	Biophysics
Dr. J. Basu (PI) Dr. M. Kundu	Understanding the mechanisms underlying mycobacterial lipoarabinomannan mediated inhibition of macrophage apoptosis (06.12.2009-05.12.2012)	Chemistry
Dr. J. Basu (PI) Dr. M. Kundu (Co-PI)	Sys TB: A Network Programme for Resolving the Intracellular Dynamics of Host Pathogen Interaction in TB Infection (09.01.2012-08.01.2017)	Chemistry
Dr. M. Kundu (PI) Dr. J. Basu	Polyphosphate kinase and its role in mycobacterial physiology (30.12.2008 TO 29.06.2012)	Chemistry
Dr. M. Kundu, (PI) Dr. J. Basu (Co-PI)	The role of two component systems and cell division proteins in mycobacterial physiology (29.09.2012-28.09.2015)	Chemistry
Dr. Jayanta Mukhopadhyay	Role of alternative sigma factors in gene regulation of <i>M. tuberculosis</i>	Chemistry
Dr. A. Bhunia	Biophysical and Structural Aspects of Oncogenic survival and death of leishmania Spectroscopy.	Division of Molecular Medicine
Dr. S. Majumdar	Identification of the host cell factors responsible for G-Quartets Bound to Drugs: Screening, High Resolution NMR and Low Resolution	Division of Molecular Medicine
Dr. S. Majumdar	Immunomodulatory role of Arabinosylated Lipoarabinomannan Against Visceral Leishmaniasis	Division of Molecular Medicine

Dr. N. Mandal	Exploration of Lichens from Barak Valley of Southern Assam and Arunachal Pradesh (North East India) and Isolation of Phytochemicals and Bioprospecting of some selected Lichens species (funded by DBT-NER Twinning)	Division of Molecular Medicine
Dr. N. Mandal	Purification and characterization of bioactive natural antioxidant, immunomodulator and anticancer products from <i>Dioscorea alata</i> L., of North Eastern region of India (funded by DBT-NER Twinning)	Division of Molecular Medicine
Dr. G. Sa Dr. T. Das	Targeted alteration of MAPK family members ERK and p38MAPK/JNK to channelize oncogenic Ras-induced proliferative-signaling into apoptotic-signaling	Division of Medicine
Dr. D. Basu (PI)	Understanding of correlation between "auxin homeostasis" and <i>Alternaria brassicicola</i> infection in <i>Brassica juncea</i> (04.12.2006 – 04.12. 2013)	Division of Plant Biology
Dr. Sampa Das (Programme Co-ordinator)	Biotic stress in Plants: A concerted approach based on functional genomic, proteomic and transgenic techniques. DBT Programme Support (December 2006- 4 th December- 2011 5 th December 2011- December 2013)	Division of Plant Biology
Dr. Sampa Das (PI) Dr. S. R. Sikdar (Co-PI)	A transgenic approach to develop aphid resistant <i>Brassica juncea</i> plant types and their field evaluation.	Division of Plant Biology
Dr. P. Kundu (PI) Dr. Sampa Das (Co-PI)	Regulation of microRNA transcription and biogenesis by fungal-stress in tomato	Division of Plant Biology
Prof. A. N. Lahiri Majumder (Co-ordinator and PI Project No.-I &II) Prof. D. N. Sengupta (PI Project No.-III) Dr. Shubho Chaudhuri (PI Project No.-IV)	Generation of salt-tolerant rice plants: A translational approach.	Division of Plant Biology

Dr. Amita Pal, P.I. Dr. Sampa Das (Programme Coordinator)	Identification of genetic loci for the development of MYMIV-resistance in Vigna.	Division of Plant Biology
Dr. T. K. Dutta (PI)	Identification of amino acid residues involved in substrate specificity of bacterial ring- hydroxylating dioxygenases using bioinformatics approach	Microbiology

Schemes funded by Wellcome Trust DBT India Alliance

Dr. Soumen Roy / Dr. PK Mohanty (SINP)	Kolkata International School cum Conference in Systems Biology (<u>KOLSYSBIO</u>) held during Dec 29, 2012 – Jan 03, 2013	Chemistry
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Scheme funded by DBT's Twinning programme for NE

Dr. Tapash C Ghosh	Understanding causes of codon usage bias in organisms	Bioinformatics
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Scheme funded by DRDO, Ministry of Defence

Dr. S. Raha <i>Principal Coordinator</i> Dr. A. Mitra <i>Investigator-in-Charge</i> Dr. S. K. Ghosh <i>Co-Investigator</i>	Studies on Microwave Scattering(SMS)	CAPSS / Physics
Dr. T. P. Sinha	Transport Properties of Double Perovskite Oxides	Physics

Scheme funded by DST

Dr. P. Chakrabarti	J.C. Bose National Fellowship	Biochemistry
Dr. J. Basu (PI) Dr. M. Kundu	Dissection of the pathway of innate immune subversion by the early secreted antigen-6 (ESAT-6) of <i>Mycobacterium tuberculosis</i> (03.12.2009-02.12.2012)	Chemistry

Dr. M.Kundu (PI) Dr. J.Basu (Co-PI)	Stress induced regulation of extracytoplasmic Sigma factors in mycobacteria (21.10.2010 to 20.10.2013)	Chemistry
Dr. G. Sa Dr. T. Das	Targeted alteration of MAPK family members ERK and p38MAPK/JNK to channelize oncogenic Ras-induced proliferative-signaling into apoptotic-signaling	Division of Molecular Medicine
Dr. D. Basu (PI)	Understanding of correlation between "auxin homeostasis" and Alternaria brassicicola infection in Brassica juncea (04.12.2006 – 04.12. 2013)	Division of Plant Biology
Dr. Nrisingha Dey (PI) Dr. A. Pal (Co-PI)	Bioprospecting of novel gene/s and promoter/s useful for better bamboo-fiber-based merchandise production	ILS, Bhubaneswar/ Division of Plant Biology
Dr. Sujoy K. Das Gupta	Investigating the mechanism by which chaperones activate DNA binding activity of the mycobacterial heat shock response regulator HspR.	Microbiology
Dr. W. Ghosh	Comprehensive Geomicrobiology of two High Temperature Hydrothermal Systems of India: Paradigms of Primitive Metabolisms and Biogeochemical Evolution, Prospects of Biotechnological Resource	Microbiology
Dr. T. P. Sinha	Dielectric relaxation in complex perovskite oxides	Physics

Scheme funded by DST and The Royal Society

Dr. Srimonti Sarkar	For organizing symposium entitled 'Protozoan parasites: engineering life with a different toolkit'	Biochemistry
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Scheme funded by DST under IRHPA, Govt. of India

Dr. S. Raha (PI)	Study of Cosmic ray interactions and Cosmic Ray–Aerosol–Cloud connection in the context of regional climate change	CAPSS/ Physics
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Project funded by DST, SERB Fast Track

Dr. A Bhunia	Design, Synthesis and Mechanistic Insights of Novel Antimicrobial Peptides (AMP) Using High Resolution NMR Spectroscopy: Role of Outer Membrane Permeability and DNA Binding.	Biophysics
Dr. Wriddhiman Ghosh	Comprehensive Geomicrobiology of two High Temperature Hydrothermal Systems of India: Paradigms of Primitive Metabolisms and Biogeochemical Evolution, Prospects of Biotechnological Resource.	Microbiology

Project funded by DST, SERC

Dr. A Lohia	Identifying proteins that determine the function of novel kinesins from <i>Entamoeba histolytica</i>	Biochemistry
Dr. K. Jana	Molecular Signalling Involved in Patho-physiological Action of Common Air Pollutant Benzo(a)pyrene in Testicular DNA Damage and Apoptosis in Connection to Male Infertility: Possible Protection by Natural Aryl Hydrocarbon Receptor antagonists	Division Molecular Medicine
Dr. A. K. Misra	Synthesis of oligosaccharide antigens of the Enterohemorrhagic <i>Escherichia coli</i> (EHEC) strains for the preparation of glycoconjugates	Division Molecular Medicine

Schemes funded by ICMR

Dr. J. Basu (PI) Dr. M Kundu (Co-PI)	Understanding cell division in mycobacteria	Chemistry
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Dr. M. Kundu (PI) Dr. J. Basu (Co-PI)	Role of secretory antigen in <i>Helicobacter pylori</i> Mediated induction of autophagy	Chemistry
Dr. S. SenMandi (Co-Ordinator) Dr. S.R.Sikdar	Centre for Advanced Research in DNA Fingerprinting and Diagnostics of Medicinal Potential in Plants of Eastern and North Eastern India	Division of Plant Biology

Scheme funded by Indo-Korean collaborative programme (DST)

Dr. J. Basu (PI)	<i>Mycobacterium tuberculosis</i> infection: understanding the role of microRNAs in regulating the immune response of macrophages	Chemistry
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Scheme funded by Indo-French Centre for the Promotion of Advanced Research

Dr. P. Chakrabarti	Analysis of protein flexibility in biological recognition	Biochemistry
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Scheme funded by Indo-Swedish Collaborative Programme

Dr. Joyoti Basu (PI)	Latency of <i>Mycobacterium</i> tuberculosis: evaluating drugs and drug targets using innovative	Chemistry
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Scheme funded by Indo Swiss Collaboration in Biotechnology

Dr. Sampa Das (PI)	Evaluation of ASAL expressing chickpea transgenic plants for the inheritance of aphid resistance (Third Phase-September, 2009 - September, 2012)	Division of Plant Biology
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Scheme funded by ICAR, National Fund

Dr. Sampa Das (P.I.) Dr. D. Basu (Co PI)	Development of pod borer resistant transgenic pigeonpea and chickpea	Division of Plant Biology
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Scheme funded by Ministry of Earth Science (MoES)

Dr. N. Mandal	Study on white spot syndrome virus (WSSV) prevalence and diversity of disease resistant population among wild giant black tiger shrimp (<i>Penaeus</i> <i>monodon</i>) of the entire coastal area of India	Division of Molecular Medicine
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Dr. N. Mandal	Study of shrimp Genome: Disease resistant DNA markers of <i>Penaeus monodon</i> through OASTC, Berhampur University funded by MoES	Division of Molecular Medicine
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Scheme funded by Ministry of Environment & Forests (MOEF)

Dr. T. K. Dutta (PI)	Development of a reporter strain to monitor toxic and/or carcinogenic polycyclic aromatic hydrocarbons (PAHs) in the environment	Microbiology
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Scheme funded by Rashtriya Krishi Vikas Yojana

Dr. T. K. Ghose (Co-PI)	Promotion of Bengal Aromatic Rice through improved production and processing system	Division of Plant Biology
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Scheme funded by NAIP

Dr. D. Basu PI Prof. S. Das (Co-PI) Prof. S. Sikdar (Co-PI)	Molecular tools for exploitation of heterosis, yield and oil quality in sesame.	Division Plant Biology
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Project guide for the Department of Library & Information Science, Kolkata

Dr. A. K. Chakraborty	A bibliometric study of the journal 'Bibliometric analysis of Indian Library and Information Science periodical Literature' 2000-2005.	Library
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Scheme funded by IITM, Pune

Dr. A. Chatterjee (PI)	Study on Biosphere-Atmosphere exchange of carbon dioxide, water vapor and energy in a Tropical High Altitude forest canopy at Eastern Himalaya	Environment Science Section
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Participation in Conferences/Symposia/Workshops & Invited Talks Delivered at Various Organizations

Dr. P. Chakrabarti (Biochemistry) presented papers/attended at (i) the seminar on Successful Indo-French S & T Cooperation: CEFIPRA, Paris, May 17, 2013; (ii) Facets of Insilico Chemical Biology for Novel Therapeutics, IICB, June 18, 2013; (iii) Workshop on Computational Biology and Protein Structure Prediction, Heritage Institute of Technology, Kolkata, September 23-27, 2013; (iv) TWAS 24th General Meeting, Buenos Aires, Argentina, October 1-4, 2013; (v) India-France Technology Summit, New Delhi, October 23-24, 2013; (vi) 42nd National Seminar on Crystallography and International Workshop on Application of X-ray Diffraction for Drug Discovery, New Delhi, November 21-23, 2013; (vii) The 12th Conference of the Asian Crystallographic Association, Hong Kong, December 7-10, 2013. He chaired sessions at (viii) International Symposium on Challenges in Chemical Biology, IICB, Kolkata, January 27 – 29, 2013; (ix) National Conference on Molecular Architecture, Dynamics and Assembly in Living Systems (MADALS 2014) at SINP, Kolkata, February 7-10, 2014; (x) Macromolecular Structures, Methods & Mechanisms, IICB, Kolkata, March 31, 2014.

Participation of conferences by Prof. P. Chakrabarti's group member.

Aritrika Pal, Dr. Debadrita Mukherjee, Dr. Tanya Chatterjee, Dr. Debamita Paul attended Facets of Insilico Chemical Biology for Novel Therapeutics, IICB, June 18, 2013; Dr. Debadrita Mukherjee and Aritrika Pal attended the conference on Bacterial Expressions, NCBS, Bangalore, October 22-25, 2013; Devlina Chakravarty and Jesmita Dhar attended the IIT Madras – Tokyo Tech Joint Symposium on Techniques and Applications of Bioinformatics, Chennai, September 27-28, 2013; Devlina Chakravarty and Jesmita Dhar attended the Satellite Workshop on Advances in Molecular Dynamics of Biomolecules, JNU, New Delhi, December 3-4, 2013; Dr. Tanya Chatterjee attended The 12th Conference of the Asian Crystallographic Association, Hong Kong, December 7-10, 2013.

Dr. Abhrajyoti Ghosh (Biochemistry) (i) acted as the Resource person of Plant Science in the North-East States Students' Training on Basic Science 2014 (NESST-BASE 2014) at Mayapuri Campus of Bose Institute, Darjeeling on 26-28th May'2014; (ii) invited to deliver lectures on Recombinant DNA technology to the M.Sc. students of Department of Biotechnology, Department of microbiology and Department of Neuroscience, University of Calcutta, Kolkata, India.

Dr. Subrata Sau and Mr. Anindya Biswas (Biochemistry) presented a poster entitled "Studies on the structures and functions of the repressor proteins of temperate *Staphylococcus aureus* phage $\phi 11$ " at the 82nd Annual Meeting of the Society of Biological Chemists held at the University of Hyderabad, Hyderabad, on 2nd-5th December 2013;

Dr. Subrata Sau (Biochemistry) delivered a talk at the 101st Indian Science congress, held at the University of Jammu, Jammu, on 3rd-7th February 2014.

Dr. T. C. Ghose (Bioinformatics) talk delivered on (i) *Use of Recombinant DNA in Modern Biotechnological Research at National Institute of Technology, Durgapur during December 2013*; (ii) BTISnet annual Coordinators meeting at Goa during February 2014.

Dr. Zhumur Ghosh's group members (Bioinformatics) : (a) Ranjan Kumar Maji presented a poster at 2013 NextGen Genomics and Bioinformatics Technologies (NGBT) conference at IGIB, Delhi (November 14-16, 2013); (b) Arijita Sarkar and Sohini Chakraborty attended (i) inStem workshop on Mouse Embryology workshop: Stem cells to Organogenesis March 10-12, 2013 organised by instem, NCBS, Bangalore. (ii) 4th international conference on stem cells and cancer (ICSCC-2013): Proliferation, Differentiation and Apoptosis 19th-22nd October, 2013, Organized by: International Centre for Stem Cells, Cancer and Biotechnology (ICSCCB), Pune, India

Dr. Shubhra Ghosh Dastidar (Bioinformatics) delivered (i) a talk and conducted hands-on session in the workshop "Modeling and Drug Designing" to be held during 18-22nd November, 2013 held in Kalyani University and (ii) a popular lecture at District Science Centre (Purulia) on National Science Day.

Dr. Sudipto Saha (Bioinformatics) (i) conducted a national workshop on computational proteomics, 3-4th March, 2014 at Bioinformatics Centre, Bose Institute; (ii) delivered two talks on 3-day workshop on Design and Statistical Analysis for Biomedical Research on 26th, March, 2014 at Biomedical Informatics Center, NICED, Kolkata.

Dr. G. Basu (Biophysics) delivered invited lectures on (i) Electrostatic steering of protein-protein association captured in a single geometric parameter at Annual Meeting of Indian Biophysical Society (MADALS 2014), SINP, Kolkata, Feb 7-10, 2014; (ii) The role of electrostatic discrimination in protein-protein interactions at BioWorld 2013: Computational Biology in Disease and Disorder, IIT Delhi, 9-11, Dec 2013; (iii) Modulation of cis/trans equilibrium of peptidyl-prolyl conformation by CH $\times \times \times$ p interactions: A combined study by NMR and MD simulations at International Conference on Biomolecular Simulations & Dynamics: Recent Advances & Future Perspectives, IIT Madras, Nov 30, 2013 IIT Madras, 28th-30th Nov, 2013; (iv) Watching Molecules Dance to Newton's Second Law at Presidency University, Kolkata, Dec 15, 2013; (v) Electrostatic steering of protein-protein association captured in a single geometric parameter at IICB-CSIR, Kolkata, March 31, 2013.

Dr. Debjani Roy (Biophysics) (i) presented poster "A bidirectional drug repositioning approach for Parkinson's disease through network-based inference" at symposium 'Frontiers in Modern Biology 2013' (FIMB 2013) organized by IISER, Kolkata, Nov 9-10, 2013. This poster was awarded the 'Best Poster' in the symposium; (ii) Delivered a talk on "Study of microRNA network in Parkinson's Disease" at 'Asian Congress on Biotechnology 2013' (ACB 2013) organized by IIT Delhi, Dec 15-19, 2013.

Dr. S. Banik (Chemistry) (i) participation in "Current Trends in Biochemical and Biophysical Modeling" at S N Bose National Center for Basic Sciences, Kolkata (October 7-8, 2013); (ii) participation in "National Symposium on Nonequilibrium Statistical Physics and Nonlinear Dynamics" at Indian Association for the Cultivation of Science, Kolkata (January 2-4, 2014); (iii) invited lecture in "Current Trends in Biochemical and Biophysical Modeling" at S N Bose National Center for Basic Sciences, Kolkata (October 7-8, 2013); (iv) invited lecture in "National Symposium on Nonequilibrium Statistical Physics and Nonlinear Dynamics" at Indian Association for the Cultivation of Science, Kolkata (January 2-4, 2014).

Dr. Joyoti Basu (Chemistry) (i) visited Chungam National University School of Medicine, South Korea in connection with Indo-Korean joint Program from February 24 to 29, 2014; (ii) delivered a lecture in the meeting Systems Biology of Infection held in Ascona, Switzerland from June 26 to 29, 2013; (iii) delivered a lecture in the IUBMB 10th International Symposium on Biochemical Roles of Eukaryotic Cell Surface Macromolecules organized by Saha Institute of Nuclear Physics from January 20 to 24, 2014.

Dr. K. P. Das (Chemistry) (i) participated in Prof. Sushil Mukherjee birth centenary celebration held at CU and Bose Institute during 29-30 July 2013 as members of the organizing committee. Also attended a one day symposium entitled Frontiers of Physical Chemistry : Colloids, Electrode Processes, Biointerfaces and Soil Processes held at Bose Institute on 30th July 2013 on this occasion; (ii) attended one day symposium on Trends in Surface Science and Related Areas (TSSRA) held at Department of Pharmaceutical Technology, Jadavpur University on 3rd June 2013 as members of the organizing committee. My student Victor Banerjee gave an oral presentation entitled: "Inhibition of insulin fibrillation by a peptide NK9" at the symposium; (iii) gave an invited talk entitled "Role of small molecules in controlling insulin fibrillation" at the 5th Asian Conference of Colloid and Interface Science (ACCIS) held at North Bengal University during November 20-23, 2013; (iv) gave an invited talk entitled "Molecular mechanism of stabilization of micellar protein α -crystallin by Zn^{+2} " at the 16th National Conference on Surfactants Emulsions and Biocolloids (NATCOSEB) held at Central Leather Research Institute, Chennai during November 28-30, 2013.

Dr. M. Kundu (Chemistry) (i) presented a paper in the Gordon Research conference on Tuberculosis Drug Development held from July 21 to 26th, 2013 in Lucca, Italy; (ii) delivered invited lecture in the conference "Genomics, biology and therapeutics in tuberculosis and other mycobacterial diseases" held in Patan Mahal, Rajasthan from March 22 to 24th, 2014.

Dr. Soumen Roy (Chemistry) delivered invited talks at (i) "Nonlinear dynamics in Biology", organised by National Mathematics Initiative and IISER Mohali at IISc Bangalore during July 8-13, 2013; (ii) 'Conference on Statistical methods for nano-researchers' organised by Centre for Research in Nanoscience and Nanotechnology (CU) & CSIR-South Africa during December 9-12, 2013.

Mr. Arnab Bandyopadhyay (CSIR-SRF) (Chemistry) participated in "The Seventh q-bio Summer School" at University of California, San Diego, USA (July 21-August 6, 2013)

Victor Banerjee, SRF (Institute) (Chemistry) participated in the Annual Conference of the Biophysical Society held at San Francisco, CA during February 15-19, 2014 and presented a poster entitled "Inhibition of insulin fibrillation by a non-toxic peptide NK9".

Dr. Sujit Roy, CSIR pool scientist (Chemistry) gave a talk entitled "Understanding the molecular mechanism of DNA damage repair and maintenance of genome stability in higher plants in response to abiotic and genotoxic stress" at Central Food Technological Research Institute (CSIR-CFTRI) on January 3, 2014.

Dr. Tanya Das (Division of Molecular Medicine) (i) delivered lecture at the annual meeting of *Molecular Immunology Forum* held at Bose Institute, Kolkata, in January, 2014; (ii) invited for delivering a talk in the 100th Indian Science Congress held at Jammu University, Jammu, February, 2014; (iii) invited for chairing a scientific session as well as to deliver a lecture at the *International Conference on Angiogenesis*, Bhubaneswar, February, 2014; (iv) delivered *Raj Kristo Dutta Memorial Award* lecture at the Indian Science Congress Association auditorium, Kolkata, February, 2014; (v) chaired a scientific session and delivered a talk at the *International Stem Cell Meeting*, Mumbai, October, 2013; (vi) invited to chair a scientific session at the *Young Scientist Conclave* organized by DST at S. N. Bose Institute, March, Kolkata, 2014; (vii) chaired a scientific session at the annual meeting of Society for Biological Chemists (Kolkata chapter), Kolkata, April, 2014.

Dr. Kuladip Jana (Division of Molecular Medicine) Deliver Invited Lecture in "5th International Symposium on Non-Surgical Contraceptive methods of Pet Population control" in Portland, Oregon, USA on Jun 20-22, 2013 (Young Scientist Travel Award from ACC&D, Portland Oregon, US).

Dr. Subrata Majumder (Division of Molecular Medicine) (i) invited speaker in the 10th IUBMB symposium on cell surface macromolecules during Jan. 20-24, 2014 at Panchwati, Kolkata; (ii) invited speaker at Vivekananda Circle, Ramakrishna Mission, Golpark on the auspices occasion of 150th Birthday Anniversary of Swami Vivekananda on 31st Oct., 2013; (iii) invited speaker at Jadavpur University, Pharmacology Department, AICTE programme on 'Future Direction of Pharmaceutical Studies and Research' July and Nov. 2013

Dr. Nripendranath Mandal (Division of Molecular Medicine) (i) participated and delivered a special invited lead lecture on "Present scenario of Medical Biotechnology in India: Importance of Medicinal plants to control iron-overload-induced hepatotoxicity and cancer" at the National symposium on "Emerging trends in Biotechnology: Present scenario and future dimensions", March 29 – March 31, 2014 organized by Post Graduate Dept. of Biotechnology, Utkal University, Odisha; (ii) participated and delivered a special invited lead lecture on "Importance of various DNA markers for the development of specific pathogen resistant (SPR) *Penaeus monodon*" at the National conference on "Current trends in Life Sciences research and challenges ahead", February 28 – March 02, 2014 organized by Dept. of Life Sciences, Sambalpur University, Odisha; (iii) participated and delivered a special invited Lecture on "Importance of patents in scientific research: A case study of microRNA research" in the International conference on "Global IPR System and WTO Issues", November 16-17, 2013 organized by Dept. of Biotechnology, Ch. Charan Singh University, Meerut (UP), India; (iv) participated and delivered a special invited Lecture on "Iron chelation by *Terminlia chebula*: New remedies from an age-old plant" in the International conference on "Biologically active substances and materials: fundamental and applied problems of production and application", May 27-June 01, 2013 Crimea, in the Novy Svet, Ukraine organized by Education-Science Center "Institute of Biology", Taras Shevchenko National University of Kyiv, Ukraine.

Dr. Anup Kumar Misra (Division of Molecular Medicine) (i) participated 27th International Carbohydrate Symposium held at Indian Institute of Science, Bangalore during January 12-17, 2014; (ii) visited Abo Academy University, Finland under DBT-Academy of Finland exchange program during August 01-October 31, 2013 on study leave.

Dr. Mahadeb Pal (Division of Molecular Medicine) (i) attended 82st Annual Conference of SBCI held in University of Hyderabad, Science City, Dec 2-5 Kolkata. Presented a poster; (ii) attended the 4th International Conference on Stem Cells and Cancer (ICSCC-2013): Proliferation, Differentiation and Apoptosis, scheduled from Oct 19, 2013 to Oct 22, 2013 at Durbar Hall, Haffkine Institute, Parel, Mumbai – 400012.

Dr. Gaurisankar Sa (Division of Molecular Medicine) (i) organized *Molecular Immunology Forum Meeting 2014* in January 2014 in Kolkata, (ii) delivered an invited lecture at *Indian Association of Cancer Research Annual Conference* at Tiruvantapuram in January 2014. He has delivered an invited lecture at JNCIRS, Bangalore in January 2014. (iii) invited for delivering

a talk in the 100th Indian Science Congress held at Jammu University, Jammu, February, 2014. (iv) chairing a scientific session as well as to deliver a lecture at the *International Conference on Angiogenesis*, Bhubaneswar, February, 2014. (v) chaired a scientific session and delivered a talk at the *International Stem Cell Meeting*, Mumbai, October, 2013. (vi) chaired a scientific session at the annual meeting of Society for Biological Chemists (Kolkata chapter), Kolkata, April, 2014.

Dr. P. C. Sen (Division of Molecular Medicine) (i) delivered invited lectures at 3rd MolMed-2013 International Conference on Mol-Med-2013 in Haikau, China during November 13-16, 2013 and 11th Annual Congress of International Drug Delivery Science & Technology-2013 (IDDST-2013) in Haikau, China during November 13-16, 2013; (ii) delivered lecture at the 101st Indian Science Congress meeting held in Jammu during February 2-7, 2014 as President of the New Biology (including Biochemistry, Biophysics & Molecular Biology and Biotechnology) Section.

Ms. Shahana Mitra (Division of Molecular Medicine) obtained the best poster award in the 82nd Annual Meeting of 'The Society of Biological Chemists (India)' held at the School of Life Sciences, University of Hyderabad, Hyderabad, India, December 2-5, 2013

Dr. Sampa Das (Division of Plant Biology) (i) delivered invited talk on "Food Security & GM Crop" on 20th September, 2013 at RAMAKRISHNA MISSION VIVEKANANDA CENTENARY COLLEGE, Rahara, Kolkata; (ii) delivered invited talk on Crop Genetic Engineering : A Powerful Technology for Agricultural Revolution in a National seminar on "Food Security" on 29th September, 2013 at Visva Bharati University; (iii) attended and delivered at 11th International Rice Functional Genomics Symposium during 20-23rd November, 2013 on a topic "BACTERIAL LEAF BLIGHT OF RICE: XANTHOMONAS- RICE PATHOSYSTEM" at New Delhi; (iv) delivered an invited talk in Agriculture and Forestry Science session of 101st Science Congress at Jammu on 6th February, 2014 on a topic "Elucidating the initial molecular interaction between Cry1Ac toxin and insect midgut derived alkaline phosphatase receptor leading to insect mortality"; (v) delivered invited talk on Reactive Oxygen Species (ROS): The key player in signaling events of Chickpea (*Cicer arietinum* L.)-*Fusarium oxysporum* f. sp. *ciceris* race 1 (Foc1) interplay in International Symposium on Plant Signaling & Behaviour at Delhi University on 10th March, 2014.

Dr. Gaurab Gangopadhyay (Division of Plant Biology) (i) acted as the Coordinator and Resource person of Plant Science in the North-Eastern States Students' Training on Basic Science 2013 (NESST-BASE 2013) at Mayapuri Campus of Bose Institute, Darjeeling from 29th April –1st May 2013. Compiled and prepared the booklet for the trainees; (ii) invited and acted as a counselor in the Directorate of Distance Education Programme of Vidyasagar University at Jogomaya Devi College P.G. Study Centre in the month of June 2013 (taken three theoretical classes in the Personal Contact Programme); (iii) invited as "Guest speaker" on the occasion of

'Banomahotsav' organized by Institute of Education for Women (Govt. of West Bengal), Hastings House, Alipore on 26.07.2013; delivered lecture on "Van mahotsav – not a 'utsav' – a mission"; (iv) participated in the workshop on "Awareness building and sensitization Workshop on National Fund for Basic, Strategic and Frontier Application Research in Agriculture (NFBSFARA)" organized by ICAR at National Institute for Research on Jute and Allied Fibers Technology (NIRJAF), Kolkata on 23rd August 2013; (v) presented a proposed collaborative research project entitled "Development of linkage map of Mulberry correlating yield with morphological and molecular markers" to Dr. S. Nirmal Kumar, Director at Central Sericultural Research & Training Institute, Berhampore on 11.11.2013; (vi) acted as one of the mentors in the DST-INSPIRE Internship Science Camp 2014 for school students on 11.01.2014 organized by JBNSTS (Jagadis Bose National Science Talent Search), Kolkata; (vii) oral presentation entitled "A simple algorithm for phenomic identification of the ideal Sesame plant type with novel architecture and an image analysis based seed phenomics for predictive Sesame Marker Assisted Breeding" in the 3rd International Plant Phenotyping Symposium organized by IPPN (International Plant Phenotyping Network) and MSSRF (M S Swami Nathan Research Foundation) held at Chennai, India on 17 – 19th February 2014.

Dr. Anupama Ghosh (Division of Plant Biology) participated in the 25th Annual General Meeting of Plant Physiology Forum and 23rd Prof. S.M. Sircar Conference held on 4th April 2014 at Bose Institute.

Dr. Tapas Kumar Ghose (Division of Plant Biology) (i) Seminar given on Genetic diversity analysis of a set of rice landraces using SSR markers in *India Biodiversity Meet 2013* held at Indian Statistical Institute Kolkata from March 14 – 16, 2013; (ii) *Seminar given on the topic Genetic Diversity of Bacterial Leaf Blight Disease in a Set of Rice Landraces of West Bengal in International Congress on Agriculture, Food Engineering and Environmental Sciences-Sustainable approaches (AFEESSA- 2014) held at Jawaharlal Nehru University, New Delhi on 29th and 30th March*; (iii) poster presented on "Genetic diversity and population structure of rice landraces from Eastern and North Eastern States of India" in *International Symposium of Rice Functional Genomics* held during November 20th – 23rd, 2013 at hotel "The Grand", New Delhi, India.

Dr. A.N.Lahiri Majumder (Division of Plant Biology) delivered invited talks at (i) the 7th International Rice Genetics symposium, organized by the International Rice Research Institute, during November 3 – November 9, 2013 in Manila, Philippines; (ii) International Symposium in Rice Functional Genomics at Delhi during November 20 – November 23, 2013; (iii) Annual meeting of the Society of Biological Chemists, India at Hyderabad during December 3 – December 5, 2013; (iv) delivered the 21st Prof S M Sircar Memorial Lecture of the Botanical Society of Bengal on January 8, 2014 at the Department of Botany, Calcutta University.

Dr. Swati Gupta Bhattacharya (Division of Plant Biology) invited to deliver a speech and to give hands on training in Aerobiological techniques in a session of "Palaeobotany and Palynology" in March, 2014 as a part of Centenary Celebration of Dept. of Botany, University of Calcutta.

Dr. Pallob Kundu (Division of Plant Biology) Invited lecture on Regulation of microRNA transcription by *Alternaria* sp.: significance in fungal pathogenesis at Genotypic Pvt. Ltd., India, Sept. 2013

Dr. Sonali Sengupta (Division of Plant Biology) (i) A history of technical advances in proteomics : A powerful biological tool. **Sonali Sengupta**. Techniques in Proteomics" workshop, National Workshop, North Eastern Hill University, Shilong, Meghalaya, India (Invited resource speaker), Feb 20-28, 2014; (ii) recent breakthroughs in plant proteomic research. **Sonali Sengupta**. Techniques in Proteomics" workshop, National Workshop, North Eastern Hill University, Shilong, Meghalaya, India (Invited resource speaker), Feb 20-28, 2014; (iii) Manipulation of Inositol metabolic cycle : Emerging role of inositol as a signalling molecule for abiotic stress tolerance in plants. **Sonali Sengupta and Arun Lahiri Majumder**, invited talk, Indo-Japanese Joint Workshop on "Signal Sensing and Transduction in Photosynthetic Organisms from Cyanobacteria to Land Plants", Dec 16-18, 2013, University of Hyderabad, Hyderabad, India; (iv) Mechanosensory reception in plants: plant neurobiology: integrated evaluation of Darwin's root brain hypothesis. **Sonali Sengupta**, invited oral presentation, 5th Indian Youth Science Congress, Dec 6-9, 2013, Visvabharati University, Shantiniketan, India. (v) Expression of Rice Galactinol Synthase genes; a form of Regulated Unproductive Splicing and Translation (RUST)? **Sonali Sengupta**, Sritama Mukherjee, Abhishek Mukherjee and Arun Lahiri Majumder (Oral presentation) ASPB Plant Biology 2013, July 20-24, 2013, Providence, USA,

Dr. Amita Pal (Division of Plant Biology) (i) elected Fellow of the West-Bengal Academy of Science and Technology; (ii) Member of the DBT Task Force Committee on Bioinformatics, Computational and Systems Biology; (iii) Associated Editor of Plant Cell Tissue and Organ Culture: A journal of Plant Biotechnology; (iv) Associated Editor, Journal of Integrated OMICS (Spain); (v) Member of the Editorial Boards of World Journal of Agriculture Sciences, Journal of Plant Biochemistry and Biotechnology and Journal of Bamboo and Rattan; (vi) Selected for the Indira Gandhi Sadbhavana Gold Medal award, 2013 by GEPRA, India.

Dr. P. K. Saha (Division of Plant Biology) delivered invited lecture entitled- "Relationship in Phenotypic and Genetic diversity of cultivated and wild Indian sesame" in the 101st Indian Science Congress held in University of Jammu, Jammu during 3rd to 7th January, 2014.

Dr. Swati Sen-Mandi (Division of Plant Biology) (i) delivered invited lecture on DNA Fingerprinting based authentication of plants from NE India and development of diagnostic DNA Markers associated with useful traits in a symposium on "Sixty Years of the Double Helix: Its impact on science and society" organized by DNA Society of India at Bose Institute on 27th September, 2013; (ii) delivered an invited lecture on "Molecular Documentation and Diagnostics of Medicinal Potential in Plants" at Indian Phytomed Summit 2014 on 25th February 2014, at the Gateway by Taj, Kolkata.

Dr. S.R. Sikdar (Division of Plant Biology) delivered invited talk on i) "Application of Biotechnology & Rural Biotechnology for the development of Tea industry" in the National Conference on 'Tea Culture and Science – special reference to present scenario of Indian Tea' organized by Department of Plantation Management and Studies, Sikkim University on April 9, 2013, ii) "Rural Biotechnology: A parallel approach of Transgenic crop for food security and poverty alleviation" in the Department of Biotechnology, Visva Bharati, Santiniketan on October 31, 2013, iii) "Plant Tissue Culture – A Biotechnological Technique for Crop Improvement" in the Department of Botany, Scottish Church College, Kolkata on March 6, 2014, iv) "How to grow edible mushroom" in the Department of Environmental Studies, Visva Bharati, Santiniketan on March 19, 2014.

Bodhisattwa Saha (Division of Plant Biology) attended Annual Congress of EAACI-WAO June, 2013, at Milan, Italy to give Poster presentation in Thematic poster session and awarded with EAACI travel grant. Bodhisattwa Saha attended 5th Annual Congress of Proteomics Society of India for Poster presentation held in IISC, Bangalore in November 2013.

Gaurab Sircar (Division of Plant Biology) attended Annual Congress of EAACI-WAO June, 2013, at Milan, Italy to give Oral and Poster presentation in Poster discussion session and awarded with EAACI travel grant. Gaurab Sircar attended 5th Annual Congress of Proteomics Society of India for Poster presentation held in IISC, Bangalore in November 2013.

Kavita Ghosal (Division of Plant Biology) attended Annual Congress of EAACI-WAO 2013, at Milan, Italy to give Poster presentation in Thematic poster session and awarded with Bose Institute travel grant.

Arunava Mandal, Deepti Sarkar and Pallob Kundu (Division of Plant Biology) Transcriptional regulation of a cell expansion gene upon Tomato Leaf Curl virus infection, American Society for Virology (ASV) 32nd Annual Meeting, 2013 Penn State University, State College, Pennsylvania, Student Travel grant awarded to Arunava Mandal.

Souvik Dhar (Division of Plant Biology) presented poster entitled "Silicon localized peculiar epidermal structures revealed by SEM and EDAX as phenomic markers to screen desirable Mulberry (*Morus alba* L.) genotypes as feeds for Silkworm (*Bombyx mori* L.) rearing" by S. Dhar,

V. Arora, **G. Gangopadhyay** and M.K. Ghosh in the International Conference on Electron Microscopy, organized by Saha Institute of Nuclear Physics (SINP) and Electron Microscope Society of India (EMSI), held at SINP, Kolkata during 3 – 5 July 2013.

Vivek Kumar (Division of Plant Biology) (i) participated in the “Workshop on FSSAI standards of edible oils and developed products vis-à-vis analytical methodologies” (27th to 28th February 2014) held at Department of Chemical Technology, University of Calcutta; (ii) delivered an oral presentation entitled “Towards deciphering molecular factor behind higher level of 'Basmati' fragrance in *Pandanus amaryllifolius* Roxb., a wild monocot” by V. Kumar, V. Arora, M. Sultana and **G. Gangopadhyay** at The International Congress on “Agriculture, Food Engineering and Environmental Science – Sustainable Approaches” (29th - 30th March 2014) organized by “Krishi Sanskriti” at JNU, New Delhi.

Marufa Sultana (Division of Plant Biology) (i) participated in Workshop on Computational Proteomics (3rd to 4th March 2014) held at CoE in Bioinformatics, Bose Institute, Kolkata; (ii) delivered an oral presentation entitled “Looking for novel proteins associated with *in vitro* morphogenesis of Pineapple” by M. Sultana and **G. Gangopadhyay** at The International Congress on “Agriculture, Food Engineering and Environmental Science – Sustainable Approaches” (29th - 30th March 2014) organized by “Krishi Sanskriti” at JNU, New Delhi.

Vivek Arora (Division of Plant Biology) delivered an oral presentation entitled “SSR markers for assessing the hybrid nature of two high yielding Mulberry varieties” by V. Arora, M.K. Ghosh and **G. Gangopadhyay** at The International Congress on “Agriculture, Food Engineering and Environmental Science – Sustainable Approaches” (29th - 30th March 2014) organized by “Krishi Sanskriti” at JNU, New Delhi.

Dr. Abhijit Chatterjee (Environmental Science) Oral presentation on Surface Ozone over Eastern Himalaya, India in International Conference called “Changing Chemistry in Changing Climate (C4)” held during 1-3 May, 2013 at Indian Institute of Tropical Meteorology, Pune, India.

Mr Chirantan Sarkar (Environmental Science) Oral Presentation on Black Carbon Scavenging over Eastern Himalaya, India in International Conference called “Changing Chemistry in Changing Climate (C4)” held during 1-3 May, 2013 at Indian Institute of Tropical Meteorology, Pune, India.

Mr Arindam Roy JRF under the supervision of Dr Abhijit Chatterjee (Environmental Science) visited Dr D. M. Chate's laboratory at IITM, MoES, Pune for a collaborative work on aerosol scavenging and aerosol-Rain interaction studies over eastern Himalaya. Visit has been made during November, 2013 for 10 days and the study is going on at present.

Dr. S. Bandyopadhyay (Physics/CAPSS) (i) visited The Institute of Mathematical Science, Chennai in June 2013 (one week), August 2013 (1 week) and in January 2014 (one week); (ii) visited Indian Institute of Technology, Jodhpur in December 2013 (one week); (iii) visited Institute of Physics, Bhubaneswar in February 2014 (3 days); (iv) invited talk on Tight bounds on the distinguishability of quantum states by separable measurements at IPQI 2014, at the Institute of Physics, Bhubaneswar, February 2013; (v) invited talk on Tight bounds on the distinguishability of quantum states by separable measurements at IPQI 2014, at the Institute of Physics, Bhubaneswar, February 2013; (vi) invited talk on Tight bounds on the distinguishability of quantum states by separable measurements at the International Meet on Quantum Correlations and Logic, Language and Set Theory 2013, IIT Jodhpur, December 2013; (vii) invited talk on Local distinguishability of quantum states at the Satellite Meeting on Quantum Correlation and its application in Communication and Cryptography at the Indian Statistical Institute, September 2013; (viii) Long Contributed talk on Tight bounds on the distinguishability of quantum states by separable measurements at AQIS 2013, Chennai, August 2013.

Dr. I. Bose (Physics) (i) delivered on invitation a talk on "Early signatures of sudden regime shifts in gene expression dynamics" at International Conference on Perspectives in Nonlinear Dynamics, University of Hyderabad, Hyderabad (July 15-18, 2013); (ii) a talk on "Biological Physics: A search for physical principles" at National Seminar on Advancement in Modern Physics organized by the Department of Physics, Ramkrishna Mission Residential College, Narendrapur (August 23-24, 2013); (iii) a talk on " Sudden regime shifts: early signatures" at National Symposium on Nonequilibrium Statistical Physics and Nonlinear Dynamics at IACS, Kolkata (January 2-4, 2014) (iv) a talk on "Early signatures of sudden regime shifts" at UGC-DSA funded National Seminar Probing Biology – in vivo, in vitro and in silico at the Department of Biophysics, Molecular Biology and Bioinformatics, University of Calcutta (February 28, 2014); (v) delivered on invitation a colloquium on "Tipping point transitions in complex dynamical systems" at the Biological Science Division, IISER, Kalyani on 3/4/13; (vi) eight lectures on statistical mechanics at the Refresher Course in Theoretical Physics (sponsored by the three Science Academies) at Assam University, Silchar (December 2-7, 2013) (vii) a talk on "The living cell: a playground for statistical physics and information theory at IISER, Kalyani in one-day meeting on condensed matter physics (December 20, 2013); (viii) the C. K. Majumdar Memorial Lecture on " Early signatures of sudden regime shifts" organized by PESA and NITTR, Calcutta February 7, 2014); (ix) a colloquium on "Biological Physics: A search for physical principles" at the Physics Department, Maulana Azad College (March 14, 2014).

Dr. B. K. Chatterjee (Physics) (i) chaired a technical session on Bionics at Institute of Engineering and Management Conference *IEMCON-13* (August 23, 2013), at Science City,

Kolkata; (ii) participated in the panel discussion on “Enthusing experimental research: Present problems and possible solutions” at the National workshop on *Exploring Radiation in Many Splendors* (November 23-24, 2013), at the Saha Institute of Nuclear Physics, Kolkata.

Dr. Supriya Das (Physics) (i) participated in the 8th Physics Week of ALICE collaboration held during May 19 – 24, 2013 at PADOVA, Italy; (ii) visited RD51 Laboratory at CERN Geneva to work on R&D for ALICE TPC upgrade program during December 8 - 22, 2013.

Dr. Sanjay Kr. Ghosh (Physics) (i) participated in the 8th Physics Week of ALICE collaboration held during May 19 – 24, 2013 at PADOVA, Italy.

Dr. Dhruba Gupta (Physics) served as a member of the organizing committee of the Workshop and Winter School on Astroparticle Physics (WAPP 2013) held at Bose Institute, Darjeeling, December 17-28, 2013 and delivered an invited talk on “Interaction of Radiation with Matter” at WAPP 2013.

Dr. Dipankar Home (Physics) attended (i) 13th Asian Quantum Information Science Conference, Organized by the Institute of Mathematical Sciences (IMSc), Chennai, held on 25 – 30 August, 2013; (ii) Meeting on Quantum Information Processing and Applications, organized by Harish-Chandra Research Institute (HRI), Allahabad, held on 02 – 08 December, 2013; (iii) Quantum correlation: Foundations and applications, organized by Indian Statistical Institute (ISI), Kolkata, held on 04 – 05 March, 2014.

Dr. Parthasarathi Joarder (Physics) (i) delivered six lectures on “Basic plasma/magnetohydrodynamic processes” at the High Energy and Cosmic ray Research (HECRRC), North Bengal University (NBU), Siliguri, West Bengal during March 5, 2013 to March 10, 2013 on invitation from Dr. Arunava Bhadra, Director, HECRRC, Siliguri as a part of the Ph.D course work for the research students at HECRRC. This visit was a part of the Visiting Faculty Programme at HERRC, NBU, Siliguri; (ii) convener and principal organizer of the international meeting “8th Winter Work-shop and Winter School on astroparticle physics, 2013” jointly held by Bose Institute, Kolkata and Tata Institute of Fundamental Research (TIFR), Mumbai at the Centre for Astroparticle Physics and Space Science (CAPSS), Mayapuri, Darjeeling Campus, Bose Institute during December 17, 2013 to December 28, 2013. The workshop and school were attended by about 32 scientists and resource persons, six of whom were scientists from various institutions abroad. About 29 students, including fresh research students, postgraduate students and advanced undergraduate students from various institutions of India, attended the Winter school; (iii) attended the “National Symposium on Very High Energy Gamma Rays” during November 25, 2013 to November 27, 2013 at Bhaba Atomic Research Centre (BARC), Mumbai; (iv) attended the “International Conference on Matter at Extreme Condition: Then and Now” organized jointly by Bose Institute, Variable Energy Cyclotron

Centre (VECC), Kolkata, Saha Institute of Nuclear Physics (SINP), Kolkata and Calcutta University during January 15, 2013 to January 17, 2013 at Bose Institute, Kolkata. Jointly with Sayan Biswas, J.N. De, Sibaji Raha and Debapriyo Syam and a poster paper at that conference.

Dr. Swapan K. Saha (Physics) presented a talk on Breakup of ^7Be in presence of heavy targets at ISOLDE Workshop and Users Meeting 2013 at European Organization for Nuclear Research (CERN), Geneva, Switzerland, November 25-27, 2013.

Dr. Achintya Singha (Physics) delivered (i) invited talk in Exposure to Frontier Research in Science and Technology organized by JBNSTS at SCS Autonomous College, Puri during February 24 – 26, 2014 (ii) Academic Council Lecture Series at Bose Institute Main Campus on 30th October, 2013 (iii) attended India-UK Scientific Seminar "From Graphene Analogues to Topological Insulators" (GATI-2014), organized by Indian Association for the Cultivation of Science, Kolkata & Physics Department, Loughborough University, UK held in Vedic Village, Kolkata, India during 27-29 January 2014.

Dr. T. P. Sinha (Physics) delivered an invited talk on "Photophysical properties and vibrational modes of perovskite oxides" in National Conference on Condensed Matter Days 2013 at National Institute of Technology, Rourkela during August 29-31, 2013. He gave an oral presentation on "Optical dielectric function and vibrational modes of perovskite oxides" in the International Union of Materials Research Society - International Conference in Asia at Indian Institute of Science, Bangalore during 16-20 **December 2013**. Dr. Sinha delivered the Materials Research Society of India (MRSI) Medal Lecture on "Optical dielectric constant of perovskite oxides" in the Annual General Meeting of MRSI at Indian Institute of Science, Bangalore during 12-14 February 2014.

Dr. T.P. Sinha's group member:

Dr. Alo Dutta presented a paper on "Ac electrical properties of NdFeO_3 nanoceramic" in the International Conference on Electron Microscopy and XXXIV Annual Meeting of the Electron Microscope Society of India at Saha Institute of Nuclear Physics, Kolkata during 3-5 July 2013. Dr Dutta also presented a paper on "Electronic structure and phonon modes of $\text{Sr}_2\text{SmNbO}_6$ " in the International Union of Materials Research Society - International Conference in Asia at Indian Institute of Science, Bangalore during 16-20 **December 2013**. Dr. Dutta presented a paper on "Electronic structure and linear optical properties of Sr_2CdWO_6 through modified Becke-Johnson potential" in the Annual General Meeting of MRSI at Indian Institute of Science, Bangalore during 12-14 February 2014. Sujoy Saha presented a paper on "*Structural and dielectric properties of NdMnO_3 nanoparticles*" in the International Union of Materials Research Society - International Conference in Asia at Indian Institute of Science, Bangalore during 16-20 December 2013. Sadhan Chanda presented a paper on "Small polaron migration

associated multiple dielectric responses and Maxwell-Wagner relaxation in Y_2CrAlO_6 in the International Union of Materials Research Society - International Conference in Asia at Indian Institute of Science, Bangalore during 16-20 December 2013. Anup Pradhan Sakhya presented a paper on "Impedance spectroscopy, a.c. conductivity and electronic structure of NdAlO_3 : Experimental and first-principles approaches" in the International Union of Materials Research Society - International Conference in Asia at Indian Institute of Science, Bangalore during 16-20 December 2013. Saswata Halder presented a paper on "Dielectric relaxation of $\text{BaFe}_{1/4}\text{In}_{1/4}\text{Ta}_{1/2}\text{O}_3$ " in the International Union of Materials Research Society - International Conference in Asia at Indian Institute of Science, Bangalore during 16-20 December 2013.

Ms Dipanwita Majumder (Physics) (i) Attended and presented a poster in 6th International Conference On Nano Science And Technology (ICONSAT2014) held in Panjab University during 3-5, March, 2014. (ii) Attended India-UK Scientific Seminar "From Graphene Analogues to Topological Insulators" (GATI-2014), organized by Indian Association for the Cultivation of Science Kolkata & Physics Department, Loughborough University, UK held in Vedic Village, Kolkata, India during 27-29 January 2014.

Mr. Shib Shankar Singha (Physics) (i) participated one day seminar on Trends in Surface Science & Related Areas (TSSRA-2013) held in the Department of Pharmaceutical Technology Jadavpur University on 3rd May 2013, (ii) participated short term course on Modern Methods in Materials Processing and Characterization (M3PAC-2013) held in National Institute of Technology Durgapur, India, during September 17-21, 2013.

Dr. Sidharth K. Prasad (Physics) presentations (i) Soft and Hard interactions in proton-proton collisions at LHC energies, Poster presentation in the XXIV International Conference on Ultrarelativistic Nucleus-Nucleus Collisions "Quark Matter 2014", Darmstadt, (Germany), May 19 – 24, 2014; (ii) Jet measurements in High Energy Experiments, Talk in Indo-Fair Coordination Centre Workshop, January 20 – 25, 2014, Darjeeling (INDIA); (iii) Soft and Hard interactions at LHC energies, Poster presentation in an International Conference on Matter at Extreme Conditions: Then & Now, January 15 – 17, 2014, Bose Institute, Kolkata, (INDIA); (iv) Soft and Hard interactions at LHC energies, Talk in ALICE India Collaboration meeting, January 12 – 14, 2014, VECC Kolkata (INDIA); (v) Measurements of jet observables at LHC", Invited talk in a Workshop on High Energy Physics and Phenomenology, December 12 – 21, 2013, Blue Lily Beach Resort, Puri, Odisha, (INDIA); (vi) Measurements of jet production cross sections and properties using ALICE at the LHC, Seminar, September 27, 2013, Institute of Physics (IOP), Bhubaneswar (INDIA); (vii) "Measurements of jet properties and cross sections using ALICE, Seminar, September 20, 2013, Bose Institute, Kolkata (INDIA); (viii) Accelerated Computing via GPU, BI-IFCC 2nd workshop, A workshop organized jointly by the Bose Institute and VECC, November 11 – 15, 2013, Bose Institute, Kolkata, (INDIA).

Dr. Mohammed Younus (CAPSS) (i) presented a talk titled 'Heavy Quark Dynamics in Quark Gluon Plasma' at QCD Group Seminar, Dept. of Physics, Bose Institute, CAPSS, on September 27, 2013; (ii) participated in International Conference on Matter Under Extreme Conditions, hosted by Bose Institute, VECC and SINP, at Bose Institute, Kolkata from January 15, 2014 to January 17, 2014; (iii) participated in Compressed Baryonic Matter Workshop held at Darjeeling, by Bose Institute from January 20, 2014 to January 24, 2014; (iv) participated in ECT* Doctoral Training Programme held at Trento, Italy from April 7, 2014 to May 16, 2014 and presented a talk titled 'Charm Quarks and Parton Cascade Model' at its seminar; (v) participated and presented a poster titled 'Energy Loss of Open Charm Produced in Relativistic Heavy Ion Collision' at XXIV International Conference on Quark Matter-QM 2014 held from May 18, 2014 to May 24, 2014 held at Darmstadt, Germany; (vi) presented a overview talk titled 'Overview of Theoretical Talks Presented at Quark Matter-2014' at QCD Group seminar, CAPSS, Bose institute on June 20, 2014.

Dr. Arun Kumar Chakraborty (Librarian) Participated and presented two papers on (i) "Innovations in libraries and information centres for the knowledge society: an overview"; and (ii) "Scientific facets of library and Information Science Discipline" in the 101st Indian Science congress 2014 during February 3rd-7th, 2014 at Jammu. The abstracts of the presented paper published in Proceedings of the 101st Indian Science Congress Part II: Section of Information and Communication Science & Technology (Including Computer Sciences), 3-7 February, 2014 (Jammu) Indian Science Congress Association, Kolkata. (iii) Invited to Chair a Technical session, Paper Presented and Nominated as a member of National Advisory Committee for "The International Seminar on Applications of Communication and Information Technology in Library (SACITIL-2014)" organised by Variable Energy Cyclotron Centre, Department of Atomic Energy, Kolkata during 28-30th January, 2014; (iv) invited to deliver a lecture and also presented a paper on "Web Based Discovery tools versus Disintermediation: the different veracity focused by current end-user" on 10th January, 2014 in the "One Day National Workshop on Web-Scale Discovery Services: Single Window Access to Library e-Resources" organized by Central Library IIT Kharagpur; (v) invited to deliver lecture in the Workshop on "Automation of Library Management System using KOHA-Open Source Software" organized by National Institute of Research on Jute & Allied Fibre Technology, Regent Park, Kolkata on 20th December, 2013; (vi) invited to deliver lecture as an Invited Speaker on "Modern Library Management and Services" held on December 20, 2013 at Netaji Nagar Day College, Kolkata; (vii) invited to attend 4th Library Advisory Committee of University of Kalyani held on December 18, 2013 in the Central University of Kalyani as one of the member; (viii) invited as member of the National Technical Programme Committee (NTPC) of

The 15th International Conference on Asia-Pacific Digital Libraries (ICADL) 2013) organized by the International School of Information Management, University of Mysore held in Bangalore, India during December 9-11, 2013; (ix) invited as a resource person to deliver a lecture on 5th December, 2013 in a 5 (five) day training programme on "Library Automation" from 2-6th December, 2013 organised by Central Library University of Kalyani in collaboration with INFLIBNET Centre, Gandhinagar (an autonomous institution established by UGC as per UGC Act 1956); (x) invited as a panelist "E-Content 2013-Library-Publisher Partnership: Bridging the access gap-integrating Content, Technology and Services" held on 25th October, 2013 at Hotel Park Plaza, Bullygunge in association with Annual Reviews, Maney Publishing, Royal Society Publishing and SPIE Digital Library, J-Gate; (xi) invited to deliver lecture on 3rd September 2013 as a Resource Person for 1-week Programme on "Research Methodology" during September 2-8, 2013 organized by Indian Association of Special Libraries & Information Centres, Kolkata; (xii) invited to "RSC Indian Librarian Advisory Committee Meeting" as a member on 29th August and the RSC Librarian Appreciation Day on 30th August, 2014; (xiii) presided 318th IASLIC Study Circle meeting held on Monday, 26th August, at the seminar room of the Association, Kolkata-700054; (xiv) nominated by Department of Science and Technology (DST), Govt. of India as LPAC (Local Project Advisory Committee) as one of the members for a project on "Measuring Scientific Value of Indian Journals: A Pilot Study on Physics-Chemistry-Biology Journals" under sponsorship of NSTMIS (DST); (xv) nominated as one of the coordinates of NKRC as well as DST Nodal Officer of National Knowledge Resource Consortium, New Delhi; (xvi) nominated as the Governing Body member as well as convener of Serial Division of Indian Association of Special Libraries and Information Centres (IASLIC), Kolkata for the period 2014-2016.

Sri Pradip Kumar Sarkar (Library) (i) participated in "E-Content 2013-Library-Publisher Partnership: Bridging the access gap-integrating Content, Technology and Services" held on 25th October, 2013 at Hotel Park Plaza, Bullygunge in association with Annual Reviews, Maney Publishing, Royal Society Publishing and SPIE Digital Library, J-Gate. (ii) participated in "Web Based Discovery tools versus Disintermediation: the different veracity focused by current end-user" on 10th January, 2013 in the "One Day National Workshop on Web-Scale Discovery Services: Single Window Access to Library e-Resources" organized by Central Library IIT Kharagpur. (iii) participated in International Conference on "Digital Libraries ICDL 2013 on Vision2020: Looking Back 10years and forgoing new frontiers" organized by JERI, New Delhi during 27-29 November, 2013; (iv) participated XXIV All India Conference 2013 on Role of Library Associations in India in Modern age on December 26-29, 2013 organised by National Institute of Virology (ICMR), Microbial Containment Complex (MCC), Pune and IASLIC, Kolkata.

Dr. (Ms.) Banhisikha Chaudhuri (Library) (i) participated in "E-Content 2013-Library-Publisher Partnership: Bridging the access gap-integrating Content, Technology and Services" held on 25th October, 2013 at Hotel Park Plaza, Bullygunge in association with Annual Reviews, Maney Publishing, Royal Society Publishing and SPIE Digital Library, J-Gate; (ii) Participated in "The International Seminar on Applications of Communication and Information Technology in Library (SACITiL-2014)" organised by Variable Energy Cyclotron Centre, Department of Atomic Energy, Kolkata during 28-30th January, 2014.

Ms. Ananya Raha (Library) Participated in "The International Seminar on Applications of Communication and Information Technology in Library (SACITiL-2014)" organised by Variable Energy Cyclotron Centre, Department of Atomic Energy, Kolkata during 28-30th January, 2014.

Ms. Sumita Dey (Library) (i) participated in "E-Content 2013-Library-Publisher Partnership: Bridging the access gap-integrating Content, Technology and Services" held on 25th October, 2013 at Hotel Park Plaza, Bullygunge in association with Annual Reviews, Maney Publishing, Royal Society Publishing and SPIE Digital Library, J-Gate; (ii) participated in "The International Seminar on Applications of Communication and Information Technology in Library (SACITiL-2014)" organised by Variable Energy Cyclotron Centre, Department of Atomic Energy, Kolkata during 28-30th January, 2014.



A seminar on Ethics and Values of Librarianship to celebrate Librarian's Day Programme on the Birth Anniversary of Late Prof. S. R. Ranganathan, National Professor of Library and Information Science on 11th August, 2013 was organized by Bose Institute Library in collaboration with BLA, IASLIC, and WBPLeA at Main Campus, Bose Institute.

Honour Received

Dr. P. Chakrabarti (Biochemistry) (i) Distinguished Alumnus Award, IIT Kharagpur, 2012; (ii) Member, Advisory Board of Journal of Molecular Recognition; (iii) Member, Scientific Advisory Committee, National Centre for Cell Sciences.

Dr. A. Lohia (Biochemistry) (i) Adjunct Scientist- CDFD Hyderabad (2009); (ii) Member of Research Advisory Council of Hyderabad Eye Research Foundation, LVPEI.

Dr. T. C. Ghosh (Bioinformatic) Member of Editorial board: BMC Genomics (From 2010 -)

Dr. Zhumur Ghosh (Bioinformatics) (a) Associate Fellow, Indian Academy of Science (2011-14), (b) Editorial Board Member, Current Bioinformatics.

Dr. Joyoti Basu (Chemistry) (i) Associate Editor for The Journal of Immunology (July, 2010 to June, 2014); (ii) Member, Editorial Board, PLoS One; (iii) Member of the Scientific Advisory Committee of the Centre for DNA Fingerprinting and Diagnostics, Hyderabad; (iv) Member of the DBT Expert Committee on Systems Biology of *Mycobacterium tuberculosis*

Dr. Manikuntala Kundu (Chemistry) (i) Member of Council of West Bengal Academy of Science and Technology and (ii) Member of Molecular Immunology Forum

Dr. Kuladip Jana (Division of Molecular Medicine) received Young Scientist Travel Award from International Congress on Animal Reproduction (ICAR)", Vancouver, British Columbia, Canada, Young Scientist (Clinical) Award-2012" from Parsemus Foundation, Berkley, California, U.S.A. and selected as an Expert Consultant of CPCSEA, Ministry of Environment & Forests, Govt. of India and also serving as a Member of the Editorial Board in: Translational Medicine, International Journal of Plant Physiology & Biochemistry, International Journal of Clinical Therapeutics and Diagnosis (IJCTD), American Journal of Medical & Biological Research (AJMBR), Journal of Cell and Molecular Biology Research (JCMBR), Signpost Open Access Journal of Animal Reproduction Studies, Journal of Translational Medicine and Epidemiology and Reproductive Biology Insights etc.

Dr. Subrata Majumder (Division of Molecular Medicine) (i) elected as Fellow of West Bengal Academy of Science and Technology in Dec. 2012 (ii) Seva Samman Award 2012 for outstanding anti-smoking campaign.

Dr. P. C. Sen (Division of Molecular Medicine) (i) Elected Editorial Board Member of "Frontiers Pharmacology"; (ii) acted as Judge in the IRIS best poster selection for INTEL competition in New Delhi, Bangalore and Chandigarh.

Dr A.N.Lahiri Majumder (Division of Plant Biology) (i) has been elected Fellow of the West Bengal Academy of Science and Technology and also its Council member (ii) member, sectional committee of Plant Sciences of the Indian National Science Academy (iii) nominated

as an external member of the Research Advisory Council of the NRCPB of IARI (iv) served as a Task Force member of two PACs of DBT.

Dr. Sonali Sengupta (Division of Plant Biology) has been selected for the DST Young Scientist Fast Track Project.

Dr. Dibyendu Narayan Sengupta (Division of Plant Biology) Member of the West Bengal academy of Science & Technology, 2012

Dr. P. S. Joarder (Physics/CAPSS) Appointed as the moderator and the examiner of Paper-X (Elective astrophysics) of the M.Sc.(Physics) examination by the Principal, Barasat Govt. College, Barasat, Kolkata for the year 2013.

Dr. Arun Kr. Chakraborty (Librarian) received “ILA-PN.Kaula Best Librarian Award-2012” from Indian Library Association (ILA) for his distinguished and dedicated services to the library profession. The award conferred during 58th ILA Conference on Next Generation Libraries: New Insights and Universal Access to Knowledge (ILANGL-2013) 24-27 February, 2013, held at the Department of Library and Information Science, Karnatak University, Dharwad.

Patents

Dr. Subhrangsu Chatterjee – PI and Dr. Anirban Bhunia – Co-PI (Biophysics) G-Quadruplex stabilizing agents and formulations involving the same as anticancerous, antiageing, antibacterial, antiviral, anti-proliferative, antitumor agents (Patent No.: 1120/KOL/2012).

Dr. Amita Pal and Dr. Jayadri Sekhar Ghosh (Division of Plant Biology) A patent application has been filed by Bose Institute entitled “Precise identification of appropriate bamboo species as raw materials for industrial applications with a novel pair of primers” (Patent Application No. 1239/KOL/2011).

Symposia and Seminar Organized

Dr. Srimonti Sarkar (Biochemistry) co-organized a symposium with Prof. Charles Turner of the University of Glasgow, U.K., entitled 'Protozoan parasites: engineering life with a different toolkit'. The symposium was jointly funded by DST and The Royal Society of U.K. on a competitive basis. It was held at The Pride Hotel, Kolkata, from February 28 to March 2, 2013 and was attended by parasitologists from both India and the U.K.

Dr. G. Basu (Biophysics) Organized the 4th Indian Peptide Society Meeting, in collaboration with SINP, Kolkata, at the Meghnad Saha Auditorium on Feb 21-22, 2012

Dr. Soumen Roy (Chemistry) (i) convenor of Kolkata International School cum Conference in Systems Biology(KOLSYSBIO), jointly hosted by Bose Institute and Saha Institute of Nuclear Physics. The School was held during Dec 29-31, 2012 at Bose Institute and the Conference during Jan 01-03, 2013 at Saha Institute of Nuclear Physics; (ii) member of the Organizing Committee for the International School cum Conference on Networks in Biology, Social Science and Engineering held during July 2-14 2012 at IISc. Bangalore

Dr. Swati Sen-Mandi and Dr. Samir Ranjan Sikdar (Division of Plant Biology) organized 2nd 'Workshop and Hands-on-Training' for young researchers of Eastern and North-Eastern India



from 20th September - 4th October, 2012, under the HRD development programme of the "Centre for Advanced Research in DNA Fingerprinting and Diagnostics of Medicinal Potential in Plants of Eastern and North Eastern India". Young researchers and faculty members from several universities and research institutes all over India attended the workshop.

Dr. Subrata Majumder (Division of Molecular Medicine) (i) Organised 81st Annual Meeting of the Society of Biological Chemists (India) at Science City, Kolkata during November 8-11, 2012; (ii) Organised 150th Birth Anniversary of Swami Vivekananda at Bose Institute in August, 2012, in association with Indian Society on Tobacco and Health.

Dr. P C Sen (Division of Molecular Medicine) (i) organised Lecture by Nobel Laureate, Dr. Venkatraman Ramakrishnan, January 4, 2013; (ii) organized Public Outreach Programme, Department of Science and Technology, January 6, 2013.

Dr. Sanjay Kr. Ghosh (Physics) (i) Coordinator of NESST-BASE 2012, a summer training programme for North-East students in basic sciences. (ii) Coordinator of DST-BASE 2012, a summer training programme, organized exclusively for school students of Darjeeling, in basic sciences.

Colloquia organized by the Department of Physics
Joint Conveners: Dr. B.K. Chatterjee and Dr. A. Singha

Colloquium 2013

Speaker	Date	Topic
Dr. Partha P. Mitra	January 24, 2013 at 4:00 pm	The Mouse Brain Architecture Project

Library

Bose Institute Library regularly organizing number of academic programmes for researchers of Bose Institute as well as nearby research institute(s) for promoting usage of Bose Institute Library subscribed resources as well as NKRC subscribed resources. These workshop(s) / training programme(s) also help scholars to lessen their research time. A good number of training programmes are organised for using databases, software etc. Library helps to all kind of research endeavor.

Academic Programmes Organised by Bose Institute Library during the year as follows :

1. Organised training programme/ awareness programme on 28th August, 2012 in Bose Institute Library on 'SCIFINDER Database: for Discovery of Research" intended for faculty and scholars of Bose Institute, Kolkata. Scholars from IACS and SNBOSE also participated.
2. Organised workshop for "South Asian Association of Physiologists (SAAP)" in collaboration with the Physiological Society of India, Bose Institute Library, Molecular Medicine Division of Bose Institute and IICB, Kolkata during 19-23rd June, 2012.
3. Organised Koha Workshop Series for Library Automation and Resource Sharing Network Project of National Mission on Education through ICT (NMEICT), sponsored by MHRD, Govt. of India during 19-22 July, 2012.
4. Organised Scientific Software (such as Genotypic, Invitrogen-Vector NTI) training programme in Centenary campus, Bose Institute Library which were purchased by library for research.
5. Webcasting of "100th Indian Science Congress-2013 : conference events" during 3-7th Jan, 2013.
6. Organised video conferencing programme on "Science Day Celebration" on 28th February, 2013.in the Centenary campus Library.
7. Organised ENDNOTE training programme for faculty/scholars at Centenary campus Library, Bose Institute, Kolkata on 19th April, 2012.
8. Library also provides training to library school students like Internship programme to LIS school students, training to Library professionals, advising different library for developing modern automated library, organising training programmes / workshops for LIS professionals etc.

To

Sir Jagadish Chunder Bose,
 Bt., F.R.S., F.R.D., D.Sc., M.A., C.S.I., Etc.
 Emeritus Professor, Presidency College.

MOST REVERED SIR,

It is with the deepest feelings of joy and pride that we, the members of the Presidency College Physical Society, offer you our hearty congratulations on the occasion of your Seventieth Birthday.

Through your work we have been made to feel in our inmost hearts the secrets of the working of the plant and have been brought closer to that spirit of Universal Harmony envisaged by the sages of old.

We feel legitimate pride when we think of the precision of the instruments that were made under your guidance by our mechanics in our own college workshop; and of the fundamental experiments on Plant Physiology which were first carried out in our laboratory, and which opened a new era in Biology.

Sir, the traditions that you have left behind in our College as a Teacher will continue to inspire generations of students to persevere in their attempts to conquer the Mysteries of Nature.

On this memorable occasion of your Birthday we feel gratified in having an opportunity of wishing you many happy returns of the same.

We remain,
 Most Revered Sir,
 Your humble admirers

The Members of the Physical Society, Presidency College.

Signed on their behalf

J.C. Mahalanobis

Secretary

President

BAKER LABORATORY
 PRESIDENCY COLLEGE
 Calcutta, 1st December, 1928

ART PRES, CALCUTTA

Service Departments

Acharya J.C. Bose Biotechnology Innovation Centre

(Madhyamgram Experimental Farm)

A new facility for animal biotechnology has been initiated and started to build a new building at the centre.

In addition, to provide facilities for field experimentation of conventional plant types, facilities have also been developed for carrying out transgenic plant development research work with bio-safe green houses.

The following scientists utilized the facilities of the farm for growing their crops.

Name of the Scientists	Name of the crops grown / facility availed by the Scientist
1. Prof. P. K. Saha	Sesame
2. Prof. Sampa Das	Mustard, Rice, Pigeon pea, Garlic, Colocassia
3. Prof. Amita Pal	<i>Vigna mungo</i> ,
4. Prof. D. N. Sengupta	Rice, Maize
5. Prof. S. R. Sikder	Mustard, Sesame
6. Prof. Debabrata Basu	Mustard, Sesame, Tomato, <i>Sinapis alba</i> , Chickpea
7. Prof. A. N. Lahiri Majumder	Rice, <i>Sorghum</i> , <i>Mimosa</i>
8. Prof. T. K. Ghose	Rice
9. Dr. Pallob Kundu	Tomato



Prof. A. K. Sharma unveiling the bust of Acharya J. C. Bose at J. C. Bose Biotechnology Innovation Centre at Modhyamgram.

The following scientists utilized the facilities of the Transgenic Green Houses for growing their crops.

Name of the Scientists Name of the crops grown by the Scientist

1. Prof. A. N. Lahiri Majumder	Rice,
2. Prof. Sampa Das	Mustard, Tobacco, Rice, Pigeon pea
3. Prof. Debabrata Basu	Mustard
4. Dr. Pallob Kundu	Tomato

“Dehydration of flowers and foliage and floral craft & their commercialization” :
Dr. S. K. Datta

Objectives :

- ♦ Development of different distinctive and artistic designs [greeting cards, get well cards, wall plates, landscapes, scenery, table tops, lamp shades, coasters, table mats, and many other products] with dry flowers and leaves for sale

Work done

Preparation of value added products

The main objective during the period was to utilize pressed dried flowers and leaves and embedded dehydrated flowers for preparation of different types of 'Floral Craft'. Dehydrated flowers and foliage have multipurpose application for preparation of 'Floral Craft'. 'Floral Craft' means skilful and artistic use of floral materials for making saleable articles for decoration purpose.

Utilization of Pressed dried flowers and leaves

Press dried materials were used for preparation of wide range value added products : artistic greeting cards, get well cards, wall hanging, wall plates, calender, pictures, landscape, table mats, costers, page markers etc. (Figs. 1-9).

Utilization of embedded dried flowers

Dried flowers were used for three dimensional arrangements in glass container for interior decoration, bouquets, gift boxes, pot pourries, flower baskets etc. (Fig. 10).

Training

The main work during the period was to organize series of training programmes on “Dehydration of Flowers and Foliage and Floral Craft”. The main objective of the training was

to develop awareness about the dehydration technique and how the seasonal cultivated flowers and unutilized road side, hill side and rural flora can be converted into value added products. The training was very helpful to set up small scale cottage industry for dry flowers in rural areas. Rural women can earn money by making dehydrated raw materials, the demand of which is increasing day-by-day and/or dehydrated materials can be utilized to prepare saleable interior decorative items. This will increase the economic status of rural people.

Training organized :

'Dehydration of Flowers and Foliage and Floral Craft', Sponsored by Horticulture Department, West Bengal at Horticultural Research Station, Krishnagar, 13-15th Dec., 2012 [No. of candidate 43]

Central Instruments Facility

The Central Instrument Facility (CIF) has been playing a vital role in the execution of research projects at Bose Institute. Some of the major facilities available are : Mass spectrometry (MALDI-TOF/TOF and GC Mass), DNA sequencing, Confocal Microscopy, Scanning Electron Microscopy, Cell Sorting, CD and fluorescence spectrometry, peptide synthesis and sequencing, NMR and Raman spectrometry, and X Ray diffraction.

The facility is used routinely by members of BI and also other nearby institutes. Some of the investigations, where CIF facilities were used extensively are as follows: the Microbial genomics group has reported the complete genome sequence of the sulfur-chemoautotroph *Tetrathibacter kashmirensis* (Ghosh, W. et al 2013, Plos One 8, e64856). The joining of contigs, derived from Next Gen Sequencing data, required extensive sequencing (more than 750 reactions) by Sanger method which was done using the 16 capillary Sequencing facility available at the CIF. Considering the huge demand in DNA sequencing, the CIF has recently procured a new 24 capillary DNA sequencing system. Plant molecular biologists at Bose Institute have developed new and efficient methodologies to study root proteomes. In another investigation members of the plant sciences group have successfully



The main Hall of CIF

characterized aero-allergens using immuno-proteomics (Sircar, G. et al. 2012, *Journal of proteomics* 77, 455-468). Both these investigations required extensive use of the 2D gel electrophoresis, MALDI-TOF/TOF and peptide sequencing facilities, at the CIF. In the area of Protein structure and function, the role played by a cis-peptide stabilizing sequence in promoting subtle changes in conformation of proteins has been investigated using the Peptide synthesis, NMR and MALDI-TOF/TOF facilities at the CIF (Ganguly, H. K. et al. 2012 *Journal of the American Chemical Society* 134, 4661-4669). Cell Biologists from the Molecular Medicine division have used the Cell sorting and Microscopy facilities of the CIF to study the apoptosis of medullary thyroid carcinoma cells in response to Theaflavin, a bioactive component of black tea, (Mazumdar M, et al. *Apoptosis* 18, 589-604, 2013).



The newly acquired 24 capillary DNA sequencer

Interactive programs:

Young students accompanied by their teachers often visit the Central facility to know about the latest techniques. The technical staff at the CIF educate these students about the applications of the various instruments. This year student groups from Zoology Department, North Bengal University and from the Centre for Studies in Bio-technology, Dibrugarh University visited the facility. The students and their teachers were highly impressed after seeing the facility.



CIF (CB)

Centre for Astroparticle Physics & Space Science

A national facility for the observational studies on Cosmic Ray and atmospheric phenomena has been developed at Darjeeling campus of Bose Institute under the IRHPA scheme of Department of Science & Technology, Govt. of India.

Atmospheric Science – Changing airspace environment in eastern Himalayas

Studies on Aerosol Optical Depth over Eastern Himalaya, India:

Dr. Abhijit Chatterjee, Dr. Sanjay Ghosh, Dr. Ajay K Singh, A Adak, Dr. Sibaji Raha

A study was made on how the natural and anthropogenic aerosols contribute to the attenuation of incoming solar radiation over eastern Himalaya. In order to do this the seasonal variations in aerosol components and black carbon along with the simultaneous measurements of aerosol optical depth (AOD, optical attenuation of solar radiation by particulate matter) was done over Darjeeling, a high altitude station (2200 masl) at eastern Himalayas. We observed a heavy loading of dust component during pre-monsoon (Apr – May) whereas during winter (Dec – Feb), the loading of anthropogenic aerosol components mainly from biomass burning were higher. These high increases in dust aerosols during pre-monsoon and anthropogenic aerosols during winter enhanced the aerosol optical depth by 25 and 40%, respectively. The natural dust transport process (during pre-monsoon) plays as important a role in the radiation effects as the anthropogenic biomass burning (during winter) and their differential effects (rate of increase of the AOD with that of the aerosol concentration) are also very similar.

Studies on Black Carbon in the Atmosphere of Eastern Himalaya, India

Chirantan Sarkar, Dr. Abhijit Chatterjee, Dr. Ajay K Singh, Dr. Sanjay K Ghosh and Dr. Sibaji Raha

In order to investigate the sources and potential impact of Black Carbon particles in the atmosphere, a detailed study on the characterization of black carbon (BC) aerosols at eastern part of Himalaya in India has been done. The measurement was carried out over a high altitude hill station Darjeeling (27° 01'N, 88°15'E; 2200 m asl). Black carbon was found to be maximum pre-monsoon ($5.02 \mu\text{gm}^{-3}$) followed by winter, post-monsoon and minimum during monsoon ($1.7 \mu\text{gm}^{-3}$). BC varied between $1.1 - 7.8 \mu\text{gm}^{-3}$ with an average of $3.45 \pm 1.19 \mu\text{gm}^{-3}$. BC exhibited strong diurnal heterogeneity with sharp morning and evening peaks. It was observed that higher BC concentration was associated to westerly and north-westerly wind flow. Fossil fuels burning from tourist vehicles during pre-monsoon and biomass burning during winter were the major sources of BC. From the context of diurnal and seasonal feature of BC; Darjeeling showed a dual nature representing a typical high altitude hill station as well as a typical urban atmosphere in India. The BC burden over Darjeeling was found to be much higher than any other high altitude stations in India and Nepal and even higher and comparable with some of the metro-cities in India which draws serious attention as it could have significant climatic consequences.

Studies on Ultrafine and Superfine Particulate Matters in the Atmosphere of Eastern Himalaya, India

A. Adak, Dr. A. Chatterjee, Dr. A. K. Singh, C. Sarkar, Dr. S. K. Ghosh and Dr. S. Raha

In order to investigate the formation, transformation and removal of atmospheric fine (less than $2.0 \mu\text{m}$) particulate matters, studies were made for the first time over eastern Himalaya in India

in order to investigate the formation and sources in two different seasons, pre-monsoon (Mar – May) and winter (Dec – Feb) for three consecutive years 2008, 2009 and 2010. The study was carried out at a high altitude hill station Darjeeling (2200 m asl) at the eastern Himalaya, India using an aerosol spectrometer (GRIMM) to measure aerosol number concentrations. It was found that the ultrafine and superfine aerosol (less than $1.0\ \mu\text{m}$) concentrations were higher in pre-monsoon compared to winter whereas fine mode aerosols were comparable in concentrations during these two seasons. Meteorological conditions like sunny/non-cloudy days with higher radiative fluxes and lower humidity favored the formation of ultrafine aerosols from their precursor gases and the initiation of this formation were observed during 0900 – 1000 hours LT. Superfine aerosols were mainly found to be the transported dust aerosols from long distances during pre-monsoon and showed peak during late morning till late afternoon. During winter, it shows higher concentration during night. On the other hand, fine mode aerosols were mainly the locally generated anthropogenic aerosols; emitted mainly from vehicular sources during pre-monsoon and from biomass burning during winter and showed sharp diurnal peaks during morning and evening. Such long-term study on size segregated aerosol concentrations is of paramount importance and can be helpful for the validation of several regional and global aerosol models and for the climate related studies over Himalayan region.

Studies on rain drop-size distribution(DSD) and its correlation with earth-space path radio link at Ku band of microwaves at Darjeeling [27°05'N, 88°26'E] : Soumendra Singh, Shyam B. Mehta, Dr. Amitabha Mitra, Dr. Sanjay K Ghosh and Dr. Sibaji Raha

It is well known that radio signals are reflected, refracted and scattered while propagating through atmosphere. Radio waves higher than 10 GHz are considerably attenuated and scattered by water in its vapour, liquid and solid form in the atmosphere. Study of atmospheric propagation of radio signals in disturbed weather at microwaves is important as it finds its application in the field of radio communication especially in the form of mobile telephone, satellite TV and other utility services of communication.

In Darjeeling a earth-space satellite link has been set up at Ku band (11.74 GHz) with a calibration under perfectly clear sky conditions for continuous monitoring of different parameters of radio signal, e.g., carrier to noise ratio, Bit error ratio (BER), etc., in the microwaves which is affected by the presence of columnar water vapour and precipitation (mainly rainfall) over the microwave link in the atmospheric over the satellite-to-earth path. Study of de-polarization of radio signals is also being done to study the signal contamination in orthogonally polarized communication channels. The rain parameters like instantaneous rain rate(mm/hr) and DSD profiles which are obtained from the continuously monitored Radar reflectivity data from vertically pointed Micro-rain radar, have been analysed and it

was found that rain DSD follows gamma distribution in general with varying distribution constants like shape & slope parameters over the altitude at Darjeeling.

Studies on Green House Gases over Eastern Himalaya (A Joint study of Bose Institute and Massachusetts Institute of Technology, USA)

Dr. Abhijit Chatterjee, Dr. Sanjay Ghosh and Dr. Sibaji Raha

The study was started from November, 2011 on the real time monitoring of Green House Gases over Darjeeling. The preliminary results show that the average concentration of Methane was slightly higher than the global average. It was observed that most of the Methane was from long distances like Indo Gangetic Plain. A little contribution was found from local sources. On the other hand, a large contribution was found from electrical discharge for loading of Sulphur Hexafluoride in the atmosphere.

Studies on Biosphere-Atmosphere exchange of Green House Gases over high altitude Himalayan forest

Dr. Abhijit Chatterjee, Dr. Sanjay Ghosh, Dr. Ammitabha Mitra, Dr. Ajay K Singh, Dr. Sibaji Raha

The study on the exchange of green house gases and energy between biosphere and atmosphere will be carried out over a high altitude Himalayan forest (Selimbong forest, Darjeeling division) under the national network called "FLUXNET" sponsored by Ministry of Earth Science, Govt. of India. In order to do this, a MoU has been signed between Department of Forest, Govt of West Bengal and Bose Institute. A land of 1 acre has been acquired in the forest (around 60 km north of Darjeeling) where a tower of 60 meter long will be erected. Several on-line analyzers and sensors will be mounted on the tower through which the data of several parameters will be collected from different heights. The main objective of the study is to find out whether the biosphere acts as a net source or sink of these green house gases. The project is at the stage of recruiting the manpower for the project and the erection of the tower and installation of the instruments will be started shortly.

Cosmic Ray air-shower array using active detectors at Darjeeling

Rupamay Bhattacharya, Sumana Singh and Dr. Supriya Das

An air-shower array using fast plastic scintillators and Photo multiplier tubes are being developed at the Darjeeling campus of Bose Institute to study the cosmic ray energy spectrum and other related issues. This array will be located at Darjeeling at an altitude of about 2100 meters. Being the only such facility at eastern part of India this will be very crucial set up which will enable us to systematically compare the results with existing facility at Ooty at similar altitude but different latitude. Moreover this facility will also provide valuable input to establish a baseline taking into account the results from Ooty and AGASA in Japan.

We have started assembling the 1m x 1m scintillator detectors at the Darjeeling campus and expect that the installation for the first set of seven detectors will be over very soon.

International Collaborations:

Bose Institute has now entered into two large international collaborative programs in the area of ultra relativistic heavy ion collision experiments. These experimental facilities provide us unique opportunity to study nuclear matter at extreme density and/or temperature which in turn help to shed lights into the properties of matter that existed at a few microseconds after the big bang or that still exists at the core of neutron stars.

ALICE Collaboration

Dr. Supriya Das, Dr. Sanjay K. Ghosh and Dr. Sibaji Raha

A Large Ion Collider Experiment (ALICE) is an ongoing experiment at CERN, Geneva which started taking data in 2010. This experiment is using two colliding beams from the world's largest collider facility called the Large Hadron Collider (LHC) to study both hadronic as well as heavy ion collisions at ultra relativistic energy. A large number of detectors systems are running in synchronised fashion to record the particles created after those collisions. Several important results from this experiment have already been come out.

At this moment LHC is going through a long shut down period for maintenance of several detectors and an upgrade of the experiment as a whole. This upgrade involves upgrading several existing detectors, read out electronics data acquisition framework etc. as well as installing several new detectors. The group from bose institute is involved in R&D for a newly proposed forward calorimeter for the ALICE upgrade. We have been working in collaboration with several other Indian institutes in this project.

CBM Collaboration

Subhasis Samanta, Ramaprasad Adak, Supriya Das, Rajarshi Ray, Sanjay K. Ghosh and Sibaji Raha

A Facility for Antiproton and Ion Research (FAIR) has been proposed to be operational at Darmstadt, Germany in 2016. This is a multi-dimensional facility for research in the areas of high energy nuclear physics, low energy nuclear reaction and astrophysics, particle physics and plasma physics. The group from bose Institute is involved in the Compressed Baryonic Matter (CBM) experiment which will study the nuclear matter at very high density and moderate temperature. These studies will help us to find nature and order of phase transition that occurs between confined hadronic matter to deconfined quark gluon plasma. Moreover the results from this experiment will help us to peep into the core of the neutron stars as nuclear matter at similar condition exists there.

We are developing a muon spectrometer using Gas Electron Multiplier (GEM) technology to detect the muon pairs coming from the decay of short lived vector mesons which are produced in the collisions. These particles are suitable probes that carry the informations from the core of

the fireball created at the collisions. Leptons (muons in this case) being the less interacting particles with the others present around them, remain undisturbed till they reach the detectors. R&D in the form of physics simulation as well as testing prototype GEM chambers using in-house as well as high energy beams are being carried out to finalize the design parameters of the muon tracking system.

Manpower Development

M.Sc Course in Physics

A postgraduate course in Physics is being run, in collaboration with, St. Xavier's College, Kolkata, since September 2007. Classes are held at both St. Xavier's College and Bose Institute. We have now started our M.Sc-Ph.D integrated course in Physics as well. Five students were selected for the year 2012-14. These students were selected through written test and interview. Degree of this course is awarded by University of Calcutta. Dr. Rajarshi Ray is coordinating this integrated course.

Outreach Programme

NESST-BASE 2012:

The North-East Students' Summer Training programme on BAasic SciEnces (NESST-BASE) which has now become an annual event of the Institute, was held at Darjeeling during May 13-26, 2012. This year, 24 students from north-east states as well as Sikkim and Darjeeling, along with one science teacher from each place, participated in this programme. The students were selected by the state authorities. These students were given hands-on training on physical, chemical and biological sciences. There was also a session with the aim to introduce the students with the fun of mathematics. One day popular lecture was arranged on 22nd May 2012. The school children from Darjeeling were also invited on this occasion. The lectures were delivered by Prof. S. K. Joshi Honorary Distinguished Scientist, National Physical Laboratory, New Delhi on "S. N. Bose, A. Einstein and dramatic state of matter" and Prof. A. Jayraman Director, National Atmospheric Research Laboratory, Gadanki on "Our Earth's Atmosphere and Climate Change".

DST-BASE 2012

This year we have started a programme "Darjeeling Students Training on Basic SciEnces (DST-BASE), a hands- on training on basic sciences exclusively for the school students (class XI mainly) of Darjeeling. This year programme was held during August 16- 21, 2012. 27 students and 9 teachers participated in this programme.

Manpower development

As a part of our commitment to develop trained manpower, we organize each year, alternatively at Ooty and Darjeeling, a winter workshop followed by a Winter school on AstroParticle Physics (WAPP). This year school was held at Cosmic Ray Laboratory, TIFR, Ooty.

The main objective of this school was to give hands-on training to these students on state-of-art instrumentation used in the present day Astroparticle Physics research and to make them aware of the research challenges in this area.

Environmental Sciences Section

Environmental Sciences Section (ESS) has been actively participating in the research on atmospheric chemistry and physics made over eastern Himalayan region. While several air pollutants (particulate matters, gases etc), optical and weather parameters are being monitored over National Facility on Astroparticle Physics and Space Science, Darjeeling campus of Bose Institute, the off-line chemical analysis of samples of particulate air pollutants collected at Darjeeling is done at ESS. ESS has the facility for Ion Chromatograph (for analysis of ionic components in the atmospheric pollutants), HPLC, Atomic Absorption Spectrophotometer (for analysis of toxic metals in atmospheric pollutants), pH Meter, Conductivity Meter etc.

Studies on Aerosol Optical Depth over Eastern Himalaya, India:

The loading of atmospheric particulate matter (aerosol) in the eastern Himalaya is mainly regulated by the locally generated anthropogenic aerosols from the biomass burning and by the aerosols transported from the distance sources. An extensive study has been made to study the seasonal variations in aerosol components and black carbon along with the simultaneous measurements of aerosol optical depth (AOD, optical attenuation of solar radiation by particulate matter) over Darjeeling, a high altitude station (2200 masl) at eastern Himalayas. We observed a heavy loading of dust component during pre-monsoon (Apr – May) whereas during winter (Dec – Feb), the loading of anthropogenic aerosol components mainly from biomass burning were higher. These high increases in dust aerosols during pre-monsoon and anthropogenic aerosols during winter enhanced the aerosol optical depth by 25 and 40%, respectively. We observed that for every 1% increase in anthropogenic aerosols, AOD increased by 0.55% during winter whereas for every 1% increase in dust aerosols, AOD increased by 0.46% during pre-monsoon. The natural dust transport process (during pre-monsoon) plays as important a role in the radiation effects as the anthropogenic biomass burning (during winter) and their differential effects (rate of increase of the AOD with that of the aerosol concentration) are also very similar.

Studies on Black Carbon in the Atmosphere of Eastern Himalaya, India

A detailed study on the characterization of black carbon (BC) aerosols at eastern part of Himalaya in India has been done in order to investigate its temporal variations, identification of potential sources and meteorological impact. The measurement was carried out over a high altitude hill station Darjeeling (27° 01'N, 88°15'E; 2200 m asl). BC exhibited strong seasonal variation with the maximum concentration during Pre-monsoon ($5.02 \mu\text{gm}^{-3}$) followed by winter, post-monsoon and minimum during monsoon ($1.7 \mu\text{gm}^{-3}$). BC varied between 1.1 - 7.8 μgm^{-3} with an average of $3.45 \pm 1.19 \mu\text{gm}^{-3}$. BC exhibited strong diurnal heterogeneity with sharp morning and evening peaks. Amongst the long distant sources, higher BC concentration was observed during westerly and north-westerly wind flow. Fossil fuels burning from tourist

vehicles during pre-monsoon and biomass burning during winter were the major sources of BC. Relative BC concentrations at 370 nm and 880 nm and wavelength exponent estimated from BC absorption coefficient showed the overall dominance of fossil fuel burning for BC emission throughout the study period. From the context of diurnal and seasonal feature of BC; Darjeeling showed a dual nature representing a typical high altitude hill station as well as a typical urban atmosphere in India. The BC burden over Darjeeling was found to be much higher than any other high altitude stations in India and Nepal and even higher and comparable with some of the metro-cities in India which draws serious attention as it could have significant climatic consequences.

Studies on Ultrafine and Superfine Particulate Matters in the Atmosphere of Eastern Himalaya, India

A study on atmospheric fine (less than 2.0 μm) particulate matters were performed for the first time over eastern Himalaya in India in order to investigate the formation and sources in two different seasons, pre-monsoon (Mar – May) and winter (Dec – Feb) for three consecutive years 2008, 2009 and 2010. Fine mode aerosols were further segregated into three modes; ultrafine (less than 0.32 μm), superfine (0.32 – 1.0 μm) and fine mode (1.0 – 2.0 μm). The study was carried out at a high altitude hill station Darjeeling (2200 m asl) at the eastern Himalaya, India using an aerosol spectrometer (GRIMM) to measure aerosol number concentrations. It was found that the ultrafine and superfine aerosol (less than 1.0 μm) concentrations were higher in pre-monsoon compared to winter whereas fine mode aerosols were comparable in concentrations during these two seasons. Meteorological conditions like sunny/non-cloudy days with higher radiative fluxes and lower humidity favored the formation of ultrafine aerosols from their precursor gases and the initiation of this formation were observed during 0900 – 1000 hours LT. Superfine aerosols were mainly found to be the transported dust aerosols from long distances during pre-monsoon and showed peak during late morning till late afternoon. During winter, it shows higher concentration during night. On the other hand, fine mode aerosols were mainly the locally generated anthropogenic aerosols; emitted mainly from vehicular sources during pre-monsoon and from biomass burning during winter and showed sharp diurnal peaks during morning and evening. Such long-term study on size segregated aerosol concentrations is of paramount importance and can be helpful for the validation of several regional and global aerosol models and for the climate related studies over Himalayan region.

Ambient Air Quality during Diwali Festival over Kolkata, India

The effects of fireworks on air quality was assessed from the ambient concentrations of aerosols (atmospheric particulate matter), water soluble ionic species, metals and SO_2 over Kolkata metropolis, India during Diwali festival in November 2010. Aerosols (less than 10 microns) concentrations on Diwali night were found to be ~ 5 times higher than the normal day night-time average. The increase in night-time concentrations of the metals on Diwali night spanned over a wide range (Al, Zn, Pb and Cd showed 5–12 times increases, Cu, Fe and Mn showed 25–40 times and Co and V showed 70–80 times) compared to normal night-time concentrations. The water soluble ionic species showed 1.5–6 times higher concentrations on Diwali night than on normal days. The most significant increases were found for K^+ , Ca^{2+} ,

Mg^{2+} and SO_4^{2-} . The diurnal variations in aerosols and SO_2 showed that their maximum concentrations were on Diwali night between 8 P.M.–3 A.M., indicating maximum firework activities during this period and concentrations increased by ~ 5 times compared to those on normal days during this period at this site. The extensive use of firecrackers during Diwali festival thus leads to significant increases in these air pollutants, and since they are associated with serious, adverse health impacts, the use of fireworks during in this kind of festival in a highly populated city, like Kolkata, India, needs to be controlled.

Falta Experimental Farm

In the Rural Biotechnology Programme at Falta Experimental Farm two training programmes were conducted on “Fish Breeding & Cultivation and Horticultural Biotechnology” and “Mushroom cultivation, Vermicompost production, Apiculture and Sericulture” during August 27- September 4, 2012 and August 9-15, 2012 respectively. Total twenty-four trainees were trained in the above two training programmes. The last training programme was organized for trainees mostly from tribal community of Santiniketan, District: Birbhum. Two survey works were conducted of which one in collaboration with Visva-Bharati and Ghosaldanga-Bishnubati Adibasi Trust during 19-20 November 2012 in five Santal villages near Santiniketan and the other one in collaboration with Berhampore College in two tribal villages of Kalanabagram block (about 20-30 km distance from Berhampore Town near Polsanda) of Murshidabad District during 23-25 December, 2012 as a part of Tribal Area Development Programme of the Institute.



Dr. Anup Kumar Dutta, Resource person for fish breeding programme was demonstrating the same to the trainees during the training programmes on “Fish Breeding & Cultivation and Horticultural Biotechnology” held during August 27- September 4, 2012 at Falta Experimental Farm under the Rural Biotechnology Programme.



Shri Lakshman Chandra Porel, Resource person for horticultural biotechnology programme was demonstrating mango plant grafting to the trainees during the training programmes on “Fish Breeding & Cultivation and Horticultural Biotechnology” held during August 27- September 4, 2012 at Falta Experimental Farm under the Rural Biotechnology Programme.



Shri Lakshman Chandra Porel, Resource person for vermicompost programme was demonstrating vermicomposting to the trainees during the training programmes on “Mushroom cultivation, Vermicompost production, Apiculture and Sericulture” during August 9-15, 2012 at Falta Experimental Farm under the Rural Biotechnology Programme.



Two trainees belonging to tribal community were selecting the silk worm cocoons at the final stage of rearing. Dr. K.C. Mondal (standing behind), the resource person for sericulture programme was guiding them during the training programmes on “Mushroom cultivation, Vermicompost production, Apiculture and Sericulture” during August 9-15, 2012 at Falta Experimental Farm under the Rural Biotechnology Programme.



One of the trainees belonging to tribal community from Santiniketan was handling the bee box during the training programmes on “Mushroom cultivation, Vermicompost production, Apiculture and Sericulture” during August 9-15, 2012 at Falta Experimental Farm under the Rural Biotechnology Programme.

J C Bose Centre **(Publication and Museum)**

J C Bose Centre comprising the Museum and the Publication section. From the very beginning of the establishment of the Museum, people take a lot of interest to visit it. The museum has been visited by many renowned scientist and also social dignitaries. Beside that it has also been visited by school children from many famous schools, Institutions of India and also from abroad. The main object of this museum to project in every walks of the society for highlighting about the invaluable works of Sir J C Bose and people can easily understood how the scientific works of Sir J C Bose give a useful effect to the society. Further development of our museum, the progressive work is going on with the help of many scientist and renowned members of the society.

Since its inception in 1980 the Publication Section has been doing all sorts of publication, i.e. Annual Report (both English & Hindi Versions); BI News; Memorial Lecture, Director's folders; Posters and leaflets of different Symposia, Seminars and Training Programmes and works of Sir J.C. Bose. Soft copy of Annual Report and BI News are available in the net (boseinst@ernet.in).

The following publications are now available for sale : J. C. Bose and Microwaves – A collection : Rs.200.00; Science and Society – Reflections : Rs.1050.00; J.C. Bose A Scientist and A dreamer – Vol. 1 : Rs.1250.00; Vol. II : Rs.1250.00; Vol. III : Rs.600.00; Vol. IV : 1500.00 ; Vol. V : Rs.550.00; Patrabali (Bengali) Rs.150.00; Acharya Jagadis Chandra Bose (Bengali) Rs.12.00; Abyakta (Bengali book written by Sir J.C. Bose) Rs.50.00; Picture Post Cards (five sets) Rs.125.00; Acharya Jagadis Chandra Bose (Bengali Combined) Rs.325.00; A. J. C. Bose (life & works) – CD Version Rs. 100.00, in the Realm Bose – Rs. 180.

Library

The Institute Library system is one of the best Science Reference Libraries in Eastern India, set up in the main campus in 1917 and a wing at the 'Centenary Building' was opened in 1983. In the year 2007 a small library was also set-up in the Salt Lake Campus of the Institute. Library provides latest information to the BI faculty, researchers, staff members and students of an "Integrated M.Sc.-Ph.D. Programme on Life Sciences and Physical Sciences" (duration approximately 6-years) which has been introduced at Bose Institute, Kolkata, in collaboration with the University of Calcutta in 2011, for their day-to-day research and development work. Library also extends its Physical Library facilities to other Institutions /Universities /R&D organisations in and around Kolkata. Library also regularly provides document delivery services and other services to Faculty / researchers. Library also extends their services to all DST and CSIR Institutes in India.

The library has total collection of 42,514 reading materials out of which 27,991 Bound journals, 14027 Books, 496 Theses as on 31.03.2013. Library also having a huge collection of other materials including Sir J. C. Bose collection. Library has subscribed to more than 5000 online journals in different packages. Library also subscribed to online-only full-text journals / databases of different academic societies such as ASM, ACS, Life Sciences Reviews, Cell Press journals of Elsevier, Blackwell, IOP, AIP. Library also subscribed to science@direct of Elsevier and all Nature Group Journals online. All these journals has access from 1997 onwards.

Library also subscribed to e-books packages such as: E-Books of E-brary, E-Books – of Cambridge University, Physics E-Books package, E-Books package of Elsevier: Agricultural and Biological Sciences; Biochemistry, Genetics and Molecular Biology, Environmental Science, Current Protocols etc.

Bose Institute Library Activities:

Collection :

Collection	Total as on 31 March 2013
Books	14027
Theses	496
Bound Volumes of Journals	27991

Other Collection

Sir J.C. Bose Collection

Reports, Newsletters, Annual Reports of other Institute(s), Publication of Bose Institute etc.

Online Journals subscribed

Online journals through National Knowledge Resource Consortia (NKRC)

Back Volume Journals (online)

Scientific Software(s)

Access Management of Resources

All Library resources can be accessed by Bose Institute Library faculty / scholar from any campuses of Bose Institute. Bose Institute Library also provides off campus access to its resources to Institute faculty members. Library uses open sources software KOHA for OPAC and D-Space for IDR.

Resources of Bose Institute Library

A. Journals Resources

E-journals are accessible from Bose Institute Library (www.boseinst.ernet.in/library)

Library subscribed to major publishers journals such as ASM, ACS, Life Sciences Reviews, Cell Press journals of Elsevier, John Wiley & Sons, Inc, IOP, AIP, APS, Adenine Press, Cambridge Journals Online, The Company of Biologists. EDP Sciences, Emerald Publishing Group / MCB University Press, Genetics Society of America, IEEE, Indian Academy of Sciences, Informa Healthcare, Japan Institute of Heterocyclic Chemistry, Japan Publications Trading Co. Ltd., Japanese Society of Allergology, Kluwer Academic Publishers Group (KAPG)/Springerlink, Landes Bioscience, Microbiology Research Foundations, National Academy of Sciences, Physical Society of Japan, Polish Academy of Sciences, Portland Press, Reed Business, Rinton Press, Rockefeller University Press, Royal Society of Chemistry / Turpin Distribution UK, Thieme, Landes Bioscience, Karger. Library also subscribed to Science@direct of Elsevier and all Nature Group Journals online. Blackwell / John Wiley Journal's Premier Online, Current Protocols (Online) of John Wiley / Blackwell, Annual Reviews Online (Back volume), Methods in Enzymology (Online).

B. Databases

Library also subscribed to different databases such as :

BIOBASE BIOLOGICAL Database-TRAN-AC/SE-O TRANSFAC[®]-Seat (Online); PROT-AC/SE-O PROTEOME[™]-Seat (Online); EXPL-AC/SE-O Explain[™]-Seat (Online); HGMD-AC/SE-O HGMD[®]-Seat (Online).

a) **Century of Science - Science Citation Index Expanded and ENDNOTE Web of ISI Web of Science, Thompson, USA.**

b) **SCOPUS the largest abstract and citation database of research literature and quality web sources of Elsevier.**

c) **SCIFINDER of ACS.**

Science of Synthesis—The Electronic Version

C. Open Access Membership

BI Library has gone for Open Access membership of

- (1) Nucleic Acids Research of Oxford University Press,**
- (2) Biomed Central (BMC)**
- (3) Public Library of Science (PLOS).**

This membership allows faculty members and scholars of Bose Institute considerable amount of discount on paper handling charges. This membership facilitates faculty / scholars to publish in open access journals.

D. New Addition(s) in 2012-2013:

During the year 2012-2013 Library subscribed new Database(s) such as:

BIOBASE BIOLOGICAL Database-TRAN-AC/SE-O TRANSFAC®-Seat (Online); PROT-AC/SE-O PROTEOME™-Seat (Online); EXPL-AC/SE-O ExPlain™-Seat (Online); HGMD-AC/SE-O HGMD®-Seat (Online).

E. Book(s) added in 2012-2013 : 323 nos.

F. Thesis added : 15 nos.

G. Bound Volumes of Journal added : 394 nos.

H. New journals added from 2011-2012

Journal Title	Journal Title
Science Signaling	Personalized Medicine
Journal of Organic Chemistry	Expert Review of Clinical Immunology
Journal of biomedical nanotechnology	Expert Review of Endocrinology & Metabolism
Journal of nanoscience and nanotechnology	Expert Review of Molecular Diagnostics
Blood	Expert Review of Proteomics
Down to Earth Magazine	Indian Journal of Theoretical Physics Print only (ISSN:0019-5693)
Biochemical Pharmacology	Heterocycles (OL)
Fertility and Sterility	RNA Biology
Free Radical Biology & Medicine	Evolutionary Bioinformatics
Journal of Theoretical Biology	Clinical Infectious Diseases
Molecular Cellular Endocrinology	Human Reproduction
Reproductive Toxicology	Journal of Infectious Diseases
The Lancet	Molecular Plant
Endocrinology	Nanoscale
Biomarkers in Medicine	Organic and Bimolecular Chemistry
Clinical Lipidology	Biology Reproduction
Diabetes Management	The Journal of Parasitology
Epigenomics	Helicobacter
Future Medicinal Chemistry	International Journal of Andrology
Future Microbiology	
Future Virology	
Nanomedicine	

F. Back Volume Journals added from 2011-2012 :

Elsevier Backfiles on ScienceDirect	Wiley Blackwell Journal Back files
1. Biochemistry, Genetics and Molecular Biology	1. Biotechnology, Biochemistry and Biophysics
2. High Energy Physics	2. Physics
3. Cell Press	3. Immunology
	4. Microbiology



G. e-Books added from 2011-2012 :

E-Books

Oxford Scholarship Online Physics 6 Module

1. Atomic Leasor and Optical Physics
2. Codensed Mater Physics/Material
3. Nuclear & Plasma Physics
4. Particle physics / Astrophysics / Cosmology
5. Soft matter/Biological Physics
6. Theoretical. Computational and Statistical Physics

G. Resources through NKRC

Library has joined with the National Knowledge Resource Consortia (NKRC) which is joint consortia of CSIR and DST Institutes for accessing online resources. Through this consortia faculty scholars can access more than 7000 online resources, SCIFINDER, ACS, Web of Science, Patent databases etc. Library could fulfill faculty / scholar demands for article resources from CSIR / DST Institutes subscribed journals. BI Library also provides article resources to all faculty/ scholars of DST / CSIR Institutes and also other institutes in India. It is expected to have more journal purchase through consortia from next year. Library is also member of FORSA Consortia.

Services and Management

Collection	Total Nos. as on 31 March 2013
Books Issued	127
Bound Volume Journal Issued	271
Loose Journal Issued	116
No. of Readers	3763
Internet Accessed (in hours)	8736
Scans	70204
Photocopies	277343
Download of Articles (from Online Journals) (Approx.)	200000

Services :

Reader's Service

The library is open to faculty member and scholars for reading and consultation during working hours from 9.45 AM to 6.15 PM (Monday to Friday).

Faculty members / scholars can access (24x7) E-resources from any of the seven campuses of Bose Institute.

Faculty members also can access E-resources from off campuses/ home access (24x7).

- Technical Query Service** Bose Institute Library responds to any query related to information regarding research insights, reference management, database(s) access, Software services/ database access or any access related issues of Bose Institute Library collection or using Library OPAC.
- Document Delivery Service** Bose Institute Library also provides article resources to all faculty/ scholars of DST / CSIR Institutes and also other institutes in India.
- Inter Library Loan Service** The library issues out its publications on 'Inter Library Loan' to the users of other libraries mostly research institutes who have Inter Library Loan arrangement(s) with Bose Institute Library.
- Institutional Membership** The library is member of various International and national organization(s) Biomed Central (BMC), Public Library of Science (PLOS), International Federation of Library Associations and Institutions (IFLA), International Society of Tea Science (ISTS), Indian Association Of Special Libraries And Information Centres (IASLIC), Indian Science Congress Association (ISCA) Membership etc.
- e - Journals Access** The library has started providing access to electronic journals subscribed by Bose Institute Library as well as subscribed through National Knowledge Resource Consortia (NKRC).
- User Awareness Programme** Library conducts user orientation programmes time to time for the benefit of users and optimal utilization of subscribed resources. User orientation programme also includes Reference management for publications, citing references in thesis, using databases, citation report, h-index compilation, using different scientific software, using of anti-plagiarism software etc.
- Reprographic Service** The library provides reprography services to its users. Photocopy services are provided to all research workers of the institution. A total 2,77,343 pages of photocopies were given to our faculty and outside users.
- Library also provides scanning services to its user.

Workshop

The Workshop of Bose Institute has been functioning independently as a full fledged Section, catering the various job requirements of different departments of Bose Institute. The Workshop of Bose Institute consists of the following units of maintenance, repair and fabrication of different instruments.

Units	Requisitions	Job executed	Continuing job
Electrical	954 (M.C. & C.B.)	100%	Nil
Mechanical	60	95%	5%
Carpentry	36	97%	3%

Apart from the above, the electrical unit of workshop has operated the Audiovisual & Public address systems throughout the year in about 150 nos of different types of seminar & lectures held at both campuses.

The Mechanical Section has fabricated various types of Gel Electrophoresis apparatus such as Submarine Gel, Perspex combs, Detector stand, Replica of Photosynthetic bubbler, different types of Perspex box, Radio shield, Detector box, Detector Tank and lid etc.

System stability check of the HT breakers of "AREVA" make of 4 panel board at Centenary Campus & oil replacement of L.T. Breakers (5 nos.) at Main Campus, Bose Institute and also Oil centrifuging and dehydration of Transformer oil of both campuses have been done under the supervision of Electric unit of workshop.

Electrical renovation work and new power line arrangements have been carried out in various campuses & departments of Institute viz., CAPSS, Madhyamgram Experimental Farm, Darjeeling Campus (Mayapuri) & Falta Experimental Farm. The functioning of the fire Alarm System, Water system & Fire fighting equipments at various premises of Bose Institute are also under the supervision of Workshop. The transport system of the Institute including the allotment of Institute vehicles and their maintenance are also under the direct supervision of Workshop.

The Carpentry unit is an very essential unit of Institute. This units, having one carpenter & one helper had completed various type of wooden jobs during the period. such as Bee keeping box, Anti chamber door, different sizes of wooden laboratory table with sun mica pasting, locking arrangement of door, door closures fitting and other repairing works of furniture of various laboratories etc.

The Store unit purchased building, electric & carpentry materials against departmental requisitions and issued various materials which were recorded in cardex system and also processed bills of all purchased items, pertaining to Workshop.

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Socially Relevant

Dr. Nripendranath Mandal (Division of Molecular Medicine) The two major thematic fields of research in Dr. N. Mandal's laboratory, viz., **Marine** and **Medical Biotechnology** has played a major role to address the basic socio-economic problems in the field of disease management in shrimp as well as human systems.

For the first time, various DNA markers have been developed to identify disease resistant population of shrimp, *Penaeus monodon* that will help to solve the disease related problem in shrimp aquaculture industry. So, this technology will be beneficial to the socio-economic aspect by revival from this devastating problem.

From the prevention point of view, early prediction of Coronary Heart Disease (CHD) in the field of **Medical Biotechnology** will be very important to control the disease. Research outcome from this arena will be useful to develop biometric chip for screening the risk of CHD among Asian Indians that will be beneficial to the society.

Again from therapeutic standpoint, screening of copious Indian medicinal plants in another **medical biotechnology** research program has revealed that most of them are potential sources of natural antioxidants and orally administrable iron chelators. Moreover, illustration of specificity between the malignant and normal cells; and selective killing of the former not only by the crude extracts of plants, but also isolated pure compounds of *Spondias pinnata* have been highly motivating. In short, research outcome in this field will provide the impetus to search for better, safer and cost effective natural antioxidants; and in course an anticancer drug.

Dr. Pallob Kundu (Division of Plant Biology) The studies described here will hint the genetic factors that determine pathogenesis. Thus alteration of these factors' expression pattern or introgression of desirable form from related species in cultivable plant varieties may lead to production of pathogen tolerant tomato plant varieties.

Dr. S. Sen Mandi (Division of Plant Biology) Increasing realization of health hazards and toxicity associated with indiscriminate use of synthetic drugs has brought about enhanced interest in the use of plant-based drugs worldwide. India's rich heritage in knowledge of medicinal plant use along with a vast repository of plant genetic resource positions this country as an important player in the trade of medicinal plants that is expected to reach US\$ 5 Trillion by the year 2050. For developing national competence in this field it is important to a) raise awareness, among the uninitiated, regarding the importance of sustainable utilization / conservation of plant genetic resource particularly in remote areas that still remain undisturbed due to urbanization / industrialization related loss of biodiversity b) deploy biotechnological tools for authentic identification and biomedical evaluation of plants, particularly those that

constitute the basis of Traditional and Folk Medicine.

Till date at the CAR in DNA Fingerprinting and Diagnostics of Medicinal Plants we have established

Species Specific DNA Markers for plant authentication that is useful in :

- establishing sovereignty / ownership right and resolving IPR issues as well as
- supplementing conventional drug assessment protocol in order to ensure uniform efficacy of drug produced in different batch.

Trait (medicinal / nutraceutical) Related DNA Markers towards bioprospecting of useful genes. Our studies have provided useful leads for

- DNA marker / probe based screening of germplasm for selection of elite genotypes.
- studying variation in gene expression between landraces growing in the wild at different locations / environment.

Bearing in mind the effect of environment on biosynthesis of medicinal compounds in plants our studies have focused on plants collected from different altitudes with variation in UV irradiation. Using tea plants our studies have established positive effects of UV irradiation as different from the generally perceived damaging effects of UV.

In addition to molecular characterization of medicinal plants, agronomic / cash crops that play a major role in the socio-economic development of North-East India viz. bamboo and rice also constitute our study material. DNA fingerprinting for documentation of bamboo genotypes have been established in several bamboo species of Manipur in collaboration with IBSD (a DBT Institute) Trait related DNA markers for screening wild germplasm have been developed for cyanogen (a poisonous compound that restricts use of bamboo in production of fermented food products) and antioxidant. Such studies could cater to the need of bamboo based industry for production of fermented food and nutraceuticals. Our studies on rice for bioprospecting of genes conferring survival value to rice seed in the field (viz seed vigour) and also through post harvest 'dry' storage (viz. seed viability) have led to the identification of ACCase as the major gene that through dual functioning confers vigour and viability to orthodox seeds.

Under the HRD activity of this programme Hands-on-training on DNA Fingerprinting has been provided to: One 2nd year M.Sc Student of St Xavier's College, Kolkata on RAPD analysis of different species of *Amaranthus*. This training was in addition to the annually held workshops on DNA fingerprinting of medicinal plants.

List of Personnel

Administration

Dr. Sibaji Raha	Sr. Professor & Director
Sri Tushar Kanti Ghorui	Officer on Special Duty (Till 11.06.2012)
Shri Surajit Panigrahi	Registrar (from 01.06.2012)

Centenary Campus: Parimal Ch. Das, Tapan Datta, Sankar Nath Sinha (Retd. on 31.12.12), Subir Sen, Ashis Chakraborty, Noreen Bhattacharjee, Sougata Banerjee, Umesh, Sisir Chakraborty, Bidyut Kr. Mandal, Manick Ch. Das, Nikhilesh Roy Ghatak, Amit Kr. Ghosh, Baladeb Goswami, Rina Roy, Amitabha Bhattacharjee, Elizabeth Pal, Dhrubajyoti Sen, Mantu Bhattacharjee, Achintya Mukherjee, Supriya Das, Nitin Sharma (joined on 13.03.13), Satya Swarup Behera (joined on 13.03.13), Ananya Malgope (joined on 13.03.13), Rubi Sarkar, Sudam Jana, Bably Marick, Rina Das, Somnath Das, Prodip Kr. Mullick, Sanjoy Krishna Chaki, Debasis Kaley, Angshuman Bhowmik, Sanjib Kr. Das, Biplab Malakar, Shaubhik Ghosh (joined on 31.05.12), Arpita Bose (joined on 01.10.12), Hemanta Kumar Sahoo (joined on 08.10.12), Goutam Behera (joined on 08.10.12), Animesh Jana (joined on 06.11.12), Ratan Saha (joined on 24.12.12), Sumanta Ghosh (joined on 28.02.13), Satyabrata Chatterjee, Ramesh Chandra Sarkar, Dipak Dutta, Chotelal Rangwa, Tapan Kr. Banerjee, Jubaraj Paul (Retd. on 01.05.12), Krishna Turi, Sudhir Turi, Khoirul Basar Malla, Nagnarayan Yadav, Kanai Hazra, Prafulla Bhunya, Kanak Baran Hazra, Duryodhan Nayak, Bablu Mandal, Sukanta Chakraborty, Subrata Banerjee, Ranjit Das, Sarada Devi, Sukumar Mandal, Bulaki Das, Jagabandhu Nayak, Jagannath Das.

Main Campus: Tarun Kumar Maji, Rabindra Nath Karmakar (died on 17.05.12), Chandra Kanta Sasmal, Sanat Kr. Dey, Mahendra Nath Shee, Madhusudhan Marick, Sanat Kr. Dhara, Kalicharan Turi, Munna Turi, Kodan Das, Rajbrat Ram, Rajkumari Balmiki, Tapas Chakraborty.

Acharya J.C. Bose Biotechnology Innovation Centre (Madhyamgram Experimental Farm)

Faculty: Dr. S. Raha (Director & Chairman), Dr. P. K. Saha (Consultant Scientist & Executive Chairman), Dr. S. K. Dutta (CSIR-ES, Project terminated on 31.01.2013)

Staff members (Lab.): Mr. Asis Kumar Dalal, Mr. Atanu Deb (Joined on 24.12.12), Dr. Gargi Biswas (Resigned on 18.06.12), Dr. Saurav Bhattacharya, Dr. Subhendu Bandyopadhyay (Joined on 19.07.12), Dr. Sutapa Chowdhury (Joined on 05.07.12 and Terminated on 31.01.13), Mr. Bapi Dey.

List of Personnel

Administration

Dr. Sibaji Raha	<i>Sr. Professor & Director</i>
Sri Tushar Kanti Ghorui	<i>Officer on Special Duty (Till 11.06.2012)</i>
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Staff Members : (Field) : Mr. Pulak Kumar Roy, Mr. Subhas Senapati (Superannuated on 28.02.13), Mr. Raj Kishore Lenka, Mr. Rabin Talukdar, Mr. Laxmi Kanta Pradhan, Sk. Inal Ali, Mr. Bhanu Kisku, Mr. Mahesh Dasgupta.

Biochemistry Department

Faculty : Dr. B. Bhattacharyya (Raja Ramanna Fellow), Dr. Pinakpani Chakrabarti, Sr. Professor, Dr. Rajagopal Chattopadhyaya, Professor, Dr. Ajit Bikram Datta, Assistant Professor and Wellcome Trust-DBT India Alliance Intermediate Fellow, Dr. Pradip Kumar Parrack, Professor, Dr. Anuradha Lohia, Sr. Professor & Chairperson, Dr. Srimonti Sarkar, Associate Professor, Dr. Subrata Sau, Associate Professor, Dr. Pratima Sinha, Sr. Professor (Retd. on 30.11.2012).

Students/RA/Project Assistant : Dr. Tanaya Chatterjee, Dr. Snehasish Basu, Shri Soumyananda Chakraborty, Shri Himadri Biswas, Shri Jaspreet Singh Grewal, Shri Sandeepan Sengupta, Shri Amritanshu Chakraborty, Shri Abhishek Sinha, Shri Biswanath Jana, Shri Abinit Saha, Shri Abhishek Mondal, Ms. Aditi Ghosh, Ms. Aritrika Pal, Ms. Gopa Dhar, Ms. Sumana Banerjee (upto 31.10.12), Shri Somnath Datta, Ms. Sayani Sarkar, Shri Aditya Prasad Behera, Shri Sukhendu Mondal, Ms. Prerana Agarwal, Ms. Indrani Kar, Ms. Devlina Chakraborty, Shri Anindya Biswas, Shri Biswanath Jana (upto 28.02.13), Dr. Arumay Pal (upto 30.06.12), Ms. Sayantani Chowdhury (from 01.06.12), Shri Shankari Prasad Datta, Shri Soumitra Polley (from 07.08.12), Ms. Nabanita Saha (from 02.07.12), Ms. Atrayee Ray (from 15.11.12), Ms. Shamila Sarwar (from 02.07.12).

Staff Members : Shri Durga Charan Das (Retd. on 30.09.2012), Shri Ashim Kumar Banerjee, Shri Subhash Chakraborty, Shri Asim Kumar Poddar, Ms. Debarati Kanjilal, Md. Asrafali Molla, Shri Basudev Ghorui, Shri Dulal Chandra Mondal, Ms. Ranubala Das, Shri Atanu Pramanik, Shri Tuhin Saha (from 11.01.2013).

Bioinformatics Centre

Faculty: Dr. Pinakpani Chakrabarti, Sr. Professor & Scientist-In-Charge, Dr. Tapash Chandra Ghosh, Professor, Deputy Co-coordinator, DBT, BIC, Dr. Shubhra Ghosh Dastidar, Asstt. Professor, Dr. Zhumur Ghosh, Faculty Fellow, Dr. Sudipto Saha, Scientist.

Students /RA /Project Assistant : Sucharita Dey, Debarati Mukherjee, Arup Panda, Deeya Saha, Jyotirmoy Das, Kakoli Biswas, Kamalika Sen, Soumita Poddar, Tina Begum, Debarun Acharya, Sandip Chakraborty, Sarmistha Majumdar, Atanu Maity, Perna Priya, Ranjan Kr. Maji, Arijita Sarkar, Sohini Chakraborty, Jesmita Dhar, Debashree Sarkar, Tonmoy Jana, Sarmistha Majumdar.

Staff Members : Tushar Kanti Bhattacharya, Sujata Roy, Sanjib Gupta, Jibananda Mondal.

Biophysics Department

Faculty : Dr. Gautam Basu, Professor, Dr. Anirban Bhunia, Assistant Professor, Dr. Subhrangsu Chatterjee, Ramanujan Fellow, Dr. Debjani Roy, Assistant Professor, Dr. Manju Roy, CSIR-Emeritus Scientist

Students/RA/Project Assistant : Dr. Tulika Chakraborty, Dr. Aparajita Pal, Saumya Dasgupta, Himal Ganguly, Madhurima Das, Sarbani Chattopadhyay, Nipa Chongdar, Paulami Chatterjee, Anirban Ghosh, Jagannath Jana, Rajib Kumar Kar, Aritreyee Datta, Soma Mondal

Staff Members : Basudeb Marick, Barun Majumder, Sudhir Turi, Swapan Jogsharma, Tanmay Debnath

Chemistry Department

Faculty : Dr. Joyoti Basu, Sr. Professor & Chairperson (from 1.3.12), Dr. Suman Kr. Banik, Asstt. Professor, Dr. K. P. Das, Sr. Professor, Dr. Pradip Das, Professor, Dr. Manikuntala Kundu, Sr. Professor, Dr. Jayanta Mukhopadhyay, Asstt. Professor, Dr. Soumen Roy, Asstt. Professor

Students/RA/Project Assistant : Joyes De, Shreya Sengupta, Srijon Kaushik Banerjee, Shamba Gupta, Chandreyee Datta, Victor Banerjee, Ranjit Kr. Prajapati, Ranjit Kumar, Paulami Rudra, Arnab Bandopadhyay, Soumyajyoti Banerjee, Manish Kumar, Anshul Chawla (9.11.2012), Sanjoy Kr. Sahoo, Siddhartha Mukherjee, Rajdeep Kaur Grewal, Saptarshi Sinha (joined on 15.11.2012), Mandavi Kumari, Arijita Subuddhi (joined on 17.05.12), Ayan Chatterjee, Shankhadeep Banerjee, Ananya Chatterjee, Arun Kr. Sharma, Dr. Sujit Roy (joined on 07.03.13)

Staff Members : Dr. Aniruddha Aich, Nikhilesh Roy Ghatak, Pranab Kr. Dey, Tapas Ghosh, Dipak Chandra Konar, Rama Chatterjee, Amarnath Bhatta, Gaurab Kr. Roy, Mrityunjoy Kundu, Subhas Chandra Paul, Asoke Kr. Maity, Sachchidanand Ram.

Central Instrumentation Facility

Faculty : Dr. Sujoy K. DasGupta, Professor & In Charge (Cent. Bldg.), Dr. T. P. Sinha, Professor & In Charge (Main Campus), Dr. Banabihari Giri (Ramanujan Fellow)

Staff Members (Cent. Campus) : Jaganmay Guin, Jaideb Chattopadhyay, Ranjan Kumar Dutta, Smriti Ranjan Maji, Mrinal Das, Swaroop Biswas, Sheolee Ghosh Chakraborty, Amarendra Nath Biswas, Pallab Chakraborty, Alpana Bhattacharya.

Staff Members (Main Campus) : Gobinda Das (Upto 30-06-2013), Arup Kumar Sen, Subhas Chandra Maikap (Upto 30-06-2012), Samir Mukherjee, Prodip Karmakar, Tanima Modak Dhar, Ranjit Ghosh, Debabrata Polley, Shankar Santra, Sarwasati Sarkar.

Division of Molecular Medicine

Faculty : Dr. Kaushik Biswas, Assistant Professor, Dr. Tanya Das, Professor, Dr. Kuladip Jana, Scientist-C, Dr. Atin Kumar Mandal, Assistant Professor, Dr. Nripendranath Mandal, Associate Professor, Dr. Subrata Majumdar, Professor, Dr. Anup Kumar Misra, Associate Professor, Dr. Mahadeb Pal, Associate Professor, Dr. Arun Kr. Ray, Emeritus Scientist, Dr. Manju Ray, Emeritus Scientist, Dr. Gaurisankar Sa, Professor, Dr. Parimal C. Sen, Senior Professor & Head, Dr. Parames Ch. Sil, Professor.

Students/RA/Project Assistant : Pinki Nandi, Swatilekha Ghosh, Argha Adhikari, Abhijit Sarkar, Parna Bhattacharya, Kirti Kajal, Argha Manna, Nikhil Baban Ghate, Supriya Chakraborty, Joyita Hazra, Joydeep Roy, Manjari Kundu, Dr. Anamika Bose, Anupam Adhikari, Bibhabasu Hazra, Jyotirmoy Ghosh, Joydeep Das, Saikat Majumdar, Shravanti Mukherjee, Gautam Guchhait, Abhishek Santra, Pabitra Bikas Pal, Sayantan Banerjee, Abhijit Sau, Poulami Khan, Monoranjan Ghosh, Kuntal Halder, Shibali Das, Barun Mahata, Tamashree Ghosh, Samik Chakraborty, Abir Kr. Panda, Amrita Bhattachajee, Sreeparna Chakraborty, Taniya Saha, Deblina Guha, Soumyadip Paul, Shahana Mitra, Kahkashan Rashid, Somanjana Khatua, Bidisha Paul Chowdhury, Dipankar Chaudhuri, Sourav Dutta, Usri Chakraborty, Ajoy Mallik, Shilpi Saha, Dr. Minakshi Mazumdar, Dr. Santanu Kar Mahapatra, Dr. Amrita Dutta, Dr. Pushpak Bhattacharjee, Dr. Anindita Roy, Dr. Nivedita Roy, Dr. Aparajita Ghosh, Sankhadeep Pal, Krishnendu Sinha, Nihar Ranjan Biswal, Shabina Parveen, Dr. Santanu Biswas, Rhitajit Sarkar.

Staff Members : Pransanta Pal, Indrajit Ray, Sukumar Maitra, Barindra Nath Mandal, Prabal Kr. Gupta, Uttam Kumar Ghosh, Arindam Basu, Debasish Majumdar, Shanghamitra Das (Sahu), Sourav Samanta, Kalyan Das, Amartya Sen, Ranjit Das, Purnendu Manna, Shankar Prasad Bari, Kanan Singh, Sudhir Turi, Pradip Kr. Mallick (LA-MoES Project).

Division of Plant Biology

Faculty (Cent. Campus) : Dr. Debabrata Basu, Assoc. Professor, Dr. Shubho Chowdhuri, Asstt. Professor, Dr. Sampa Das, Sr. Professor & Head, Dr. Pallob Kundu, Asstt. Professor, Dr. A.N.

Lahiri Majumder, Raja Ramanna Fellow, DAE, Dr. Amita Pal, Sr. Professor (CSIR Emiretus from 01.03.2013), Dr. S.R. Sikdar, Professor. *Staff Scientist* :- Dr. Sonali Sengupta (DBT Project)

Faculty (Main Campus) : Dr. Gourab Gangopadhyay, Asstt. Professor , Dr. T.K. Ghose, Assoc. Professor , Dr. P. K. Saha, Consultant Scientist, Dr. D.N. Sengupta, Sr. Professor, Dr. Swati Sen-Mandi, Emeritus Medical Scientist, ICMR, Dr. Swati Gupta-Bhattacharya, Professor

Students/RA/Project Assistant : (Cent. Campus) : Dr. Saswati Sengupta, Dr. Srirupa Das, Dr. Shubhendu Bandopadhyay, Dr. Rajeswari Mukherjee, Dr. Sumanti Gupta, Dr. Niranjana Behura, Dr. Nilanjana Banerjee, Dr. Sourav Bhattacharya, Dr. Gargi Biswas (Saha), Dr. Santosh Kumar, Ms. Lekha Bandopadhyay, Mrs. Rumdeep K. Grewal, Shri Subrata Kundu, Shri Anirban Kundu, Ms. Anindita Sengupta, Shri Mrinmoy Majunder, Shri Amit Roy, Shri Pijush Mullick, Ms. Suparna Ghosh, Ms. Arpita Bala, Ms. Sritama Mukherjee, Shri Ayan Das, Shri Anirban Jyoti Debnath, Ms. Monia Chatterjee, Shri Anirban Bhar, Shri Prithwi Ghosh, Shri Arunava Mondal, Shri Anindya Bhattacharya, Ms. Upala Saha, Ms. Deepti Sarkar, Ms. Jayanti Joddar, Shri Dipan Roy, Ms. Adrita Roy, Shri Amit Paul, Ms. Senjuti Sen, Shri Joydeep Chakraborty, Ms. Papri Basak, Ms. Anju Patel, Shri Sourav Bose, Ms. Payel Bhattacharya, Ms. Sayani Dey, Ms. Payel Ganguli, Ms. Amrita Mukherjee Ganguli, Ms. Banani Mondal, Ms. Sefa Parveen, Ms. Poulami Sarkar, Mrs. Sanghamitra Adak, Ms. Dipannita Mitra.

Students/RA/Project Assistant : (Main Campus) : Dr. Sangita Dey, Dr. Harshata Pal, Ms. Basabdatta Das, Shri Himadri S. Chakraborty, Shri Bodhisattwa Saha, Shri Tathagata Nath, Shri Vivek Arora, Shri Sankar Bakshi, Ms. Sayantani Sihi, Ms. Marufa Sultana, Ms. Debarati Dey, Ms. Kavita Ghosal, Ms. Bipasha Roy, Shri Gaurab Sircar, Shri Subhabrata Ghosh, Shri Shekhar Ghosh, Ms. Ranjana Prasad, Ms. Basabdatta Das, Ms. Niti Yashvardhini, Shri Arup Samanta, Ms. Nandini Ghosh, Shri Debmalaya Dasgupta, Shri Susanta Chatterjee - (Resigned w.e.f. 18.12.12), Arup Nayak- (Resigned w.e.f. 07.02.13).

Staff members (Cent. Campus) : Mrs. Puspita Mukherjee, Shri Ashim K. Nath, Shri Subal Basak, Shri Binoy K. Modak, Shri Jayasish Ghosh, Shri Motilal Singh, Shri Arup K. Dey, Shri Nadiram Kayal, Shri Birendra K. Bari, Shri Sashanka S. Bera, Shri Sudipta Basu, Shri Uttam Das, Shri Swarnava Das, Shri Abhishek Mukherjee, Ms. Srabani Sen, Shri Bapi Dey and Shri Niladri S. Roy, Mrs. Debapriya Chattopadhyay, Ms. Kakoli Mondal.

Staff Members (Main Campus) : Dr. Ramit Poddar, Shri Sukumar Majumdar, Shri Chanchal Chakraborty, Shri Jadab Kr. Ghosh, Mrs. Kaberi Ghosh, Ms. Chaitali Roy, Shri Bipul Kr. Nag, Shri Siddhartha Roy, Mrs. Sarama Pradhan, Mrs. Moumita Mondal,

Environmental Science Section

Faculty : Dr Abhijit Chatterjee, Faculty Fellow, Dr. Sibaji Raha, *Sr. Professor, Head & Director,*

Students : Chirantar Sarkar (JRF)

Staff Members : Anandamay Adak, Saral Chandra Das, Bhaskar Roy (IRHPA Project), Miss Debolina Seal (IRHPA project)

Falta Experimental Farm

Faculty : Dr. S.R. Sikdar (Division of Plant Biology), *Professor & Coordinator Rural Biotechnology Programme,* Dr. K.K. Mukherjee (Consultant and resource person).

Staff Members : Shri Sobhan Roy Chowdhury (Senior Technical Assistant on contract), Shri Debarshi Porel & Shri Shuvankar Roy (both are Technicians on contract), Sk. Ansar Ali (Helper-G)

Microbiology Department

Faculty : Dr. Sujoy K. Dasgupta, *Professor,* Dr. Tapan K. Dutta, *Assoc. Professor,* Dr. Wriddhiman Ghosh, *Faculty Fellow,* Dr. Sibaji Raha, *Director & Chairman*

Students : Sri Boudhyan Bandhopadhyay (upto 30/9/12), Sm. Joyita Sarkar (31/8/12), Sri Debajyoti Ghosal, Sm. Priyanka Bhowmick, Pratick Khara, Sri Prithwiraj Kirtania, Sm. Piyali Pal Chowdhury, Sm. Soumita Dutta, Masrura Alam, Sm. Shreya Ghosh, Sri Soumik Basu, Sri Arindam Dutta, Sri Prasenjit Pyne, Sri Sourav Samaddar, Sm. Soniya Chatterjee, Dr. Joydeep Chakrabarty, Sri Chayan Roy, Sm. Niketa Bhawsinghka, Sm. Neha Gupta (from 6/7/12)

Staff Members : Biswanath De Sarkar, Provat K. Chattopadhyay, Saifullah Gazi, Debashis Sarkar, Prabir Halder, Dilip Bhattacharyya, Ramesh Prasad, Robin Paul, Narayan Patali.

Physics Department

Faculty : Dr. Sibaji Raha, *Sr. Professor, Director,* Dr. Indrani Bose, *Sr. Professor,* Dr. Dipankar Home, *Sr. Professor & Chairman,* w.e.f. 01.02.2012, Dr. Barun Kumar Chatterjee, *Sr. Professor,* Dr. Swapan Kr. Saha, *Professor,* Dr. Tripurari Prasad Sinha, *Professor,* Dr. Sanjay Kumar Ghosh, *Professor,* Dr. Somshubhro Bandyopadhyay, *Asstt. Professor,* Dr. Amitabha Mitra, *Associate Professor,* Dr. Dhruva Gupta Gupta, *Asstt. Professor,* Dr. Rajarshi Ray, *Asstt. Professor,* Dr. Supriya Das, *Asstt. Professor,* Dr. Achintya Singha, *Asstt. Professor,* Dr. Partha S. Joarder, *Associate Professor,* w.e.f. 21.09.2012.

Students/RA/Project Assistant : Dr. Alo Dutta, Dr. Sumana Chakraborty, Dr. Anindita Banerjee, Dr. Rupa Sarkar, Dr. Binita Ghosh, Mr. Anirban Lahiri, Ms. Sarbani Majumder, Mr. Amit Kumar Pal, Ms. Sayantari Ghosh, Mr. Sayan Biswas, Ms. Sudipa Upadhyay, Mr. Soumitra Maity, Mr. Subhasis Samanta, Mr. Kinkar Saha, Rama Prasad Adak, Mr. Sujoy Saha, Mr. Sadhan Chanda, Ms. Dipanwita Majumder, Mr. Mainak Pal, Anup Pradhan, Dyutima Das, Mr. Saswata Haldar, Mr. Shib Shankar Singha, Mr. Saronath Halder, Mr. Prasenjit Deb.

Staff Members : Mr. Sankar Prasad Singha, Mr. Shyamsundar Mallick, Dr. Subhasis Banerjee, Mr. Manas Dutta, Mr. Subrata Das, Mrs. Rita Chakraborty, Mr. Sujit Basu, Mr. Kaushik Maiti, Mr. Sumanta Ghosh, (joined w.e.f. 12.03.2013), Mr. Bonsi Dutta, Mr. Rajkumar Mourya, Mr. Amarnath Hela.

DRDO Project SMS : Scientist-“B”: Mr. Soumendra Singh, Mr. Vineet Surana, Mrs. Ayona Chakraborty, Consultant (Administration): Mr. Arun K. Dasgupta, Technical Assistant: Mrs. Sarmistha Saha, Mr. Abhirup Biswas, Mr. Bikram Mahatha.

IRHPA PROJECT : Research Scientist: Dr. Partha Sarathy Joarder, (upto 20.9.12), Dr. Ajay Kumar Singh, Dr. Sandhya Dey (Mandal), Shri Soumendra Singh (w.e.f. 07.02.2013), Research Associate: Dr. Atanu Maulik, JRF: Mr. Rupamoy Bhattacharyya, Mr. Shyam Bihari Mehta, Mr. Avik Banerjee, Technical Assistant: Mrs. Sumana Singh, Mr. Bhaskar Roy, Mr. Bivek Gurung, Mr. Sabyasachi Majee, Ms. Debolina Seal.

J. C. Bose Centre (Publication and Museum)

Faculty : Dr. Sibaji Raha, Director & Chairman, Dr. K K Mukherjee (Consultant/Advisor)

Staff Members : Tarun Kumar Maji, Chandra Kanta Sasmal

Library

Faculty : Dr. Arun Kumar Chakraborty, **Librarian**

Staff Members : Shri Samir Kumar Pal, Shri Pradip Kumar Sarkar, Dr.(Mrs.) Banhisikha Chaudhuri, Mrs. Gopa Dasgupta, Ms. Ananya Raha, Ms. Sumita Dey, Shri Gautam Mukherjee, Shri Sarat Chandra Bhuiyan, Shri Mrityunjoy Jogsharma, Shri Arun Nandi, Shri Dinanath Das.

Workshop

Mr. Raju Chandra Paul, Workshop Supdt. (joined on 30th October, 2012)

Main Campus : Sisir Ghosal, retired on 31st March, 2012, Kalachand Sen (retired on 30.04.2012), Ashutosh Sarkar, Samar Dutta, Sk. Md. Ehia Hossain, Basanta kr. Shit, Bholanath Saren, Abdul Rahaman Molla, Panchanan Santra, Panchugopal Karak, Sk. Md. Farruck, W.D. Rozario, Rajkumar Das, Pranab Banerjee, Brahmdeo Prasad, Subrata Basak, Sanjoy Santra, Nageswar Das, Fullchand Sardar and Kissan Das

New Campus : Mr. Ramprasad Ray (Consultant Electrical Engineer) Tapan Mandal, (retired on 31st March, 2012), Ashit Banerjee, Md. Raffick, Murari Mohan Shee, Baidya Nath Murmu



Acharya J. C. Bose and Lady Abala Bose – Mayapuri, Darjeeling, 1933

Statement of Accounts
for the year
2012-2013



Auditors' Report

To the Members of the Council of the Bose Institute, Kolkata

- 1.0 We have audited the attached Balance Sheet of the Bose Institute as on 31st March, 2013 and also the Income and Expenditure Account for the year ended on that date annexed thereto. These financial statements are the responsibility of the management of the Institute. Our responsibility is to express an opinion on these financial statements based on our audit.

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

- 2.0 On the basis of our audit as indicated in paragraph 1.0 above and subject to our Audit Observations (Annexure-I attached herewith) and also subject to our Audit Observations (Annexure-II forming part of our Audit Report of Bose Institute, Indo - FAIR Coordination Centre of P -1/12, C.L.T. Scheme VII M, Kolkata -700054, attached herewith), we report that:
- i. We have obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purpose of our audit.
 - ii. In our opinion, proper books of account as appears from our examination of those books;
 - iii. The Balance Sheet and Income & Expenditure Account dealt with by this report are in agreement with the books of account;
 - iv. The Balance Sheet and Income & Expenditure Account dealt with by this report have been prepared in the specified form as applicable to Central Autonomous

Bodies (NPOs) and in accordance with applicable accounting standards issued by the ICAI, except as stated in our Audit Observations (Annexure -I) attached herewith;

- v. In our opinion and to the best of our information and according to the explanations given to us, the said accounts read with the schedules 1 to 17 enclosed thereto and subject to our comments in Audit Observations above, give the information in the manner so required and give a true and fair view.
 - a) In the case of the Balance Sheet, of the state of affairs of the Institute, as at 31st March, 2013; and
 - b) In case of the Income & Expenditure Account, of the surplus for the year ended on that date.

For M. Saha & Co.
Chartered Accountants

Place : Kolkata

Date : 19th August, 2013

Partner
CA. Debarshi Saha
(Mem No : 061398, FRN : 305135E)

Addendum to Audit Report

We confirm that we have audited the attached Balance Sheet of Bose Institute as at 31st March 2013 and Income & Expenditure Account for the year ended on that date. In our opinion and according to the explanations and documents provided to us, the minor deviations made by the aforesaid reporting institution in relation to presentation of the aforesaid financial statements, as mentioned in our audit observations forming part of our audit report dated 19th day of August, 2013, do not materially affect the true and fair view of the aforesaid financial statements. Further in our opinion the aforesaid deviations in presentation in financial statements in no case affect the propriety of the expenses incurred in the related account heads for the period under our audit i.e. from 01.04.2012 to 31.03.2013.

For M. Saha & Co.
Chartered Accountants

Date : 28.11.2013

Place : Kolkata

Sd/-

Partner

CA. Debarshi Saha
(Mem No : 061398, FRN : 305135E)



Source: *The Philadelphia Press* 30.12.1914

Among the notable figures at yesterday's sessions of the American Association for the Advancement of Science were Dr. Bose, his wife and his assistant, Dr. Sen, all of Calcutta, and Dr. Holmes of the United States National Museum. Dr. Holmes is the official leader of anthropological research in the United States and has been a pioneer in work in Central and South America. Behind him is the model of a prehistoric palace of Yucatan, the "Governor's House", which is regarded as the most important structure of antiquity on this continent. Dr. Bose, his wife and assistant are shown beside a complex machine which Dr. Bose invented for recording the sensitiveness of plants to electricity.

Audit Observations

Annexure-1

1. The Financial Statements of the reporting Institution have been prepared in accordance with the prescribed Form for Central Autonomous Bodies (Non-profit organizations and similar Institutions) except in the following cases -

- i) Depreciation on fixed assets has been shown by way of netting off from Capital Fund instead of charging the same to Income and Expenditure Account as mentioned in the prescribed Form. Depreciation for the year of Rs. 6,23,89,584/- has been shown as deduction from Capital Fund. According to management contention, since Capital expenditure made out of grant money have been charged to Income and Expenditure Account till F.Y. 2011-12 and in F.Y. 2012-13 the Capital Grant portion has been directly credited to Capital Fund, the depreciation has been shown by way of deduction from related fixed assets and correspondingly the same has been deducted from Capital Fund. This system of Accounting which is in accordance with the generally accepted accounting principles has been followed by the management over the years.
- ii) Statutory Liabilities have not been segregated between a) overdue and b) others as required by the Prescribed Form.
- iii) Serial no 7 of the Fixed Assets Schedule (SCHEDULE- 8) of the prescribed form accounts applicable for Central Autonomous Bodies (Non-profit organizations and similar Institutions) account for "Computer/Peripheral" which has not been done and purchases of Computers are shown under "Apparatus & Equipment"
- iv) Segregation of Sundry Creditors between goods and others has not been made and the entire Sundry Creditors for both goods and others have been shown under "Sundry Creditors".

2. **Fixed Assets Register**

No physical verification of Fixed Assets have been made during the year under audit. A sum of Rs. 6,66,57,578.15 has been shown as Institute Development and Modernization Fund Investment in Fixed Assets under Schedule 05 of "Investment from Earmarked Funds" and we have been told by the management that Fixed Assets were purchased during the year 1991-92 and subsequent years out of Grant received from Planning Commission, Government of India and since then the said amount has been carried forward as investment. The management of the reporting institution has been able to make a list of such Fixed Asset acquired, however as the same has not been identified and

valued till date. We have been further told by the management that many of the items of such fixed assets have either reached their salvage value or might have been disposed off. In the absence of Fixed Assets Register and identification marks on the fixed assets, these assets could not be identified and hence could not be capitalized. Moreover in the absence of proper identification, physical verification and valuation by approved valuer of the Fixed Assets in hand, provision for impairment could not be estimated and hence not accounted for. According to management's verbal representation, the attempts made for the preparation of Fixed Assets Register did not yield fruitful results. The management of the reporting institution has already issued tender for appointment of an external agency to identify the Fixed Assets and thereafter prepare a Register showing necessary details with proper value. Moreover, Assets purchased out of grants for different Projects were shown under the head "Projects" and not taken in total Fixed Assets Schedule on the plea that those Fixed Assets do not belong to the Institute and will be accounted for only on termination of the Project. In the absence of Fixed Assets Register for the Projects those fixed assets could not be identified.

3. Contingent Liability :

According to management written representation, there are no money suits filed against the Institution as on date and hence the question of provision of Contingent Liability does not arise.

4. Stale Cheques :

A sum of Rs. 5,06,263.75 is being carried forward since 2010-11. The management is advised to review the corresponding expenses and find out which are not payable at all and necessary reversal entries need to be passed.

5. Advances:

Included in Total Other Advances in Schedule 07 of Rs. 95.83 Lacs, there are balances including Bank Suspense of Rs. 46,029.90 which have been brought forward for more than 3 years, The management of the Institution is advised to make a detailed study of such unadjusted advances and thereafter determine whether they at all subsist or not.

6. Insurance on House Building Loan:

Insurance covers of the building or flats purchased out of House Building Loans taken by staff were not available for verification.

7. Pension & Provident Fund:

No trust deed of the Bose Institute Pension Fund, Contributory Pension Fund and General Provident Fund were available for verification. There is no structured Investment Plan for the aforesaid Funds and investments have been kept with Banks Fixed Deposits.

8. Import of Equipment in Progress:

Out of total work in progress of Rs. 16,88,51,846/- as on 31.03.2013, Rs. 17,79,092/- involves import of equipment in progress. Again out of such Rs. 17,79,092/-:

- i. Rs. 3,64,182/- pertains to balance brought forward since last year for which no necessary details were produced. It is not ascertainable whether such Equipments have actually been received or not. The management is advised to take necessary action as the same balance is being brought forward for years. Necessary provision for loss needs to be made after verification is completed.
- ii. Rs. 14,14,910/- was shown as addition in Import of Equipment in Progress for the year under audit for which the necessary details are enlisted below:

Name of the Supplier	Description of Equipment	Price in US Dollars/ Euro/Yen	Price in Indian Currency (Rs)	L/CNo.	L/C date	Date of actual receipt by Bose Inst.
M/s.GE Healthcare Bio-Sciences Ltd, Hong-Kong	Spares of GE Micro Cal VP-ITC	\$ 12,714	6,85,152	Wire Transfer	15-01-2013	06-05-2013
M/s. Simag Div Della Frimont SpA Italy	Ice Flaker Machine	€ 2,950	2,10,122	Wire Transfer	22-03-2013	06-05-2013
M/s. CA. EN. SpA Italy	4 Channels NIM Programmable Power (Type V 1470)	€ 3,955	2,80,624	Wire Transfer	25-03-2013	18-05-2013
M/s. ET Enterprise Limited UK	PMTwith Mumetal Shield and encapsulated voltage divider	€ 2,866	2,39,012	Wire transfer	22-03-2013	06-05-2013
TOTAL			14,14,910/-			

The expenditure in relation to the above equipments have been considered as expense for the current period under audit as the funds have been transferred to the foreign suppliers within the year and the events occurring after the Balance Sheet date confirm the actual import. Moreover the same accounting policy is being followed by the reporting Institution consistently over the years.

9. Gratuity :

Gratuity has been accounted for on cash basis on actual payment which is in contrary to AS-15 issued by the Institute of Chartered Accountants of India. No approved Gratuity Fund has been set up and no provision for Gratuity has been made during the year under audit. In the absence of actuarial valuation the provision for Gratuity required for the year and the total liability as 31, March 2013 could not be ascertained.

10. Unreconciled Bank Balances:

A sum of Rs. 46,029.90 (Dr.) included in Loans, Advances and other assets of Rs. 95,82,901.81 (Sch-7 : Council) and Rs. 6,04,388 (Cr.) included in Total other liabilities of Rs. 85,08,549.53 (Sch-3 : Council) have been shown under the head "Bank Suspense A/c" and " Bank Suspense Project A/c" respectively which are pending for reconciliation for years. The management is advised to take expeditious measures and adjust the same at the earliest.

11. Current Liabilities:

Out of total Current Liabilities of Rs. 73,33,23,022.55 in Sch - 3, balances of Rs. 56,27,008.88, Rs. 16,29,247.13 and Rs. 24,00,000/- shown as Terminated Scheme and Fellowship, Terminated Consultancy Project and RSIC respectively under balance payable. These balances have been brought forward for more than 3 years without any adjustment. The Finance Committee of the reporting institution should review these balances in these accounts and determine whether it would be expedient to appropriate such balances.

12. Balance Confirmation:

Balances lying in Sundry Creditors for Goods and services of Rs. 95,42,739/- (Council + Governing Body) are subject to confirmation from respective parties which were not yet available on record.

13. Internal Audit :

The reporting institution has an in-house Internal Audit Department, but the scope and power of the Internal Auditor could not be judged in the absence of any report. Keeping in view, the size, nature and complexity of the activities of the Institute, we recommend an Internal Audit Policy and scope be immediately defined and that the Internal Audit Department should be properly constituted so as to make the Internal Audit more meaningful and effective.

14. Stock Verification:

The Institution has a practice of charging the whole expenditure on account of purchase of consumables, chemicals etc in its revenue account in the year in which the

expenditure is met. This system of accounting has been consistently followed by the Institution over the years. However in reality, at the year end there remains a stock of consumables, chemicals etc. which are never accounted or reflected anywhere in the financial statements. According to management written contention, the nature, size and practical problems in physical identification and measurement of chemicals makes the process of physical verification of stock impossible. This contention of the management is not acceptable in totality as normal / abnormal losses in stock of consumables and chemicals are never identified or reflected. In our opinion, the stock of Consumables, chemicals etc should be independently verified by a team of Internal Auditors together with technical experts / Project Heads at the year-end (to the extent feasible) and thereafter be reflected in the notes to the accounts with valuation thereof which shall be a more realistic presentation of the financial statements and shall also ensure a reasonable check on stock holding.

For M.Saha & Co.
Chartered Accountants

Place:Kolkata

Date:19th August,2013

Partner
CA.Debarshi Saha
(Mem No:061398,FRN:305135E)

**BOSE INSTITUTE
KOLKATA**

BALANCE SHEET AS AT 31ST MARCH, 2013

(Amount in ₹)

	Schedules	As At 31.03.2013	As At 31.03.2012
CAPITAL FUND AND LIABILITIES			
CAPITAL FUND	1	586,618,616.56	432,238,760.01
EARMARKED FUNDS	2	162,147,241.16	150,319,387.32
OTHER FUNDS	2A	245,496,143.75	204,968,393.43
CURRENT LIABILITIES	3	733,323,022.55	241,284,922.41
TOTAL		1,727,585,024.02	1,028,811,463.17
ASSETS			
FIXED ASSETS	4	604,972,537.40	450,958,548.85
INVESTMENTS-FROM EARMARKED FUNDS	5	139,817,163.95	107,301,161.56
INVESTMENTS- OTHERS	6	237,181,649.42	196,340,572.10
CURRENT ASSETS, LOANS, ADVANCES ETC.	7	745,613,673.25	274,211,180.66
TOTAL		1,727,585,024.02	1,028,811,463.17
SIGNIFICANT ACCOUNTING POLICIES	16		
NOTES ON ACCOUNTS	17		

Place : Kolkata

Date : 19th August, 2013

Signed in terms of our separate
Report of even date.

Sd/-
(S.Panigrahi)
Registrar

Sd/-
(Prof. S.Raha)
Director

Sd/-
(Subir Sen)
Accounts Officer

For M Saha & Co.
Chartered Accountants

Sd/-
(P.C.Das)
Audit & Finance Officer

Sd/-
(Umesh)
Accounts Officer

Sd/-
(A. Mukherjee)
Accountant

BOSE INSTITUTE
INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31.03.2013

(Amount in ₹)

	Schedules	For the year ended 31.03.2013	For the year ended 31.03.2012
INCOME			
Income from Services	8	8,568,041.00	7,858,633.00
Grants	9	478,710,000.00	517,000,000.00
Interest Earned	10	28,327,789.33	7,719,026.88
Other Income	11	1,098,818.08	359,933.00
TOTAL (A)		516,704,648.41	532,937,592.88
EXPENDITURE			
Establishment Expenses	12	354,618,532.00	295,904,606.76
Other Administrative Expenses	13	75,518,262.68	63,404,989.59
Laboratory Expenses.	14	73,795,029.20	52,994,883.46
Fund for Capital Expenditure	15	0.00	86,214,666.90
TOTAL (B)		503,931,823.88	498,519,146.71
BALANCE (A-B) BEING SURPLUS/ DEFICIT (-) FOR THE CURRENT YEAR		12,772,824.53	34,418,446.17
TRANSFER TO FUND FOR OTHER DEVELOPMENT		-4,200,832.00	-13,000,589.00
CARRIED FORWARD FROM PREVIOUS YEAR: DEFICIT (-)		19,000,662.64	-2,417,194.53
CAPITAL EXPENSES MET OUT OF UNSPENT GRANT OF PREVIOUS YEAR		-14,892,961.55	0.00
CARRIED TO CURRENT LIABILITIES UNDER THE HEAD PAYABLE AS UNSPENT GRANT		12,679,693.62	19,000,662.64
SIGNIFICANT ACCOUNTING POLICES	16		
NOTES ON ACCOUNTS	17		

Place : Kolkata

Date : 19th August, 2013

Signed in terms of our separate
Report of even date.Sd/-
(S.Panigrahi)
RegistrarSd/-
(Prof. S.Raha)
DirectorSd/-
(Subir Sen)
Accounts OfficerFor M Saha & Co.
Chartered AccountantsSd/-
(P.C.Das)
Audit & Finance OfficerSd/-
(Umesh)
Accounts OfficerSd/-
(A. Mukherjee)
Accountant

Significant Accounting Policy

Annexure-16

1.0 General:

The accompanying financial statements have been prepared on historical cost convention and conform to the fundamental accounting assumptions.

2.0 Fixed Assets:

The fixed assets of the Council are valued at cost of acquisition with the directly attributable expenses for putting the assets into use for operation of the Institute. The fixed assets of Terminated Projects are also valued at cost.

3.0 Depreciation:

3.1 Depreciation on Councils fixed assets has been incorporated in accumulated net balances as on 1990-91 and subsequent additions till 2011-12. The total depreciation upto 31st March 2012 has been deducted from the Capital fund of the Institute.

3.2 The depreciation is calculated on Written Down Value Method as per the following rates irrespective of dates of putting the same in use:

- i. Building -10%
- ii. Equipment -15%
- iii. Books & Journals -10%
- iv. Furniture -10%
- v. Vehicles -15%
- vi. Air Conditioner -10%
- vii. Electric Installation -10%
- viii. Internet - 60%

4.0 Revenue Recognition:

4.1 All incomes other than Government Grant and Bank Interest are accounted for on cash basis. Govt. Grants are accounted for on accrual basis provided the order sanctioning the Grant is received before the end of the financial year.

- 4.2 The Institute has a system of accounting in respect of expenses for items like Salary, Gratuity, Leave Salary, Rates & Taxes etc. on cash basis. Liabilities for amount payable to suppliers for materials and services are accounted for on accrual basis.
- 4.3 Consumable Stores are charged to expenditure for purchases.
- 4.4 Revenue expenditure on Scheme/Project and the specific grant therefore are recognised in the accounting period in which the corresponding expenditure and grant arise.
- 4.5 Government Grants received during the year are shown in the Income & Expenditure Account and surplus/deficit during the current year is reflected in the Balance Sheet.

5.0 Retirement/Post Retirement Benefits:

- 5.1 The Institute has General Provident Fund, Contributory Provident Fund and Pension Schemes.
- 5.2 Leave encashment, Gratuity, Provident Fund Contribution and Pension are accounted for on cash basis.

6.0 Earmarked Funds:

Earmarked Funds shall be treated as a liability on their creation.

Income on investments out of Earmarked Fund is recognised and credited to Earmarked Fund wherever accrued. Any expenditure of a revenue nature which is incurred specifically on selected Scheme/Project is charged to the relevant Earmarked Fund.

7.0 Foreign Currency Transactions:

Transactions in foreign currency are recorded at the exchange rate applicable on the date of transaction.

8.0 Research and Development Costs:

Research and Development costs are charged to the Income & Expenditure Account for the year in which these are incurred.

Sd/-
(Umesh)
Accounts Officer

Sd/-
(A. Mukherjee)
Accountant

For M Saha & Co.
Chartered Accountants

Notes on Accounts

Schedule: 17

1.0 Accounting System

The Statement of Accounts has been drawn in the specified form applicable to Central Autonomous Bodies (NPOs) and Similar Institutions. The Balance Sheet has been drawn by consolidating Statement of Accounts of Council and the Governing Body with schedules thereon without incorporating the consolidated transactions in the Income and Expenditure Account. Further, the transactions of the Governing Body have not been incorporated in the books of Council. This principle of accounting has been consistently followed from year to year.

2.0 Fixed Assets

2.1 Land at Madhyamgram

The Institute got possession of 18.73 acres out of 40.99 acres land allotted for Experimental Farm by Govt. of West Bengal. The Governing Body of the Institute decided on 31.07.1989 not to claim the balance land in dispute from the Government considering other related factors.

2.2 Fixed Asset Register

Institute has decided to appoint external agency to identify and prepare Fixed Asset Register and has already advertised for expression of interest from suitable and interested firms/valuer vide Tender No. BI/T/EOI/03/2013-14 dt. 31.7.2013. Assets acquired from the Institute Development and Modernisation Fund (provided by Planning Commission) has been classified but not identified and yet to physically verified. Depreciation on such asset has not been provided. Fixed Asset Regional Sophisticated Instrumentation Centre (RSIC) for which Register has not been maintained. Physical verification of fixed assets has not been carried out. There were no activities during financial year under audit and depreciation has not been provided for.

2.3 Work-in-Progress

The particulars of fixed assets, under construction/installation are given in Schedule: 04.

2.4 Import in Progress

Import in Progress has been amounted for on the basis of bank advice on the date of actual payment.

2.5 Valuation of assets

- a. The valuation of Fixed Assets has been made at cost less depreciation for the years 1990-91 till date.
- b. The assets related to terminated projects have been identified up to 2005-06. Further identification of the assets relating to the years 2006-07 to 2012-13 is in progress.
- c. The identification of assets, impaired if any, as required in AS-28 issued by ICAI, has not been done.

3.0 Grants-in-Aid

- 3.1. During financial year 2012-13, Grant-in-Aid for Council has been received under the head General, Salaries and Capital, Grant-in-Aid under General and Salaries have been treated as revenue grant. Out of Unspent Grant of Rs. 1,90,00,662.64 of previous year Rs. 1,48,92,961.55 have been used for the Capital Expenditure during the year.
- 3.2 Stipend payable to Research Scholars under Sponsored Project Account is treated on Cash basis, while other expenses are treated on accrual basis.
- 3.3 Net excess of receipts over expenditure of grants-in-aid schemes, sponsored by various agencies are represented in bank balances.

4.0 Staff Benefits

The interest on loans, being recoverable after realisation of principal amount is accounted for as and when it becomes receivable and the said interest is credited to the House Building Advance Fund. This is done as per Central Govt. Guidelines.

5.0 System of Fund Accounts

- 5.1 The suggestion of Jt. Secretary and F.A. Dept. of Science and Technology, Govt. of India in the Finance Committee meeting held on 24.09.1996 for managing the Provident Fund through Trust Committee is yet to be implemented.

5.2 Although by virtue of the provision 9 of the Bose Institute Employees Pension Scheme Regulations approved by the Dept. of Science and Technology, Govt. of India and Rule 3.3 of the Bose Institute Contributory Provident Fund Rules, the Pension Fund, General Provident Fund and Contributory Provident Fund vest with the Bose Institute, separate Statement of Account with Income and Expenditure Account & Balance Sheet in respect of these three funds are annexed herewith.

6.0 Advances

A sum of Rs. 26,16,921/- included under "Advance Council" is shown in the Balance Sheet under the head Advances (Schedule-7) which include a sum of Rs.6,61,334/- pending recovery/adjustment prior to 2010-11 out of which Rs. 3,18,957/- has already been adjusted during the financial year 2013-14.

7.0 Contingent Liability

Legal expenses include the cost to defend the court cases lodged against the Institute; contingent liability for such cases is not ascertained.

8.0 Change in Accounting Policy

Annual Subscription for access of online journals was being booked under the head Books and Journals. During the Financial Year 2012-13 such annual subscription has been charged to Income & Expenditure Account but no effect has been given for previous years. Upto the financial year 2011-12 there was no bifurcation between capital and revenue grant and the entire grant received during the year was credited to Income and Expenditure Account as income and the related capital expenditure, if any, was debited to Income and Expenditure Account as capital expenditure met out of revenue grant. However, in the financial year 2012-13 the grants were separately bifurcated between capital and revenue portion by the granting authorities and the grant for revenue expenses was accordingly credited to Income and Expenditure Account while grant for capital expenses were credited to fund directly.

During the financial year 2012-13 capital expenses were made out of Capital fund and such. Question of debiting Income and Expenditure Account for capital expenses met out of revenue income did not arise. The effect of this change in Accounting Policy as compared to earlier years could not be ascertained as previous years' grants did not contain necessary bifurcation.

9.0 Previous year's Figures

The previous year's figures have been re-grouped and re-arranged in conformity with the figures of current year.

Sd/-
(Umesh)
Accounts Officer

Sd/-
(A. Mukherjee)
Accountant

For M Saha & Co.
Chartered Accountants

**BOSE INSTITUTE
KOLKATA**

Receipt and Payment accounts for the year ended 31-03-2013 (COUNCIL A/C)

Particulars	Sch. No.	Amount (₹)	Particulars	Sch. No.	Amount (₹)
Opening Balance	1	91,570,444.42	Establishment Expenses	9	354,618,532.00
Grant in aid	2	554,710,000.00	Laboratory Expenses	10	73,795,029.20
Grant in aid for Unified Campus		496,833,654.00	Other Administrative Expenses	11	75,518,262.68
Income From Services	3	8,568,041.00	Advances	6	26,763,679.56
Interest Earned	4	28,327,789.33	Building	12	7,366,649.00
Other Income	5	1,098,818.08	Other Assets	13	53,061,848.55
Advances	6	22,693,436.00	Capital Work in Progress	14	155,772,611.00
Import of Equip. Work in Progress		1,212,446.00	Import of Equip. Work in Progress		1,414,910.00
Intellectual Property Dev. Fund			Intellectual Property Dev. Fund		313,327.00
Interest on HBL		516,473.00	Interest on HBL		516,473.00
Depreciation on Building	12	6,827,607.00	Depreciation on Fixed Asset (Fund)		62,389,584.00
Depreciation on Other Assets	13	55,561,977.00	Other TDS Receivable		22,207.00
Receivable From Security Staff		90,000.00	TDS on Interest (Receivable)		30,317.77
Receivable From Party			BI/MIT COLLABORATION		185,573.00
BI/MIT COLLABORATION		372,363.00	Prof. S.M.Sarkar Lecture Fund Investment		2,597.61
			Employees Welfare Fund Investment		11,752.23
			Other Fund in Fixed Deposit		5,563,787.00
Co-Operative		18,316,767.00	Co-operative		18,288,297.00
Group Insurance		413,976.50	Group Insurance		359,093.50
DST Woman Scientist		46,134.00			
IASTA 2010		35,408.00			
Prepaid Insurance		9,390.00			
100th Indian Science Congress		101,544,593.00	100th Indian Science Congress		100,545,581.00
Inter Unit Account			Inter Unit Account		
Scheme/Project		970,499,957.42	Scheme/Project		1,094,469,595.89
IRHPA (Prof. S. Raha)		9,330,964.00	IRHPA (Prof. S. Raha)		11,947,232.00
FAIR		10,000.00	FAIR		401,356.00
			Governing Body		35,027.00
Sundry Creditors		9,338,254.00	Sundry Creditors		8,463,771.00
Statutory Liabilities	7	62,704,866.60	Statutory Liabilities	7	58,479,103.60
Other Liability	8	26,319,478.93	Other Liability	8	24,570,159.75
Earmarked Funds	8A	8,499,115.82	Earmarked Funds	8A	867,093.98
			Closing Balance	1	339,678,502.78
		2,475,451,954.10			2,475,451,954.10

BOSE INSTITUTE
KOLKATA

Receipt and Payment accounts for the year ended 31.03.2013 (Projects)

Particulars	Sch. No.	Amount (₹)	Particulars	Sch. No.	Amount (₹)
OPENING BALANCE	1	135,412,884.19			
RECEIPT OF PROJECTS	2	286,422,374.48	PAYMENTS OF PROJECTS	2	182,655,123.69
RECEIPT OF IRHPA-S RAHA	3	6,289,256.61	PAYMENTS OF IRHPA-S RAHA	4	6,287,899.61
RECEIPT OF IRHPA-A LOHIA	5	718.00	PAYMENTS OF IRHPA-A LOHIA	6	104.00
RECEIPT OF FAIR (IFCC)	7	135,793,875.50	PAYMENTS OF FAIR (IFCC)	8	115,671,984.08
CMS		6,300.00	CMS		6,300.00
CPF EMPLOYEE CONTRIBUTION		51,468.00	CPF EMPLOYEE CONTRIBUTION		51,468.00
CPF EMPLOYER CONTRIBUTION		51,468.00	CPF EMPLOYER CONTRIBUTION		51,468.00
DST INDO-UK SC.WORKSHOP DR.			DST INDO-UK SC.WORKSHOP DR.		
SRIMONTI SARKAR		720,000.00	SRIMONTI SARKAR		720,000.00
I TAX (PARTY)		553,537.00	I TAX (PARTY)		101,239.00
I TAX (SALARY)		413,363.00	I TAX (SALARY)		413,363.00
LABOUR WELFARE CESS		26,000.00	LABOUR WELFARE CESS		–
LIABILITY (11-12)		–	LIABILITY (11-12)		425,807.00
LIABILITY (TAPAN DATTA)		–	LIABILITY (TAPAN DATTA)		104,150.00
LIABILITY (2012-2013)		260,603.00	LIABILITY (2012-2013)		44,944.00
OVER HEAD		7,638,828.00	OVER HEAD		7,638,828.00
PAYBLE TO STAFF		52,964.00			
P TAX		54,520.00	P TAX		54,520.00
SALES TAX		52,000.00	SALES TAX		–
SECURITY DEPOSIT		–	SECURITY DEPOSIT		254,422.00
STALE CHEQUE		265,337.00	STALE CHEQUE		67,253.00
MISC INCOME		0.08	MISC INCOME		0.08
PICKUP SERVICE		6,100.00	PICKUP SERVICE		6,00.00
BANK CHARGES		2,814.00	BANK CHARGES		2,814.00
RECEIVABLE FROM SCHOLARS		82,380.00	RECEIVABLE FROM SCHOLARS		64,448.00
100TH INDIAN SCIENCE CONGRESS		153,771,500.00	100TH INDIAN SCIENCE CONGRESS		153,771,500.00
			GRANT-IN-AID RECEIVABLE		1,113,578.00
Inter Unit Account			Inter Unit Account		
BOSE INSTITUTE (COUNCIL)		1,094,577,797.89	BOSE INSTITUTE (COUNCIL)		970,608,159.42
IRHPA DR A LOHIA		–	IRHPA DR A LOHIA		–
IRHPA PROF.SIBAJI RAHA		2,615,662.70	IRHPA PROF.SIBAJI RAHA		7,478,140.31
FAIR (IFCC)		62,554,375.00	FAIR 9IFCC)		62,627,375.00
			Closing Balance	1	377,455,138.26
		1,887,676,126.45			1,887,676,126.45

Auditors' Report Governing Body

We have audited the attached Balance Sheet of Bose Institute, Governing Body, 93/1, Acharya Prafulla Chandra Road, Kolkata - 700 009 as at 31st March, 2013 and also Income and Expenditure Account for the year ended on that date annexed thereto. These financial statements are the responsibility of the Bose Institute, Governing Body's Management. Our responsibility is to express an opinion on these financial statements based on our audit.

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

We observed that-

1. FIXED ASSETS

Fixed Assets Register showing full particulars including quantitative details and situations of Fixed Assets has not been maintained. Physical verification of Fixed Assets has not been conducted during the year under audit. According to last year's Auditor's Report Fixed Assets were not depreciated as per Accounting Policy. In our opinion as the Balance Sheet and Income and Expenditure Account and Receipts & Payments Account of the Governing Body are consolidated with the Financial Statements of the Bose Institute, hence the Accounting Policy of the Governing Body should be in consonance with that of the Bose Institute. In the absence of Fixed Assets Register, the year of origin of the Fixed Assets could not be determined and as a result how much depreciation over the years (including the year under audit) has not been provided for could be ascertained. We recommend that the management should immediately identify the Fixed Assets and take proper steps to value them as according to management information the Fixed Assets have been acquired for more than 10 years and the same have reached their scrap value.

2. INVESTMENTS

Investment Register showing details of Investments, interest received and/ or accrued, closing balance as on 31st March of every year, has not been maintained. A list of Term Deposits with State Bank of India, Calcutta Main Branch has been submitted for our verification. Further, the share certificates of 843 Nos 7.5% preference CE SC Ltd. were not available for verification. Dividend on Preference Shares has not been accounted for.

3. ADVANCES

The detail list of Festival Advance Rs 9,300.00/- and Advance to Staff Rs. 16,820/- were not available. In the absence of list of advances we are unable to ascertain the realisability of the aforesaid advances. The management is advised to act expeditiously in this respect and take appropriate steps for recovery of these advances or take necessary steps for write off if irrecoverable.

4. CASH IN HAND

The cash in hand balance as on 31" March 2013 of the Governing Body of Rs. 8,150.05 is same as the cash balance as on 31" March 2012 as per the last year audited Balance Sheet. No Cash transactions were noticed during the year under audit. The management of the Governing Body did neither produce any physical cash balance certificate nor were we able to physically verify the actual cash balance.

5. In our opinion and to the best of our information and according to the explanations given to us subject to the effect on financial statement of matters referred to in the preceding paragraph and the financial statements give a true and a fair view in conformity with the accounting principles generally accepted in India:

i) In the case of Balance Sheet, of the state of affairs of Bose Institute, Governing Body as at 31" March, 2013;

and

ii) In the case of Income and Expenditure Account, of the surplus of Income over expenditure for the year ended on that date.

For M. Saha & Co.
Chartered Accountants

Place : Kolkata

Date : 19th August, 2013

Partner

CA. Debarshi Saha
(Mem No : 061398, FRN : 305135E)

BOSE INSTITUTE (GOVERNING BODY)

93/1, ACHARYA PRAFULLA CHANDRA ROAD, KOLKATA - 700009

BALANCE SHEET AS AT 31ST MARCH 2013

	Schedule No.	As on 31/03/2013	As on 31/03/2012
FUNDS & LIABILITIES		(₹)	(₹)
CAPITAL FUND			
AS PER LAST ACCOUNT		2,317,833.36	2,317,833.36
ACHARYA JC BOSE CENTENARY FUND			
AS PER LAST ACCOUNT		1,599,768.40	1,599,768.40
SPECIAL FUND			
AS PER LAST ACCOUNT	1	3,042,629.96	3,047,629.96
DEPOSITS & OTHER LIABILITIES	2	1,196,579.66	1,161,552.66
TOTAL		8,156,811.38	8,126,784.38
PROPERTIES & ASSETS			
FIXED ASSETS			
AS PER LAST ACCOUNT	3	2,374,712.85	2,374,712.85
INVESTMENTS			
AS PER LAST ACCOUNT	4	4,424,172.67	4,050,528.67
RECEIVABLE & DEPOSITS			
AS PER LAST ACCOUNT	5	32,795.00	32,795.00
CASH & BANK BALANCES	6	1,106,021.37	1,083,770.37
INCOME & EXPENDITURE A/C			
EXCESS OF EXPENDITURE OVER INCOME		219,109.49	584,977.49
TOTAL		8,156,811.38	8,126,784.38

INCOME & EXPENDITURE STATEMENT FOR THE YEAR ENDED 31ST MARCH 2013

Particulars	2012-13 (₹)	2011-12 (₹)
INCOME		
INTEREST ON TERM DEPOSIT	373,644.00	546,568.94
INTEREST ON SAVINGS BANK	22,911.00	1,894.00
TOTAL	396,555.00	548,462.94
EXPENDITURE		
SALARY & WAGES	21,600.00	22,800.00
ACCOUNTING CHARGES	—	—
AUDIT FEES	8,427.00	8,427.00
BANK CHARGES	660.00	110.00
EXCESS OF INCOME OVER EXPENDITURE FOR THE YEAR	365,868.00	517,125.94
TOTAL	396,555.00	548,462.94
INCOME BROUGHT DOWN AND ADJUSTED WITH LAST YEAR	365,868.00	517,125.94
BALANCE BROUGHT DOWN FROM LAST A/C (DEBIT)	584,977.49	1,102,103.43
BALANCE TAKEN TO BALANCE SHEET (DEBIT)	219,109.49	584,977.49

Signed in terms of our separate report of even date

Auditors' Report

We have audited the attached Balance Sheet of Bose Institute, Indo - FAIR Coordination Centre of P - 1/12, C.LT, Scheme VII M, Kolkata - 700 054 as at 31st March, 2013 and also Statement of Expenditure for the year ended on that date annexed thereto, These financial statements are the responsibility of the Bose Institute, Indo - FAIR Coordination Centre's management. Our responsibility is to express an opinion on these financial statements based on our audit.

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

On the basis of our audit as indicated in earlier paragraph we report that:

- i. We have obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purpose of our audit.
- ii. In our opinion, proper books of account as appears from our examination of those books;
- iii. The Balance Sheet and Statement of Expenditure dealt with by this report are in agreement with the books of account;
- iv. In our opinion and to the best of our information and according to the explanations given to us and subject to our audit observation in Annexure II, the said accounts read with the schedules 1 to 3 enclosed thereto, give the information in the manner so required' and give a true and fair view in conformity with the accounting principles generally accepted in India:
 - a) In the case of Balance Sheet, of the state of affairs of Bose Institute, Indo - FAIR Coordination Centre as at 31st March, 2013;
and
 - b) In the case of Statement of Expenditure, of the total expenses for the year ended on that date.

For M. Saha & Co.
Chartered Accountants

Place : Kolkata
Date : 19th August, 2013

Partner
CA. Debarshi Saha
(Mem No : 061398, FRN : 305135E)

BOSE INSTITUTE (IFCC)

KOLKATA

BALANCE SHEET AS AT 31ST MARCH 2012

As on 31st March 2012 (₹)	Liabilities	As on 31st March 2013 (₹)	As on 31st March 2012 (₹)	Assets	As on 31st March 2013 (₹)
54,732.00	Fund for Creation of Asset	259,722.00	54,732.00	Shares in FAIR GmbH	54,732.00
				Office Equipment	204,990.00
	Unspent Grant				
96,856,723.96	Grant from Department of Science and Technology (Schedule-1)	69,394,738.38	275,018,454.00		
6,352,825.00	Grant from Department of Atomic Energy (Schedule-2)	45,665,125.00		Receivable from Bose Institute	
5,005,200.00	Interest Earned (Schedule-3)	12,818,194.00		Bank Balances	
16,751.00	Audit Fees Payable	11,236.00	2,259,670.96	S.B. A/c Union Bank of India	1,043,590.38
166,721.00	Payable to Bose Institute	631,077.00	106,138,550.00	Fixed Deposits	127,476,522.00
108,452,952.96		128,780,092.38	108,452,952.96		128,780,092.38

STATEMENT OF EXPENDITURE FOR THE YEAR ENDED 31ST MARCH 2012

For the year ended 31st March 2012 (₹)	Particulars	For the year ended 31st March 2013 (₹)
25,000.00	Accommodation Charges	—
544,672.00	Advertisement Expenses	24,626.00
32,630.00	Bank Charges	263.58
10,000.00	Honorarium Expenses	—
4,742.00	Meeting Expenses	1,014,507.00
107,355.00	Salary	1,008,580.00
32,000.00	Conveyance	115,199.00
1,969.04	Telephone Expenses	13,684.00
1,027,932.00	Travelling Expenses	2,442,884.00
16,751.00	Audit Fees	11,235.00
	Contingency	53,443.00
	Legal Expenses	—
1,803,051.04		4,684,422.58

Place : Kolkata
Date : 19th August, 2013

Signed in terms of our separate
Report of even date.

For M Saha & Co.
Chartered Accountants

Sd/-
(Umesh)
Accounts Officer

Sd/-
Administrative/Accounts Office
Bose Institute (IFCC)

Sd/-
(Prof. S.Raha)
Director

BOSE INSTITUTE (IFCC)
KOLKATA

Receipt and Payment Accounts for the year ended 31.03.2013 (FAIR)

Particulars	(₹)	Particulars	(₹)
Opening Balance			
S.B A/c Union Bank of India	2,259,670.96		
Fixed Deposits	106,138,550.00		
Grant From D.A.E.	62,500,000.00		
Grant From D.S.T. (IFCC Exps.)			
(Adjustments of previous year)	615,128.00		
Interest on SB a/c	160,131.00		
Interest on term deposits	7,652,863.00		
Advance	236,500.00	Advance	236,500.00
Advance Against Meeting Expenses	25,000.00	Advance Against Meeting Expenses	25,000.00
Advertisement Expenses	495,826.00	Advertisement Expenses	520,452.00
Bank Charges	464.50	Bank Charges	728.08
Honorarium Expenses	8,000.00	Honorarium Expenses	8,000.00
Travelling Expenses	544,794.00	Travelling Expenses	2,897,678.00
Legal Expenses	110,000.00	Leval Expenses	110,000.00
Security Deposit	9,853.00	Security Deposit	9,853.00
Liability for Audit Fees	11,236.00	Liability for Audit Fees	16,751.00
Profession Tax	3,990.00	Profession Tax	3,990.00
TDS	118,063.00	TDS	118,063.00
Sundry Creditors	419,671.00	Sundry Creditors	419,671.00
Festival Advance	10,000.00	Festival Advance	10,000.00
		Receivable from R. K. Bhandari	258.00
		Contingency Expenses	53,443.00
		Meeting Expenses	1,014,507.00
		Salary	1,008,580.00
		Conveyance	115,199.00
		Telephone Expenses	13,684.00
		Audit Fees	11,236.00
		Office Equipment	204,990.00
		Power Converter	45,828,129.00
		Vaccum Chamber	547,272.00
Inter Unit Account		Inter Unit Account	
Bose Institute (Council)	401,356.00	Bose Institute (Council)	10,000.00
Scheme/Project	62,573,000.00	Scheme/Project	62,500,000.00
		Closing Balance	
		S.B A/c Union Bank of India	1,043,590.38
		Fixed Deposits	127,476,522.00
	244,294,096.46		244,294,096.46

Place : Kolkata
Date : 8th November, 2012

Signed in terms of our separate
Report of even date.

For M Saha & Co.
Chartered Accountants

Sd/-
(Umesh)
Accounts Officer

Sd/-
Administrative/Accounts Office
Bose Institute (IFCC)

Sd/-
(Prof. S.Raha)
Director

Compilation Report of the Institute

**BOSE INSTITUTE
93/1, ACHARYA PRAFULLA CHANDRA ROAD
KOLKATA-700 009**

COMPLIANCE REPORT OF THE INSTITUTE ON THE AUDIT OBSERVATIONS FINANCIAL YEAR 2012-13

Sl. No.	Audit Observations	Replies
1 (I)	Depreciation on fixed assets has been shown by way of netting off from Capital Fund instead of charging the same to Income and Expenditure Account as mentioned in the prescribed Form. Depreciation for the year of Rs. 6,23,89,584/- has been shown as deduction from Capital Fund. According to management contention, since Capital expenditure made out of grant money have been charged to Income and Expenditure Account till F.Y. 2011-12 and in F.Y. 2012-13 the Capital Grant portion has been directly credited to Capital Fund, the depreciation has been shown by way of deduction from related fixed assets and correspondingly the same has been deducted from Capital Fund. This system of Accounting which is in accordance with the generally accepted accounting principles has been followed by the management over the years.	The policy is being consistently followed year after year. Depreciation being non cash item and not taken in Income and Expenditure Account facilitates the comparison of Grant-in-Aid with the expenditure incurred there from.
(ii)	Statutory Liabilities have not been segregated between a) overdue and b) others as required by the Prescribed Form.	Noted for compliance during 2013-14 and will be segregated accordingly.
(iii)	Serial no 7 of the Fixed Assets Schedule (SCHEDULE- 8) of the prescribed form accounts applicable for Central Autonomous Bodies (Non-profit organizations and similar Institutions) account for "Computer/Peripheral" which has not been done and purchases of Computers are shown under "Apparatus & Equipment"	Noted for compliance during 2013-14 and will be segregated accordingly.
(iv)	Segregation of Sundry Creditors between goods and others has not been made and the entire Sundry Creditors for both goods and others have been shown under "Sundry Creditors".	The entire Sundry Creditors is for the procurement of goods and services. However, attempts will be taken to bifurcate the Sundry Creditors during 2013-14 as suggested.

2 Fixed Assets Register :

No physical verification of Fixed Assets have been made during the year under audit. A sum of Rs. 6,66,57,578.15 has been shown as Institute Development and Modernization Fund Investment in Fixed Assets under Schedule 05 of "Investment from Earmarked Funds" and we have been told by the management that Fixed Assets were purchased during the year 1991-92 and subsequent years out of Grant received from Planning Commission, Government of India and since then the said amount has been carried forward as Investment. The management of the reporting institution has been able to make a list of such Fixed Asset acquired, however as the same has not been identified and valued till date the same could not be capitalized to respective heads of Fixed Assets. We have been further told by the management that many of the items of such fixed assets have either reached their salvage value or might have been disposed off. In the absence of Fixed Assets Register and identification marks on the fixed assets, these assets could not be identified and hence could not be capitalized. Moreover in the absence of proper identification, physical verification and valuation by approved valuer of the Fixed Assets in hand, provision for impairment could not be estimated and hence not accounted for. According to management's verbal representation, the attempts made for the preparation of Fixed Assets Register did not yield fruitful results. Hence the management of the reporting institution has already issued tender for appointment of an external agency to identify the Fixed Assets and thereafter prepare a Register showing necessary details with proper value. Moreover, Assets purchased out of grants for different Projects were shown under the head "Projects" and not taken in total Fixed Assets Schedule on the plea that those Fixed Assets do not belong to the Institute and will be accounted for only on termination of the Project. In the absence of Fixed Assets Register for the "Projects" those assets could not be identified.

Institute has already advertised for expression of interest from suitable and interested firms/ valuer vide Tender No. BIIT/EOII03/2013-14 dt. 31.7.2013. Selection process is in progress and the firm/valuer will be appointed within September 2013.

3 Contingent Liabilities :

According to management contention, there are no money suits filed against the Institution as on date and hence the question of provision of Contingent Liability does not arise.

The observation is self explanatory, hence no comment.

4 Stale Cheques

A sum of Rs. 5,06,263.75 is being carried forward since 2010-11. The management is advised to review the corresponding expenses and find out which are not payable at all and necessary reversal entries need to be passed.

As per Rule 189 (I) of Central Government Account Receipt and Payment Rules, all deposits and balance in the books unclaimed for three year shall be credited to Government under Consolidated Fund, keeping a note in the register of deposits. Similar action will be taken at appropriate time.

5 Advances :

Included in Total Other Advances in Schedule 07 of Rs. 95.83 Lacs, there are balances including Bank Suspense of Rs. 46,029.90 which have been brought forward for more than 3 years. The management of the Institution is advised to make a detailed study of such unadjusted advances and thereafter determine whether they at all subsist or not.

Steps have been taken to identify and adjust the advances.

6 Insurance on House Building Loan:

Insurance covers of the building or flats purchased out of House Building Loans taken by staff were not available for verification.

The records are being updated to produce before the next audit.

7 Pension & Provident Fund:

No trust deed of the Bose Institute Pension Fund, Contributory Pension Fund and General Provident Fund were available for verification. There is no structured Investment Plan for the aforesaid Funds and investments have been kept with Banks Fixed Deposits.

Institute has GPF, CPF and Pension Scheme based on CCS (Pension Rules 1972) and duly approved by the DST. Draft Trust Deed in respect of GPF for the employees prior to 01-01-2004 is under consideration of the appropriate authority for execution. In the absence of Trust, the fund is being invested in Fixed Deposits with Nationalised Banks and is earning sufficient interest to pay the interest on GPF and CPF.

8 Import of Equipment in Progress:

Out of total work in progress of Rs. 16,88,51,846/- as on 31.03.2013, Rs. 17,79,092/- involves import of equipment in progress. Again out of such Rs. 17,79,092/-:

- a) Rs. 3,64,182/- pertains to balance brought forward since last year for which no necessary details were produced.' It is not ascertainable whether such Equipments have actually been received or not. The management is advised to take necessary action as the same balance is being brought forward for years. Necessary provision for loss needs to be made after verification is completed.
- b) Rs. 14,14,910/- was shown as addition in Import of Equipment in Progress for the year under audit for which the necessary details are enlisted below :

(a) Administrative exercise has already been initiated to identify the equipments for capitalization. Balance will be ready for production before the next audit.

(b) The observation is self explanatory, hence no comment.

Name of the Supplier	Description of Equipment	Price in US Dollars/ Euro/ Yen	Price in Indian Currency (Rs)	L/C No.	L/C date	Date of actual receipt by Bose Institute
M/s GE Healthcare Bio-Sciences Ltd, Hong-Kong	Spares of GE Micro Cal VP-ITC	\$ 12,714	6,85,152/-	Wire Transfer	15-01-2013	06-05-2013
M/s Simag Div Della Frimont SpA Italy	Ice Flaker Machine Edge	€ 2,950	2,10,122/-	Wire Transfer	22-03-2013	06-05-2013
M/s C.A. E.N. SpA Italy	4 Channels NIM Programmable Power (Type V 1470)	€ 3,955	2,80,624/-	Wire Transfer	25-03-2013	18-05-2013
M/s ET Enterprise Limited UK	PMT with Mumetal Shield and encapsulated voltage divider	€ 2,866	2,39,012/-	Wire Transfer	22-03-2013	06-05-2013
TOTAL			14,14,910/-			

The expenditure in relation to the above equipments have been considered as expense for the current period under audit as the funds have been transferred to the foreign suppliers within the year and the events occurring after the Balance Sheet date confirm the actual import. Moreover the same accounting policy is being followed by the reporting Institution consistently over the years.

9 Gratuity :

Gratuity has been accounted for on cash basis on actual payment which is in contrary to AS-IS issued by the Institute of Chartered Accountants of India. No approved Gratuity Fund has been set up and no provision for Gratuity has been made during the year under audit. In the absence of actuarial valuation the provision for Gratuity required for the year and the total liability as 31" March 2012 could not be ascertained.

Institute follows the policy of treating the expenditure on Gratuity on Cash Basis and is being followed consistently year after year.

10 Unreconciled Bank Balances :

A sum of Rs. 46,029.90 (Dr.) included in Loans, Advances and other assets of Rs. 95,82,90.81 (Sch-7 : Council) and Rs. 6,04,388 (Cr.) included in Total other liabilities of Rs. 85,08,549.53 (Sch-3 : Council) have been shown under the head "Bank Suspense A/c" and " Bank Suspense Project A/c" respectively which are pending for reconciliation for years. The management is advised to take expeditious measures and adjust the same at the earliest.

Measures has already been undertaken to identify the Unreconciled items pending with banks. As soon as suitable explanations are available, necessary entries will be made and the books of accounts will be updated accordingly.

11 Current Liabilities :

Out of total Current Liabilities of Rs. 73,33,23,022.55 in Sch - 3, balances of Rs. 56,27,008.88, Rs. 16,29,247.13 and Rs. 24,00,000/- shown as, Terminated Scheme and Fellowship, Terminated Consultancy Project and RSIC respectively under balance payable. These balances have been brought forward for more than 3 years without any adjustment. The Finance Committee of the reporting institution should review these balances in these accounts and determine whether it would be expedient to appropriate such balances

Noted for compliance

12 Balance Confirmation :

Balances lying in Sundry Creditors for Goods and services of Rs. 95,42,739/- (Council + Governing Body) are subject to confirmation from respective parties which were not yet available on record.

Noted for compliance during 2013-14.

13 Internal Audit :

The reporting institution has an in-house Internal Audit Department, but the scope and power of Internal Auditor could not be judged in the absence of any report. Keeping in the view, the size, nature and complexity of the activities of the Institute, we recommend an Internal Audit Policy and scope be immediately defined and that the Internal Audit Department should be properly constituted so as to make Internal Audit more meaningful and effective.

The Institute is going to undertake a Cadre Restructuring process, in which it is proposed to strengthened the Internal Audit department, The program will define Internal Audit Policy and scope as well to make it more meaningful and effective

14 Stock Verification :

The Institution has a practice of charging the whole expenditure on account of purchase of consumables, chemicals etc in its revenue account in the year in which the expenditure is met. This system of accounting has been consistently followed by the Institution over the years. However in reality, at the year end there remains a stock of consumables, chemicals etc. which are never accounted or reflected anywhere in the financial statements. According to verbal management contention, recognition of such stock in any particular accounting year will inflate the surplus, which in turn shall not exhibit a true and fair view. In our opinion, the stock of Consumables, chemicals etc should be independently verified by a team Internal Auditors together with technical experts at the year end and thereafter be reflected in the notes to the accounts with valuation thereof which shall be a fair presentation of the financial statements and shall also ensure a check on stock holding.

Requisition of consumables and chemicals are prepared keeping in mind the un-even flow of supply as well as availability in the market to maintain un-interrupted research activities, which may last for months and years as well. As and when consumables and chemicals are received as indented by the departments, they issue the entire stock to the concerned Scientist/Fellow indenter. In every project consumables and chemicals used are more than hundred in number and there are more than three hundred projects are in operation, so it's near to impossible to maintain the stock of every item. There is no standard quantity of usage of chemical for each experiment, so when a number of times liquid chemical is used for experiment from the bottle, the balance chemical needs to be poured in measuring cups to ascertain the balance, which is not possible, and the process may make the chemical unusable for experiment. Moreover most of the chemicals are volatile in nature; in case of each experiment and for storing a long period chemical gets evaporated, in absence of any standard for measuring evaporation loss this factor could not be accounted for and it is difficult to measure the balance of consumables and chemicals remained as on the date of preparation of financial statement.

List of ongoing Projects

SL. No.	Name of Project	Opening Balance as on 1.4.12	Grant Received during 2012-13	Other Receipts during 2012-13	Expenditure during the year 2012-13	Debit/Credit Balance as on 31.3.13
1	"Centre of Excellence(COE) at Bose Institute"	1,586,494.85	4,720,000.00	43,007.00	2,097,947.47	4,251,554.38
2	"Award of J.C. Bose Fellowship to Prof. Pinakpani Chakrabarti"	258,612.25	-	-	1,360,103.00	(1,101,490.75)
3	Molecular mechanisms of immune evasion by tumor : Role of curcumin in ameliorating dendritic and T - regulatory cell-mediated immune dysfunction	196,442.00	344,233.00	-	472,094.10	68,580.90
4	Towards identification of aphid resistance gene(s) from wild crucifer <i>Rorippa indica</i> through differential transcriptomic approach	41,941.66	766,740.00	-	691,403.00	117,278.66
5	Regulation of microRNA transcription and biogenesis by fungal-stress in tomato	(133,913.86)	1,154,000.00	3,356.00	1,294,697.00	(271,254.86)
6	Raja Ramanna Fellowship	313,231.00	567,169.00	-	856,689.00	23,711.00
7	"Generation of salt -tolerant rice plants : A translational approach"	8,511,983.59	4,681,000.00	214,662.00	12,695,275.91	712,369.68
8	Immunomodulatory role of Arabinosylated Lipoarabinomannan against Visceral Leishmaniasis	1,324,414.33	-	21,437.00	1,405,864.00	(60,012.67)
9	Identification of amino acid residues involved in substrate specificity of bacterial ring hydroxylating dioxygenases using bioinformatics approach	(30,715.00)	700,000.00	193.00	881,203.00	(211,725.00)
10	"Stress-induced regulation of extracytoplasmic sigma factors in mycobacteria "	165,932.26	1,000,000.00		936,091.50	229,840.76
11	"Purification and characterization of bioactive natural antioxidant, immunomodulator and anticancer products from <i>Dioscorea alata</i> L; of North Eastern Region of India"	85,802.24	478,000.00	2,249.00	581,289.00	(15,237.76)
12	Understanding cell division in mycobacteria	187,521.00	727,707.00	-	875,551.78	39,676.22
13	Role of secretory antigen Hp0175 in <i>Helicobacter Pylori</i> mediated induction of autophagy	(248,015.49)	1,572,023.00		742,463.00	581,544.51
14	Studies on the protective of antioxidant protein molecule purified from the herb, <i>phyllanthus niruri</i> : Signal transduction mechanism in organ pathophysiology	(62,892.00)	787,309.00	-	550,805.00	173,612.00

15	Development of pod borer resistant transgenic pigeonpea and chickpea	(311,606.45)	1,280,417.00	-	979,227.00	(10,416.45)
16	Understanding the molecular mechanism of the energy homeostasis in normal and malignant cells : the role and interrelationship of creatine kinase and AMP-activated protein kinase	299,144.00	854,153.00	-	867,124.00	286,173.00
17	Isolation of the conditional lethal mutants of mycobacteriophage L1 repressor possessing high operator binding affinities and development of an expression vector for mycobacterial systems	111,857.14	-		285,046.00	(173,188.86)
18	Function of Molecular Chaperone Hsp70 in quality control of protein kinase	134,831.61	100,663.00	-	228,700.00	6,794.61
19	Molecular mechanisms of tumor progression :Role of tumor derived products in mediating tumor cell growth, motility and metastasis	211,622.95	300,000.00	-	245,381.81	266,241.14
20	Identification of the host cell factors responsible for survival and death of leishmania	1,738,843.24	-	29,351.00	1,774,417.24	(6,223.00)
21	"Mycobacterium tuberculosis infection : understanding the role of microRNAs in regulating the immune response of macrophage"	497,778.85	1,155,856.00	53,833.00	1,463,654.00	243,813.85
22	Development of sheath blight resistance in rice through transgenic approach	(215,478.73)	2,184,000.00	25,186.00	1,986,728.43	6,978.84
23	Understanding of correlation between "auxin homeostasis" and Alternaria brassicicola infection in Brassica juncea	(388,372.25)	1,685,000.00	12,933.00	1,225,991.96	83,568.79
24	Identification of the genetic loci for development of MYMIV-resistance in Vigna	(708,364.96)	1,777,000.00	8,500.00	856,449.17	220,685.87
25	Targeted drug delivery of Nanoparticulate Formulation of methylglyoxal and assessment of their antitumor activities	62,586.00	1,100,000.00	6,569.00	1,297,357.00	(128,202.00)
26	Role of protein complexes and protein interaction network in eukaryotic protein evolution	836,718.00	-	22,320.00	540,196.00	318,842.00
27	Structural study of de novo designed novel antifreeze peptides from leucosporidium antacticum antifreeze protein-1(AFP-1)	616,911.00	349,034.00	-	1,006,588.78	(40,643.78)
28	Role of micro RNAs in the immune response to mycobacterial infection	656,211.00	36,000.00	-	695,267.98	(3,056.98)

LIST OF ONGOING PROJECTS

29	Understanding the origin(s), evolution and interaction(s) of different molecular mechanisms of chemotrophic sulfur oxidation : Elucidating the metabolic strategies of early life	516,650.00	233,350.00	-	764,408.59	(14,408.59)
30	Theoretical and experimental analyses of bacterial GlxRS-tRNA Glx_GatCAB Co-evolution and the molecular basis of their interaction	720,131.00	209,000.00	-	1,087,538.35	(158,407.35)
31	"Synthesis of oligosaccharides corresponding to shigella dysenteriae for the preparation of glycoconjugates to treat shigelosis"	887,500.00	262,500.00	-	1,159,088.33	(9,088.33)
32	Exploration of Lichens from Barak Valley of Southern Assam and Arunachal Pradesh (North East India) and Isolation of Phytochemicals and Bioprospecting of some selected Lichens species	-	976,000.00	17,953.00	812,359.88	181,593.12
33	Molecular signaling involved in pathophysiological action of common air pollutant 'benzo(a)pyrene' in testicular DNA damage and apoptosis in connection to male infertility: possible protection by natural aryl hydrocarbon receptor antagonists	700,000.00	-	-	656,614.00	43,386.00
34	Sys TB : A Network Program for Resolving the Intracellular Dynamics of Host Pathogen Interaction in TB infection	2,500,000.00	4,548,800.00	104,876.00	6,399,380.55	754,295.45
35	Synthesis of oligosaccharide antigens of the Enterohemorrhagic Escherichia coli (EHEC) strains for the preparation of glycoconjugates	537,249.00	500,000.00	-	1,010,648.00	26,601.00
36	Role of DNA-dependent protein kinase in transcription control in human cells	-	2,027,330.00	47,896.00	1,852,693.19	222,532.81
37	Identification and characterization of a 19S proteasomal component of the early diverging eukaryote Giardia lamblia	-	2,951,800.00	42,085.00	2,928,355.62	65,529.38
38	Targeted alteration of MAPK family members ERK and p38MAPK/JNK to channelize oncogenic Ras-induced proliferative-signaling into apoptotic-signaling	-	3,600,000.00	-	730,435.35	2,869,564.65
39	"Functional characterization of the lipid-binding FYVE protein from Giardia lamblia"	-	873,333.00	-	83,309.00	790,024.00

40	"Mechanistic insights into dendritic cell maturation and its role in Leishmania donovani infection : Emphasis on dendritic cell-based anti-leishmanial therapy"	-	443,333.00	-	114,512.00	328,821.00
41	"The role of two-component systems and cell division proteins in mycobacterial physiology"	-	5,668,800.00	-	203,486.00	5,465,314.00
42	"Understanding Causes of Codon Usage Bias in Organisms"	-	593,000.00	-	25,000.00	568,000.00
43	Remodeling the cellular calcium homeostasis by ethyl-4-(3-nitro)-phenyl-6-methyl-2-oxo-1,2,3,4-tetrahydropyrimidine-5-carboxylate (Nifetepimine) : a mechanistic approach towards cancer regression and immune rejuvenation	-	959,875.00	-	64,875.00	895,000.00
44	Comprehensive Geo-microbiology of two high temperature hydrothermal systems of India : Paradigms of Primitive Metabolisms and biogeochemical evolution, prospects of biotechnological resource	-	400,000.00	-	397,827.77	2,172.23
45	Designs, synthesis and mechanistic insights of novel antimicrobial peptides (AMP) using high resolution NMR spectroscopy : Role of outer membrane permeability and DNA-binding	-	730,000.00	-	320,822.14	409,177.86
46	ALICE-Operation and Utilization	-	500,000.00	-	-	500,000.00
47	Setting up of a State-of-the-art 600 MHZ FT-NMR with Cryoprobe facility at Bose Institute	-	26,782,000.00	-	-	26,782,000.00
48	"Study on Biosphere-Atmosphere Exchange of Carbon dioxide, nWater Vapor and Energy in a Tropical High Altitude Forest Canopy at Eastern Himalaya"	-	2,660,800.00	-	240,000.00	2,420,800.00
49	Investigating the mechanism by which chaperon activate DNA binding activity of the mycobacterial heat shock response regulatory HspR	382,445.00	500,000.00	-	545,208.00	337,237.00
50	"Study of cosmic ray interactions and cosmic ray aerosol cloud connection in the context of regional climate change "	-	110,258,000.00	-	3,681,868.00	106,576,132.00
51	Quantum entanglement & distributed quantum information processing	-	200,000.00	-	-	200,000.00
52	Centre for DNA Fingerprinting and Diagnostics of Medicinal Potential in Plants of Eastern and North Eastern India	(1,502,813.01)	6,467,314.00	100,000.00	3,454,486.84	1,610,014.15



Prof. Venkatraman Ramakrishnan, who shared the 2009 Nobel Prize in Chemistry with Thomas A. Steitz and Ada E. Yonath for their work on ribosomes, visited Bose Institute on January 3, 2013. He is seen discussing with the audience after delivering a lecture on “The road to Ribosome Structure: A Personal Journey”.



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