ANNUAL REPORT 2019-20

BOSE INSTITUTE

KOLKATA

Prof. Joachim Frank, (*Nobel Laureate,* Chemistry, 2017) Department of Biochemistry and Molecular Biophysics and Department of Biological Sciences, Columbia University, New York, NY 10032 delivered a lecture on **"Single-particle cryo-EM: Visualization of biological molecules in their native states"** at Unified Academic Campus of Bose Institute on January 22, 2020. He also visited J.C. Bose Museum at Main Campus of Bose Institute.

BOSE INSTITUTE

KOLKATA

ANNUAL REPORT

2019-2020

Edited by the members of
J. C. Bose Museum and Publication unit

Gautam Basu	(Chairman)
Gaurab Gangopadhyay	(Member)
Somsubhro Bandopadhyay	(Member)
Achintya Singha	(Member)
Tarun Kr. Maji	(Member)
Ishani Chatterjee	(Convener)

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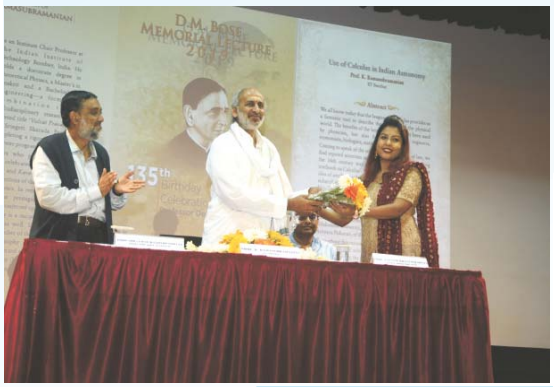
135th Birthday Celebration of Prof. Debendra Mohan Bose



135th Birthday of Prof. Debendra Mohan Bose was celebrated on November 26, 2019, at the Unified Academic Campus of Bose Institute. Prof. K. Ramasubramanian, Department of Humanities and Social Sciences, IIT Bombay, graced the occasion as Guest of Honour and delivered the D.M. Bose Memorial Lecture - 2019 on the topic "Use of Calculus in Indian Astronomy". Prof. Gautam Bhattacharyya, Acting Director, Saha Institute of Nuclear Physics presided over the programme.

FROM THE DIRECTOR'S DESK

FROM THE DIRECTOR'S DESK

I am delighted to present the Annual Report of Bose Institute for the year 2019-20 that reflects the dedicated and committed endeavours of the century-old Institute to fulfil the research needs of the country. The Institute continues its onward journey towards fulfilling the vision of its legendary founder Acharya J. C. Bose and proving itself worthy of this glorious inheritance, towards bringing glory to the nation.

It is pertinent to mention that academic revolution has already taken place with the evolution of consciousness marked by a paradigm shift in scope and opportunity. Major shifts have ushered in within scientific, philosophical and other academic disciplines. With the advent of globalization resulting fragmentation of knowledge, commodification of knowledge exists in large numbers as a socio-cultural by-product of globalization where education is now marketed as the 'product' in a globally competitive 'knowledge industry'. Higher education systems are facing greater challenges like achieving the goal of excellence at various spheres like student performance and competitiveness, faculty qualification and promotion of research etc. and undergoing radical changes in recent times both to ensure quality and social accountability. One of the important keys to achieve excellence in this perspective is good governance which is instrumental in specifying the roles and responsibilities of various stakeholders in such a way that is consistent with attaining quality higher education. In a bid to achieve a sustainable qualitative higher education, we need to embrace more upgraded, self-reflective, organic ways of thinking in re-shaping education enabling the younger generation to be better equipped for the complex, paradox and unpredictable future. In this connection, it is relevant to mention about academic autonomy. Academic autonomy in respect of institutions represents freedom from active Government control over spending, teaching and curriculum decisions empowering institutions to take decisions for imparting skills and training commensurating with the ongoing market requirements. Therefore academic freedom alongwith accountability for enhanced educational outcome is very important. Besides, a technically sound and upgraded information system can accelerate decision making in academic and administrative areas like teaching & research, student welfare & finance and day-to-day administration through its easily accessible database and well-connected network. So, revamping of the higher education by strategically shifting the pattern/model/standard in the policy framework and holistic functioning is the need of the hour to meet the challenge of an increasingly complex, rapidly changing expectations and socio-economic requirements as well.

Bose Institute was founded by Acharya J. C. Bose, the doyen of Modern Indian Science, in the year 1917, well before the independence and also before the establishment of Indian Constitution and

The Parliament, with the objective to develop and disseminate knowledge freely for the benefit of the mankind. The Institute, keeping this noble objective in view, continues to render outstanding contributions to the country accomplishing its cutting-edge scientific research for more than 100 years. Bose Institute pursues research for augmentation of fundamental knowledge-base and developing solutions to national problems in the areas of healthcare, food security, environmental pollution and climate change. Research is pursued in areas such as understanding stress response and disease biology, anthropogenic activity-induced environmental changes, bioremediation of environmental pollutants and geomicrobiology, fundamental understanding of subatomic particles, development of detectors/sensors- from cosmic rays to biomolecules and the dynamics of atmospheric pollutants, especially in the Himalayan region.

During the year 2019-20, Bose Institute had published 175 numbers of full length peer reviewed research papers in referred journals. The Institute had produced 31 Ph.D. students and trained 22 research manpower (other than Ph.Ds) and 07 technical manpower who are successfully leading their professional lives all over the globe. Our Institute has also guided 11 nos. of M.Tech/M.Sc./M.Phil projects during the period. A considerable number of funded projects from National and International agencies and Industries have been brought by the Institute.

It is noteworthy to mention here some of the important global and national collaborations with Bose Institute viz. *Indo-UK Water Quality Research Project (WQRP): The development and implementation of sensors and treatment technologies for freshwater systems in India (Newton-Bhaba Fund); Indo-Swedish Collaborative Programme: Antimicrobial peptides against crop disease; ALICE Collaboration: Study of hadronic as well as heavy ion collisions at ultra-relativistic energy at the LHC, CERN, Switzerland; CBM Collaboration: study of nuclear matter at very high density and moderate temperature at FAIR, Germany; Multi-Dimensional Research to Enable Systems Medicine: Acceleration using a Cluster Approach with NIBMG, Kalyani, IISER Kolkata, TMC, Kolkata, ISI, Kolkata, IICB, Kolkata; National Carbonaceous Aerosols Programme (NCAP) WGIII: Carbonaceous Aerosols Emmissions, Source appointment and Climate effects with IIT Bombay and 16 others; Fabrication of Infrared Photo-detector based on 2D systems and Tuning the Detection Windows by coupling with Nanostructures with Jadavpur University etc.*

To mention major events including outreach programmes organized/coordinated by the Institute, I may refer a few like *India International Science Festival (IISF) 2019, jointly organized by Ministry of Science & Technology, Ministry of Earth Sciences and Department of Health Research, Government of India in association with Vijnana Bharati (VIBHA), held during November 05 – 08, 2019. Biswa Bangla Convention Centre and Science City in Kolkata were the prime sites for the events at this 5th edition of IISF 2019. Bose Institute, Indian Institute of Chemical Biology and Satyajit Ray Film & Television Institute were the sites for a few other events during the festival. Among various events/programmes hosted by IISF 2019, Bose Institute successfully coordinated and accomplished six events/programmes, duly assigned, viz. Global Indian Scientists & Technocrats Meet, International Science Literature Festival – VIGYANIKA, State S&T Ministers Conclave (SSTMC), Traditional Crafts and Artisan Meet & Expo, Agriculture Conclave and Expo and Science & Technology Media Conclave; Rural Biotechnology Programme: The people from rural*

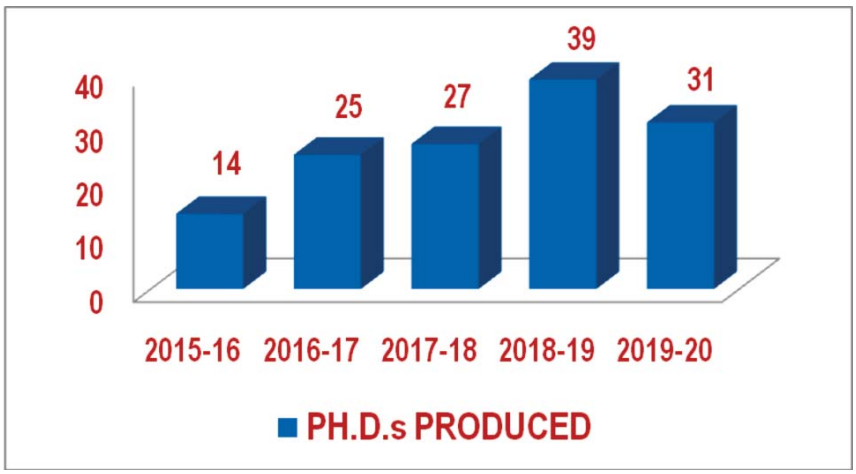
sectors have been imparted training for Mushroom cultivation, Pisciculture, Sericulture, Apiculture, Vermicompost production, Fishery, Food processing, Goat rearing, Rainwater harvesting for agriculture as well as drinking purpose, Country chicken rearing, Betel leaf cultivation, Crab culture etc. and various women empowerment, awareness generation programmes; The 13th North East Students' Summer Training in Basic Sciences 2019 (NESST-BASE 2019) programme was conducted at the Darjeeling Campus of Bose Institute during June 3-15, 2019 – Educational upliftment programme for school children from North-East India. Hands-on training camps have also been organized for school teachers of North-Eastern states of India including Darjeeling to help them integrating the experiment-based teaching with their regular class room teaching.

Apart from pioneering efforts in the interdisciplinary areas of science alongwith myriad R&D activities covering fundamental and applied contributions, the Institute has been dedicated for designing and repurposing small molecules against COVID-19.

Bose Institute hosted lectures by eminent scientists viz. *Prof. Subhash Kak, Regents Professor, School of Electrical and Computer Engineering, Oklahoma State University, Stillwater, USA, delivered the 81st Acharya Jagadis Chandra Bose Memorial Lecture on "Computation, Indian Scientific Tradition, and Artificial Intelligence" on the 103rd Foundation Day Celebration of Bose Institute on 30-11-2019; Prof. K Ramasubramanian, Department of Humanities and Social Sciences, Indian Institute of Technology Bombay, delivered the Professor DM Bose Memorial Lecture on "Use of Calculus in Indian Astronomy" on 26-11-2019, the 135th Birth Day of Professor Debendra Mohan Bose; The special Centenary Lecture 2020 was delivered by Prof. Joachim Frank, Nobel Laureate in Chemistry 2017, on "Single particle cryo-EM: Visualization of biological molecules in their native states" on 22-01-2020; Prof. Grant Jensen, CALTECH, HHMI, USA delivered Bose Institute Colloquium lecture on "Electron Cryotomography: present capabilities and future potential" on 29-01-2020.*

I am highly grateful to the Members of Bose Institute Council especially to our Hon'ble Chairman for kind advice, wisdom and vision from time to time ensuring effective implementation of the plans/ideas for holistic development of the Institute. I express my sincere gratitude to our funding agency, Department of Science and Technology, Government of India, for their continuous support in terms of uninterrupted flow of funds and valuable advice enabling us to build a stimulating and supportive environment of research and research-based activities as well as empowering us to render significant contributions to the country by nurturing highly developed and professionally competent scientific manpower.

Prof. (Dr.) Uday Bandyopadhyay
Director
Bose Institute, Kolkata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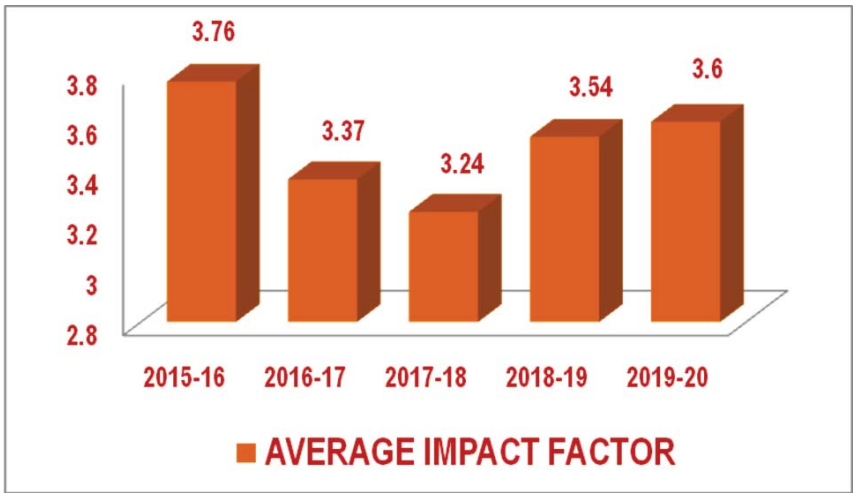
PEER REVIEWED PUBLICATIONS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AVERAGE IMPACT FACTOR

MANAGEMENT OF THE INSTITUTE

MANAGEMENT OF THE INSTITUTE

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. The Institute also has a Finance Committee responsible for the financial policies and management.

BOSE INSTITUTE GOVERNING BODY

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

BOSE INSTITUTE COUNCIL

1. Prof. Gautam R. Desiraju, Chairman
   IISc, Bangalore
2. Prof. Dipankar Chatterji
   Honorary Professor, Molecular Biophysics Unit, IISc, Bangalore.
3. Prof. G. Balakrish Nair
   Distinguished Professor, RGCB Bio Innovation Center,
   Thiruvananthapuram, Kerala
4. Prof. Subodh R Shenoy
   Visiting Professor TIFR, Hyderabad
5. Prof. Basanta Kumar Nandi
   Dept. of Physics, IIT Mumbai.
6. Secretary, DST or his nominee
7. Financial Adviser, DST
8. The Chief Secretary, Govt. of WB or his nominee
9. The Director, Indian Association for the Cultivation of Science, Kolkata
10. The Director, S. N. Bose National Centre for Basic Sciences, Kolkata
11. The Director, Bose Institute
12. The Registrar, Bose Institute – Non-Member Secretary

MEMBERS OF THE FINANCE COMMITTEE

The Chairman, Bose Institute Council, Chairman.

Secretary, DST,
Govt. of India or his nominee
The Director, Bose Institute

Financial Advisor, DST
Govt. of India or his nominee
The Registrar, Bose Institute - Secretary

MEMBERS OF THE RESEARCH ADVISORY COUNCIL (RAC)

Prof. D. N. Rao, Chairman,
Department of Biochemistry, IISc, Bangalore

Prof. Dipankar Nandi, Member
Department of Biochemistry
IISc, Bangalore

Prof. Prasanta K. Panigrahi, Member
Department of Physical Science, IISER, Kolkata

Prof. Ashwini Nangia, Member
Director, CSIR - NCL,
Pune and University of Hyderabad

Prof. Arindam Ghosh, Member
Department of Physics, IISc, Bangalore

Dr. Ramesh V Sonti, Member
CSIR - Centre for Cellular & Molecular Biology, Hyderabad

Prof. J. N. Moorthy, Member
Director, IISER, Thiruvananthapuram

Dr. Amit Sharma, Member
Protein Structure & Bioinformatics Research Group, ICGEB, New Delhi

Prof. Mahan Maharaj, Member,
TIFR, Mumbai

Registrar, Secretary, Bose Institute, Kolkata

LIST OF PERSONNEL (Administration)

Prof. (Dr.) Uday Bandyopadhyay, Director (Joined on 03-04-2019)
Prof. Rajarshi Ray, Registrar (Officiating)

Noreen Bhattacharjee, Deputy Registrar
Sougato Banerjee, Assistant Registrar
Achintya Mukherjee, Accounts Officer
Vikash Kumar, Audit & Finance Officer

Rina Roy	Sisir Chakraborty	Mantu Bhattacharya	Tarun Kumar Maji
Vineet Kumar Tandon	Supriya Das	Kamal Sing	Debdas Nandi
Somnath Das	Rubi Sarkar	Sudam Ch. Jana	Amitava Bhattacharyya
Babli Marrick	Satyaswaroop Behara	Ananya Malgope	Nitin Sharma
Gopa Dasgupta	Rina Das	Sanjoy Krishna Chaki	Debasish Koley
Angshuman Bhowmik	Sukanta Chakraborty	Sujata Roy	Dr. Ishani Chatterjee
Arjun Das	Biplab Malakar	Bipul Kr. Nag	Arpita Bose
Animesh Jana	Ratan Saha	Shaubhik Ghosh	Atanu Deb
Sumanta Ghosh	Tuhin Saha	Mahendra Nath Shee	Kanai Hazra
Sanat Kumar Dhara	Khairul B. Mollah	Madhu Sudan Marrick	Sk. Md. Kalu
Kali Charan Turi	Prafulla Bhuiya	Chandra Kanata Sasmal	Duryodhan Nayak
Sarda Devi	Raj Kumari Balmiki	Bablu Mondal	Rajbrat Ram
Hemanta Kr. Sahoo	Goutam Behera	Gourango Paramanick	

ABOUT
BOSE INSTITUTE

INTRODUCTION

The doyen of modern science in India, Acharya Jagadish Chandra (J. C.) Bose was a pioneer in the real sense of the word. He was the first to demonstrate wireless transmission of signals. That research paved the way for radio communications, although Guglielmo Marconi received the Nobel Prize for the discovery. J. C. Bose was the first in the world to employ semiconductor technology, sixty years ahead of the times, in the words of the Nobel Laureate Sir Neville Mott. His seminal work on electrophysiology started the discipline of Biophysics.

Despite all these achievements, the scientific career of J. C. Bose was full of continuous struggles. The West promptly hailed his first discovery of wireless transmission, but they denied or often ridiculed his later works on 'living and non-living'. To prove his results, J. C. Bose fabricated his scientific instruments. The accuracy and ingenuity of those instruments amaze the scientific community until now. Since he had no institutional support until then, J. C. Bose acutely felt theneed for an institute, which will cater to the need generations to come. He found generous support in his resolve from stalwarts like Rabindra Nath Tagore, Sister Nivedita, Gokhale, and Mahatma Gandhi, to name a few.

After retirement from Presidency College in Kolkata (then Calcutta), J. C. Bose devoted himself entirely to the establishment of this haven, Bose Institute. He committed the savings of his and his wife Lady Abala, and the inheritances to this task but that were, expectedly inadequate. Many patriots, some of whom named above, helped and contributed him at that time. J. C. Bose even resorted to giving scientific demonstration-lectures all over India. The organizers charged the admission fees to help found the Institute. Thus, the establishment of Bose Institute is the manifestation of India's hope to establish the nation's self-esteem as an equal to the colonizing west. On 30th November 1917, which coincided with his birthday, J. C. Bose inaugurated Bose Institute at the premises located at 93/1, Upper Circular Road (now A. P. C. Road) adjacent to the Rajabazar Science College. His profound proclamation was *"I dedicate today this Institute – not merely a Laboratory but a Temple".*

J. C. Bose encouraged his followers to pursue *the investigation of the ever-opening problems of developing science. In his own words "which includes both Life and Non-Life…The advance of science is the principal objective of this Institute and also the diffusion of knowledge.. to associate the advancement of knowledge with the widest possible civic and public diffusion of it, and this without any academic limitations, henceforth to all races and languages, to both men and women alike, and for all the time coming.. Thus the lines of physics, physiology and psychology converge and merge. And here will assemble those who would seek oneness amidst the manifold".* These are indeed prophetic words, motivating the pursuit of seamless science, or inter-disciplinary scientific research, as we call it today.

With this lofty ideal, Bose Institute is striving for the past hundred years to justify the expectation of its illustrious Founder. After his demise in 1937, his nephew, Dr. Debendra Mohan (D. M.) Bose, then Sir Rashbehari Ghose Professor of Physics at the University of Calcutta, was prevailed upon by Rabindra Nath Tagore to take over the reins of Bose Institute as Director. During his leadership of 30 years, Bose Institute progressed to a modern laboratory to compete in the international scientific scene. Under his tutelage, the research in high energy physics and nuclear physics started for the first time in India. D. M. Bose and his student Biva Chowdhury succeeded in detecting a new elementary particle, the pi meson, by exposing photographic emulsions at mountain altitudes. The Nobel Prize also eluded them for this profound discovery. It is a matter of ill-fate since they needed some emulsion of more acceptable resolution than the ones they were using, quantifying their results conclusively but were unable to procure such films because of the raging Second World War at the time.

Meanwhile, C. F. Powell independently succeeded in discovering with the required accuracy and bagged the Noble Prize for it. In his Nobel Lecture, however, Powell did acknowledge the original work of Bose and Chowdhury. After J. C. Bose, that was another occasion of Bose Institute, and India, being deprived of a well-deserved Nobel Prize.

D. M. Bose set Bose Institute on a course of an international contemporary and competitive programme. He established the first Microbiology Department in India at Bose Institute. D. M. Bose initiated research in understanding the observations of J. C. Bose in plant electrophysiology from the standpoint of biochemical processes. He paved the way for establishing the discipline of molecular biology in India. Bose Institute was one of the first institutions in India to embark on such studies and earned an enviable reputation in the area. Another significant discovery, worthy of a Nobel Prize, was carried out in the Chemistry laboratory of Bose Institute, the seminal discovery of the Cholera endotoxin, by Prof. Sambhu Nath De, a professor of pathology at Calcutta Medical College. Nobel Laureate Joshua Lederberg did nominate De for the Nobel Prize on more than one occasion, but unfortunately without success.

The later generations of scientists at Bose Institute have followed in these lofty paths, if not with similar achievements but with intense dedication and commitment and commendable success. They can boast of significant contributions in plant genetics and biotechnology, structural and computational biology, microbiology, systems biology, molecular medicine, astroparticle, particle

and quantum physics, and the environmental sciences. The Bose Scientists have collaborated in several international endeavours both in physical and biological sciences.

Faithful to the exhortation of the Founder, Bose Institute undertakes extensive social outreach programmes in rural biotechnology, aiming at bringing the fruits of science and technology to the economically weaker section. Bose Institute conducts regular science camps for school children and science teachers, especially from the North-Eastern states of India through the hands-on programme. The Institute also runs an integrated MSc- PhD programme in Physical and Life Sciences besides training of a large number of doctoral and post-doctoral students. The activities of Bose Institute encompass over seven academic campuses, and experimental field stations spread all over the state of West Bengal.

Acharya J. C. Bose was an ardent nationalist who desired India to rediscover its glorious heritage and reclaim its leading position in the world of science and technology. Bose Institute indeed is fortunate to inherit his great legacy and tries to prove itself worthy of this inheritance. To keep the spirit of inquiry alive and fulfil the Founder's dream, the Institute plans to embark on some new directions of research in the coming years, which would build on the present expertise and take on new challenges.

Recent Activities:

1. **Areas of Focus :**

Bose Institute pursues fundamental research and developing solutions to national problems in the areas of food security, healthcare, environmental pollution, and climate change. Taking advantage of the diverse and complementary research expertise of the faculty members, coherent and synergistic multi-disciplinary research approaches focus on achieving scientific goals that are completely aligned with the mandate of the Department of Science and Technology, Government of India. Research is pursued in areas like the understanding stress response of plants, disease biology, anthropogenic activity-induced environmental changes, bioremediation of environmental pollutants and geomicrobiology, fundamental understanding of subatomic particles, development of detectors/sensors- from cosmic rays to biomolecules, and the dynamics of atmospheric pollutants, especially in the Himalayan region. The efforts of the institute's researchers have yielded several exciting results, which are as follows:

2. **Major Accomplishments:**

Plant Molecular Biology

- Development of inter-specific hybrid sesame with improved oil quality
- Identification of a marker (WUSCHEL) for in vitro shoot morphogenesis in tobacco and *Beta*
- Understanding the role of Trithorax factor (ULTRAPELATA 1), which specifically binds to the putative polycomb responsive elements "GAGAG" to regulate the cold-induced transcription in Rice

- Deciphering the role of secreted ribonucleases from *Ustilago maydis*, which scavenge extracellular RNA
- Over-expression of miR6024 in tomato plants has accelerated plant cell death in response to a pathogen attack and facilitates necrotrophic pathogenesis. It proves that the miR6024 is an essential component of plant immune response signaling
- Development of *Alternaria brassicicola*-tolerant *Brassica juncea* lines through conditional expression of ABA-auxin crosstalk factor ARF10

Microbiology

- Development of chromosome-based bioreporter strain to monitor environmental pollutants
- Microbial diversity and in *silico* functional metagenomic analysis of Hilsa gut microbiota
- Study of novel bioactive compounds and polyketide synthase gene clusters from mangrove plant associated microbes by culturable and non-culturable procedures
- Classification of the Ring Hydroxylating Oxygenase (RHO) enzyme system to explore the evolutionary mechanism using various bioinformatics tools including docking, MD simulation etc.
- Exploration of host-pathogen interaction by in *silico* analysis of human-bacteria protein-protein interaction network for better understanding of pathogenicity and drug design
- Elucidation of the earliest ancestor of the Green Sulfur Bacteria *(Chlorobia)* and discovery of crypto-aerobic microbial life in anoxic (sulfidic) marine sediment

Bioinformatics

- Adapted and optimized computational protocols to quantify the contributions of some specific amino acid residues of proteins/peptides to determine their capacity to penetrate into the membrane; particularly the role of charged residues were underscored.
- Demonstration of the role of cholesterol molecules to influence the membrane fusion
- Development of Long non-coding RNA target prediction tool, and a new version of database, which hosts information on lncRNAs harbouring SNPs in breast, cervical and ovarian cancer patients

Biochemistry

- Demonstration of the domain structure and the folding-unfolding mechanism of a staphylococcal cyclophilin
- Identification of a paralogous family of vesicle-mediated protein transport machinery component in the human enteric pathogen *Giardia lamblia* that do not have any human counterparts

- Novel membrane-bending proteins of the human pathogen *Giardia lamblia* with unusual lipid-binding domain
- Understanding the oligomeric plasticity and inter-molecular cross-talk between heat shock proteins of *Sulfolobus acidocaldarius*, which protect stress-induced protein aggregation and membrane destabilization
- Analysis of diversity and distribution of Antibiotic resistome in the Sundarban mangrove ecosystem

Molecular Medicine

- Elecated histone H3 acetylation and the loss of the Sp1-HDAC1complex de-repress the GM2-synthase gene in renal cell carcinoma
- *Ricinus communis* L. fruit extract inhibits migration/invasion, induces apoptosis in breast
- cancer cells and arrests tumor progression in vivo

Biophysics

- Tumor suppressor p53-mediated structural reorganization of the transcriptional co-activator p300
- The three dimensional cryo-EM density map of the p300-p53 complex was constructed.

Physics

- Characterization and stability study of different gaseous detectors for ALICE and CBM experiments
- R&D of straw tube detector and low resistive RPC detector, measurement of spark probability of MPGD which are the first time in India
- The only cosmic ray extended air shower (EAS) array in Eastern part of India, has been commissioned and taken data continuously for last two years in the Darjeeling campus of Bose Institute
- Demonstration of the tuning of light-matter coupling in exciton-plasmon (2D-0D) hybrid system. We have shown for the first time the switching between the optical emissions due to the transitions of exciton and trion in Ws2.
- Characterization of the hot and dense quark gluon plasma (QGP) medium produced in heavy ion collisions, by studying jet modifications in presence of the medium using ALICE detectors and using the framework of theoretical models EPOS and JEWEL.
- Understanding the dynamics of particle production in small systems (proton-proton collisions) at LHC energy through study of jet properties.

- Development of a water based cooling system for the Muon Detector (MUCH) for the mini-CBM experiment at GSI, Germany.
- Data quality assurance and calibrations of the LHC data obtained by Photon Multiplicity Detector (PMD) in the ALICE experiment at CERN, Geneva.
- Nuclear physics aspect of the decades old cosmological lithium problem studied through high lying resonances in 7Be + d reaction. The experiment was carried out at the radioactive ion beam facility HIE-ISOLDE at CERN, Geneva, Switzerland and is the first experiment at HIE-ISOLDE from an institute in India.

Environmental Sciences

- A 15 year long-term study shows that Sundarban mangrove forest acts like an umbrella
- regions (Jhum Cultivation) and inhibits their further advection towards further north of West Bengal including Kolkata
- Sources were identified and quantitatively estimated their strength for the extremely carcinogenic Polynuclear Aromatic Hydrocarbons in the atmosphere of Kolkata and the exposures to the people of different ages and occupation
- Models have been developed to quantitatively predict the deposition flux of nutrients on the Himalayan soil when rain rates and aerosol pollutions are known.
- Bose Institute has been selected as the Nodal Institute and Dr Abhijit Chatterjee has been selected as the Nodal Officer and the Advisor for making action plans for air pollution for the state of West Bengal under National Clean Air Programme (NCAP), Govt of India

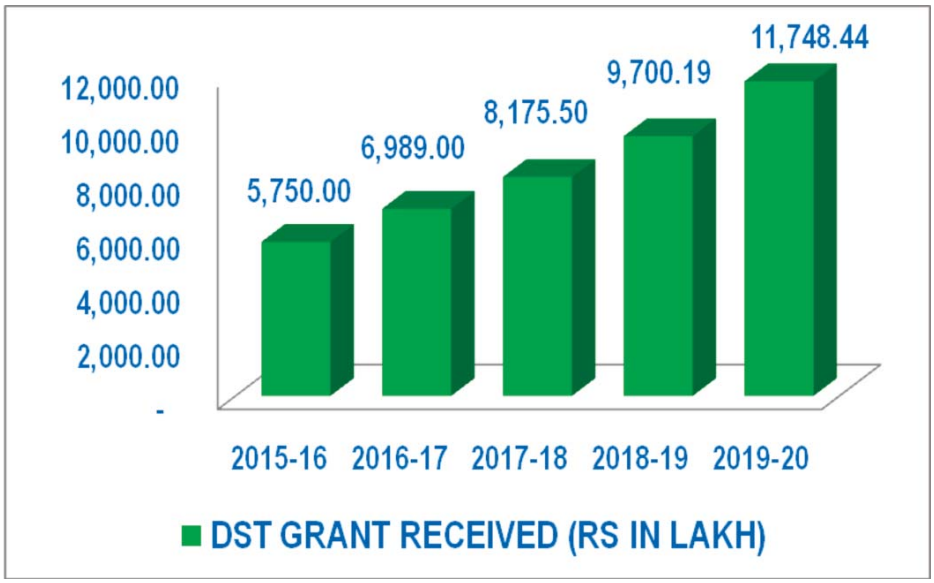
3. Important Global and National Collaborations

Indo-UK Water Quality Research Project (WQRP)- The development and implementation of sensors and treatment technologies for freshwater systems in India (Newton-Bhaba Fund)

Indo-Swedish Collaborative Programme- Antimicrobial peptides against crop disease

ALICE Collaboration- Study of hadronic as well as heavy ion collisions at ultra-relativistic energy at the LHC, CERN, Switzerland

CBM Collaboration- study of nuclear matter at very high density and moderate temperature at FAIR, Germany.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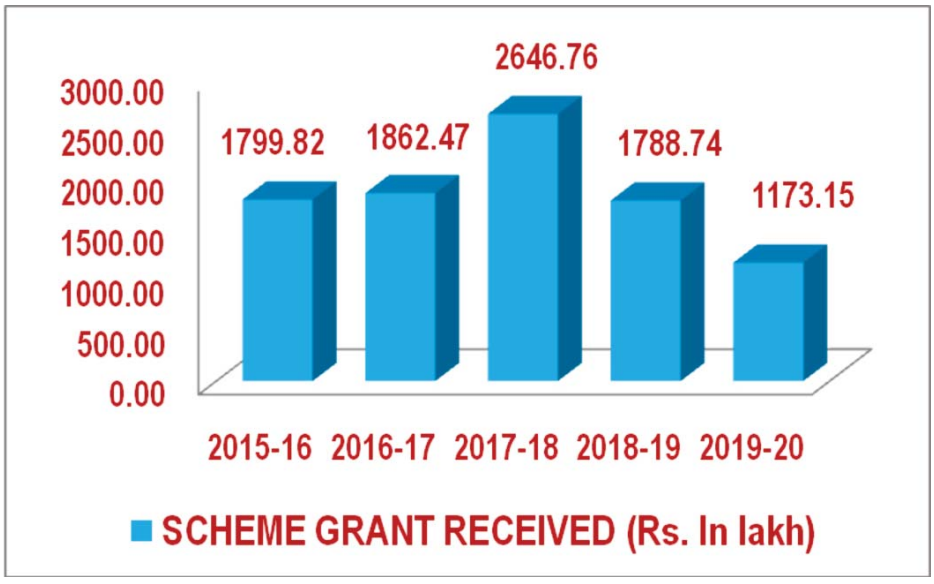
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SCHEME GRANT RECEIVED (Rs. In lakh)

MEMBERSHIP / HONOURS / AWARDS

Bioinformatics

Dr. Zhumur Ghosh

1. Member of the National Academy of Science.

Environment Sciences

Dr. Abhijit Chatterjee

1. Selected as the Nodal Faculty for the state of West Bengal of "National Clean Air Program", Govt. of India to build action plans for mitigation of air pollution in Kolkata.

Dr. Sanat Kumar Das

Memberships of:

1. Indian Aerosol Science and Technology Association (IASTA)
2. Indian Physics Association (IPA)
3. Asia Oceania Geosciences Society (AOGS)
4. American Geosciences Union (AGU)
5. European Geosciences Union (EGU)
6. Japan Geosciences Union (JpGU)

Physics

Dr. Soumen Roy

1. Regular Associate, International Centre for Theoretical Physics (UNESCO), Trieste, Italy.

Dr. Saikat Biswas

1. Selected as a jury of the Young scientist's conference (YSC) at India International Science Festival 2019, 5-8 November 2019, Kolkata.

Plant Biology

Dr. Gaurab Gangopadhyay

1. Invited as the Chief Guest by STE (Save the Environment), Kolkata to celebrate the programme of 'World Environment Day' on June 5, 2019.
2. Invited to provide a feedback by the Joint Secretary, Department of Science and technology and Biotechnology, Government of WB on proposed Kolkata Biotech Park on January 20, 2020.

PATENT GRANTED

Biophysics

Dr. Subhrangsu Chatterjee

1. Cancer chemotherapeutic agent/formulation, manufacture and use thereof-AU2018201532B2 **(Australian Patent granted).**

EDITOR / REVIEWER OF JOURNALS

Molecular Medicine

Dr. Gaurisankar Sa

1. Editor-in–Chief: International J Immunology
2. Sectional Editor: Scientific Reports, Proceeding of National Academy of Science, India, Section-B, Head & Face Medicine; Austin J. Clinical Immunology, J Cancer Research & Molecular Medicine.

Physics

Dr. Soumen Roy

1. Academic Editor: PLOS ONE.

Plant Biology

Dr. Gaurab Gangopadhyay

1. Reviewer: 3 Biotech (October 2019), Applied Biological Research (March 2020), Genetic Resources and Crop Evolution (March 2020)

EVALUATOR / EXAMINER

Physics

Dr. Soumen Roy

1. Evaluator of Ph. D thesis for Department of Electrical Engineering, Indian Institute of Technology, Delhi.
2. Evaluator of Ph. D thesis for Department of Chemical Engineering, Indian Institute of Technology, Bombay.

Plant Biology

Dr. Gaurab Gangopadhyay

1. Invited to act as an external member of Departmental Research Committee in Botany, University of Kalyani on September 3, 2019.
2. Invited to evaluate the Final Technical Report of Science Research Scheme (SRS) Kerala State Council for Science, Technology and Environment (KSCSTE) on December 20, 2019.
3. Evaluator of the Ph. D thesis: Faculty of Science (Botany), Visva-Bharati University (February 2020), Faculty of Agricultural Biotechnology, Bidhan Chandra Krishi Viswavidyalaya (March 2020).

PH.D. AWARDED

Biochemistry

- **Aditya Prasad Behera** : Structure-function analysis of microtubule associated ubiquitin E3 Ligasa ZNRF1. Supervisor: Dr. Ajit Bikram Dutta.
- **Nabanita Saha** : Study of vesicular trafficking pathway in *Giardia lamblia*. Supervisor: Prof. Srimonti Sarkar.
- **Shankari Prasad Datta** : Identification and Characterization of Proteins Involved in Vesicular Fusion Events of *Giardia lamblia*. Supervisor: Prof. Srimonti Sarkar.
- **Shamila Sarwar** : Studies on the antibacterial activity of ZnO nanoparticle and its effect on *Vibrio cholerae* proteome. Supervisor: Prof. Pinakpani Chakraborty.
- **Sukhendu Mandal** : Studies on the DNA binding mechanism of a global virulence regulator of *Staphylococcus aureus*. Supervisor: Prof. Pinakpani Chakraborty.

Bioinformatics

- **Debasree Sarkar** : Systematic discovery of linear motifs mediating protein-protein interactions. Supervisor: Dr. Sudipto Saha.
- **Prerna Priya** : Understanding the mechanisms of high affinity ligands inhibiting Bcl-2 family members with flexible pockets : molecular dynamics simulation approach, Supervisor: Dr. Shubhra Ghosh Dastidar.
- **Sarmistha Majumdar** : Understanding the mechanisms of Ligand induced inhibition / perturbation of protein-protein interactions navigating the conformational landscape along the principal subspaces, Supervisor: Dr. Shubhra Ghosh Dastidar.
- **Tanmoy Jana** : Computer-aided prediction of potential drug candidates against cancer using protein-protein interaction modulators, Supervisor: Dr.Sudipto Saha.
- **Ranjan Kumar Maji** : Investigating the functional complexity of regulatory RNAs as versatile modulators-a systems approach, Supervisor: Dr. Zhumur Ghosh.

Biophysics

- **Anirban Ghosh** : Supervisor: Dr. Anirban Bhunia.
- **Rajiv K. Kar** : Supervisor: Dr. Anirban Bhunia.

- **Aritreyee Datta** : Supervisor: Dr. Anirban Bhunia.
- **Priya Mondal** : Peptides as a tool to understand signalling and epigenetic networks, Supervisor: Prof. Siddhartha Roy.

Chemistry

- **Chandreyee Dutta** : *Helicobacter* pylori induced host cell signalling and the role of the secreted protein, HP0175, Supervisor: Prof. Manikuntala Kundu.

Microbiology

- **M. J. Rameej** : Molecular biology of chemolithotrophicsulfur oxidation by Paracoccusthiocyanatus SST. Supervisor: Dr. Wriddhiman Ghosh

Molecular Medicine

- **Shabina Parveen** : Role of host phosphatase and kinase during visceral Leishmaniasis disease: involvements to toll like receptors and protein kinase C. Supervisor: Prof. Subrata Majumdar
- **Junaid Jibran Jawad** : Role of protein kinase C isoforms in the regulation of T-cell subsets during *Leishmaniadonovani* infection. Supervisor: Prof. Subrata Majumdar.
- **Pritam Sadhukhan** : Oxidative stress and disease: targeting by different small molecules. Supervisor: Prof. Paramesh C. Sil.
- **Ishani Bhaumik** : Synthesis of the polysaccharide fragments corresponding to the bacterial O-antigens. Supervisor: Prof. Anup Kumar Mishra.
- **Soumyadip Paul** : Studies on control of heat shock factor-1 and its target gene under proteotoxic stress in human cells, Supervisor: Prof. Mahadeb Pal.
- **Kirti Kajal** : Studies on control of heat shock factor-1 and its target gene under proteotoxic stress in human cells, Supervisor: Prof. Gourisankar Sa and Prof. Tanya Das.
- **Tapasree Basu** : Studies on control of heat shock factor-1 and its target gene under proteotoxic stress in human cells, Supervisor: Prof. Nripendranath Mandal.
- **Avisek Banerjee** : Defining the epigenetic regulation of ganglioside synthase genes in cancer, Supervisor: Dr. Kaushik Biswas.
- **Sharmistha Banerjee** : Elucidation of signalling mechanism of the effect of gaseous mediators on inflammatory bowel disease (colitis) and role of small bioactive molecules on drug induced inflammatory response, Supervisor: Prof. Paramesh C. Sil.

PH.D. AWARDED

Physics

- **Saswata Halder** : Lattice vibrational dynamics and electron transport in strongly corelated rare earth based oxides. Supervisor: Prof. T.P. Sinha.
- **Rupamoy Bhattacharyya** : Detector development for exploring rare events in Cosmic Rays at terrestrial altitude. Supervisor: Prof. Sanjay K. Ghosh.
- **Debarshi Das** : Probing fundamental aspects of spatial and temporal quantum correlations, Supervisor: Prof. Dipankar Home.

Plant Biology

- **Anirban Jyoti Debnath** : Optimization of regeneration and transformation in *Sesamum indicum* L. cultivar JK-1 for studying tissue specific promoters. Supervisor: Prof. Samir Ranjan Sikdar.
- **Ms. Papri Basak** Functional promoter analysis of INO1 genes in wild and cultivated rice from Calcutta University (Biotechnology).Supervisor: Prof. A. N. Lahiri Majumder.

Library

- **Sanat Kumar Biswas** : Information literacy awareness and role of libraries : a study on students and faculty users of undergraduate college libraries under university of Kalyani in West Bengal. Supervisor: Dr. Arun Kumar Chakraborty.

LIST OF PUBLICATIONS

Sl. No.	Authors	Title	Year	Source title	Impact factor
1	Debnath, U; Mukherjee, S; Joardar, N; Sinha B, Santi P.; Jana, K; Misra, A K	Aryl quinolinyl hydrazone derivatives as anti-inflammatory agents that inhibit TLR4 activation in the macrophages.	2019	European Journal of Pharmaceutical Sciences 134	
2	B.N. Ratha, R. K. Kar, S. Kalita, S. Kalita, S. Raha, A. Singha, K. Garai, B. Mandal, A. Bhunia	Sequence specificity of amylin-insulin interaction: a fragment-based insulin fibrillation inhibition study	2019	Biochimica et BiophysicaActa (BBA)Proteins and Proteomics	2.371
3	Laha S, Kumar D, Sengupta DN, Gangopadhyay G	*In silico* characterization of SAMdC from Pokkali rice and its over-expression in transgenic tobacco.	2019	Vegetos (Springer) 32	
4	Bhattacharya S, Sengupta S, Karmakar A, Sarkar SN, Gangopadhyay G, Datta K, Datta SK	Genetically engineered rice with *appA* gene enhanced phosphorus and minerals	2019	Journal of Plant Biochemistry and Biotechnology, 28	0.773
5	Mohid SA, Ghorai A, Ilyas H, Mroue KH, Narayanan G, Sarkar A, Ray SK, Biswas K, Bera AK, Malmsten M, Midya A, Bhunia A.	Application of tungsten disulfide quantum dot-conjugated antimicrobial peptides in bio-imaging and antimicrobial therapy.	2019	Colloids Surf B Biointerfaces., 176	
6	Das A, Narayanam MK, Paul S, Mukhnerjee P, Ghosh S, Dastidar DG, Chakrabarty S, Ganguli A, Basu B, Pal M, Chatterji U, Banerjee SK, Karmakar P, Kumar D, Chakrabarti G	A novel triazole, NMK-T-057, induces autophagic cell death in breast cancer cells by inhibiting γ-secretase-mediated activation of Notch signaling.	2019	J Biol Chem 294(17)	
7	Ghosh, S., Roy, A., Chatterjee, A., Sikdar, S.R.	Effect of regional wind circulation and meteorological factors on long-range migration of mustard aphids over indo-gangetic plain	2019	Scientific Reports	4.122
8	Mukherjee, R., Mukherjee, A., Bandyopadhyay, S., Mukherjee, S., Sengupta, S., Ray, S., Majumder, A.L.	Selective manipulation of the inositol metabolic pathway for induction of salt-tolerance in indica rice variety	2019	Scientific Reports	4.122
9	Roy, A., Chatterjee, A., Ghosh, A., Das, S.K., Ghosh, S.K., Raha, S.	Below-cloud scavenging of size-segregated aerosols and its effect on rainwater acidity and nutrient deposition: A long-term (2009–2018) and real-time observation over eastern Himalaya	2019	Science of the Total Environment	4.61
10	Patra, S.K., Samaddar, S., Sinha, N., Ghosh, S.	Reactive nitrogen species induced catalases promote a novel nitrosative stress tolerance mechanism in Vibrio cholerae	2019	Nitric Oxide - Biology and Chemistry	4.367
11	Kundu, M., Sadhukhan, P., Ghosh, N., Chatterjee, S., Manna, P., Das, J., Sil, P.C.	pH-responsive and targeted delivery of curcumin via phenylboronic acid-functionalized ZnO nanoparticles for breast cancer therapy	2019	Journal of Advanced Research	4.327
12	Debnath, U., Mukherjee, S., Joardar, N., Sinha Babu, S.P., Jana, K., Misra, A.K.	Aryl quinolinyl hydrazone derivatives as anti-inflammatory agents that inhibit TLR4 activation in the macrophages	2019	European Journal of Pharmaceutical Sciences	3.466
13	Dutta, S., Mahalanobish, S., Saha, S., Ghosh, S., Sil, P.C.	Natural products: An upcoming therapeutic approach to cancer	2019	Food and Chemical Toxicology	3.977
14	Roy, C., Bakshi, U., Rameez, M.J., Mandal, S., Haldar, P.K., Pyne, P., Ghosh, W.	Phylogenomics of an uncultivated, aerobic and thermophilic, photoheterotrophic member of Chlorobia sheds light into the evolution of the phylum Chlorobi	2019	Computational Biology and Chemistry	1.412
15	Ghosh, S., Pal, A., Ray, M.	Methylglyoxal in combination with 5-Fluorouracil elicits improved chemosensitivity in breast cancer through apoptosis and cell cycle inhibition	2019	Biomedicine and Pharmacotherapy	3.457
16	Rudra, M., Halder, S., Saha, S., Dutta, A., Sinha, T.P.	Temperature dependent conductivity mechanisms observed in Pr <inf>2</inf> NiTiO <inf>6</inf>	2019	Materials Chemistry and Physics	2.21
17	Bhattacharyya, A., Ghosh, S.K., Maity, S., Raha, S., Ray, R., Saha, K., Samanta, S., Upadhaya, S.	Thermodynamics of strongly interacting matter in a hybrid model	2019	Physical Review C	3.304
18	Sengupta, P., Bhattacharya, A., Sa, G., Das, T., Chatterjee, S.	Truncated G-Quadruplex Isomers Cross-Talk with the Transcription Factors to Maintain Homeostatic Equilibria in c-MYC Transcription	2019	Biochemistry, 58(15)	2.997
19	Zuppardo, M., Ganardi, R., Miller, M., Bandyopadhyay, S., Paterek, T.	Entanglement gain in measurements with unknown results	2019	Physical Review A	2.925

Sl. No.	Authors	Title	Year	Source title	Impact factor
20	Roy, A., Bhattacharya, S.S., Mukherjee, A., Ganguly, N., Paul, B., Mukherjee, K.	Several trade off features of quantum steering in distributed scenario	2019	European Physical Journal D	1.393
21	S. Acharya et al. (ALICE Collaboration)	Charged-particle pseudorapidity density at mid-rapidity in p–Pb collisions at vsNN = 8.16 TeV	2019	European Physical Journal C	5.172
22	Seal, S., Polley, S., Sau, S.	A staphylococcal cyclophilin carries a single domain and unfolds via the formation of an intermediate that preserves cyclosporin A binding activity	2019	PLoS ONE	2.766
23	Biswas, S., Das, S., Ghosh, S.K., Prasad, S.K., Raha, S.	Jet fragmentation transverse momentum measurements from di-hadron correlations in vs=7 TeV pp and vsNN=5.02 TeV p–Pb collisions	2019	Journal of High Energy Physics	5.541
24	Bhattacharyya, D., Mohite, G.M., Krishnamoorthy, J., Gayen, N., Mehra, S., Navalkar, A., Kotler, S.A., Ratha, B.N., Ghosh, A., Kumar, R., Garai, K., Mandal, A.K., Maji, S.K., Bhunia, A.	Lipopolysaccharide from Gut Microbiota Modulates α-Synuclein Aggregation and Alters Its Biological Function	2019	ACS Chemical Neuroscience, 10 (5)	4.211
25	Ghosh, T., Sarkar, S., Bhattacharjee, P., Jana, G.C., Hossain, M., Pandya, P., Bhadra, K.	In vitro relationship between serum protein binding to beta-carboline alkaloids: a comparative cytotoxic, spectroscopic and calorimetric assays	2019	Journal of Biomolecular Structure and Dynamics	3.107
26	Priyadharshini, B., Verma, S., Chatterjee, A., Sharma, S.K., Mandal, T.K.	Chemical characterization of fine atmospheric particles of water-soluble ions and carbonaceous species in a tropical urban atmosphere over the eastern Indo-Gangetic plain	2019	Aerosol and Air Quality Research	2.589
27	Chakraborty, J., Ghosh, P., Sen, S., Nandi, A.K., Das, S.	CaMPK9 increases the stability of CaWRKY40 transcription factor which triggers defense response in chickpea upon Fusarium oxysporum f. sp. ciceri Race1 infection	2019	Plant Molecular Biology	3.543
28	Chatterjee, A., Devara, P.C.S., Balasubramanian, R., Jaffe, D.A.	Aerosol climate change connection (AC3) special issue: An overview	2019	Aerosol and Air Quality Research	2.589
29	Huo, C.-X., Dhara, D., Baliban, S.M., Tahmasebi Nick, S., Tan, Z., Simon, R., Misra, A.K., Huang, X.	Synthetic and immunological studies of: Salmonella Enteritidis O-antigen tetrasaccharides as potential anti-Salmonella vaccines	2019	Chemical Communications	6.29
30	Brender, J.R., Ghosh, A., Kotler, S.A., Krishnamoorthy, J., Bera, S., Morris, V., Sil, T.B., Garai, K., Reif, B., Bhunia, A., Ramamoorthy, A.	Probing transient non-native states in amyloid beta fiber elongation by NMR	2019	Chemical Communications	6.29
31	T. S. Bhattacharya, P. Maitra, D. Bera, K. Das, P. Bandyopadhyay, S. Das, D. S. Bhar, A. Singha, P. Nandy	Investigation of the origin of voltage generation in potentized homeopathic medicine through Raman spectroscopy	2019	Homeopathy, 108, 121	1.524
32	J. Doherty, S. Biswas, D. McNulty, C. Downing, S. Raha, C. O'Regan, A. Singha, C. O'Dwyer, J. D. Holmes	One-step fabrication of GeSn branched nanowires,	2019	Chemistry of Materials, 31	10.159
33	Majumdar S, Basu D, Ghosh Dastidar S.	Conformational States of E7010 Is Complemented by Microclusters of Water Inside the α,β-Tubulin Core.	2019	J Chem Inf Model., 28;59(5):2274-2286.	
34	Bhaumik I, K Pal, Debnath U, Karmakar P, Jana K, Misra, A K.	Natural product inspired allicin analogs as novel anti-cancer agents.	2019	Bioorganic Chemistry, 86	
35	Arin G, Misra, A K	Influence of remote functional groups towards the formation of 1,2-*cis* glycosides: special emphasis on β-mannosylation,	2019	Org. Biomol. Chem. 17	3.5
36	S. Acharya et al. (ALICE Collaboration)	Analysis of the apparent nuclear modification in peripheral Pb–Pb collisions at 5.02 TeV	2019	Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics	4.254

Sl. No.	Authors	Title	Year	Source title	Impact factor
37	S. Acharya et al. (ALICE Collaboration)	Λ <inf>c</inf>+ production in Pb–Pb collisions at s <inf>NN</inf> =5.02 TeV	2019	Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics	4.254
38	Dey, S., Purkait, R., Pal, K., Jana, K., Sinha, C.	Aggregation-Induced Emission-Active Hydrazide-Based Probe: Selective Sensing of Al 3+ , HF <inf>2</inf>- , and Nitro Explosives	2019	ACS Omega	2.584
39	Das, D., Sasmal, S., Roy, S.	Detecting Einstein-Podolsky-Rosen steering through entanglement detection	2019	Physical Review A	2.925
40	Chakravorty, D., Banerjee, K., Mapder, T., Saha, S.	In silico modeling of phosphorylation dependent and independent c-Myc degradation	2019	BMC Bioinformatics, 20 (1)	2.213
41	Ghosh, N., Hossain, U., Mandal, A., Sil, P.C.	The Wnt signaling pathway: a potential therapeutic target against cancer	2019	Annals of the New York Academy of Sciences	4.295
42	Saha, T., Ranjan, V.K., Ganguli, S., Thakur, S., Chakraborty, B., Barman, P., Ghosh, W., Chakraborty, R.	Pradoshia eiseniae gen. nov., sp. nov., a spore-forming member of the family Bacillaceae capable of assimilating 3-nitropropionic acid, isolated from the anterior gut of the earthworm Eisenia fetida	2019	International journal of systematic and evolutionary microbiology	1.932
43	S. Acharya et al. (ALICE Collaboration)	Energy dependence of exclusive J / ψ photoproduction off protons in ultra-peripheral p–Pb collisions at v sNN=5.02 TeV	2019	European Physical Journal C	5.172
44	S. Acharya et al. (ALICE Collaboration)	Measurement of D , D + , D * + and Ds+ production in pp collisions at v s=5.02TeV with ALICE	2019	European Physical Journal C	5.172
45	Bhakuni, D.S., Dattagupta, S., Sharma, A.	Effect of noise on Bloch oscillations and Wannier-Stark localization	2019	Physical Review B	3.813
46	Maity, R., Sheikh, M.S., Dutta, A., Sinha, T.P.	Visible Light Driven Photocatalytic Activity of Granular Pr Doped LaFeO <inf>3</inf>	2019	Journal of Electronic Materials	1.566
47	Chakraborty, D., Pati, S., Bose, S., Dhar, S., Dutta, S., Sa, G.	Cancer immunotherapy: present scenarios and the future of immunotherapy	2019	Nucleus (India)	0.27
48	Gucchait, A., Misra, A.K.	Influence of remote functional groups towards the formation of 1,2-cis glycosides: Special emphasis on β-mannosylation	2019	Organic and Biomolecular Chemistry	3.564
49	Chowdhury, S., Bhattacharjee, P., Basak, S., Chowdhury, S., Kundu, P.	Method to study dynamics of membrane-bound plant transcription factors during biotic interactions in tomato	2019	Methods in Molecular Biology	0.91
50	Dasgupta, P., Chaudhuri, S.	Analysis of DNA methylation profile in plants by chop-PCR	2019	Methods in Molecular Biology	0.91
51	Paul, A., Chaudhuri, S.	Change in nucleosome dynamics during stress responses in plants	2019	Methods in Molecular Biology	0.91
52	Chowdhury, S., Ghosh, S., Das, A.K., Sil, P.C.	Ferulic acid protects hyperglycemia-induced kidney damage by regulating oxidative insult, inflammation and autophagy	2019	Frontiers in Pharmacology	3.83
53	Chatterjee, M., Chakraborty, J., Das, S.	Abscisic Acid–Responsive 18 (CaABR18) Protein from Chickpea Inhibits the Growth of the Wilt-Causing Fusarium oxysporum f. sp. ciceri Race1	2019	Plant Molecular Biology Reporter	1.08
54	Halder, S., Sheikh, M.S., Maity, R., Ghosh, B., Sinha, T.P.	Investigating the optical, photosensitivity and photocatalytic properties of double perovskites A <inf>2</inf> LuTaO <inf>6</inf> (A = Ba, Sr): A combined experimental and density functional theory study	2019	Ceramics International	1.83
55	Dey, D., Gupta Bhattacharya, S.	Allergenicity assessment of fungal species using immunoclinical and proteomic techniques: a study on Fusarium lateritium	2019	International Journal of Environmental Health Research	0.65

Sl. No.	Authors	Title	Year	Source title	Impact factor
56	Bhattacharya, S., Sengupta, S., Karmakar, A., Sarkar, S.N., Gangopadhyay, G., Datta, K., Datta, S.K.	Genetically engineered rice with appA gene enhanced phosphorus and minerals	2019	Journal of Plant Biochemistry and Biotechnology 0.57	0.57
57	Bhattacharya, T.S., Maitra, P., Bera, D., Das, K., Bandyopadhyay, P., Das, S., Shankar Bhar, D., Singha, A., Nandy, P.	Investigation of the Origin of Voltage Generation in Potentized Homeopathic Medicine through Raman Spectroscopy	2019	Homeopathy	0.31
58	Roy, P., Sengupta, A., Joardar, N., Bhattacharyya, A., Saha, N.C., Misra, A.K., Babu, S.P.S.	Influence of autophagy, apoptosis and their interplay in filaricidal activity of C-cinnamoyl glycosides	2019	Parasitology	2.22
59	Das, A., Narayanam, M.K., Paul, S., Mukhnerjee, P., Ghosh, S., Dastidar, D.G., Chakrabarty, S., Ganguli, A., Basu, B., Pal, M., Chatterji, U., Banerjee, S.K., Karmakar, P., Kumar, D., Chakrabartia, G.	A novel triazole, NMK-T-057, induces autophagic cell death in breast cancer cells by inhibiting γ-secretase-mediated activation of Notch signaling	2019	Journal of Biological Chemistry	2.73
60	Roy, P; Sengupta, A; Joardar, N; Bhattacharyya, A; Saha, N Chandra; Misra, A K; Sinha B, Santi P.	Influence of autophagy, apoptosis and their interplay in filaricidal activity of C-cinnamoyl glycosides	2019	*Parasitology* 146(11)	
61	Chakraborty, P, Sarker, R, K, Roy, R, Ghosh, A, Maiti, D, Tribedi, P.	Bioaugmentation of soil with *Enterobacter* cloacae AKS7 enhances soil nitrogen content and boosts soil microbial functional-diversity	2019	3 Biotech 9 (7)	
62	Kundu, A., Singh, P.K., Dey, A., Ganguli, S., Pal, A.	Complex molecular mechanisms underlying MYMIV-resistance in Vigna mungo revealed by comparative transcriptome profiling	2019	Scientific Reports	4.122
63	Pariary, R., Bhattacharyya, D., Bhunia, A.	Mitochondrial-membrane association of α-synuclein: Pros and cons in consequence of Parkinson's disease pathophysiology	2019	Gene Reports	0.176
64	Sarkar, D., Das, S., Chattopadhyay, S.	Investigating the particle production at intermediate p<inf>T</inf> using identified triggered correlation in pp collisions at s = 7 TeV	2019	Nuclear Physics A	1.992
65	Mukherjee, A., Ghosh, S., Pal, M., Singh, B.	Deciphering the effective sequestration of DNA bounded bioactive small molecule Safranin-O by non-ionic surfactant TX-114 and diminution its cytotoxicity	2019	Journal of Molecular Liquids	4.513
66	Podder, S., Saha, D., Ghosh, T.C.	Deciphering the intrinsic properties of fungal proteases in optimizing phytopathogenic interaction	2019	Gene	2.498
67	S. Acharya et al. (ALICE Collaboration)	Multiplicity dependence of (anti-)deuteron production in pp collisions at s=7TeV	2019	Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics	4.254
68	Chakraborty, P., Sarker, R.K., Roy, R., Ghosh, A., Maiti, D., Tribedi, P.	Bioaugmentation of soil with Enterobacter cloacae AKS7 enhances soil nitrogen content and boosts soil microbial functional-diversity	2019	3 Biotech	1.786
69	S. Acharya et al. (ALICE Collaboration)	Production of the ρ(770)0 meson in pp and Pb-Pb collisions at sNN =2.76 TeV	2019	Physical Review C	3.304
71	Biswas, A.	Multivariate information processing characterizes fitness of a cascaded gene-Transcription machinery	2019	Chaos	2.415
72	Laha, S., Kumar, D., Sengupta, D.N., Gangopadhyay, G.	In silico characterization of SAMdC from Pokkali rice and its overexpression in transgenic tobacco	2019	Vegetos	0.04
73	Sarkar, S., Behera, A.P., Borar, P., Banka, P.A., Datta, A.B.	Designing active RNF4 monomers by introducing a tryptophan: Avidity towards E2 Ub conjugates dictates the activity of ubiquitin RING E3 ligases	2019	Biochemical Journal, 476(10)	3.857
74	Roy, D., Bhattacharyya, D., Bhunia, A.	Do catechins (ECG and EGCG)bind to the same site as thioflavin T (ThT) in amyloid fibril? Answer from saturation transfer difference NMR	2019	Natural Product Communications	0.809

Sl. No.	Authors	Title	Year	Source title	Impact factor
75	Halder, S., Sinha, T.P.	Phase transitions in Ca<inf>2-:X</inf>Ba<inf>x</inf>NdSbO<inf>6</inf> complex perovskites: A combined crystallographic and vibrational investigation	2019	CrystEngComm	3.304
76	Banerjee, B., Chakraborty, S., Chakraborty, P., Ghosh, D., Jana, K.	Protective effect of resveratrol on benzo(a)pyrene induced dysfunctions of steroidogenesis and steroidogenic acute regulatory gene expression in Leydig cells	2019	Frontiers in Endocrinology	1.69
77	Karmakar, S., Biswas, S., Das, K.P., Tripathy, U.	Surface plasmon resonance study of the interaction of 4,4'-dianilino-1,1'-binaphthyl-5,5'-disulfonic acid dipotassium salt (bis-ANS) and adenosine triphosphate (ATP) with oligomeric recombinant human lens αa-crystallin	2019	Canadian Journal of Chemistry	1.084
78	Romoli, O., Mukherjee, S., Mohid, S.A., Dutta, A., Montali, A., Franzolin, E., Brady, D., Zito, F., Bergantino, E., Rampazzo, C., Tettamanti, G., Bhunia, A., Sandrelli, F.	Enhanced Silkworm Cecropin B Antimicrobial Activity against Pseudomonas aeruginosa from Single Amino Acid Variation	2019	ACS Infectious Diseases	3.6
79	Doherty, J., Biswas, S., McNulty, D., Downing, C., Raha, S., O'Regan, C., Singha, A., O'Dwyer, C., Holmes, J.D.	One-Step Fabrication of GeSn Branched Nanowires	2019	Chemistry of Materials	9.89
80	Ghosh, A., Roy, A., Das, S.K., Ghosh, S.K., Raha, S. and Chatterjee, A.,	Identification of most preferable reaction pathways for chloride depletion from size segregated sea-salt aerosols: A study over high altitude Himalaya, tropical urban metropolis and tropical coastal mangrove forest in eastern India.	2019	Chemosphere, 245	5.8
81	Roy, A., Chatterjee, A., Das, S. K. Ghosh, S. K., Raha S.	Below-cloud scavenging of size-segregated aerosols and its effect on rainwater acidity and nutrient deposition: A longterm (2009–2018) and real-time observation over eastern Himalaya,	2019	Science of the Total Environment, 674	6.6
82	Kundu, M; Bhaumik, I; Misra, A K	Organocatalyzed preparation of 1,4,5-trisubstituted-glycosyl-1,2,3-triazole derivatives,	2019	Glycoconjugate Journal 36(5),	
83	Nawale GN , Bahadorikhalili S , Sengupta P , Kadekar S , Chatterjee S , Varghese OP .	4'-Guanidinium-modified siRNA: a molecular tool to control RNAi activity through RISC priming and selective antisense strand loading.	2019	Chem Commun (Camb). 55(62)	
84	Roy, M., Biswal, D., Sarkar, O., Pramanik, N.R., Drew, M.G.B., Sadhukhan, P., Kundu, M., Sil, P.C., Chakrabarti, S.	New mononuclear and binuclear oxomolybdenum(V) complexes containing N[sbnd]N chelator: Syntheses, DFT calculations, interaction with BSA protein and in vitro cytotoxic activity	2019	Journal of Inorganic Biochemistry	3.224
85	S. Acharya et al. (ALICE Collaboration)	Measurement of jet radial profiles in Pb–Pb collisions at s<inf>NN</inf>=2.76 TeV	2019	Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics	4.162
86	Paul, S., Dutta, A., Basak, U., Dutta, A., Das, A., Chakraborty, S., Bhattacharya, A., Banerjee, S., Sengupta, D., Mazumdar, D., Guha, D., Mukherjee, S., Das, T.	Cancer stem cell fate determination: a nuclear phenomenon	2019	Nucleus (India)	0.27
87	Jebarathinam, C., Das, D., Kanjilal, S., Srikanth, R., Sarkar, D., Chattopadhyay, I., Majumdar, A.S.	Superunsteerability as a quantifiable resource for random access codes assisted by Bell-diagonal states	2019	Physical Review A	2.907
88	Dey, S., Pal, K., Jana, K., Sinha, C.	Effect of -OMe Substituent on Salicylaldehyde Schiff Base to Influence the Zn2+ Sensitivity and the Cancer Cell Line Imaging	2019	ChemistrySelect	1.716

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89	Ganai, R., Mondal, M., Shiroya, M.K., Ahammed, Z., Chattopadhyay, S.	Performance studies of oil-free bakelite multi-gap resistive plate chamber with cosmic rays	2019	Journal of Instrumentation	1.366
90	Biswas, S., Das, S., Ghosh, S.K., Prasad, S.K., Raha, S.	Calibration of the photon spectrometer PHOS of the ALICE experiment	2019	Journal of Instrumentation	1.366
91	Bose, I., Ghosh, S.	Bifurcation and criticality	2019	Journal of Statistical Mechanics: Theory and Experiment	2.371
92	S. Acharya et al. (ALICE Collaboration)	Impact of biomass burning plumes on the size-segregated aerosol chemistry over an urban atmosphere at Indo-Gangetic plain	2019	Aerosol and Air Quality Research	2.735
93	Kundu, M., Bhaumik, I., Misra, A.K.	Organocatalyzed preparation of 1,4,5-trisubstituted-glycosyl-1,2,3-triazole derivatives	2019	Glycoconjugate Journal	2.926
94	Mukherjee, P., Mitra, A., Roy, M.	Halomonas rhizobacteria of avicennia marina of indian sundarbans promote rice growth under saline and heavy metal stresses through exopolysaccharide production	2019	Frontiers in Microbiology	4.259
95	Sengupta, K., Alam, M., Pailan, S., Saha, P.	Biodegradation of 4-nitrophenol by a Rhodococcus species and a preliminary insight into its toxicoproteome based on mass spectrometry analysis	2019	Journal of Environmental Biology	0.555
96	Basu, T., Kumar, B., Shendge, A.K., Panja, S., Chugh, H., Gautam, H.K., Mandal, N.	An Indian Desert Shrub 'Hiran Chabba', Farsetia hamiltonii Royle, Exhibits Potent Antioxidant and Hepatoprotective Effect Against Iron- Overload Induced Liver Toxicity in Swiss Albino Mice	2019	Current drug discovery technologies	2.642
97	Silwal, P., Kim, Y.S., Basu, J., Jo, E.-K.	The roles of microRNAs in regulation of autophagy during bacterial infection	2019	Seminars in Cell and Developmental Biology	0.13
98	Varnava, K.G., Mohid, S.A., Calligari, P., Stella, L., Reynison, J., Bhunia, A., Sarojini, V.	Design, Synthesis, Antibacterial Potential, and Structural Characterization of N-Acylated Derivatives of the Human Autophagy 16 Polypeptide	2019	Bioconjugate Chemistry	4.349
99	Patra RN, Singaraju RN, Dalal S, Biswas S, Viyogi YP, Nayak TK	Characteristic study of a quadruple GEM detector in different electric field configurations.	2019	Nuclear Instruments and Methods in Physics Research A 936 (2019) 433- 435.	
100	Mukherjee A, Mazumder M, Jana J, Srivastava AK, Mondal B, De A, Ghosh S, Saha U, Bose R, Chatterjee S, Dey N, Basu D.	Enhancement of ABA Sensitivity Through Conditional Expression of the ARF10 Gene in Brassica juncea Reveals Fertile Plants with Tolerance Against Alternaria brassicicola.	2019	Mol Plant Microbe Interact. 32(10)	
101	Ilyas H, Kim J, Lee D-K, Malmsten M, Bhunia A	Structural insights into the combinatorial effects of antimicrobial peptides reveal a role of aromatic-aromatic interactions in antibacterial synergism.	2019	The Journal of Biological Chemistry 294(40)	
102	Meher G, Sinha S, Pattnaik GP, Ghosh Dastidar S, Chakraborty H.	Cholesterol Modulates Membrane Properties and the Interaction of gp41 Fusion Peptide To Promote Membrane Fusion	2019	J Phys Chem B., 123(33)	
103	Sahu .I, Nanaware P., Mane M, Roy S.and Venkatraman P.	Role of a 19S proteasome subunit - PSMD10 Gankyrin in neurogenesis of human neuronal progenitor cells.	2019	International Journal of Stem Cells, 12, 463-473	
104	Roy S., Nandi N., Adak, R.P. , Biswas S., Das S.,. Ghosh S.K., Prasad S.K., Raha.S.	Study of performances of a straw tube detector with high rate.	2019	Nuclear Instruments and Methods in Physics Research A 936	
105	Chatterjee S., Chakraborty, S. Roy S. Biswas S Das S., Ghosh SK, Prasad SK, Raha S.	Study of uniformity of characteristics over the surface for triple GEM detector.	2019	Nuclear Instruments and Methods in Physics Research A 936	
106	Roy S., Chakraborty S., Chatterjee S., Biswas S., Das S., Ghosh S.K., Maulik A., Raha.S.	Plastic scintillator detector array for detection of cosmic ray air shower	2019	Nuclear Instruments and Methods in Physics Research A 936	

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107	Roy S., Rudra S., Shaw S., Chatterjee S., Chakraborty, Adak R.P., Biswas S., Das S., Ghosh S.K., Prasad S.K., Raha S.	Stability study of gain and energy resolution for GEM detector	2019	Nuclear Instruments and Methods in Physics Research A 936	
108	Das, S.K., Pal, K., Bhattacharya, T.S., Karmakar, P., Chowdhury, J.	Fabrication of SERS active Langmuir–Blodgett Film substrate for screening human cancer cell lines: Experimental observations supported by multivariate data analyses	2019	Sensors and Actuators, B: Chemical	6.393
109	Sarkar, C., Venkataraman, C., Yadav, S., Phuleria, H.C., Chatterjee, A.	Origin and properties of soluble brown carbon in freshly emitted and aged ambient aerosols over an urban site in India	2019	Environmental Pollution	5.714
110	S. Acharya et al. (ALICE Collaboration)	Study of the Λ–Λ interaction with femtoscopy correlations in pp and p–Pb collisions at the LHC	2019	Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics	4.162
111	Alam, A., Taye, N., Patel, S., Thube, M., Mullick, J., Shah, V.K., Pant, R., Roychowdhury, T., Banerjee, N., Chatterjee, S., Bhattacharya, R., Roy, R., Mukhopadhyay, A., Mogare, D., Chattopadhyay, S.	SMAR1 favors immunosurveillance of cancer cells by modulating calnexin and MHC I expression	2019	Neoplasia (United States)	3.837
112	Das, D., Sasmal, S., Roy, A.	Role of maximally entangled states in the context of linear steering inequalities	2019	Quantum Information Processing	2.222
113	Sarkar, D., Saha, S.	Machine-learning techniques for the prediction of protein–protein interactions	2019	Journal of Biosciences	1.823
114	Ghosh, R., Kaypee, S., Shasmal, M., Kundu, T.K., Roy, S., Sengupta, J.	Tumor Suppressor p53-Mediated Structural Reorganization of the Transcriptional Coactivator p300	2019	Biochemistry	2.952
115	Zhang, R., Jin, L., Zhang, N., Petridis, A.K., Eckert, T., Scheiner-Bobis, G., Bergmann, M., Scheidig, A., Schauer, R., Yan, M., Wijesundera, S.A., Nordén, B., Chatterjee, B.K., Siebert, H.-C.	The sialic acid-dependent nematocyst discharge process in relation to its physical-chemical properties is a role model for nanomedical diagnostic and therapeutic tools	2019	Marine Drugs	3.772
116	Dastidar, D.G., Das, A., Datta, S., Ghosh, S., Pal, M., Thakur, N.S., Banerjee, U.C., Chakrabarti, G.	Paclitaxel-encapsulated core-shell nanoparticle of cetyl alcohol for active targeted delivery through oral route	2019	Nanomedicine	4.717
117	Sannigrahi, A., Nandi, I., Chall, S., Jawed, J.J., Halder, A., Majumdar, S., Karmakar, S., Chattopadhyay, K.	Conformational Switch Driven Membrane Pore Formation by Mycobacterium Secretory Protein MPT63 Induces Macrophage Cell Death	2019	ACS chemical biology	4.374
118	Manna, T., Pal, K., Jana, K., Misra, A.K.	Anti-cancer potential of novel glycosylated 1,4-substituted triazolylchalcone derivatives	2019	Bioorganic and Medicinal Chemistry Letters	2.448
119	Meher, G., Sinha, S., Pattnaik, G.P., Dastidar, S.G., Chakraborty, H.	Cholesterol Modulates Membrane Properties and the Interaction of gp41 Fusion Peptide to Promote Membrane Fusion	2019	Journal of Physical Chemistry B, 123(33):7113-7122.	2.923
120	Nawale, G.N., Bahadorikhalili, S., Sengupta, P., Kadekar, S., Chatterjee, S., Varghese, O.P.	Correction: 4'-Guanidinium-modified siRNA: A molecular tool to control RNAi activity through RISC priming and selective antisense strand loading (Chem. Commun. (2019) 55 (10028): DOI: 10.1039/c9cc04141a)	2019	Chemical Communications	6.164
121	Nawale, G.N., Bahadorikhalili, S., Sengupta, P., Kadekar, S., Chatterjee, S., Varghese, O.P.	4'-Guanidinium-modified siRNA: A molecular tool to control RNAi activity through RISC priming and selective antisense strand loading	2019	Chemical Communications	6.164
122	Manna, T.; Misra, AK	Glycosyl selenoacetates: versatile building blocks for the preparation of stereoselective selenoglycosides and selenium linked disaccharides	2019	*Organic & Biomolecular Chemistry* 17(39)	

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123	A. Mondal, S. Pal, A. Sarkar, T. S. Bhattacharya, S. Pal, A. Singha, S.K. Ray, P. Kumar, D. Kanjilal, D. Jana	Raman investigation of N-implanted ZnO: Defects, disorder and recovery,	2019	Journal of Raman Spectroscopy, 50	2.809
124	Sarkar, D.and Saha, S.	Machine-learning techniques for the prediction of protein–protein interactions	2019	Journal of biosciences 44, (4)	
125	Bhowmik, M., Majumdar S., Dasgupta A., Gupta Bhattacharya S., and Saha S.	Pilot-Scale Study Of Human Plasma Proteomics Identifies ApoE And IL33 As Markers In Atopic Asthma	2019	Journal of asthma and allergy, 12	
126	Mondal, D., Mandal, N.	Molecular phylogeny of mitochondrial DNA: Shrimp species identification by multiplex and real-time PCR	2020	Food Control	4.248
127	Rameez, M.J., Pyne, P., Mandal, S., Chatterjee, S., Alam, M., Bhattacharya, S., Mondal, N., Sarkar, J., Ghosh, W.	Two pathways for thiosulfate oxidation in the alphaproteobacterial chemolithotroph Paracoccus thiocyanatus SST	2020	Microbiological Research	3.701
128	S. Acharya et al. (ALICE Collaboration)	Coherent J/ψ photoproduction at forward rapidity in ultra-peripheral Pb–Pb collisions at s<inf>NN</inf>=5.02 TeV	2019	Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics	4.162
129	Mukherjee, A., Mazumder, M., Jana, J., Srivastava, A.K., Mondal, B., De, A., Ghosh, S., Saha, U., Bose, R., Chatterjee, S., Dey, N., Basu, D.	Enhancement of ABA Sensitivity through conditional expression of the ARF10 Gene in Brassica juncea reveals fertile plants with tolerance against Alternaria brassicicola	2019	Molecular Plant-Microbe Interactions	3.649
130	Polley, S., Lyumkis, D., Horton, N.C.	Mechanism of Filamentation-Induced Allosteric Activation of the SgrAI Endonuclease	2019	Structure	4.576
131	Bhattacharyya, S., Biswas, D., Ghosh, S.K., Ray, R., Singha, P.	Novel scheme for parametrizing the chemical freeze-out surface in heavy ion collision experiments	2019	Physical Review D	4.368
132	Nandi, M., Banik, S.K., Chaudhury, P.	Restricted information in a two-step cascade	2019	Physical Review E. 100	2.353
133	Saha, S., Mahalanobish, S., Dutta, S., Sil, P.C.	Mangiferin ameliorates collateral neuropathy in: T BHP induced apoptotic nephropathy by inflammation mediated kidney to brain crosstalk	2019	Food and Function	3.241
134	S. Acharya et al. (ALICE Collaboration)	Production of muons from heavy-flavour hadron decays in pp collisions at v s = 5.02 TeV	2019	Journal of High Energy Physics	5.833
135	S. Acharya et al. (ALICE Collaboration)	One-dimensional charged kaon femtoscopy in p-Pb collisions at s NN = 5.02 TeV	2019	Physical Review C	3.132
136	Bhattacharjee, P., Majumdar, P., Biswas, S., Joarder, P.S.	Analysis of Fermi-LAT data from Tucana-II: Possible constraints on the Dark Matter models with an intriguing hint of a signal	2019	Journal of Cosmology and Astroparticle Physics	5.524
137	Biswas, R., Choudhury, S., Prasad, S.K., Das, S.	Study of jet-medium interactions using jet shape observables in heavy ion collisions at LHC energies with JEWEL	2019	Journal of Physics G: Nuclear and Particle Physics	3.534
138	Ansari, Z., Bhattacharya, T.S., Saha, A., Sen, K.	γ-Irradiated Ni-hesperidin nanocomposite for selective trace-level sensing of sulfide ions	2019	Journal of Radioanalytical and Nuclear Chemistry	1.186
139	Singh, S., Kumar, M., Kumar, S., Sen, S., Upadhyay, P., Bhattacharjee, S., Naveen, M., Tomar, V.S., Roy, S., Dutt, A., Kundu, T.K.	The cancer-associated, gain-of-function TP53 variant P152Lp53 activates multiple signaling pathways implicated in tumorigenesis	2019	Journal of Biological Chemistry	4.106
140	Ilyas, H., Kim, J., Lee, D., Malmsten, M., Bhunia, A.	Structural insights into the combinatorial effects of antimicrobial peptides reveal a role of aromatic-aromatic interactions in antibacterial synergism	2019	Journal of Biological Chemistry	4.106
141	Ray D., Ghosh, A., Chatterjee, A., Ghosh, S. K., Raha, S.	Size-specific PAHs and Associated Health Risks over a Tropical Urban Metropolis: Role of Long-range Transport and Meteorology.	2019	Aerosol and Air Quality Research, 19.	2.8

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142	Manna, T; Pal, K; Jana, K; Misra, A K	Anti-cancer potential of novel glycosylated 1,4-substituted triazolylchalcone derivatives,	2019	Bioorganic & Medicinal Chemistry Letters	
143	Majumder M, Debnath S, Gajbhiye RL, Saikia R, Gogoi B, Samanta SK, Das DK, Biswas K, Jaisankar P, Mukhopadhyay R	*Ricinus Communis* L. Fruit Extract Inhibits Migration/Invasion, Induces Apoptosis in Breast Cancer Cells and Arrests Tumor Progression in Vivo	2019	*Sci Rep.19(1)*	
144	Polley S., Lyumkis D., C. Horton, N.C.	Mechanism of Filamentation-Induced Allosteric Activation of the SgrAI Endonuclease	2019	Structure, 27 (10)	
145	Manpoong, C., De Mandal, S., Bangaruswamy, D.K., Perumal, R.C., Benny, J., Beena, P.S., Ghosh, A., Kumar, N.S., Tripathi, S.K.	Linking rhizosphere soil biochemical and microbial community characteristics across different land use systems in mountainous region in Northeast India	2020	Meta Gene	0.8
146	Kundu, M., Misra, A.K.	Selective acetolysis of primary benzyl groups in carbohydrate derivatives under the mild reaction condition	2019	Carbohydrate Research	1.91
147	Guha, D., Saha, T., Bose, S., Chakraborty, S., Dhar, S., Khan, P., Adhikary, A., Das, T., Sa, G.	Integrin-EGFR interaction regulates anoikis resistance in colon cancer cells	2019	Apoptosis,24	4.1
148	Majumder, M., Debnath, S., Gajbhiye, R.L., Saikia, R., Gogoi, B., Samanta, S.K., Das, D.K., Biswas, K., Jaisankar, P., Mukhopadhyay, R.	Ricinus communis L. fruit extract inhibits migration/invasion, induces apoptosis in breast cancer cells and arrests tumor progression in vivo	2019	Scientific Reports	4.12
149	Mondal, P., Saleem, S., Sikder, S., Kundu, T.K., Biswas, S.C., Roy, S.	Multifunctional transcriptional coactivator PC4 is a global co-regulator of p53-dependent stress response and gene regulation	2019	Journal of biochemistry	2.27
150	S. Acharya et al. (ALICE Collaboration)	Two-particle differential transverse momentum and number density correlations in p- Pb collisions at 5.02 TeV and Pb-Pb collisions at 2.76 TeV at the CERN Large Hadron Collider	2019	Physical Review C	3.24
151	Halder, A., Singh, S., Adhikari, A., Singh, P., Sarkar, P.K., Pal, U., Ghosh, R., Shikha, D., Solanki, Y.S., Agarwal, M., Gupta, A.B., Chakraborty, R., Saha-Dasgupta, T., Das, R., Pal, S.K.	Selective and Fast Responsive Sensitized Micelle for Detection of Fluoride Level in Drinking Water	2019	ACS Sustainable Chemistry and Engineering	6.97
152	S. Acharya et al. (ALICE Collaboration)	Inclusive J/ψ production at mid-rapidity in pp collisions at $\sqrt{s}$ = 5.02 TeV	2019	Journal of High Energy Physics	5.833
153	S. Acharya et al. (ALICE Collaboration)	Charged-particle production as a function of multiplicity and transverse spherocity in pp collisions at $\sqrt{s}$=5.02 and 13 TeV	2019	European Physical Journal C	4.84
154	Dutta, B., Pal, K., Jana, K., Sinha, C., Mir, M.H.	Fabrication of a Zn(II)-Based 2D Pillar Bilayer Metal-Organic Framework for Antimicrobial Activity	2019	ChemistrySelect	1.7
155	Ray, D., Singh, S., Ghosh, S.K., Raha, S.	Dynamic response of light absorption by PM2.5 bound water-soluble organic carbon to heterogeneous oxidation	2019	Aerosol Science and Technology	2.435
156	Bhowmik, M., Majumdar, S., Dasgupta, A., Bhattacharya, S.G., Saha, S.	Pilot-scale study of human plasma proteomics identifies ApoE and IL33 as markers in atopic asthma	2019	Journal of Asthma and Allergy	3.03
157	Manna, T., Misra, A.K.	Glycosyl selenoacetates: Versatile building blocks for the preparation of stereoselective selenoglycosides and selenium linked disaccharides	2019	Organic and Biomolecular Chemistry	3.49
158	Basu, C., Chatterjee, A., Bhattacharya, S., Dutta, N., Sur, R.	S-allyl cysteine inhibits TNF-α-induced inflammation in HaCaT keratinocytes by inhibition of NF- κB-dependent gene expression via sustained ERK activation	2019	Experimental Dermatology	2.86
159	Chandra, A., Das, M., Pal, K., Jana, S., Dutta, B., Ray, P.P., Jana, K., Sinha, C.	Three-Dimensional-Coordination Polymer of Zn(II)-Carboxylate: Structural Elucidation, Photoelectrical Conductivity, and Biological Activity	2019	ACS Omega	2.56

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160	Subba, N., Polok, K., Piatkowski, P., Ratajska-Gadomska, B., Biswas, R., Gadomski, W., Sen, P.	Temperature-Dependent Ultrafast Solvation Response and Solute Diffusion in Acetamide-Urea Deep Eutectic Solvent	2019	Journal of Physical Chemistry B	2.923
161	Dutta, P., Islam, S., Choppara, S., Sengupta, P., Kumar, A., Kumar, A., Wani, M.R., Chatterjee, S., Santra, M.K.	The tumor suppressor FBXO31 preserves genomic integrity by regulating DNA replication and segregation through precise control of cyclin A levels	2019	Journal of Biological Chemistry, 294(41)	4.106
162	Kundu S,RanaTK, Bhattacharya C, Banerjee K, Pandey R, Manna S,MeenaJK, Saha AK, SahooJK, Dhara P, Dey A, Gupta D,GhoshTK,Roy P, Mukherjee G,SahaR M, Roy S,Bajirao SR, Sen A,Bhattacharya S	Chakra: The high resolution charged particle detector array at VECC	2019	Nuclear Inst. and Methods in Physics Research A 943	1.265
163	Chattopadhyaya, S., Chakravorty, D., Basu, G.	A collective motion description of tubulin βT7 loop dynamics.	2019	Biophys Physicobiol. 16	
164	Sarkar D, Chakraborty I, Condorelli M, Ghosh B, Mass T, Weingarth M, Mandal AK, La Rosa C, Subramanian V, Bhunia A.	A.Self-Assembly and Neurotoxicity of β-Amyloid (21-40) Peptide Fragment: The Regulatory Role of GxxxG Motifs.	2019	Chem Med Chem.	
165	Shohan MUS, Sinha S, Nabila FH, Ghosh Dastidar S, Seraj ZI.	HKT1;5 Transporter Gene Expression and Association of Amino Acid Substitutions With Salt Tolerance Across Rice Genotypes.	2019	Front Plant Sci., 10:1420. HKT1;5	
166	S. Acharya et al. (ALICE Collaboration)	Multiplicity dependence of light (anti-)nuclei production in p–Pb collisions at s<inf>NN</inf>=5.02 TeV	2020	Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics	4.11
167	Shit, P., Gucchait, A., Misra, A.K.	Straightforward sequential and one-pot synthesis of a pentasaccharide repeating unit corresponding to the cell wall O-antigen of Shigella boydii type 18	2019	Tetrahedron	2.46
168	Khan, P., Bhattacharya, A., Sengupta, D., Banerjee, S., Adhikary, A., Das, T.	Aspirin enhances cisplatin sensitivity of resistant non-small cell lung carcinoma stem-like cells by targeting mTOR-Akt axis to repress migration	2019	Scientific Reports	4.12
169	S. Acharya et al. (ALICE Collaboration)	Measurement of charged jet cross section in pp collisions at s =5.02 TeV	2019	Physical Review D	4.38
170	S. Acharya et al. (ALICE Collaboration)	Measurement of γ(1S) Elliptic Flow at Forward Rapidity in Pb-Pb Collisions at sNN =5.02 TeV	2019	Physical Review Letters	9.2
171	Shohan, M.U.S., Sinha, S., Nabila, F.H., Dastidar, S.G., Seraj, Z.I.	HKT1;5 Transporter Gene Expression and Association of Amino Acid Substitutions With Salt Tolerance Across Rice Genotypes	2019	Frontiers in Plant Science	4.3
172	Ray, D., Ghosh, A., Chatterjee, A., Ghosh, S.K., Raha, S.	Size-specific pahs and associated health risks over a tropical urban metropolis: Role of long-range transport and meteorology	2019	Aerosol and Air Quality Research	2.74
173	Mondal, D., Dutta, S., Chakrabarty, U., Mallik, A., Mandal, N.	Development and characterization of white spot disease linked microsatellite DNA markers in Penaeus monodon, and their application to determine the population diversity, cluster and structure	2019	Journal of Invertebrate Pathology	2.16
174	Ghosh, S., Mazumder, M., Mondal, B., Mukherjee, A., De, A., Bose, R., Das, S., Bhattacharyya, S., Basu, D.	Morphological and SSR marker-based genetic diversity analysis of Indian mustard (Brassica juncea L.) differing in Alternaria brassicicola tolerance	2019	Euphytica	1.62
175	S. Acharya et al. (ALICE Collaboration)	Measurement of the inclusive isolated photon production cross section in pp collisions at √s=7 TeV	2019	European Physical Journal C	4.77

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176	Sutradhar, R., Gop, S., Chakrabarty, S., Tripathi, H.S., Rudra, M., Sinha, T.P.	The interaction of silver nanoclusters with Watson-Crick Adenine base: A DFT study	2019	AIP Conference Proceedings	0.4
177	Gop, S., Sutradhar, R., Chakraborty, S., Sinha, T.P.	The study of energetic and electronic properties of metal-adenine complex in solvent phase: A density functional theory approach	2019	AIP Conference Proceedings	0.4
178	Tripathi, H.S., Mukherjee, R., Rudra, M., Sutradhar, R., Kumar, R.A., Sinha, T.P.	Insulator to semiconductor transition in graphene quantum dots	2019	AIP Conference Proceedings	0.4
179	Mukherjee, S., Rudra, A., Das, D., Mal, S., Home, D.	Persistence of quantum violation of macrorealism for large spins even under coarsening of measurement times	2019	Physical Review A	2.95
180	S. Acharya et al. (ALICE Collaboration)	Event-shape and multiplicity dependence of freeze-out radii in pp collisions at v s = 7 TeV	2019	Journal of High Energy Physics	3.95
181	Kumar, M., Majumder, D., Mal, S., Chakraborty, S., Gupta, P., Jana, K., Gupta, U.D., Ghosh, Z., Kundu, M., Basu, J.	Activating transcription factor 3 modulates the macrophage immune response to Mycobacterium tuberculosis infection via reciprocal regulation of inflammatory genes and lipid body formation	2019	Cellular Microbiology	4.06
182	Dhar, J., Kishore, R., Chakrabarti, P.	Delineation of a new structural motif involving NHN γ-turn	2019	Proteins: Structure, Function and Bioinformatics	2.501
183	Halder, S., Kumar, R.A., Dutta, A., Sinha, T.P.	Exploring the intricacies in the conduction mechanism of the perovskite series Ba<inf>2</inf>HoSb<inf>1- x</inf>Ru<inf> x</inf>O<inf>6</inf>: A conductivity scaling approach	2019	Journal of Physics and Chemistry of Solids	2.87
184	Chakraborti, S., Chakrabarti, P.	Self-Assembly of Ferritin: Structure, Biological Function and Potential Applications in Nanotechnology	2019	Advances in Experimental Medicine and Biology	6.64
185	Bhattacharyya, R., Chakraborty, I., Chakrabarti, A., Mandal, S.	Recent studies on accurate measurements of NMR transverse relaxation times	2019	Annual Reports on NMR Spectroscopy	2.41
186	T. S. Bhattacharya, S. Mitra, S. S. Singha, P. K. Mondal, A. Singha	Tailoring light-matter interaction in WS_2–gold nanoparticles hybrid systems	2019	Phys. Rev. B 100 (23)	3.736
187	Mondal S, Maji RK, Ghosh Z, Khatua S.	ParStream-seq: An improved method of handling next generation sequence data	2019	Genomics, 111(6)	
188	Shit, P ,Gucchait, A; Misra, AK	Straightforward sequential and one-pot synthesis of a pentasaccharide repeating unit corresponding to the cell wall O-antigen of Shigella boydii type 18	2019	*Tetrahedron* 75(49)	
189	Paul S, Chakrabarty S, Ghosh S, Nag D, Das A, Dastidar DG, Dasgupta M, Dutta N, Kumari M, Pal M, Chakrabarti G	Targeting cellular microtubule by phytochemical apocynin exhibits autophagy-mediated apoptosis to inhibit lung carcinoma progression and tumorigenesis.	2019	Phytomedicine ,67	
190	Ghosh, A., Roy, A., Das, S.K., Ghosh, S.K., Raha, S., Chatterjee, A.	Identification of most preferable reaction pathways for chloride depletion from size segregated sea-salt aerosols: A study over high altitude Himalaya, tropical urban metropolis and tropical coastal mangrove forest in eastern India	2020	Chemosphere	3.35
191	Chatterjee, T., Das, G., Chatterjee, B.K., Dhar, J., Ghosh, S., Chakrabarti, P.	The role of isoaspartate in fibrillation and its prevention by Protein-L-isoaspartyl methyltransferase	2020	Biochimica et Biophysica Acta - General Subjects	3.74
192	Mahapatra, K., Ghosh, A.K., De, S., Ghosh, N., Sadhukhan, P., Chatterjee, S., Ghosh, R., Sil, P.C., Roy, S.	Assessment of cytotoxic and genotoxic potentials of a mononuclear Fe(II) Schiff base complex with photocatalytic activity in Trigonella	2020	Biochimica et Biophysica Acta - General Subjects	3.74
193	Mahalanobish, S., Saha, S., Dutta, S., Sil, P.C.	Matrix metalloproteinase: An upcoming therapeutic approach for idiopathic pulmonary fibrosis	2020	Pharmacological Research	5.78
194	Paul, S., Chakrabarty, S., Ghosh, S., Nag, D., Das, A., Dastidar, D.G., Dasgupta, M., Dutta, N., Kumari, M., Pal, M., Chakrabarti, G.	Targeting cellular microtubule by phytochemical apocynin exhibits autophagy-mediated apoptosis to inhibit lung carcinoma progression and tumorigenesis	2020	Phytomedicine	4.11

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195	Palodhi, K., Chatterjee, J., Bhattacharyya, R., Dey, S., Ghosh, S.K., Maulik, A., Raha, S.	Convolution based hybrid image processing technique for microscopic images of etch-pits in Nuclear Track Detectors	2020	Radiation Measurements	1.51
196	S. Acharya et al. (ALICE Collaboration)	Erratum to: Insight into particle production mechanisms via angular correlations of identified particles in pp collisions at s = 7 TeV (The European Physical Journal C, (2017), 77, 8, (569), 10.1140/epjc/s10052-017-5129-6)	2019	European Physical Journal C	4.77
197	S. Acharya et al. (ALICE Collaboration)	Measurement of prompt D0, D+, D*+, and DS+ production in p–Pb collisions at vsNN = 5.02 TeV	2019	Journal of High Energy Physics	3.95
198	Roy, L., Halder, A., Singh, S., Patwari, J., Singh, P., Bhattacharya, K., Mondal, S., Pal, S.K.	Spectroscopy of an intrinsic fluorophore in animal and plant milk for potential identification of their quality	2019	Journal of Dairy Science	3.12
199	Dey, S., Maity, S., Pal, K., Jana, K., Sinha, C.	The oxidative dehydrogenation of a coumarinyl scaffold with copper ion and metal ion detection in human liver cancer cells (HepG2)	2019	Dalton Transactions	4.06
200	Mazumdar, S., Ghosh, A.K., Dinda, M., Das, A.K., Das, S., Jana, K., Karmakar, P.	Evaluation of wound healing activity of ethanol extract of Annona reticulata L. leaf both in vitro and in diabetic mice model	2019	Journal of Traditional and Complementary Medicine	3.08
201	Mehta, S., Singh, S., Mitra, A., Ghosh, S.K., Raha, S., Mehta, S.K.	Modeling of Raindrop Size Distribution Observed Using Micro Rain Radar Over Darjeeling (27.05oN, 88.26oE): An Eastern Himalayan Region	2019	Pure and Applied Geophysics	1.46
202	Sarkar, D., Chakraborty, I., Condorelli, M., Ghosh, B., Mass, T., Weingarth, M., Mandal, A.K., La Rosa, C., Subramanian, V., Bhunia, A.	Self-Assembly and Neurotoxicity of β-Amyloid (21–40) Peptide Fragment: The Regulatory Role of GxxxG Motifs	2019	ChemMedChem	2.8
203	Seal, S., Chowdhury, N., Biswas, R., Chakraborty, T., Sinha, D., Bagchi, A., Sau, S.	Removal of an atypical region from a staphylococcal cyclophilin affects its structure, function, stability, and shape	2019	International Journal of Biological Macromolecules	4.94
204	S. Acharya et al. (ALICE Collaboration)	Measurement of the inclusive isolated photon production cross section in pp collisions at 7 TeV	2019	Eur. Phys. J. C 79:	4.83
205	S. Acharya et al. (ALICE Collaboration)	Measurement of Y(1S) elliptic flow at forward rapidity in Pb-Pb collisions at 5.02 TeV	2019	Phys. Rev. Lett. 123	8.385
206	S. Acharya et al. (ALICE Collaboration)	Charged-particle production as a function of multiplicity and transverse spherocity in pp collisions at 5.02 and 13 TeV	2019	EPJC 79	4.83
207	S. Acharya et al. (ALICE Collaboration)	Study of lambda-lambda interaction with femtoscopy correlations in pp and p-Pb collisions at the LHC	2019	Phys. Lett. B 797	4.16
208	S. Acharya et al. (ALICE Collaboration)	Multiplicity dependence of (multi-)strange hadron production in proton-proton collisions at 13 TeV	2019	EPJC 80	4.83
209	S. Acharya et al. (ALICE Collaboration)	Inclusive J/Psi production at mid-rapidity in pp collisions at 5.02 TeV	2019	JHEP 10	5.87
210	S. Acharya et al. (ALICE Collaboration)	Event-shape and multiplicity dependence of freeze-out radii in pp collisions at 7 TeV	2019	JHEP 09	5.87
211	S. Acharya et al. (ALICE Collaboration)	Investigations of anisotropic flow using multi-particle azimuthal correlations in pp, p-Pb, Xe-Xe, and Pb-Pb collisions at the LHC	2019	Phys. Rev. Lett. 123	8.385
212	S. Acharya et al. (ALICE Collaboration)	Coherent J/Psi photoproduction at forward rapidity in ultra-peripheral Pb-Pb collisions at5.02 TeV	2019	Phys.Lett. B798	4.16
213	S. Acharya et al. (ALICE Collaboration)	Measurement of jet radial profiles in Pb-Pb collisions at 2.76 TeV	2019	Phys. Lett. B 796	4.16

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214	S. Acharya et al. (ALICE Collaboration)	Measurement of the production of charm jets tagged with D0 mesons in pp collisions at 7 TeV	2019	J. High Energ. Phys.	5.87
215	S. Acharya et al. (ALICE Collaboration)	Two particle differential transverse momentum and number density correlations in p-Pb and Pb-Pb at the LHC;	2019	Phys. Rev. C 100	2.98
216	S. Acharya et al. (ALICE Collaboration)	Production of muons from heavy-flavour hadron decays in pp collisions at 5.02 TeV	2019	JHEP 2019	5.87
217	S. Acharya et al. (ALICE Collaboration)	Multiplicity dependence of (anti-)deuteron production in pp collisions at 7 TeV	2019	Phys. Lett. B 794	4.16
218	S. Acharya et al. (ALICE Collaboration)	First observation of an attractive interaction between a proton and a multi-strange baryon	2019	Phys. Rev. Lett. 123	8.385
219	S. Acharya et al. (ALICE Collaboration)	Analysis of the apparent nuclear modification in peripheral Pb-Pb collisions at 5.02 TeV	2019	Phys.Lett. B793	4.16
220	S. Acharya et al. (ALICE Collaboration)	Energy dependence of exclusive J/Psi photoproduction off protons in ultra-peripheral p-Pb collisions at 5.02 TeV	2019	Eur. Phys. J. C 79:	4.83
221	S. Acharya et al. (ALICE Collaboration)	\Labmda$_c^+$ production in Pb-Pb collisions at 5.02 TeV	2019	Phys.Lett. B793	4.16
222	S. Acharya et al. (ALICE Collaboration)	Measurements of D0, D+, D*+, D+s production in pp collisions at 5.02 TeV	2019	Eur.Phys.J. C79 (5)	4.83
223	S. Acharya et al. (ALICE Collaboration)	Relative particle yield fluctuations in Pb-Pb collisions at 2.76 TeV	2019	Eur. Phys. J. C 79	4.83
224	S. Acharya et al. (ALICE Collaboration)	Charged-particle pseudorapidity density at mid-rapidity in p-Pb collisions at 8.16 TeV	2019	Eur. Phys. J. C, 79	4.83
225	S. Acharya et al. (ALICE Collaboration)	Jet fragmentation transverse momentum measurements from di-hadron correlations in 7 TeV pp and 5.02 p-Pb collisions	2019	J. High Energ. Phys.	5.87
226	Chakraborty Arun Kumar, Dey Sumita, Mallick Sukalpa and Roy Sohini	Precision and Recall Value: A Focused Approach to Disintermediation Tool	2019	Librarianship in the New Paradigm, Jadavpur University Dept. of LIS and HRDC, JDU, pp.97-101	3.5
227	A. Bose, S. Ray, V. K. Singh, A. Banerjee, C. Nayak, A. Singha, A. Bhattacharyya, D. Chattopadhyay, A. Chakrabarti, S. Das, A. K Dasgupta	Differential graphene functions on two photosynthetic microbes,	2020	Advances in Natural Sciences: Nanoscience and Nanotechnology, 11,	0.584
228	Manna, T; Gucchait, A; Misra, AK	Convenient synthesis of the pentasaccharide repeating unit corresponding to the cell wall O-antigen of *Escherichia albertii* O4	2020	Beilstein Journal of Organic Chemistry (2020), 16	
229	GhosalA., Das D., Roy S, Bandyopadhyay S.	Optimal two-qubit states for quantum teleportation vis-à-vis state properties	2020	Phys. Rev. A 101	
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231	Subuddhi A, Kumar M, Majumder D, Sarkar A, Ghosh Z, Vasudevan M, Kundu M, Basu J.	Unraveling the role of H3K4 trimethylation and lncRNA HOTAIR in SATB1 and DUSP4-dependent survival of virulent *Mycobacterium tuberculosis* in macrophages	2020	Tuberculosis (Edinb).	
232	Dutta A, Rudra P, Banik SK, Mukhopadhyay J.	Evidence of Robustness in a Two-Component System Using a Synthetic Circuit	2020	J Bacteriol.,202(4)	
233	Mandal, S., Rameez, M.J., Chatterjee, S., Sarkar, J., Pyne, P., Bhattacharya, S., Shaw, R. and Ghosh, W.,	Molecular mechanism of sulfur chemolithotrophy in the betaproteobacterium *Pusillimonas ginsengisoli*	2020	Microbiology, 166	
234	Rameez, M.J., Pyne, P., Mandal, S., Chatterjee, S., Alam, M., Bhattacharya, S., Mondal, N., Sarkar, J. and Ghosh, W.	Two pathways for thiosulfate oxidation in the alphaproteobacterial chemolithotroph Paracoccus thiocyanatus SST	2020	Microbiological Research, 230	

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236	Sheikh, M.S., Ghosh, D., Bhowmik, T.K., Dutta, A., Bhattacharyya, S., Sinha, T.P.	When multiferroics become photoelectrochemical catalysts: A case study with BiFeO<inf>3</inf>/La<inf>2</inf>NiMnO<inf>6</inf>	2020	Materials Chemistry and Physics	2.88
237	Pandit, G., Biswas, K., Ghosh, S., Debnath, S., Bidkar, A.P., Satpati, P., Bhunia, A., Chatterjee, S.	Rationally designed antimicrobial peptides: Insight into the mechanism of eleven residue peptides against microbial infections	2020	Biochimica et Biophysica Acta - Biomembranes	3.79
238	S. Acharya et al. (ALICE Collaboration)	Measurement of strange baryon–antibaryon interactions with femtoscopic correlations	2020	Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics	4.11
239	S. Acharya et al. (ALICE Collaboration)	Evidence of rescattering effect in Pb–Pb collisions at the LHC through production of K(892)0? and ?(1020) mesons	2020	Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics	4.11
240	Gupta, G., Das, A., Lee, J., Mandal, N., Lee, C.Y.	Multinuclear Ir-BODIPY complexes: Synthesis and binding studies	2020	Inorganic Chemistry Communications	1.795
241	Gop, S., Sutradhar, R., Chakraborty, S., Sinha, T.P.	Tautomeric effect of guanine on stability, spectroscopic and absorbance properties in cytosine–guanine base pairs: a DFT and TD-DFT perspective	2020	Theoretical Chemistry Accounts	1.57
242	Mondal, D., Mandal, N.	Extended protocol and real-time PCR dataset for shrimp species identification	2020	Data in Brief	1
243	Halder, A., Shikha, D., Adhikari, A., Ghosh, R., Singh, S., Adhikari, T., Pal, S.K.	Development of a nano-sensor (FeNSOR) based device for estimation of iron ions in biological and environmental samples	2020	IEEE Sensors Journal	3.78
244	Appidi, T., Pemmaraju, D.B., Khan, R.A., Alvi, S.B., Srivastava, R., Pal, M., Khan, N., Rengan, A.K.	Light-triggered selective ROS-dependent autophagy by bioactive nanoliposomes for efficient cancer theranostics	2020	Nanoscale	8.87
245	Ray, D., Ghosh, S.K., Raha, S.	Impacts of some co-dissolved inorganics on in-cloud photochemistry of aqueous brown carbon	2020	Atmospheric Environment	4.3
246	Ganguly, H.K., Basu, G.	Conformational landscape of substituted prolines	2020	Biophysical Reviews	4.06
247	Kundu, M., Gucchait, A., Misra, A.K.	Convergent synthesis of a pentasaccharide corresponding to the cell wall O-polysaccharide of enteropathogenic Escherichia coli O115	2020	Tetrahedron	2.46
248	Jain, A., Chakraborty, J., Das, S.	Underlying mechanism of plant–microbe crosstalk in shaping microbial ecology of the rhizosphere	2020	Acta Physiologiae Plantarum	1.82
249	Ganguly, S., Purohit, A., Chaudhuri, R.K., Das, S., Chakraborti, D.	Embryonic explant and plumular meristem transformation methods for development of transgenic pigeon pea	2020	Methods in Molecular Biology	10.71
250	Chakraborty, A., Das, A., Raha, S., Barui, A.	Size-dependent apoptotic activity of gold nanoparticles on osteosarcoma cells correlated with SERS signal	2020	Journal of Photochemistry and Photobiology B: Biology	4.17
251	Singh, S., Halder, A., Sinha, O., Sarkar, P.K., Singh, P., Banerjee, A., Ahmed, S.A., Alharbi, A., Obaid, R.J., Ghosh, S.K., Mitra, A., Pal, S.K.	Nanoparticle-based 'turn-on' scattering and post-sample fluorescence for ultrasensitive detection of water pollution in wider window	2020	PLoS ONE	2.87
252	Sen, S., Saha, T., Bhattacharya, S., Nidhi, Mondal, N., Ghosh, W., Chakraborty, R.	Draft genome sequences of two boron-tolerant, arsenic-resistant, Gram-positive bacterial strains, Lysinibacillus sp. OL1 and Enterococcus sp. OL5, isolated from boron-fortified cauliflower-growing field soils of northern West Bengal, India	2020	Microbiology Resource Announcements	NF

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254	Roy, A., Singha, S.S., Majumder, S., Singha, A., Banerjee, S., Satpati, B.	Electroless Deposition of Pd Nanostructures for Multifunctional Applications as Surface-Enhanced Raman Scattering Substrates and Electrochemical Nonenzymatic Sensors	2019	ACS Applied Nano Materials	NF
255	Nag, P., Shriti, S., Das, S.	Microbiological strategies for enhancing biological nitrogen fixation in nonlegumes	2019	Journal of Applied Microbiology	2.71
256	Das, B., Sengupta, S., Bhattacharya, K., Bhattacharya, S.G.	A wild encounter to ensure a food secure 2050	2019	Current Science	4.65
257	Banerjee, S.K., Lata, S., Sharma, A.K., Bagchi, S., Kumar, M., Sahu, S.K., Sarkar, D., Gupta, P., Jana, K., Gupta, U.D., Singh, R., Saha, S., Basu, J., Kundu, M.	The sensor kinase MtrB of Mycobacterium tuberculosis regulates hypoxic survival and establishment of infection	2019	Journal of Biological Chemistry	3.96
258	Kundu, Monalisa; Gucchait, Arin; Misra, Anup Kumar	Convergent synthesis of a pentasaccharide corresponding to the cell wall O-polysaccharide of enteropathogenic Escherichia coli O115.	2020	*Tetrahedron* 76(8)	
259	Gucchait, Arin; Ghosh, Sritin; Misra, Anup Kumar,	Synthesis of Novel Glycosyl Carbamo(dithioperoxo)thioate Derivatives,	2020	*Synthesis* 52(10)	
260	Manpoong, C, De Mandal, S, Bangaruswamy, D,K, Perumal, R,C, Benny, J, Beena, P,S, Ghosh, A,Senthil Kumar, N, Tripathi, S, K.	Linking rhizosphere soil biochemical and microbial community characteristics across different land use systems in mountainous region in Northeast India.	2020	Meta Gene, 23	
261	S. Ghosh, T. Bhattacharyya, A. Chatterjee, Das S.K., S. Singh	Study of fair weather surface atmospheric electric field at high altitude station in Eastern Himalayas	2020	Atmospheric Research, 239	
262	Sarkar A.,Ghosh S., Shaw R.,Patra M., Calcuttawala F., Mukherjee N., Das Gupta S.K.	*Mycobacterium tuberculosis* thymidylate synthase (ThyX) is a target for plumbagin, a natural product with antimycobacterial activity	2020	PlosOne 2020. 15(2)	
263	Wadehra, N., Tomar, R., Varma, R.M., Gopal, R.K., Singh, Y., Dattagupta, S., Chakraverty, S.	Planar Hall effect and anisotropic magnetoresistance in polar-polar interface of LaVO<inf>3</inf>-KTaO<inf>3</inf> with strong spin-orbit coupling	2020	Nature Communications	11.8
264	Bhattacharyya, T., Chatterjee, A., Das, S.K., Singh, S., Ghosh, S.K.	Study of fair weather surface atmospheric electric field at high altitude station in Eastern Himalayas	2020	Atmospheric Research	4.41
265	Pariary, R., Ghosh, B., Bednarikova, Z., Varnava, K.G., Ratha, B.N., Raha, S., Bhattacharyya, D., Gazova, Z., Sarojini, V., Mandal, A.K., Bhunia, A.	Targeted inhibition of amyloidogenesis using a non-toxic, serum stable strategically designed cyclic peptide with therapeutic implications	2020	Biochimica et Biophysica Acta - Proteins and Proteomics, 1868 (5	2.58
266	Asthana, S., Bhattacharyya, D., Kumari, S., Nayak, P.S., Saleem, M., Bhunia, A., Jha, S.	Interaction with zinc oxide nanoparticle kinetically traps α-synuclein fibrillation into off-pathway non-toxic intermediates	2020	International Journal of Biological Macromolecules	4.94
267	Barua, A., Maity, S., Kumar, S., Dutta, A., Sinha, T.P.	Structural, optical and electrical characterization of Ba<inf>2</inf>YbTaO<inf>6</inf>	2020	Physica B: Condensed Matter	1.88
268	Singha, S.S., Rudra, S., Mondal, S., Pradhan, M., Nayak, A.K., Satpati, B., Pal, P., Das, K., Singha, A.	Mn incorporated MoS<inf>2</inf> nanoflowers: A high performance electrode material for symmetric supercapacitor	2020	Electrochimica Acta	5.34
269	Biswas, S., Das, S., Ghosh, S.K., Prasad, S.K., Raha, S.	Exploration of jet substructure using iterative declustering in pp and Pb–Pb collisions at LHC energies	2020	Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics	4.11
270	Saha, S., Ewing, R.M.	Editorial: Integrated Omics for Defining Interactomes	2020	Frontiers in Physiology, 11	3.16
271	Ghose, S., Singh, S., Bhattacharya, T.S.	Charge Transfer-Mediated Blue Luminescence in Plasmonic Ag-Cu<inf>2</inf>O Quantum Nanoheterostructures	2020	ACS applied materials & interfaces	8.46

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272	Momin, M.S.A., Biswas, A., Banik, S.K.	Coherent feed-forward loop acts as an efficient information transmitting motif	2020	Physical Review E	2.35
273	S. Acharya et al. (ALICE Collaboration)	Measurement of electrons from heavy-flavour hadron decays as a function of multiplicity in p-Pb collisions at vsNN = 5.02 TeV	2020	Journal of High Energy Physics	3.95
274	S. Acharya et al. (ALICE Collaboration)	Studies of J/ψ production at forward rapidity in Pb–Pb collisions at vsNN = 5.02 TeV	2020	Journal of High Energy Physics	3.95
275	S. Acharya et al. (ALICE Collaboration)	Measurement of Λ (1520) production in pp collisions at vs=7TeV and p–Pb collisions at vsNN=5.02TeV	2020	European Physical Journal C	4.77
276	Datta, S.K.	Induced mutations: technological advancement for development of new ornamental varieties	2020	Nucleus (India)	0.56
277	Sarkar, A., Ghosh, S., Shaw, R., Patra, M.M., Calcuttawala, F., Mukherjee, N., Das Gupta, S.K.	Mycobacterium tuberculosis thymidylate synthase (ThyX) is a target for plumbagin, a natural product with antimycobacterial activity	2020	PloS one	2.87
278	Sarkar, A., Rahaman, A., Biswas, I., Mukherjee, G., Chatterjee, S., Bhattacharjee, S., Mandal, D.P.	TGFβ mediated LINC00273 upregulation sponges mir200a-3p and promotes invasion and metastasis by activating ZEB1	2020	Journal of Cellular Physiology	4.02
279	Naha, S., Sands, K., Mukherjee, S., Roy, C., Rameez, M.J., Saha, B., Dutta, S., Walsh, T.R., Basu, S.	KPC-2-producing Klebsiella pneumoniae ST147 in a neonatal unit: Clonal isolates with differences in colistin susceptibility attributed to AcrAB-TolC pump	2020	International Journal of Antimicrobial Agents	4.6
280	Das, J., Mapder, T., Chattopadhyay, S., Banik, S.K.	Computational study of parameter sensitivity in DevR regulated gene expression	2020	PLoS ONE	2.87
281	Mukherji, S, Ghosh, A, Bhattacharyya, C, Mallick, I, Anish Bhattacharyya, A, Mitra, S, Ghosh, A.	Molecular and culture-based surveys of metabolically active hydrocarbon-degrading archaeal communities in Sundarban mangrove sediments.	2020	Ecotox Environ Safety,195	
282	Sinha S., Kaur Grewal R.and Roy S.	Modeling phage-bacteria dynamics,	2020	Methods in Molecular Biology	
283	Das. U., W. Ward , C. J. Pan , Das S.K.	Migrating and Non-Migrating Tides Observed in the Stratosphere from FORMOSAT-3/COSMIC Temperature Retrievals	2020	AnnalesGeophysicea, 38	
284	Sarkar, J., Dutta, A., Pal Chowdhury, P., Chakraborty, J. and Dutta, T. K.	Characterization of a novel family VIII esterase EstM2 from soil metagenome capable of hydrolyzing estrogenic phthalates	2020	Microbial Cell Factories, 19	
285	Banerjee, K., Jana, T., Ghosh, Z., Saha, S.	PSCRIdb: A database of regulatory interactions and networks of pluripotent stem cell lines	2020	Journal of Biosciences, 45 (1)	1.8
286	Mukherji, S., Ghosh, A., Bhattacharyya, C., Mallick, I., Bhattacharyya, A., Mitra, S., Ghosh, A.	Molecular and culture-based surveys of metabolically active hydrocarbon-degrading archaeal communities in Sundarban mangrove sediments	2020	Ecotoxicology and Environmental Safety	4.527
287	Pal, K., Roy, S., Parida, P.K., Dutta, A., Bardhan, S., Das, S., Jana, K., Karmakar, P.	Corrigendum to ??Folic acid conjugated curcumin loaded biopolymeric gum acacia microsphere for triple negative breast cancer therapy in invitro and invivo modelâ€? [Mater. Sci. Eng. C (2019) 204??216](S0928493118303059)(10.1016/j.msec.2018.10.071)	2020	Materials Science and Engineering C	5.08
288	Banerjee, S., Mukherjee, S., Bhattacharya, A., Basak, U., Chakraborty, S., Paul, S., Khan, P., Jana, K., Hazra, T.K., Das, T.	Pyridoxine enhances chemo-responsiveness of breast cancer stem cells via redox reconditioning	2020	Free Radical Biology and Medicine	5.657
289	Das, S., Satpati, B., Bhattacharya, T.S., Bala, T.	Synthesis of Auâ€“Ag triangular nanocomposite with promising SERS activity	2020	Nano-Structures and Nano-Objects	1.02

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291	Gancar, M., Ho, K., Mohid, S.A., Thai, N.Q., Bednarikova, Z., Nguyen, H.L., Bhunia, A., Nepovimova, E., Li, M.S., Gazova, Z.	7-Methoxytacrine and 2-Aminobenzothiazole Heterodimers: Structure-Mechanism Relationship of Amyloid Inhibitors Based on Rational Design	2020	ACS Chemical Neuroscience	3.861
292	Barik, S., Mandal, N.C.	Altered growth and envelope properties of polylysogens containing bacteriophage lambda Nâ^'clâ^' prophages	2020	International Journal of Molecular Sciences	4.183
293	Sircar, G., Bhowmik, M., Sarkar, R.K., Najafi, N., Dasgupta, A., Focke-Tejkl, M., Flicker, S., Mittermann, I., Valenta, R., Bhattacharya, K., Bhattacharya, S.G.	Molecular characterization of a fungal cyclophilin allergen Rhi o 2 and elucidation of antigenic determinants responsible for IgE-cross-reactivity	2020	Journal of Biological Chemistry	4.106
294	Ratha, B.N., Kar, R.K., Bednarikova, Z., Gazova, Z., Kotler, S.A., Raha, S., De, S., Maiti, N.C., Bhunia, A.	Molecular Details of a Salt Bridge and Its Role in Insulin Fibrillation by NMR and Raman Spectroscopic Analysis	2020	Journal of Physical Chemistry B	2.923
295	Gucchait, A., Misra, A.K.	Convenient synthesis of glycosylsulforaphane derivatives	2020	Journal of the Indian Chemical Society	0.15
296	S. Acharya et al. (ALICE Collaboration)	Measurement of Î› (1520) production in pp collisions at â^šs=7TeV and pâ€"Pb collisions at â^šsNN=5.02TeV	2020	European Physical Journal C	4.843
297	Manna, T., Gucchait, A., Misra, A.K.	Convenient synthesis of the pentasaccharide repeating unit corresponding to the cell wall O-antigen of Escherichia albertii O4	2020	Beilstein Journal of Organic Chemistry	2.595
298	Sinha, S., Grewal, R.K., Roy, S.	Modeling Phage-Bacteria Dynamics	2020	Methods in molecular biology (Clifton, N.J.)	10.71
299	Panda, S., Banerjee, N., Chatterjee, S.	Solute carrier proteins and c-Myc: a strong connection in cancer progression	2020	Drug Discovery Today	6.88
300	Sett, S., Aggarwal, V.K., Singha, A., Bysakh, S., Raychaudhuri, A.K.	Si microline array based highly responsive broadband photodetector fabricated on silicon-on-insulator wafers	2020	Semiconductor Science and Technology, 35	2.654
301	Adak, S., Datta, S., Bhattacharya, S., Ghose, T.K., Lahiri Majumder, A.	Diversity analysis of selected rice landraces from West Bengal and their linked molecular markers for salinity tolerance	2020	Physiology and Molecular Biology of Plants	1
302	Das, S., Sheikh, M.S., Mukherjee, R., Dutta, A., Sinha, T.P.	Size-dependent Structural, Optical and Vibrational Properties of ZnTe Nanoparticle	2020	International Journal of Nanoscience	Not Found
303	Pal, S., Pal, K., Mukherjee, S., Bera, D., Karmakar, P., Sukhen, D.	Green cardamom mediated phytosynthesis of ZnONPs and validation of its antibacterial and anticancerous potential	2020	Materials Research Express	1.449
304	Biswas, S., and Chakraborty A K	Information Management Systems in College Libraries: A Study on College Libraries of Nadia District in West Bengal	2020	College Libraries, 35 (.I)	
305	S. Acharya et al. (ALICE Collaboration)	Measurement of electrons from semileptonic heavy-flavour hadron decays at midrapidity in pp and Pb-Pb collisions at 5.02 TeV	2020	PLB 804	4.16
306	S. Acharya et al. (ALICE Collaboration)	Longitudinal and azimuthal evolution of two-particle transverse momentum correlations in Pb-Pb collisions at 2.76 TeV	2020	PLB 804	4.16
307	S. Acharya et al. (ALICE Collaboration)	Measurements of inclusive jet spectra in pp and central Pb-Pb collisions at 5.02 TeV	2020	Phys. Rev. C 101,	2.98

PUBLICATIONS

Sl. No.	Authors	Title	Year	Source title	Impact factor
308	S. Acharya et al. (ALICE Collaboration)	Scattering studies with low-energy kaon-proton femtoscopy in proton-proton collisions at the LHC	2020	Phys. Rev. Lett. 124	8.83
309	S. Acharya et al. (ALICE Collaboration)	Studies of J/Psi production at forward rapidity in Pb-Pb collisions at 5.02 TeV;	2020	JHEP 02, 041	5.87
310	S. Acharya et al. (ALICE Collaboration)	Measurement of electrons from heavy-flavour hadron decays as a function of multiplicity in p-Pb collisions at 5.02 TeV;	2020	JHEP02. 077	5.87
311	S. Acharya et al. (ALICE Collaboration)	Exploration of jet substructure using iterative declustering in pp and Pb-Pb collisions at LHC energies	2020	PLB 802	4.16
312	S. Acharya et al. (ALICE Collaboration)	Evidence of rescattering effect in Pb-Pb collisions at the LHC through production of K*(892)0 and Phi(1029)	2020	PLB 802	4.16
313	S. Acharya et al. (ALICE Collaboration)	Measurement of strange baryon-antibaryon interactions with femtoscopic correlations	2020	PLB 802	4.16
314	S. Acharya et al. (ALICE Collaboration)	Measurement of prompt D0, D+, D*+, D+s production in p-Pb collisions at 5.02 TeV.	2020	JHEP 2019, 92	5.87
315	S. Acharya et al. (ALICE Collaboration)	Multiplicity dependence of light (anti-) nuclei production in p-Pb collisions at 5.02 TeV	2020	Phys.Lett. B800	4.16
316	S. Acharya et al. (ALICE Collaboration)	Measurement of charged jet cross section in pp collisions at5.02 TeV	2020	Phys. Rev. D 100	4.83

LIST OF BOOKS / BOOK CHAPTERS / INVITED REVIEWS

Biochemistry

Dr. Abhrajyoti Ghosh

1. Bhattacharyya C, Roy R, Tribedi P, Ghosh A, Ghosh A (2020) Biofertilizers as substitute to commercial agrochemicals. In M.N.V. Prasad (eds.), Agrochemicals Detection, Treatment and Remediation, Pesticides and Chemical Fertilizers, January 2020, 263-290
2. Mukherji S, Haldar S, Ghosh A (2019) Investigation of the Structural and Functional Microbial Diversity in Indian Mangroves. B. Giri, A. Varma (eds.), Microorganisms in Saline Environments: Strategies and Functions, Soil Biology, July 2019, 56: 93-130(ISBN 978-3-030-189747).
3. Mallick I, Ghosh A, Ghosh A (2019) Microbe-Mediated Removal of Heavy Metals for Sustainable Agricultural Practices. B. Giri et al. (eds.), Biofertilizers for Sustainable Agriculture and Environment, Soil Biology, August 2019, 55: 521-544 (ISBN 978-3-030-18932-7).

Biophysics

Dr. Gautam Basu

1. Ganguly H K, Basu G (2020) Conformational landscape of substituted prolines. Biophys. Rev. 12: 25-39.

Molecular Medicine

Dr. Anup Kumar Misra

1. Si Anshupriya and Misra Anup Kumar (2020) Perspective on the transformation of carbohydrates under green and sustainable reaction conditions in Recent Trends in Carbohydrate Chemistry 2020, Rauter, A. P.; Christensen, B. J.; Somsak, L.; Kosma, P.; Adamo, R. Eds, Elsevier.

Dr. Mahadeb Pal

1. Dutta N, Pal K and Pal M (2020) “heat shock factor 1 and its small molecule modulators with therapeutic potential” in Heat Shock Proteins and Stress edited by Asea, Alexzander A. A. and Kaur Punit (eds.), Springer, in press.
2. Dutta N, Ghosh S and Pal M (2020) “Neurodegenerative diseases and small molecule protein chaperone activator of natural origin” in Evidence Based Validation of Traditional Medicines – A Comprehensive Approach’ edited by Subhash Mandal, Raja Chakraborty and Saikat Sen. Springer in press.

Physics

Dr. Dhruba Gupta

1. Ali Sk M,Gupta D, Kundalia K,SahaS K, Tengblad O,OvejasJD, Perea A, Martel I, Cederkall J, Park J, Szwec S (2019) Resonance excitations in the 7Be + d experiment at CERN-ISOLDE, Proceedings of the DAE-BRNS Symposium on Nuclear Physics 64, 570, ISBN 978-8-18-372081-6.

2. Kundalia K, Saha S K, AliSk M,Gupta D, Tengblad O,OvejasJD, Perea A, Martel I, Cederkall J, Park J, Szwec S (2019) Study of □-cluster transfer reaction with 7Be, Proceedings of the DAE-BRNS Symposium on Nuclear Physics 64, 582, ISBN 978-8-18-372081-6.

3. Ali Sk M, Gupta D, Kundalia K, Saha S K(2019) NPTool simulations for 7Be + d experiment at CERN-ISOLDE, Proceedings of the DAE-BRNS Symposium on Nuclear Physics 64, 892, ISBN 978-8-18-372081-6.

Dr. Supriya Das

1. Editorial board member for 'Anu-Tarang' (a brochure published covering the 7 mega science projects featured in Vigyan Samagam).

Plant Biology

Dr. Pallob Kundu

1. Chowdhury S, Bhattacharjee P, Basak S, Chowdhury S, and Kundu P (2019) Method to study dynamics of membrane-bound plant transcription factors during biotic interactions in tomato, Chapter 7, Plant Innate Immunity, Methods Mol Biol, 1991, 61-68; Springer.

Dr. Anupama Ghosh

1. Bhattacharyya C, Roy R, Tribedi P, Ghosh A, Ghosh A (2020) Biofertilizers as substitute to commercial agrochemicals. M.N.V Prasad (Eds.), Agrochemicals Detection, Treatment and Remediation, Pesticides and Chemical Fertilizers, 11: 263-290 (ISBN 978-0-08-103017-2).

2. Mallick I, Ghosh A, Ghosh A (2019) Microbe-Mediated Removal of Heavy Metals for Sustainable Agricultural Practices. In: B. Giri et al. (eds.), Biofertilizers for Sustainable Agriculture and Environment, Soil Biology, August 2019, 55: 521-544 (ISBN 978-3-030-18932-7). https://link.springer.com/chapter/10.1007/978-3-030-18933-4_24.

Senior Scientist

Prof. Sampa Das

1 Shriti S, Jain A, Das S (2019) Evergreening: An Equivocal Affair in Pharmaceutical Industries. In Intellectual Property Issues in Microbiology, Singh H., Keswani C., Singh S. (eds). Springer, Singapore. https://doi.org/10.1007/978-981-13-7466-1_17.

ON-GOING PROJECTS

FUNDING AUTHORITY	DATE OF COMMENCEMENT	DATE OF TERMINATION	PRINCIPAL INVESTIGATOR	DEPTT./ SEC.	TITLE OF THE PROJECTS	GRANT SANCTIONED	GRANT RECEIVED	RECEVING DATE	Co-P.I.
CSIR	01-Jun-16	31-May-19	Prof. Manju Roy	Biophysics	Assessment of the anti-cancer effect of Methylglyoxal in combination with conventional anticancer drugs at Metronomic doses with special reference to cancer stem cells	24,43,800	5,68,333 6,08,858 8,14,600	17-08-2016 - 23-08-2018	Dr. Kuladip Jana
CSIR	01-Jul-17	30-Jun-20	Dr. Anirban Bhunia	Biophysics	Structural insight and Dynamical properties of Alpha synuclein fibrillation in the context of Mitochondrial membrane or Biological membrances : Pathological role in synaptic transmission Aggregation property and cellular toxicity	24,43,800	1,87,500/- 81,766/- 4,40,200/-	28.08.2017 04.05.2018 15.06.2018	
CSIR	10-Jul-17	31-Jul-20	Prof. Subrata Majumdar	DMM	Crucial role of transcription factor-EB(TFEB) in regulating differential antigen presentation and cross presentation during Leishmania donovani infection	25,93,800	6,71,000 1,35,981 4,82,577	26-09-2017 09-07-2018 17-10-2018	Prof. P. C. Sil
CSIR	01-Aug-17	31-Jul-20	Prof. Samir Ranjan Sikdar	DPB (CB)	Proteome analysis during Lipaphis erysimi - Rorippa indica incompatible interaction to identify putative proteins responsible for aphid tolerance and their interacting partners	15,00,000	4,58,333 3,48,646	29.11.2017 20.06.2018	
CSIR	25-Jul-17	31-Jul-20	Prof. Swati Gupta Bhattacharyya	DPB(MC)	Deciphering the in-planta secretome of Rhizoctonia solani AG1-1A during infection of rice	28,93,800	7,62,667 1,92,559	11.01.2018 20.02.2019	Dr. Anupama Ghosh
DBT		31-Mar-20	Prof. Pinakpani Chakrabarti	B.I.C.	"National Facility on Interactive Graphics Computer System for Biomolecular Modeling, Molecular Dynamics & Structures at Bose Institute, Kolkata"		10,32,000 6,30,000 2,70,000 4,91,329	10/08/06 21/11/07 16/10/08 14/02/2017	
DBT		31-Mar-20	Prof. Pinakpani Chakrabarti	Biochemistry	"Centre of Excellence(COE) at Bose Institute"	2,92,50,000	76,70,000 11,60,000 20,65,000 13,52,000 19,00,000 40,52,000 23,00,000 1,11,000 38,00,000	01/11/04 30/01/06 10/02/06 10/02/06 22/06/07 08/11/07 26/09/08 19/01/09 05/10/09	

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							12,00,000 22,35,000	19/11/09 25/04/11	
DBT	23-Aug-16	22-Aug-19	Prof. Swati Gupta Bhattacharyya	Botany	Development of Molecular Diganostics and Immunotherapeutic Vaccines for Prawn and Brinjal Allergy	47,13,600	12,60,000 8,00,000 11,71,038	31.08.2016 31.08.2016 05.06.2018	Dr. Sudipto Saha
DBT	19-Oct-16	18-Oct-19	Prof. Debabrata Basu	DPB (CB)	Development of High yielding, Non lodging and Biotic resistant Varieties of Black Scented Rice of Manipur and Joha Rice of Assam through Biotechnological Intervention	7,35,000	7,35,000 5,34,000	27-10-2016 24-08-2018	
DBT	19-Jan-17	18-Jul-20	Prof. Tapan K. Dutta	Microbiology	Hydrogenogenic carbon monoxide conversion under mesophilic condition using anaerobic granular sludge biomass for biodesulphurization	25,74,000	12,13,000 4,80,600	21-03-2017 16-08-2018	Prof. Subrata Sau
DBT	09-Jan-17	08-Jan-21	DIRECTOR, BOSE INSTITUTE	Bose Institute	Multi-dimensional Reserch to Enable Systems Medicine: Acceleration using a Cluster Approach' at Kalyani, West Bengal	14,05,32,000			
DBT	13-Jul-17	12-Jul-20	Prof. Manikuntala Kundu	Chemistry	Transcriptional regulator RegX3-dependent modulation of the macrophage immune response by Mycobacterium tuberculosis	61,84,000	9,70,600/- 17,37,800/- 16,38,530/-	19.07.2017 20.07.2017 05.12.2018	Dr. Zhumur Ghosh
DBT	30-Jan-18	29-Jan-21	Prof. Mahadeb Pal	DMM	Understand molecular mechanism of action of a protein chaperone inducer azadiradione and its therapeutic development for Parkinson's disease treatment	36,02,000	5,80,000 10,14,000 9,57,360	13-02-2018 13-02-2018 27-11-2019	Prof. Anup Kr. Misra
DBT	16-Jul-18	15-Jul-21	Dr. Pallob Kundu	DPB (CB)	Developing an optimized toolkit for induicible genome editing and regulation of gene expression in tomato plant: implicaitons in adjusting complex traits via synthetic biology approach	78,06,800	30,50,000 15,70,000	24-07-2018 24-07-2018	Dr. Anirban Bhunia
DBT	24-Sep-18	23-Sep-21	Prof. Gaurisankar Sa	DMM	Development of delivery system for miR-325-3p for immunotherapy of cancer	79,29,800	8,45,000 23,61,600	27-09-2018 27-09-2018	Prof. Tanya Das

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DBT	23-Mar-18	22-Mar-21	Prof. Siddhartha Roy	Biophysics	Solid tumor targeting using homing peptides and plasmonic photothermal technique	46,84,800	12,00,000 11,61,600	31-03-2018 31-03-2018	
DBT-RGCB	29-Jul-15	27-May-19	Dr. Kaushik Biswas	DMM	Role of c-Jun N-Terminal Kinase (JNK) in tumor derived soluble factor mediated T cell apoptosis	24,90,000	11,70,000 6,60,000	05-10-2015 24-05-2017	
DBT-WB	31-Aug-16	30-Aug-20	Prof. Amita Pal	DPB (CB)	Genome wide transcriptome analysis to develop strategies for quality improvement of blackgram	30,47,320	12,98,320/- 3,66,392/- 1,95,275/-	31.08.2016 23.03.2018 06.11.2019	Dr. Pallob Kundu
DBT-WB	15-May-18	14-May-21	Dr. Gaurab Gangopadhyay	DPB (MC)	Development of Transgenic Pineapple Over-expressing AcSERK to Combat Fungal Pathogens	19,99,645	10,30,245	09-03-2018	
DBT-WB	02-Jul-18	01-Jul-21	Dr. Shubho Chaudhuri	DPB (CB)	Investigating the role of Trithorax factor ULTRAPETALA1 in salt stress response in rice	43,31,840	20,20,840	22-03-2018	
DBT-WB	28-Aug-18	27-Aug-21	Prof. Gautam Basu	Biophysics	The significance of feedback loop between ZEB1 and PRMT in Fbroblast growth factore (FGF)-mediated epithelial-mesenchymal transition in Breast Cancer	30,30,000	16,00,000	28-09-2018	
DST	10-Jul-14	31-Mar-20	Prof. Sibaji Raha	Physics	ALICE - A Large Ion Collider Experiment (ALICE) upgrade, operation and utilization	6,05,00,000	70,00,000 37,00,000 35,00,000 1,48,00,000	30.09.2004 30.09.2014 03.09.2016 03.09.2016	
DST	20-Mar-17	19-Mar-20	Prof. P.C.Sen	DMM	Targeting onco-miRNAs with a novel oleic acid-pluoronic stabilized porous TiO2 nanoparticle for specific synergistic delivery of small molecule combination to combat triple negative breast cancer	42,91,584	11,61,000	31-03-2017	

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DST	28-Mar-19	27-Mar-21	Prof. Sanjay K. Ghosh	CAPSS	Development of a cost effective and portable electro-optical system for effective investigation of residual ambient gases using spark emission spectrometry towards the estimation of atmospheric gases compostiton w.r.t. height using high flying drones	24,37,600	12,73,800 13,73,270	28-03-2019 17-05-2019	
DST(SPLICE-Climate Change Programme)	22-Mar-18	21-Mar-21	Dr. Abhijit Chatterjee	Evn. Sci. Sec.	Understanding the Role of Local and Transported Biogenic and Anthropogenic Aerosols on Microphysical and Chemical Properites of Low Level Clouds Over Eastern Himalaya, India	74,08,800	5,90,000 55,92,000 5,78,920	22-03-2018 23-03-2018 25-11-2019	
DST-Technology Mission Division(INDO-UK)	26-Feb-18	25-Feb-21	Prof. Tapan K. Dutta	Microbiology	The development and implementation of sensors and treatment technologies for freshwater systems in India	3,42,27,700	95,66,200	26-02-2018	
ICMR	01-Mar-17	29-Feb-20	Dr. Sudipto Saha	BIC	Systematic identification of regulatory networks in pluripotent cells integrating coding and noncoding word	33,00,000	13,03,800 86,956 2,57,250 4,54,223	21-03-2017 10-08-2018 29.09.2018 26.05.2019	Dr. Zhumur Ghosh
ICMR	01-Mar-17	29-Feb-20	Dr. Zhumur Ghosh	BIC	Epigenetic Alterations Inducing Oncogenicity in Stem Cell Derivatives	21,89,200	15,30,000 2,24,044	27-03-2017 30-06-2018	
IFCC	01-Aug-16	31-Jul-22	Prof. Sanjay K. Ghosh	CAPSS	CBM MUCH	28,80,40,000	1,50,00,000	01-08-2016	Prof. Supriya Das

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IITM(MOES)	13-Sep-18	12-Sep-21	Dr. Abhijit Chatterjee	Evn. Sci. Sec.	Study on Biosphere-Atmosphere Exchange of Carbon Dioxide, Water Vapour and Energy in a High Altitude Forest Canopy at Eastern Himalaya	25,08,000	21,87,876	13.09.2018	
Indo-Swedish	20-Jun-17	19-Jun-19	Dr. Anirban Bhunia	Biophysics	Antimicrobial peptides against crop disease	31,39,000	17,94,500/-	01.07.2017	
MoEFCC	29-Mar-17	28-Jun-22	Dr. Abhijit Chatterjee	Evn. Sci. Sec.	National Carbonaceous Aerosols Programme (NCAP) WGIII: Carbonaceous Aerosols Emmissions, Source appointment and Climate effects	1,06,08,000	15,00,000 25,00,000	29-03-2017 29-03-2017	
SERB	20-Jan-16	14-Jul-19	Prof. Siddhartha Roy	Biophysics	Development of Synthetic Transcription Factors against pluripotency to Target Cancer Stem Cells	56,65,099	32,05,098/- 8,00,000/-	15-01-2016 21-03-2018	Dr. Mrinal Kanti Ghosh, CSIR-IICB
SERB	18-Jul-16	28-Dec-19	Dr. Somshubhra Bandyopadhyay	CAPSS	Studies on quantum entanglement as a resource for quantum information processing	17,89,344	1,00,000 5,63,114 3,00,000	18/07/2016 18/07/2016 19/12/2018	
SERB	30-Aug-16	29-Aug-19	Dr. Subhrangsu Chatterjee	Biophysics	Understanding the role of G-quadruplex structures in BC1-2, KRAS and c-MYC promoters in the development of cancer	46,94,750	14,47,750 10,82,250 10,00,000	30-08-2016 30-08-2016 19-07-2018	
SERB	10-Mar-17	09-Sep-20	Dr. Zhumur Ghosh	BIC	Elucidating the GWAS-Associated Genetic Variants within lncRNA candidate loci: Role in Cancer	45,18,800/-	6,00,000 14,00,000 10,00,000 10,00,000	10.03.2017 11.09.2017 25.07.2018 07.02.2020	Dr. Kaushik Biswas
SERB	21-Mar-17	20-Mar-20	Dr. Atin Kumar Mandal	DMM	Role of co-chaperones in triage decision of Hsp70	39,43,000	7,00,000 11,14,000 11,10,000 8,00,000	21-03-2017 27-06-2017 27-06-2018 04.06.2019	
SERB	21-Mar-17	20-Mar-20	Dr. Kaushik Biswas	DMM	A novel role of ganglioside GM2 in the regulation of the Hippo signaling pathway in tumorigenesis	44,16,183	8,99,300/- 11,00,083/- 11,00,000/-	21-03-2017 28-09-2017 16.08.2018	

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							8,52,000/-	26.07.2019	
SERB	16-Mar-18	15-Mar-21	Dr. Anupama Ghosh	DPB (CB)	Evaluation of secreted proteases of Ustilago maydis as potential effector proteins	25,53,394	14,60,633	16-03-2018	
SERB	24-Jul-18	23-Jul-21	Dr. Shubho Chaudhuri	DPB (CB)	Investigating the role of Arabidopsis ARID-HMG protein, AtHMGB15, in the pollen development process	46,29,744	10,00,000 6,10,000 7,00,000	24-07-2018 24-07-2018 01.11.2019	
SERB	09-Aug-18	08-Aug-21	Dr. Zhumur Ghosh	B.I.C.	SERB Women Excellence Award to Dr. Zhumur Ghosh, BIC "LncRNA target connectivity to Small Molecules: Implication in Cancer Therapy"	18,00,000	6,00,000	09-08-2018	
SERB	15-Sep-18	14-Sep-21	Dr. Achintya Singha	Physics	Fabrication of Infreared Photo-detector based on 2D systems and Tuning the Detection Windows by coupling with Nanostructures	50,33,714	44,86,714	15-09-2018	Dr. Kaustuv Das, Jadavpur University
SERB	11-Oct-18	10-Oct-21	Dr. Jayanta Mukhopadhyay	Chemistry	Evaluating the role and mechanism of function of delta factor of Bacillus subtilis	30,69,000	4,99,000 8,51,000 8,74,000	11-10-2018 11-10-2018 25.11.2019	
SERB	26-Mar-19	25-Mar-22	Dr. Abhrajyoti Ghosh	Biochemistry	Response of B. aryabhattai AB211 to maize root exudates: insights from transcriptome analysis	38,68,803	23,17,750	26.03.2019	Dr. Anupama Ghosh
SERB(DST)	03-May-07	02-May-22	Prof. Pinakpani Chakrabarti	Biochemistry	Award of J.C. Bose Fellowship to Prof. Pinakpani Chakrabarti	40,00,000	8,00,000 8,00,000 8,00,000 13,55,000	17/07/07 30/01/09 12/11/09 01/10/10	
SERB(DST)	26-Mar-07	31-Mar-22	Prof. Siddhartha Roy	Biophysics	Award of J.C. Bose Fellowship to Prof. Siddhartha Roy	9000000 (FOR LAST 5YEARS)	10,00,711/- 6,00,000/- 13,00,000/-	13.08.2015 22.01.2016 29.09.2016	
SERB(DST)	12-Sep-16	11-Sep-19	Dr. Shubhro Ghosh Dastidar	BIC	Mechanistic insight into the ligand induced perturbation on the intrinsic dynamics and conformational sampling of the α, β dimer of Tubulin: Applications to combat cancer	30,80,000	26,93,330 2,00,000	12.09.2016 11.08.2017	
SERB(DST)	25-Oct-16	24-Oct-19	Prof. Parames C. Sil	DMM	Targeting the mrRNA axis with a synthetic small molecule, Nifetepimine to restrict migration of triple negative breast cancer cells	43,12,800	3,00,000 13,37,599 13,00,000 5,00,000	26-09-2016 26-09-2016 27-06-2017 29-10-2018	
SERB(DST)	23-Mar-17	22-Mar-20	Dr. Wriddhiman Ghosh	Microbiology	Quest for the biophysical basis of habitability of dydrothermal vent ecosystems	35,84,420	8,83,420/- 9,33,000/- 8,75,000/-	23-03-2017 10-10-2017 06-03-2019	
SERB(DST)	01-Apr-17	31-Mar-22	Prof. Joyoti Basu	Chemistry	Award of J.C. Bose Fellowship to Prof. Joyoti Basu	54,00,000	1,00,000 14,00,000 16,00,000	24.03.2017 01.11.2017 06.09.2018	

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SERB(DST)	05-Mar-18	04-Mar-21	Prof. Tanya Das	DMM	Role of Cancer Stem Cells in Tumor Neo-Angiogenesis : A mechanistic study	48,76,800	9,70,000	05-03-2018	
SERB(DST)	21-Mar-18	20-Mar-21	Prof. Sujoy K. Das Gupta	Microbiology	Phage inspired antibiotics for mycobacteria	38,96,800	9,90,000 10,00,000	21-03-2018 20.05.2019	
SERB(DST)	15-Mar-18	14-Mar-21	Prof. Parames C. Sil	DMM	Nanoparticle-mediated co-delivery of chemotherapeutic drugs and genes for synergistic cancer treatment	28,66,800	9,55,000	15-03-2018	
WWF	01-Dec-16	31-Jul-19	Prof. Swati Gupta Bhattacharyya	DPB (MC)	Study to understand the pollination ecology as well as applicability of placing apiary boxes in the forested area of Sundarbans	30,00,000	5,00,000	07-02-2017	
			Prof. Siddhartha Roy	Biophysics	Shanti Swarup Bhatnagar Honorarium				
CSIR	01-Aug-19	31-Jul-22	Prof. Gaurisankar Sa	DMM	Developmental and functional aspects of newly identified CD8+ T-regulatory cells in tumor microenvironment	21,00,000			
DBT	20-Dec-18	19-Dec-21	Prof. Gaurisankar Sa	DMM	Investigation of the Transcriptional Regulation of miR-325 and Evaluating its Potential as a Therapeutic Agent for Cancer	80,00,000	9,60,000 23,36,600	20.12.2018 20.12.2018	Prof. Tanya Das
CCRH	01-Aug-19	31-Jul-20	Prof. Gaurisankar Sa	DMM	Role of Silica in Cancer regression : A mechanistic study	11,59,830			Prof. Tanya Das
SERB	05-Dec-18	04-Dec-21	Dr. Anirban Bhunia	Biophysics	Intracellular Dyamics of Small Molecules During Novel AMP-mediated Resilience in Planta: A Multidisciplinary Approach	30,70,000	13,60,000 10,71,000	05-12-2018 26.11.2019	Dr. Pallob Kundu
SERB	06-Jul-19	05-Jul-22	Dr. Pallob Kundu	DPB (CB)	Convergent miRNA actions in coordination of stress-response to Alternaria solani infection in tomato lines	52,30,828	24,50,276	06-07-2019	
SERB	07-May-19	06-May-22	Prof. Srimonti Sarkar	Biochemistry	Characterization of the cellular roles of the proteasome and its deubiquitinase GIRpn11 of the differently-diverged eukaryote Giardia lamblia	42,33,000	24,24,000	07-05-2019	
CSIR	01-Sep-19	31-Aug-22	Dr. Sanat Kr. Das	Evn. Sci. Sec.	Physico-chemical factors influencing Aerosol Hygroscopicity during fog, its effect on Aerosol Radiative Properties and fog nowcasting: a study in the context of Regional Climate Change over Eastern India	30,52,000	13,00,000	01-10-2019	Prof. Sanjay Kr. Ghosh, Dr. Abhijit Chatterjee,
CSIR	26-Aug-19	31-Aug-22	Dr. Anupama Ghosh	DPB (CB)	Deciphering the involvement of programmed cell death in the pathogenic development of *Ustilago maydis*	19,60,000	10,70,000	11-10-2019	

ON-GOING PROJECTS

FUNDING AUTHORITY	DATE OF COMMENCEMENT	DATE OF TERMINATION	PRINCIPAL INVESTIGATOR	DEPTT./ SEC.	TITLE OF THE PROJECTS	GRANT SANCTIONED	GRANT RECEIVED	RECEVING DATE	Co-P.I.
Indo-Swiss	24-Jun-19	23-Jun-23	Prof. Siddhartha Roy	Biophysics	Next generation advanced therapies for fight β-hemoglobinopathies via rational intervention in Y-globin regulatory network	1,16,21,600	21,99,360 19,92,000	01-07-2019 29-06-2019	Prof. Gautam Basu
ICMR	08-Aug-19	07-Aug-21	Dr. Sudipto Saha	Div. of Bioinformatics	Development of knowledge base on pulmonary diseases for estimating the prevalece and etiology : a pilot study in eastern India	1,66,000	1,66,000		Dr. Parthasarathi Bhattacharyya
DBT	09-Oct-19	08-Oct-22	Dr. Anirban Bhunia	Biophysics	Tailor Made Peptidomimetics Designing Against Human Islet Amyloid Polypeptide (hIAPP) Aggregation: A Therapeutic Approach Associated With Type-2 Diabetes	66,74,500	18,74,500 15,80,000	16-10-2019	Dr. Atin Kr. Mandal
DBT	30-Sep-19	29-Sep-22	Prof. Debabrata Basu	DPB	Understanding the mechanisms of resistance to sucking pest, Helopeltis theivora and development of microbe – based bioformulation against major tea pests	39,00,396	11,11,292 5,07,000	01-10-2019	
CSIR	26-Aug-19	31-Aug-22	Dr. Abhrajyoti Ghosh	Biochemistry	Decipherig the cross-talk between rhizosphere microbiome and the plant: insights from tea rhizosphere microbiome, metabolome and culture dependent analyses	20,00,000	14,93,333	23.12.2019	
ICMR	28-Aug-19	27-Aug-22	Dr. Kaushik Biswas	DMM	Understand the epigenetic regulation of GM2-synthase gene in cancer	25,30,000	25,30,000	18-11-2019	Dr. Pallob Kundu
SERB	04-Dec-18	03-Dec-21	Prof. Mahadeb Pal	DMM	Understand regulation of heat shock factor 1 activities in human cells	30,65,148	13,48,000 12,73,000	04-12-2018 19.02.2020	
SERB	29-Jan-20	28-Jan-23	Prof. Anup Kumar Misra	DMM	Synthesis of the polysaccharide fragments of opportunistic human pathogens Providencia strains and their glycoconjugate derivatives	26,02,800	8,74,000	29.01.2020	
ISRO RESPOND -	5 AUG-2015 -	5 AUG-2019	Prof. Dhruba Gupta	Physics	Astrophysical S-factor from nuclear reactions with a rare isotope beam of 7Be	39,54,000	18,45,000 14,20,000 6,89,000	14-08-2015 18-07-2017 11-06-2019	Prof. Swapan K. Saha (superannuated 31/01/2019)

PARTICIPATION IN CONFERENCES / SYMPOSIA / WORKSHOPS / INVITED TALKS DELIVERED AND TRAVEL GRANT

Biochemistry

Prof. Subrata Sau

1. Seal S and Sau S presented a poster entitled 'Domain structure and the folding-unfolding mechanism of a staphylococcal cyclophilin involved in pathogenesis' in 'International Conference on Biotechnology & Biological Sciences BIOSPECTRUM 2019' held at University of Engineering & Management, Kolkata during August 8 – 10, 2019.
2. Seal S and Sau S presented a poster entitled 'Understanding the structure, function, unfolding mechanism, and stability of an unfamiliar cyclophilin expressed by *Staphylococcus aureus'* in International Conference on Emerging Areas in Biosciences and Biomedical Technologies (eBBT-2) held at Indian Institute of Technology Indore during February 7 – 9, 2020.

Dr. Abhrajyoti Ghosh

1. Delivered an invited lecture entitled "Evaluating microbial communities in the tea rhizosphere with respect to their potential as biofertilizers" in the one-day seminar on **"Impact of Advanced Biology on Society"** organized by Department of Microbiology and Internal Quality Assurance Cell of Scottish Church College, University of Calcutta on March 6, 2020.
2. Delivered an invited lecture entitled "Exploring the microbial diversity in tea rhizosphere of Darjeeling and an assessment of resident Plant Growth Promoting Rhizobacteria (PGPR)" in the *"International Workshop on nutrient management in shifting cultivation in North-east India"* held at Mizoram University, Mizoram during January 22 – 24, 2020.

Bioinformatics

Dr. Shubhra Ghosh Dastidar

1. Seminar organized by Society of Biological Chemists, Kolkata chapter, CSIR-IICB, Kolkata June, 2019.
2. Invited talk at the conference cum brainstorming session entitled 'National Frontier of Science' at Jaipur during 6 - 8 November, 2019, organized by Indian National Young Academy of Science with the support of the Office of the Principal Scientific Advisor (PSA) to the Govt. of India.
3. Talk at BelurVidyamandir, February 2020.
4. Talk at the seminar on "Symposium: Drug-on: a battle tale of two creatures – microbes and humans" organized by JIS Institute of Advanced Studies and Research Kolkata on February 29, 2020.

Dr. Zhumur Ghosh

1. Delivered invited talk entitled "Long noncoding RNAs: Versatile molecules orchestrating disease biology" in Frontiers in Modern Biology-2020 (FIMB-2020) symposium during February 28 – 29, 2020 organised by IISER-Kolkata at Mohanpur campus.
2. Das T, Parida S and Ghosh Z presented a poster entitled "Elucidating the genetic variants within lncRNA candidate loci and their role in Cancer" in the **10th RNA Group Meeting** held at RGCB from May 2 – 4, 2019.

PARTICIPATION

Dr. Sudipto Saha

1. Presented a poster entitled "Meta-analysis for identifying relationship of Human Gut-Lung Microbiome to lung function of Asthma using GLMdb" in IndiaIEMBO symposium on "Human microbiome: Resistance and disease", held at National Institute of Biomedical Genomics (NIBMG), Kalyani during November 9 – 12, 2019.

2. Delivered an invited talk at the National Workshop and Hands-on Training on Computational Biology with Modern Tools, MAKAUT, WB on "Big data in Network Biology" on June 19, 2019.

Group Members of Dr. Sudipto Saha :

3. **Saran N** presented a poster entitled "Genome sequencing of Fluoroquinolone resistant M.smegmatis identifies key mutations in few genes associated with drug resistance" in IndiaIEMBO Symposium on "Mycobacterial heterogeneity and host tissue tropism", held at National Institute of Immunology(NII) and International Centre for Genetic Engineering and Biotechnology (ICGEB), New Delhi during February 11 – 15, 2020 .

4. **Abhirupa Ghosh** presented a poster entitled "Towards identifying drug-resistant gene-mutation signatures in lung microbiome of antibiotic exposed individual" in IndiaIEMBO symposium on "Human microbiome: Resistance and Disease", held at National Institute of Biomedical Genomics (NIBMG), Kalyani during November 9 – 12, 2019.

5. **Shazia Firdous** attended the "1st TCGA conference and workshop in India" held at IISER Pune and presented a poster entitled "Biomarkers of Cancer Stem Cells (BCSCs) database" during September 20-21, 2019.

6. **Abhirupa Ghosh** presented a poster entitled *"Prediction of drug resistance in MTB using machine learning algorithms"* and won the best poster bronze award in InCoB 2019 held at Universitas YARSI, Jakarta, Indonesia during September 10 – 12, 2019.

7. **Debangana Chakravorty** delivered a short talk on *"Computational approach to target USP28 for regulating Myc"* in InCoB 2019 held at Universitas YARSI, Jakarta, Indonesia 10 – 12, 2019.

Biophysics

Dr. Smarajit Polley

1. Delivered Invited lecture in the conference Animal Research Today: Basic and Applied Area March 13-14, 2020 at Midnapore College, West Bengal.

2. Delivered invited lecture in the EMBO Practical Course CEM3DIP2020: Single Particle CryoEM of Macromolecular Assemblies and Cellular Tomography, January 19-30, 2020 at IISER and IICB, Kolkata.

3. Delivered Invited lecture in the 1st International Conference on Chemical and Environmental Sciences (ICCES 2019); September 19-21, 2019 at the Institute of Engineering and Management, Kolkata.

4. Organized the EMBO Practical Course CEM3DIP2020: Single Particle CryoEM of Macromolecular Assemblies and Cellular Tomography, January 19-30, 2020 at IISER and IICB, Kolkata.

5. Hosted Prof. Joachim Frank (Nobel Laureate, Columbia University) and Prof. Grant Jensen (Pioneer of Cryo-Electron Tomography, Caltech) at Bose Institute.

Chemistry

Dr. Jayanta Mukhopadhyay

1. Attended the Robustness in a Two-Component System Using a Synthetic Circuit, MCube, CDFD, Hyderabad during July 10 – 12, 2019.

Environmental Sciences

Dr. Abhijit Chatterjee

1. Delivered invited talks entitled "strategic action plans for air pollutants mitigation in India" held at Central Pollution Control Board, New Delhi on June, 2019

2. Delivered invited talks entitled "Sundarban-the savior of Kolkata from air pollution and extreme events" held at Central Glass and Ceramic Research Institute (CSIR), Kolkata on March, 2020.

3. Delivered invited talks entitled "Activities on NCAP, Govt of India over Kolkata" held at Ministry of Environment, Uttarpradesh (Lucknow) on October, 2019.

4. Attended conference on "Air Quality management in India" by World Bank held at Chandigarh University, Chandigarh on December, 2019.

Dr. Sanat Kumar Das

1. Delivered a talk on air quality index and heath effect at the 16th annual meeting of Asia Oceania Geosciences Society (AOGS 2019), during July 28 – August 3, 2019.

2. Chair and Convener of session (IG20) on "Big Data, Machine Learning, and Data Analytics in Geosciences" in AOGS2019 during July 28 – August 3, 2019.

3. Delivered an invited talk in Regional Remote Sensing Centre-Central, National Remote Sensing Center (NRSC)/ISRO during December 16 – 20, 2019

4. Participated in North East student Summer Training Program (NESST-BASE) held at Darjeeling campus of Bose Institute during May, 2019.

Microbiology

Prof. Sujoy Kumar Das Gupta

1. Presented a lecture on the topic "Ancient imprints in the genomes of mycobacterial plasmids and phages offer new insight into the evolutionary origin of DNA replication and transcriptional machineries." at the Meeting on molecular biology, " (Mcubed) 2019 meeting held at CDFD Hyderabad. 10-12 July 2019.
2. Delivered a lecture entitled "an autobiography of the gene" at the 'Biospectrum 2019' conference organized by the University of Engineering and Management, Kolkata on the 9th August 2019.
3. Delivered a lecture entitled "TB research and drug development" at the 'B star 19' symposium organized by Dr. KPC life sciences Pvt Ltd. Kolkata on the 13th of Nov 2019.
4. Invited lecture on the topic "Phage inspired antibiotics for mycobacteria" at the 107th Indian Science Congress held at the Bangalore, January 3-7, 2020.
5. Invited lecture at the "National Seminar on Advancement of Biotechnology in Human Welfare" organized by the Govt. Of West Bengal Department of Science and Technology and Biotechnology and SHRM biotechnologies limited. February 24th 2020 on the topic "An autobiography of the DNA – the beautiful molecule of life" at the Suresh Neotia Centre for excellence for leadership, Salt Lake, Kolkata.
6. Delivered an invited lecture entitled "The DNA story" in connection with the National Science Day Celebration, February 28th 2020 organized by the Sister Nivedita University, New Town, Kolkata.

Molecular Medicine

Prof. Gaurisankar Sa

1. Delivered invited lecture at the *7th Federation of Immunological Societies of Asia-Oceania Congress (FIMSA-2018)* at Bangkok, Thailand.
2. Invited as a key speaker at the BIT's 16th Annual Conference on *International Drug Discovery Science and Technology*, held in Boston, USA.
3. Delivered talk as an invited faculty at the *International Conference of Asian Society of Mastology* held in Maldives.
4. Delivered key-note address at the *Immunocon*-2018 at TISTI, Faridabad.
5. Delivered invited lecture at the *Indo-Australian Biotechnology Conference* at Mumbai.
6. Delivered invited lecture at the *Indo-USA conference at IISc*, Bengaluru.
7. Delivered invited lecture at the *Indo-Japan conference* at Kolkata.

8. Invited to deliver inaugural speech at the International Seminar on Homeopathy and Auxiliary Therapy of Oncology held in Nasik.
9. Delivered plenary lecture at the International Conference of Pysiologfical Society of India Physicon-2018 at Sreerampore College.
10. Delivered plenary lecture as a resource person at the Immunology Day at PGMIR, Chandigarh.
11. Delivered key-note address at the Flowcytometry Meeting-2019 at JNCSER, Bengaluru.
12. Delivered key-note address at the World Cancer Day at CNCI, Kolkata.
13. Delivered plenary lecture at NEHU, Shilong.
14. Delivered plenary lecture at VU, Midnapore.
15. Delivered invited lecture at the RMRC-2018 at Guwahati.
16. Delivered plenary lecture at Kalyani University, Kalyani.
17. Delivered plenary lecture at Lady Brabourne College, Kolkata.
18. Delivered plenary lecture as a resource person at the Refresher's Course of Dept. of Physiology, Calcutta University, Kolkata.
19. Invited for delivering lecture at the 38th Annual Convention of Indian Association for Cancer Research at Chandigarh.

Prof. Mahadeb Pal

1. Delivered invited talk at the 5th conference on recent trend on pre-translational to translational research organized by Indian Society of Translational Research (ISTR) held at NCCS Pune during November 7 – 9, 2019.
2. Advances at the Interface of Biology & Chemistry held at BARC Mumbai during November 1 – 3, 2019.

Dr. Atin Kumar Mandal

1. Delivered invited talk at the '88th Annual Meeting of Society of Biological Chemists (I)'. BARC, Mumbai, October 31 – November 3, 2019.
2. Delivered talk at the '37th Annual Meeting of Indian Academy of Neurosciences'. AIIMS, Delhi, November 19 – 21, 2019.

Group Members of Dr. Atin Kumar Mandal :

3. Baijayanti Ghosh presented poster at the EMBO Workshop on "Protein quality control: From mechanisms to disease", Costa de la Calma (Mallorca), Spain during April 28 – May 03, 2019.

Dr. Kaushik Biswas

1. Delivered an invited talk titled *"Cancer Immunotherapy at The Cross Roads-Modulating the Accelarators & Brakes for Optimal Outcome"* at the One Day National Level Seminar and Poster presentation competition organized by the Swami Vivekananda Research Center (SVRC) on "How to Checkmate Cancer – the Emperor of all Maladies" organized by the Dept. of Zoology at Ramakrishna Mission Vidyamandira, Belur Math on March 06, 2020.
2. Participated at the SBC, Kolkata Chapter Annual Meeting.

Physics

Prof. Somshubhro Bandyopadhyay

1. Delivered an invited talk titled "Fidelity deviation in quantum teleportation" at Quantum Information and Computation-2019, QIC-2019, IIT Jodhpur, December 8 – 11, 2019.
2. Delivered an invited talk titled "Strong quantum nonlocality without entanglement" at "Quantum Frontiers and Fundamentals: Experimental Studies and Theoretical Ramifications", QFF2020, RRI Bangalore, January 13 – 18, 2020.

Prof. Dhruba Gupta

1. Delivered an invited talk titled "Transfer and breakup reactions involving 7Be at ISOLDE" at the ISOLDE Workshop and Users Meeting during December 5 – 6, 2019, CERN, Geneva, Switzerland.

Dr. Supriya Das

1. Delivered a lecture on"Matter at extreme density: core of a neutron star" at FAIR week in VigyanSamagam, Mumbai; June 25, 2019.
2. Delivered a lecture on "Research at FAIR: from neutron stars to cancer therapy" in the Inaugural session of VigyanSamagam, Bengaluru; July 30, 2019.
3. Delivered a lecture on "High Energy Physics experiment: a synergy between science and technology" at FAIR week in VigyanSamagam, Bengaluru; September 7, 2019.
4. Delivered a lecture on "High Energy Physics experiment: Science, Technology and Career" at FAIR week in VigyanSamagam, Kolkata; November 21, 2019.

Dr. Saikat Biswas

1. Delivered invited talk title "Detectors for Physics and Medical Imaging: an introduction" during FAIR week, Vigyan Samagam, Nehru Science Centre, Mumbai, June 24 – 30, 2019; VITM, Bengaluru, September 3 – 7, 2019 and Science City, Kolkata, November 19 – 23, 2019.
2. Participated in the Workshop on Dynamics of QCD matter, NISER, Bhubaneswar, August 15-17, 2019 entitle Detectors for Muon chamber of CBM experiment.

3. Organized the FAIR week at Vigyan Samagam, Nehru Science Centre, Mumbai, 24-30 June 2019; VITM, Bengaluru, 3-7 September 2019; Science City, Kolkata, November 19 – 23, 2019.
4. Act as convener of 34th CBM Collaboration meeting, UAC, Bose Institute, September 29 – October 3, 2019. Before the collaboration meeting, there were a 2- day CBM software school and 1-day CBM Junior's day.
5. Act as Volunteer Coordinator for the FAIR project, Vigyan Samagam, Mumbai, Bengaluru, Kolkata, Delhi. June, 2019 – March, 2020.
6. Act as convener of the FAIR week at Vigyan Samagam, Mumbai, Bengaluru, Kolkata.

Mr. Sayak Chatterjee (student of Dr. Saikat Biswas):

1. Received the Best Poster Award in Workshop on Dynamics of QCD matter, NISER, 15-17 August, 2019: The title of poster was "Characterisation of GEM detector for CBM Muon Chamber".

Dr. Achintya Singha

1. Delivered invited talk entitle "Optical Properties of Plasmon–Coupled 2D Materials" at Flatlands and Beyond (2019) held at S. N. Bose National Centre for Basic Sciences during September 5 – 6, 2019.
2. Delivered invited talk entitle " Optical and Vibrational Properties of Direct Bangap Ge1-x Snx Nanowires" at XXth International Workshop on Physics of Semiconductor Devices (IWPSD-2019) held at Novotel Hotel and Residences, Kolkata during December 16 – 20, 2019.
3. Delivered invited talk entitle "Mn Incorporated MoS2 Nanoflowers: A High Performance Electrode Material for Symmetric Supercapacitor" at International Conference on Nano Science and Technology (ICONSAT-2020) held at Biswa Bangla Convention Centre, New Town, Kolkata during March 5 – 7, 2020.
4. Acted as Member of Organizing Committee of International Conference on Nano Science and Technology (ICONSAT-2020).

Dr. Soumen Roy

1. Delivered a lecture entitled "A discrete mathematical approach to mutagenesis: Systems perspectives from phage resistance experiments" at the Indian Statistical Physics Community Meeting at ICTS-TIFR, Bangalore during February 19 – 21, 2020.
2. Delivered an invited lecture entitled "Systems Biology: From networks to microbes" at the UGC-HRDC Refresher Course, Jadavpur University, Kolkata from January 27 – February 8, 2020.

Dr. Sidharth Kumar Prasad

1. Delivered invited talk on "Jet measurements at LHC" in a Workshop on Dynamics of QCD Matter, held at NISER, Bhubaneswar (INDIA), during August 15 – 17, 2019.

2. Delivered invited talk on "ALICE detectors: Probing minibang with jets" in CERN week of Vigyan Samagam at Science City Kolkata on November 09, 2019.

3. Organized "DAE-BRNS symposium on Contemporary and Emerging Topics in High Energy Nuclear Physics (CETHENP 2019)" during 25 – 27 November, 2019 at VECC, Kolkata.

Mr. Abhi Modak (student of Dr. Sidharth Kumar Prasad):

1. Received the second prize for best oral presentation in "National Conference on Frontiers in Modern Physics (NCFMP2020)" held at Adamas University, Kolkata during 06-07 February 2020.

Plant Biology

Prof. Shubho Chaudhuri

1. Delivered invited talk on Chromatin Remodelling: Role of Histone and Non-Histone Proteins at Adamas University, West Bengal.

2. Presented a Poster in the Plant Biology 2019 organized by American society of Plant Biologist, held at San Jose, California, USA, August 3 – 7, 2019.

3. Presented a Poster on "Understanding the regulation of a transcription factor, OsDREB2a, induced by salt stress in Oryza sativa L". Ruby Biswas, Amit Paul, Pratiti Dasgupta and Shubho Chaudhuri. IISF, 2019.

4. Received the SERB International travel grant (ITS) to attend Plant Biology 2019, San Jose, California, USA

Prof. Gaurab Gangopadhyay

1. Resource person of Plant Science in the North-Eastern States Students' Training on Basic Science 2019 (NESST-BASE 2019) at the Darjeeling Campus, BI from June 9 – 11, 2019.

2. Invited as a resource person for a seminar organized by Department of Botany, New Alipore College Kolkata on August 8, 2019.

3. Participated in the 23rd National Science Exhibition on behalf of the Bose Institute from August 28 – 31, 2019 at Amrabati Maidan, Sodepur, Kolkata.

4. Invited to deliver a lecture in the National Seminar entitled "Recent Advances in Chemical and Biological Sciences, RACB-2019" organized by the Department of Chemistry, St. Xavier's College, Kolkata on September 23, 2019.

5. One of the coordinators of International Science Literature Festival 2019 "Vigyanika", IISF, Kolkata during November 5 – 8, 2019.

6. Participated in the 15th Jatiya Sanhati Utsab-o-Bharat Mela held at Chadmari, South 24 parganas on behalf of the Bose Institute from December 14 – 18, 2019.

7. Invited to deliver a lecture in the International Seminar entitled "Innovation, Expansion, Impacts and Challenges in Chemical and Biological Sciences, ICBS-2020" organized by the Department of Chemistry, Surendranath College, Kolkata on January 9, 2020

Group Members of Dr. Gaurab Gangopadhyay :

8. Ms Soumili Pal, JRF - poster entitled "Exploring the dual role of AcSERK gene homologues in pineapple: Expression analysis during somatic embryogenesis and Fusarium-induced pathogenesis" by S. Pal, D. Kumar and G. Gangopadhyay at the 1st National Conference on Neglected and Underutilized crop species on August 2, 2019 (Organized by NIPGR, New Delhi).

8. Ms Diptasree Kumar, JRF - poster entitled "Over-expression of samdc (S-adenosyl methionine decarboxylase) from Pokkali, an Indian rice landrace, imparts salt tolerance to tobacco, a salt-sensitive model plant" by D. Kumar, S. Laha and G. Gangopadhyay at the 1st National Conference on Neglected and Underutilized crop species on August 2, 2019 (Organized by NIPGR, New Delhi).

10. Ms Manisha Pal, M. Sc. Project student - poster entitled "Expression analysis of dt gene in contrasting sesame genotypes: Towards the development of candidate gene-based marker for determinate growth habit" by M. Pal, D. Dutta and G. Gangopadhyay at the 1st National Conference on Neglected and Underutilized crop species on August 2, 2019 (Organized by NIPGR, New Delhi).

11. Ms Soumili Pal, SRF - poster entitled "AcSERK3: The most potent homologue of SERK gene family to combat fusariosis in pineapple" by S. Pal and G. Gangopadhyay at the International Conference on "Algae, Fungi and Plants: Systematics to Applications – AFPSA-2020" on January 24 – 25, 2020 (Organized by Department of Botany, University of Calcutta).

12. Mr Vivek Kumar Awon, JRF - poster entitled "The potential of Mortierella elongata as a beneficial fungus to boost the growth of Darjeeling Tea" by V. K. Awon and G. Gangopadhyay at the International Conference on "Algae, Fungi and Plants: Systematics to Applications – AFPSA-2020" on January 24 – 25, 2020 (Organized by Department of Botany, University of Calcutta). It was awarded for the best paper presentation.

Dr. Pallob Kundu

1. Delivered a lecture on "Plant Immunity" in Teachers' training programme at Botany Department, University of Kolkata. "Applications of modern tools and technique in Plant Biology', at the Department of Botany, University of Calcutta, Kolkata on March 6, 2019. Organised by the West Bengal Academy of Science and Technology (WAST), Center for Advanced Studies, Dept. of Botany, CU and Archana Sharma Foundation of Kolkata.

2. Delivered a lecture on 'Novel CRISPR-Cas toolkits: shaping the crops of the future' in short term hands on training course on 'Recent advances in mutation breeding for crop improvement' at FACC, Bidhan Chandra Krishi Viswavidyalaya on January 28, 2020.

3. Pallob Kundu, Sayan Mal, Supriyo Chowdhury, Souradip Paul, Shrabani Basak, Himadri Das and Payel Bhattacharjee, Sensing stress on the membrane: functional analysis of a membrane-bound NAC transcription factor of tomato, in IndiaIEMBO Symposium on "Sensing and signalling in plant stress response", April 15 – 17, 2019, New Delhi, India

4. Rohit Das, Jayanti Jodder, Sayan Mal and Pallob Kundu, Mechanistic insights of miR167a regulation during temperature stress in tomato plant, Plant Biology 2019, American Society for Plant Biology Annual Meeting, August 3 – 7, 2019, San Jose, California.

Mr. Rohit Das (student of Dr. Pallob Kundu):

1. Received travel fellowships for attending the Plant Biology 2019 symposium held in the USA.

   i) DBT-CTEP travel grant covering return airfare

   ii) CSIR travel grant covering return airfare

   iii) CCSTDS travel fellowship covering partial registration/accommodation

Group Member of Dr. Anupama Ghosh :

1. Rahul Datta received CSIR Travel Grant and presented a poster entitled "An insight into the apoplast of rice during Rhizoctonia solani AG1-IA infection" in the XVIII Congress of IS-MPMI held at SEC Glasgow during July 14 – 18, 2019.

Senior Scientist

Prof. Joyoti Basu

1. Delivered a lecture inthe 14th World Congress of Inflammation held in Sydney, Australia, September 15-19, 2019.

Prof. Pinakpani Chakrabarti

Presented papers at :

(i) workshop on 'Bioinformatics: Tools and Applications', Dibrugarh University, April 23 – 29, 2019;

(ii) 2019 Australasian Protein Engineering Symposium and Conference of the International Network of Protein Engineering Centres (INPEC), Canberra, Australia, December 5 – 7, 2019;

(iii) Meeting on 100 Years of Hydrogen Bonding, IISc, Bangalore, January 9 – 10, 2020;

(iv) International Conference on Synergy of Sciences (ICSS - 2020), SASTRA Deemed University, Thanjavur, February 27 – 29, 2020.

Delivered talk at :

(v) Department of Biological Sciences, IISER, Bhopal, April 18, 2019;

(vi) Discipline of Biosciences and Biomedical Engineering at IIT Indore in the "Special Lecture Series" to celebrate its 10 glorious years, July 18, 2019;

Special lecture :

(vii) organized by the Department of Microbiology, Raiganj University, March 3, 2020.

Chaired :

(viii) a session on Biodiversity at the Young Scientists' Conference at India International Science Festival 2019, Kolkata, November 5 – 8, 2019.

Prof. Sampa Das

1. Delivered an invited talk entitled "Colocasia esculenta tuber agglutinin, a newly characterised non-allergenic protein provides resistance to Indian mustard, against most devastating sucking insect, mustard aphid" in the 7th Annual South Asia Biosafety Conference at Dacca, Bangladesh, organized by BCIL and ILSI Research Foundation during September 14–16, 2019.
2. Delivered an invited lecture on "Plant biotechnology research for protecting crops from Biotic stresses" in a National Seminar on Recent Advances in Plant Science at Midnapur College on March 3, 2020.
3. Delivered an invited talk on "Biotechnological intervention in an aim to improve food crop productivity" in a National Conference on Biotechnology & Agriculture Based Technological Interventions Towards Sustainable Rural Development organized by Brainware University, Kolkata on March 14, 2020.

Library

Dr. Arun Kumar Chakraborty

1. Acted as the Vice-Chancellor Nominee for the RUSA functional Sub-committee for the procurement of Books / Journals of the University of Kalyani, Kalyani, on December 18, 2019.
2. Conducted the 6th meeting as a Chairman of the "Smart Library" at Nazrul Tirtha, New Town, on November 27, 2019.
3. Attended meeting of the Board of Studies (BOS) in the Library and Information Science Department, the University of Calcutta on October 22, 2019.
4. Participated in the "Round Table Meet," which was organized by ISCS, Kolkata in collaboration with ICCR (Indian Council For Cultural Relations), Kolkata on "New Paradigm of India-Bangladesh Economic Cooperation" on October 21, 2019 as a Committee member.

5. Attended the meeting as one of the members of the Technical Advisory Committee (TAC) of the Library, Documentation Information Science Division of the Indian Statistical Institute (ISI) held on July 20, 2019.

6. Invited as a Panelist in the 12th Science Communication Meet jointly organized by INSA, Kolkata, and Vigyan Prasar, DST Delhi, on March 13, 2020, in the West Bengal State University, Barasat.

7. Chaired a Technical Session in the Conference on Reorienting Information Literacy in the LIS during the 75th Year Celebration of CU, DLIS, on February12, 2020.

8. Acted as the Rapporteur General in the "International Conference for FICTKMS-2020" January 30 – February 1, 2020 at Pindohari, Ratanpura, Varanasi, Mau, Uttar Pradesh (India).

9. Participated as Chief Guest in the Workshop on Library Digitization at Gurudas College, Kolkata, on January 10, 2020.

10. Participated as Chief Guest in the International Conference on Next Generation Libraries-2019 (NGL-2019) at the National Institute of Technology, Rourkela, India, on December12, 2019.

11. Participated in the International Symposium on Digital Library at IIT Delhi “International Symposium on Knowledge Engineering for Digital Library Design (KEDL 2019)” from December 09 – 11, 2019.

12. Attended a session as Guest of Honour in the National Seminar on Special Needs Towards Inclusive Library Services In India at the National Institute for Locomotor Disabilities (DIVYANGJAN), Kolkata, Ministry of Social Justice, Government of India on November 16, 2019.

13. Delivered a lecture in a Specific Refresher Course in Library & Information Science (SRCLIS), University of Calcutta, on November 13, 2019.

14. Delivered lecture in DLIS Refresher Course, DLIS, Jadavpur University on August 27, 2019

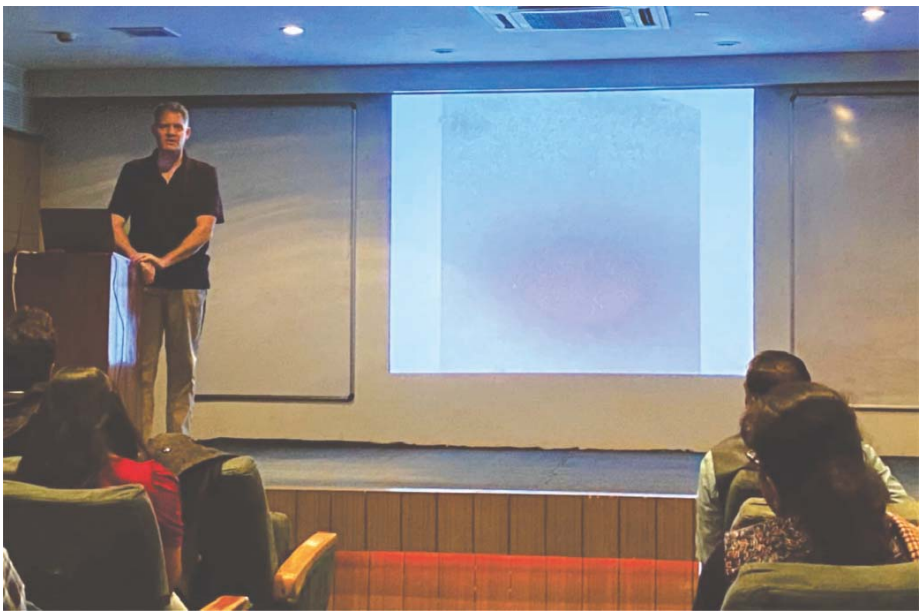
15. Delivered the Keynote Address at the National Level Conference organized by the Dept. of Library, Maharani Kasiswari College on August 14, 2019.

16. Co-Chaired a session on November 7, 2019, at the International Science Literature Festival, India, International Science Festival (IISF-2019) in Kolkata, India, on November 07, 2019.

17. Invited to deliver a lecture as an Honourable Special Guest of the Opening program of Howrah District oldest Library “The Belur Public Library “for the celebration of 125th anniversary on April 19, 2019.

J.C Bose Centre
(Publication & Museum)

1. ***Tarun Kumar Maji, Amitava Bhattacharyya and Ishani Chatterjee*** participated at the 23rd National Science Exhibition Kolkata during August 28-31, 2019.
2. ***Gaurab Gangopadjhyay, Tarun Kumar Maji, Amitava Bhattacharyya, Ishani Chatterjee Rajbrat Ram, C.K. Sasmal*** participated at the 5th India International Science Festival (IISF-2019) at Science City held during November 5-8, 2019.
3. ***Gaurab Gangopadjhyay, Tarun Kumar Maji, Ishani Chatterjee*** participated at the 15th Jatiya Sanhati Utsab-o-Bharat Mela at Sonarpur, South 24 Pgs held during December 14-18, 2019.
4. ***Gaurab Gangopadjhyay, Tarun Kumar Maji, Ishani Chatterjee*** participated in the Sri Ramakrishna Mela-cum-Exhibition Science Exhibition at Ramakrishna Mission Ashram, Narendrapur during January 21-25, 2020.
5. ***Tarun Kumar Maji, Amitava Bhattacharyya, Ishani Chatterjee, Rajbrat Ram and C.K. Sasmal*** participated at the 44th International Kolkata Book Fair 2020 held at Central Park Mela Ground, Salt Lake during January 30- February 10, 2019



Prof. Grant Jensen, CALTECH, HHMI, USA delivered Bose Institute Colloquium lecture on "Electron Cryotomography: present capabilities and future potential" on 29-01-2020.

SCIENTIFIC REPORT
DEPARTMENT OF BIOCHEMISTRY

Department of Biochemistry

OVERVIEW

The Department of Biochemistry aims to apply the knowledge of structure, function and homeostasis of biomolecules to target pathogenic microbes, solve environmental challenges and ameliorate the processes involved in neurodegenerative diseases. Although the department started on 1st January, 1974, the history of biochemical research at Bose Institute dates back to its founder, Sir J. C. Bose, who studied photosynthesis in the aquatic plant Hydrilla. Over the years, the department has addressed various national needs, including combating diseases such as tuberculosis, pneumonia, meningitis and cholera, understanding the biology of neglected tropical diseases, and assessing environmental effects of rampant antibiotic use. Current research activities focus on the following: (i) Understanding virulence factors and virulence regulators of Staphylococcus aureus; (ii) Deciphering key cellular processes of the enteropathogen, Giardia lamblia; (iii) Decoding molecular interaction between microbial communities in ecologically and/or economically sensitive zones; (iv) Understanding structural determinants of plasticity and specificity of protein-protein interactions in ubiquitination; (v) Devising enzyme-mediated prevention of protein fibrillation, a key molecular event in neurodegenerative diseases. This department has a rich legacy of not only nurturing excellence in science, but also fostering a spirit of cooperation and camaraderie among its researchers.

LIST OF PERSONNEL

Faculty Members : Prof. Pinakpani Chakrabarti (J.C. Bose Fellow), Prof. Subrata Sau, Prof. Srimonti Sarkar (Chairperson), Dr. Ajit Bikram Datta, Dr. Abhrajyoti Ghosh.

Students : JRF/SRF : Manish Sarkar, Ankita Das, Avishikta Chatterjee, Tushar Chakraborty, Kaustav Bhakta, Arghya Bhowmick, Nabanita Patra, Rupsa Roy, Pritha Mondal, Trisha Ghosh, Debasmita Sinha, Priya Rai, Chandrima Bhattacharyya, Soham Seal, Mousam Roy, Sayantan Mukherjee, Debabrata Sinha, Sayandeep Gupta. RA : Dr. Chumki Bhattacharya, Dr. Triparna Mukherjee, Dr. Swapan Kr. Jana, Jesmita Dhar. Women Scientist : Dr. Tanaya Chatterjee.

Staff Members : Subhash Chakraborty, Asim Kumar Poddar, Rama Chatterjee, Debarati Kanjilal, Atanu Pramanik, Kissun Turi.

DR. ABHRAJYOTI GHOSH
Assistant Professor

Group Members :
Chandrima Bhattacharyya, *INSPIRE Fellow-Adhoc*
ShayantanMukherji, *UGC-Adhoc*
Mausam Roy, *UGC-Adhoc*
Sayandeep Gupta, *CSIR-SRF Adhoc*
ArghyaBhowmick, *CSIR-Adhoc*
Koustav Bhakta, *Institute Fellow*
Dr. Triparna Mukherjee, *ICMR-RA*

Scientific Report

Background and Vision :

The major focus of my laboratory is to understand the microbial adaptation under stress conditions in the natural environment. We study stress adaptation in model organisms as well as in microbial communities of various environmental niches. To achieve our goals, we use a variety of techniques starting with biochemistry, microbiology, and genomics to unravel the molecular players important in the adaptation and evolution of microorganisms.

Aims and Objectives :

The broad focus of our research group is to understand the microbial stress response, adaptation, and evolution in the environment. With this broad idea, we defined the current objectives as :

a) To understand how human intervention alters microbial structure and function in the natural environment.

b) Antibiotic resistome analysis in the natural environment.

c) Stress-adaptation of rhizobacteria and the role of anthropic factors.

d) Understanding stress-response in archaea: insights from ancient molecular motors.

Work Achieved :

a) Understanding the diversity and function of metabolically active hydrocarbon-degrading archaeal communities in Sundarban mangrove sediments.

b) Genome sequencing of hydrocarbon-degrading haloarchaea from Sundarban mangrove.

Future Research Plans :

a) Understanding the cross-talk between microbes in the environment and their hosts under stress conditions.

b) Evaluation of microbial adaptation and function in tea and mangrove rhizosphere.

c) Role of anthropogenic factors in the co-selection of antibiotic resistance in the natural environment and experimental evolution studies on the effect of antimicrobials in the natural environment.

d) Investigation of the interactions between heat shock proteins in archaea in the maintenance of the cellular protein homeostasis.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	03	03	02	02	NIL	NIL

DR. AJIT BIKRAM DATTA
Assistant Professor

Group Members :
Pritam Naskar,
Sayani Sarkar

Collaborator :
Prof. M. Dasgupta, Dept. of Biochemistry, University of Calcutta, Kolkata

Scientific Report

Background and Vision :

Modification of proteins such as ubiquitination and phosphorylation regulate diverse cellular processes in eukaryotes. In fact, kinases and ubiquitinE3 ligases constitute two largest classes of enzymes coded by all eukaryotic genomes. Phosphorylation/dephosphorylation has been found to act as an indispensable regulatory step in various signaling pathways. Ubiquitination has also been found to play part in a plethora of processes including proteostasis, cell-cycle progression, transcription regulation, and DNA repair. Understandably, defects in thesepost-tranalational modifications have been implicated in diverse diseases including various types of cancers and neurodegenerative disorders. We aim to understand the specificity of these modification machinery and the regulatory mechanisms that bring spatio-temporal control over these enzymes.

Specific Objectives :

Our primary objective is to unravel atomic level determinants of the specificities of ubiquitination enzymes that lead to their discriminatory recognition of other proteins in the pathways. We are also involved in understanding the functional aspects of a orphan receptor kinase from leguminous plant *Arachis hypogea*, in collaboration with Prof. Maitrayee Dasgupta. The specific objectives that were addressed this year are as follows-

- Residue specific insight into the structure-function relationship of RING E3 ligases.
- Understanding the role of a gatekeeper tryptophan residue in regulating the activity of symbiosis receptor kinase (SYMRK).
- The basis of E2 discrimination by non-canonical ubiquitin E1, Uba6.

Summary of the work done:

Role of a RING E3 tryptophan residue in E2 binding and activity:We identified that monomeric RINGs contain a conserved tryptophan in their E2 binding site while dimeric E3 ligases mostly contain a residue other than the tryptophan. We used a series of biochemical assays and binding experiments using a number of E3s that represented one or the other class to establish that this tryptophan is essential for monomeric E3s to display their ligase activity at biologically relevant concentrations whereas dimeric E3s, if contained the tryptophan, became hyperactive. Suggesting a evolutionary removal of that particular residue from E3s upon dimerization.

Structural basis of SYMRK activity:In collaboration with Prof. Dasgupta's lab we determined the crystal structure of various SYMRK mutants that showed phenotypic difference in root nodule formations both in apo form and also in complex with the non-hydrilyzableATP analog AMP-PNP/Mg^{2+}. Studies are underway to understand the role of these residues from a structural perspective.

Role of Ufd domain in E2 recognition and Expression/Purification of full-length Uba6: We previously determined the crystal structure of the Ufd domain from Uba6 as this domain was implicated in discriminatory recognition of E2s by this E1. We also probed into the importance of the Ufd domain in E2 recognition by binding studies betweenUba6_Ufd and E2s such as Ube2Z, Ube2R1 and Ube2D2. The studies revealed that Uba6 Ufd binds to Ube2Z with measurable affinity but does not bind to Ube2R1. Interestingly, we also failed to observed binding between Uba6 Ufd and Ube2D2 suggesting that ITC may not be the best way to probe into this interaction. We therefore planned to carry out biochemical analyses but were thwarted by the failure to express and purify full-length Uba6. This year we finally took a synthetic gene approach to optimize the codons for the human Uba6 to allow its expression and purification in soluble form in *E. coli*. Further studies are underway..

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
01 & 01 (Thesis submitted)	01	NIL	NIL	NIL	NIL	NIL

PROF. SRIMONTI SARKAR
Professor

Group Members :
Dr. Chumki Bhattacharya, *RA*
Shankari Prasad Datta, *INSPIRE Fellow-SRF Adhoc*
Nabanita Saha, *UGC-SRF Adhoc*
Ananya Jana, *Institute Fellow-SRF*
Nabanita Patra, *CSIR-JRF Adhoc*
Ankita Das, *INSPIRE Fellow-JRF Adhoc*
Avishikta Chatterjee, *INSPIRE Fellow-JRF Adhoc*
Pritha Mondal, *CSIR-JRF Adhoc*; Trisha Ghosh, *UGC-JRF Adhoc*

Scientific Report

Background and Vision :

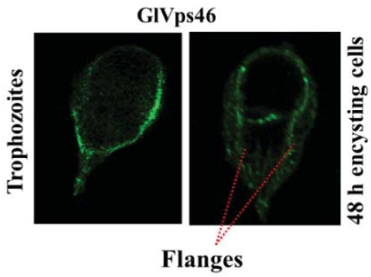
Giardia lamblia (a.k.a. *G. Intestinalis*) is the causative agent of giardiasis, the most common protozoal diarrhoea in humans. The disease also afflicts cattle, thereby impairing their health, reproduction, growth, and productivity. It is particularly prevalent in tropical countries such as India. The high incidences of reinfection and the emergence of strains resistant to currently available drugs, makes it is imperative to identify new parasite-specific therapeutic targets. With this aim, my laboratory focuses on understanding the protein degradation machineries of this unicellular protist as protein turnover is vital for the infectious cycle of the parasite. We are exploring the molecular players involved in both vacuolar, as well as proteasomal protein degradation.

Our key interest is the ESCRT-mediated vacuolar protein sorting events in this parasite as this machinery plays a crucial role in protein degradation within the vacuole. Besides, it is vital for several other fundamental cellular processes, such as cell division, plasma membrane repair, extracellular vesicle formation, nuclear pore quality control etc. The ESCRT machinery is composed of several multi-subunit complexes that act sequentially. The concerted action of these ESCRT protein complexes induces negative curvature of membranes thereby making them bulge away from the cytoplasm.

Summary of Research Work :

We have documented that although *Giardia* does not encode many ESCRT components, there are multiple paralogues of at least two, Vps46/Did2 and Vps4. In the process of characterizing these paralogues, we have observed that not

only is the ESCRT pathway of *Giardia* likely to be vital for morphological changes that accompany the transition from trophozoites to cysts, but have also uncovered a clear functional divergence between the ESCRT machinery of the host and the parasite. Vps4 and Vps46 of the host physically interact so that the membrane recruitment of Vps4, an ATPase, at the sites of ESCRT action, is via Vps46. Our studies show that unlike the human host's ESCRT machinery, none of the giardial Vps46 paralogues have the potential to recruit any of the Vps4 paralogues onto cellular membranes. Instead, Vps4 membrane recruitment is likely to be dependent on another ESCRT protein, Ist1. In yeast, Ist1 is also known to recruit Vps4, but this is a minor, if not redundant pathway, with the bulk of Vps4 membrane association depending on Vps46. Similar functional divergence between the host and parasite is also evident in the assembly of the proteasomal lid complex, which is responsible for recognition of cytoplasmic proteins that are targeted for proteasomal degradation.



Redistribution of Vps46 to the protruding flanges of encysting trophozoites

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
02	NIL	NIL	02	01	NIL	NIL

PROF. SUBRATA SAU
Professor

Group Members :
Mr. Debabrata Sinha, *SRF*
Mr. Soham Seal, *SRF*
Mr. Tushar Chakraborty, *JRF*
Ms. Debasmita Sinha, *JRF*

Scientific Report

Background and Vision :

Staphylococcus aureus, a disease-causing bacterium, remains a health hazard primarily due to the emergence of the antibiotic-resistant strains of this microbe and the lack of effective vaccine. To eliminate staphylococcal infections, the inhibitors capable of preventing its virulence factors and virulence regulators may be very useful. As the virulence factors /regulators are dispensable, *S. aureus* will less likely develop resistance against their inhibitors but will be weakened by them easily. Currently, a few inhibitors of virulence factors /regulators are known but their efficacy is not understood fully. Therefore, additional inhibitors need to be designed or screened immediately. The clues on the structure, function, folding-unfolding mechanism and stability of the virulence factors/regulators though have potentiality in the discovery of new inhibitors have been very little studied so far. Under this context, we are working to understand the structure, function, stability of *S. aureus*-encoded Cyp, σ^B, and CapF using different probes. σ^B, an alternative sigma factor,

functions as a virulence regulator, whereas CapF, a capsule-producing enzyme, and Cyp, a cyclophilin, are virulence factors. Besides, a natural inhibitor of σ^B (RsbW) and an inhibitor of RsbW (RsbV) are also being investigated in detail.

Summary of Research Work :

An internal region in Cyp that carries 28 amino acid residues is present in many putative cyclophilins but absent in the well-studied cyclophilins. To demonstrate the precise roles of this atypical region in Cyp and orthologous proteins, we have studied a deletion mutant (CypΔ) of Cyp using different probes. The data suggest that this region is indispensable for preserving the structure, function, stability, and shape of Cyp.

CapF, an enzyme of 369 amino acid residues, participates in the synthesis of *N*-acetyl-L fucosamine, one of the components of S. aureus-made capsule. In S. aureus, capsule acts as an anti-phagocytic agent. To understand the stability and folding-unfolding mechanism of CapF, a recombinant CapF was purified and found to have NADPH binding activity.

σ^B , RsbW, and RsbV were purified and found to physically interact with each other. Additionally, thermodynamic stability of RsbV is enhanced in the presence of RsbW. Apart from blocking σ^B , RsbW acts as a serine kinase and phosphorylates RsbV using ATP. As kinase enzymes act as the virulence factor in many bacteria including *S. aureus*, the above stabilization data may be useful in screening inhibitors of these proteins.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	NIL	NIL	02	NIL	NIL	NIL

SCIENTIFIC REPORT
DIVISION OF BIOINFORMATICS

Division of Bioinformatics

OVERVIEW

Today's Division of Bioinformatics started its journey three decades ago as a DBT funded BTIS Network's center at Bose Institute to offer Bioinformatics facility and skill-set. Later the full time research was started at the center and thereby it evolved as a 'Centre of Excellence in Bioinformatics', as graded by the DBT. The Bose institute has upgraded this center into its regular Division. The broader objectives of the research carried out in this division are to provide fundamental insights into Biology, to rationalize complex experimental observations, to make applications with long term goal to come up with scientific strategies for modern therapeutic approaches. The division has decent infrastructure of bioinformatics and computational biology research.

Faculty Members : Dr. Shubhra Ghosh Dastidar, Dr. Zhumur Ghosh, Dr. Sudipto Saha

Students : JRF/SRF : Aritra Deb, Troyee Das, Byapti Ghosh, Sreyashi Majumdar, Krishnendu Banerjee, Saran N, Debangana Chakravorty, Abhirupa Ghosh, Shazia Firdous, Debarati Paul, Debadrita Basu, Nibedita Ray Chaudhuri, Premananda Basak, Souvik Sinha, Nishita Mandal.

RA : Dr. Sibun Parida. Women Scientist : Dr. Arpana Verma.

Staff Members : Sanjib Kumar Gupta, Sujata Roy, Jibananda Mondal, Sarama Pradhan.

DR. SHUBHRA GHOSH DASTIDAR
Associate Professor

Group Members :
Souvik Sinha, *SRF*
Debadrita Basu, *SRF*
Debarati Paul, *JRF*
Nibedita Raychaudhuri, *JRF*
Premananda Basak, *JRF*
Nishita Mandal, *Trainee*

Scientific Report

Background and Vision :

The atoms and molecules in a cell are always jiggling, dancing and bumping into each other and occasionally carrying out a specific reaction or a process. Hence it is important to understand how exactly this is choreographed, i.e. how such motions influence the molecular structures. Such dynamics of the molecular structures forms the basis of the conformational changes of the molecules, their interaction with other molecules and thus determines the function of the molecules. Therefore dissecting the characteristics of the dynamics of a bimolecular system paves the way to the understanding of the molecular mechanism of their function. The general interest of our group is to gain novel insight into biology analyzing the structure, dynamics and the statistical thermodynamics of the molecular systems using computer simulations. These methods not only help to understand the biomolecular mechanism of functions but can also reveal how the molecular defects can lead to a disease, which becomes useful for designing drugs in a rational manner. Overall, we are dealing with protein-protein, protein-lipid bilayers, and protein-ligand interactions in all atom description.

Summary of Research Work :

The overall research activities of the group could be broadly classified into the following directions: (a) Computed predictions of the free energy landscape of the membrane-insertion of peptides (b) Conformational switching of tubulin: Comparison between the effects of the microtubule stabilizing and destabilizing agents (c) Understanding the role of microclusters of water in the ligand binding, (d) Miscellaneous collaborative works with the experimentalists Such activities

have lead to several specific achievements and in more specific scientific language it would be the following: (i) How the Conformational States of promising lead compounds against α,β-Tubulin could get influenced by the isolated water molecule which are trapped inside the protein and thus could become important in the drug design. (ii) We have demonstrated how the free energy of insertion of peptides in membranes could be sensitive on the actual position of the polar residues in their primary sequences, which would be tremendously important for designing peptidomimetic drugs.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
01	03	NIL	NIL	01	NIL	NIL

DR. SUDIPTO SAHA
Associate Professor

Group Members :
Shazia Firdous, *JRF*
Krishnendu Banerjee, *JRF*
Abhirupa Ghosh, *SRF*
Debangana Chakravorty, *SRF*
Saran N, *SRF*
Sreyashi Majumdar, *SRF*

Scientific Report

Background and Vision :

The overall goal of my lab is to improve diagnosis, prognosis and treatment of lung diseases like asthma/COPD and MDR-TB using bioinformatics and systems biology approaches.

Summary of Research Work :

- A pilot-scale study in humans was performed to identify differentially expressed proteins in blood plasma of healthy controls and treatment-naïve atopic asthma patients using quantitative label-free liquid chromatography-tandem mass spectrometry proteomics and ELISA. We identified two proteins and their expression was distinct in asthmatics. ApoE was down-regulated and IL33 was up-regulated in atopic asthma patients compared to healthy volunteers. These two proteins' profiles were distinct in atopic asthma from healthy and COPD plasma samples. Differential expression of these proteins could serve as a probable candidate for a two-protein classifier-based prognostic biomarker of atopic asthma.

- c-Myc degradation by two F-box proteins was mathematically evaluated based on the importance of c-Myc turnover. Dynamic modelling technique was used to build two exclusive models for phosphorylation dependent degradation of Myc by FBXW7 (Model 1) and phosphorylation independent degradation by Skp2 (Model 2). This study was performed in a homeostatic system, and thus prompts us the exploration of c-Myc degradation in cancer state and in pluripotent state.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
01 & 01 Thesis submitted	05	NIL	07	02	NIL	NIL

DR. ZHUMUR GHOSH
Associate Professor

Group Members :
Troyee Das, *CSIR-SRF*
Byapti Ghosh, *DST Inspire Fellow*
Aritra Deb, *Institute SRF*
Dr. Arpana Mukherjee, *SERB WOS-A*
Sibun Parida, *Project RA*

Scientific Report

Background and Vision :

Our lab has the main focus to understand the role of regulatory noncoding RNAs in cancer and early embryonic development where stem cell plays a crucial role.

Our lab's vision is to develop relevant tools and databases (aligned to our lab's research focus) which will boost nation-wide implementation of omics facilities in clinical settings by efficient big data management so as to promote personalized therapy in India.

Aims and Objectives :

Aim 1: Investigating the role of regulatory RNAs in cancer and early embryonic development.

Aim 2: Role of regulatory RNAs and transcription factors in maintaining cellular pluripotency and their differentiation.

Work Achieved :

A. Investigating the role of regulatory RNAs in cancer: LncRNA loci harbouring SNPs has been elucidated for the three most prevalent female cancers in India viz. breast, cervical and ovarian cancer. Apart from those reported in dbSNP, several novel variants have also been detected by our SNP detection pipeline. A database named ClinicLSNP has been hosted within LncRBase V.2 (2nd version of lncRNA database has been launched) which contains detailed information about these SNPs.

B. Developed LncRTPred- a machine learning based lncRNA-target prediction tool

C. A streaming access technique named 'ParStream-seq' has been developed that splits the bulk sequence data, accessed from a remote repository into short manageable packets followed by executing their alignment process in parallel in each of the compute core. This streaming access technique will provide means to overcome the hurdle of storing the entire volume of sequence data corresponding to a particular experiment, prior to its analysis (Mondal et al., Genomics 2019).

Future Research Plans :

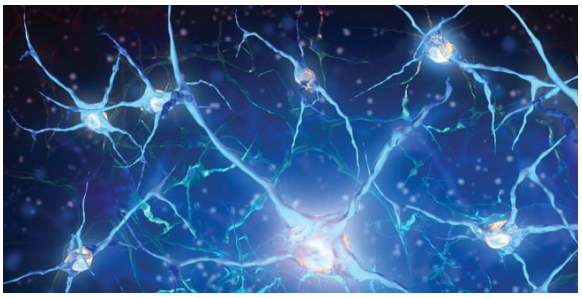
a) Detecting the role of miRNAs as epigenetic modulators inducing oncogenicity in stem cell derivatives.

b) Studying the role of regulatory noncoding RNAs(ncRNAs) as regulators during fertilization and early stages of murine development and identifying potential ncRNA-mRNA interaction which is having significant role in determining fertility.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	02	NIL	02	04	NIL	01

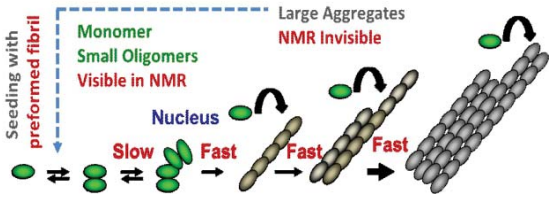
SCIENTIFIC REPORT
DEPARTMENT OF BIOPHYSICS

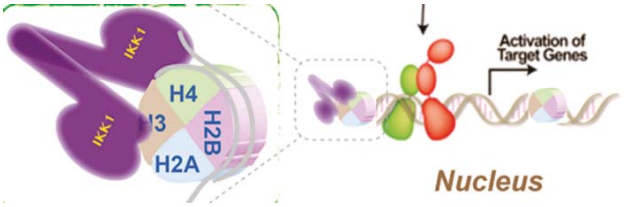


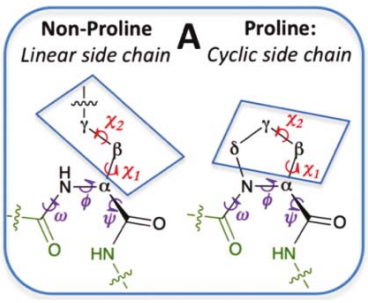
Department of Biophysics

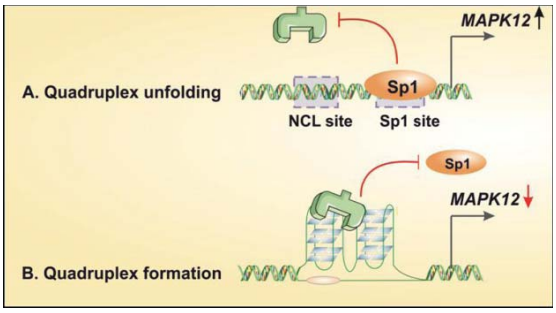
OVERVIEW

The Department of Biophysics was established in September 1983. Although a relatively young department and small in size, the department is very active in research primarily focused on Molecular Biophysics, Biophysical Chemistry and Structural Biology. The primary mission of the Department is to understand biological systems at a molecular level from a vantage point of physics, physical chemistry and computational chemistry, chemical and structural biology. This includes a detailed description in terms of molecular structure, conformation and dynamics and their interactions using both experimental and theoretical tools. In addition to generating fundamental knowledge in the field, the mission is to work in a collaborative fashion with other disciplines on fundamental as well as applied problems and solve them using cutting edge tools/ methodologies









LIST OF PERSONNEL

Faculty Members : Prof. Gautam Basu (Chairman), Dr. Anirban Bhunia, Dr. Subhrangsu Chatterjee, Dr. Debjani Roy, Dr. Smarajit Polley.

Research Scantiests : Prof. Siddhartha Roy, J. C. Bose Fellow; Prof. Manju Roy, Visiting Scientist; Dr. Moitri Basu, DST Inspire Faculty.

Students : RA/JRF/SRF/Project Assistant : Bankim Mondal, Anindya Dutta, Nilanjan Banerjee, Ms. Meghamukta Mukherjee,. Swapna Bera, Sudakshina Ganguly, Dr. Aparajita Pal, Ananya Dutta, Bhawna Pandey, Dr. Aditya Dev, Dr. Piya Ghosh, Dr. Madhumita Chakraborty, Dr. Gitashree Naiya, Humaira Ilyas, Sonali Ghosh, Sk. Abdul Mohid, Pallabi Sengupta, Suman Panda, Chandradeep Basu, Dwijit Guha Sarkar, Dr. Debmitra Chakraborty, Nilanjana Maji, Dr. Trina Dutta, Dibakar Sarkar, Dipita Bhattacharyya, Pronita Roy, Dr. Gopa Dhar, Ranit Pariary, Dr. Supriya Das, Karishma Biswas, Shruti Mukherjee, Swarnali Kar, Prateeka Borar, Mitali Manna, Nabarupa Chowdhury, Dr. Swati Bhowmick, Deeparna Sutradhar, Samrat Mitra, Debapriya Bose, Dr. Payel Bhatterjee, Laboni Roy, Dr. Ipsita Chakraborty and Dipanwita Roy, Ananya Roy.

Staff Members : Basudeb Marick, Barun Majumder, Tanmoy Debnath, Soumya Shankha Biswas, Swapan Joghsharma, Sudhir Turi, Nagnarayan Yadav.

DR. ANIRBAN BHUNIA
Associate Professor

Group Members :
Dipanwita Roy, *JRF*; Karishma Biswas, *JRF*
Dipita Bhattacharyya, *SRF*; Sk. Abdul Mohid, *SRF*
Humaira Ilyas, *SRF*; Ranit Pariary, *SRF*
DibakarSarkar, *SRF*; Shruti Mukherjee, *SRF*
Dr. Ipsita Chakraborty, *RA*

Scientific Report

Background and Vision :

Biological membranes are an important functional interface for a plethora of physiological reactions, taking place within the cell. Thus all biological membranes serve as an indispensable platform for several surface proteins, membrane-integrated proteins/peptides and other ions and signalling molecules. The determination of molecular structure and dynamics of biomembranes and the associated functional peptides and proteins is, in fact, one of the most significant challenges in contemporary science. In this connection, vesicles and liposomes mimicking the lipid bilayer structure have been used to study membrane-protein/peptide interaction. Recently, nanodiscs, composed of lipid bilayer and membrane scaffold proteins (MSP), represent a more native environment than liposomes/ bicelles or detergent micelles. Recent developments of NMR spectroscopy have facilitated in-depth characterization of the dynamics of interactions at the atomic-resolution. This precise structural knowledge is very much crucial to correlate with their membrane-directed functioning. Dr. Bhunia's laboratory involves several biophysical techniques, including cutting-edge solid- as well as solution-state NMR spectroscopic techniques to characterize the membrane-associated functioning of several biologically active peptides and proteins.

Aims and Objectives :

- Understanding the structural characterization of small amyloid oligomers at an atomic resolution.
- Membrane induced amyloid pathogenicity.
- Molecular mechanism of fibrillation of Amyloidogenic peptide and design of inhibitors.
- Rational design of antimicrobial peptides to develop pathogen-resistant transgenic plants.
- Regulation of Lipopolysaccharide (LPS) induced signalling cascade in sepsis or septic shock.

Work Achieved :

- Three-dimensional solution structure of several antimicrobial peptides targeting pathogenic model membrane mimic.
- Probed transient non-native states in Aβ40 fibril formation by NMR.
- Understanding the role of Alzheimer pathogenicity from the investigation of core amyloid forming Aβ40 fragments in membrane.
- Pioneer in determining three-dimensional solution structure in live cell.
- Decipher the epitope of early nucleation events for α-synuclein familial mutants using NMR.
- Probing the LPS binding structural motif in α-synuclein that modulates disease propagation from gut to brain.
- Developed reduced dimensionality experiments to record 3D HNCACB and CBCACONH to monitor the kinetics and dynamics of Aβ fibrillation.
- Identified a non-toxic and serum stable heptapeptide that inhibits insulin amyloid fibrillation, implicated in Type II Diabetes.

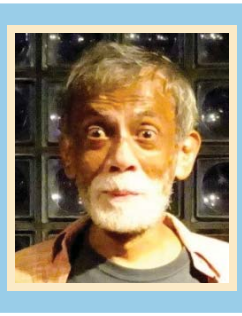
Future Research Plans :

- To develop nanodisc technology to study aggregation kinetics of Amyloid proteins.
- Designing inhibitors against toxic oligomers.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
03 awarded & 02 Thesis submitted	01	NIL	NIL	01	NIL	NIL

Ms. Humaira Ilyas
Joint winner of Prof. B. B. Biswas Outstanding Student Award
for the year 2019



PROF. GAUTAM BASU
Professor

Group Members :
Dr. Aditya Dev, *RA*; Dr. Debamitra Chakravorti, *RA*
Sudakshina Ganguly, *SRF*; Bankim Mondal, *SRF*
Chandradeep Basu, *SRF*; Bhavna Pandey, *SRF*

Scientific Report

Background and Vision :

All biological phenomena are driven by specific molecular interactions via cognate recognition and non-cognate discrimination processes. Both recognition and discrimination are mediated by specific structural and dynamic elements of the interacting molecules. Therefore in order to understand molecular triggers of biological functions it is important to understand structure and conformations of molecules. Given known structures (or a known set of sequences), it is also important to know how different elements interact via specific or non-specific physical forces. In my lab we use biophysical, spectroscopic as well as computational tools to understand structural properties of biologically important molecules and their significance in biology.

Aims and objectives :

We work on a number of diverse projects with specific aims. Here are some specific objectives:

- Structure-function-evolution of aminoacyl tRNA-synthetases

- Peptide conformation and design
- Electrostatic interactions in biomacromolecules
- Protein and Nucleic Acid dynamics
- Small molecule-DNA interaction

Work Achieved :

- Solved the crystal structure of structure of C-terminal domain of PC4 in presence of a peptide from the C-terminal domain of p53.
- Established a dual DNA binding mode of a turn-on red fluorescent probe thiazole coumarin (TC).
- Identified a unique equilibrium unfolding intermediate in HipA, a protein implicated in bacterial persistence.
- Using a series of designed short designed peptides, completed investigations on the effect of simultaneous occurrence of 4S (4R) fluorine ring substitution and CH-π interaction on proline cis-trans isomerization

Future Research Plans :

In the next two years some projects that we would like to pursue are:

- Complete studies and analysis relating to the DNA-binding mechanism of the novel fluorescent probe QCy-DT.
- Generate long MD trajectories and complete analysis to understand the effect of phosphorylation of GluRS by HipA in inhibiting aminoacylation of tRNA-Glu.
- Complete studies and analysis relating to incorporation of Gly-cisPro in designed beta-sheets.
- Understand the role of a conserved disulphide linked loop, present in the receptor binding domains of spike proteins of SARS-CoV and SARS-CoV-2, in modulating the binding affinity with human ACE2 receptor.

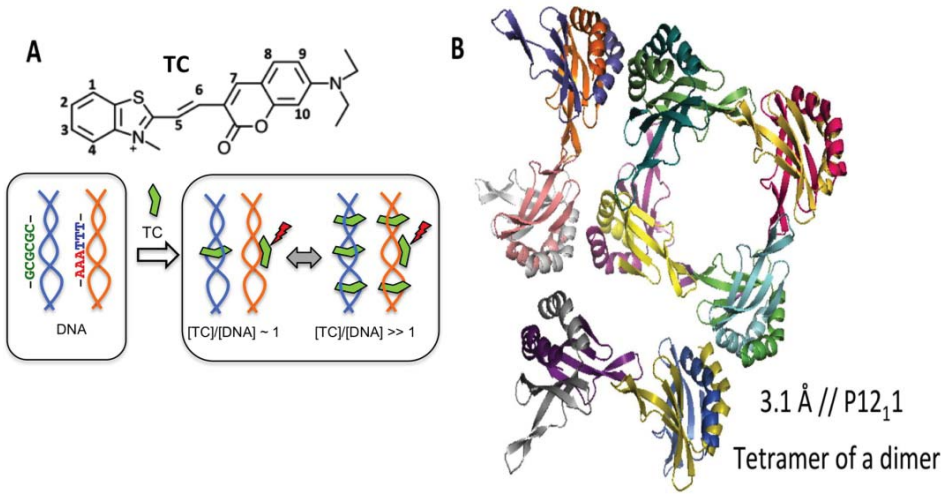


Figure 1.A. The molecular structure of the DNA binding near IR probe Thiazole Coumarin (TC) (top) and its differential mode of binding to GC-rich and AT-rich stretches. A dual binding mode (intercalation at low [TC]/DNA while minor groove binding at high [TC]/DNA] for AT-rich sequences) was established by us. B. Crystal structure of the C-terminal domain of PC4 in presence of a sever residue peptide from the C-terminal domain of p53.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	01	01	12	NIL	NIL	NIL

DR. SUBHRANGSU CHATTERJEE
Associate Professor

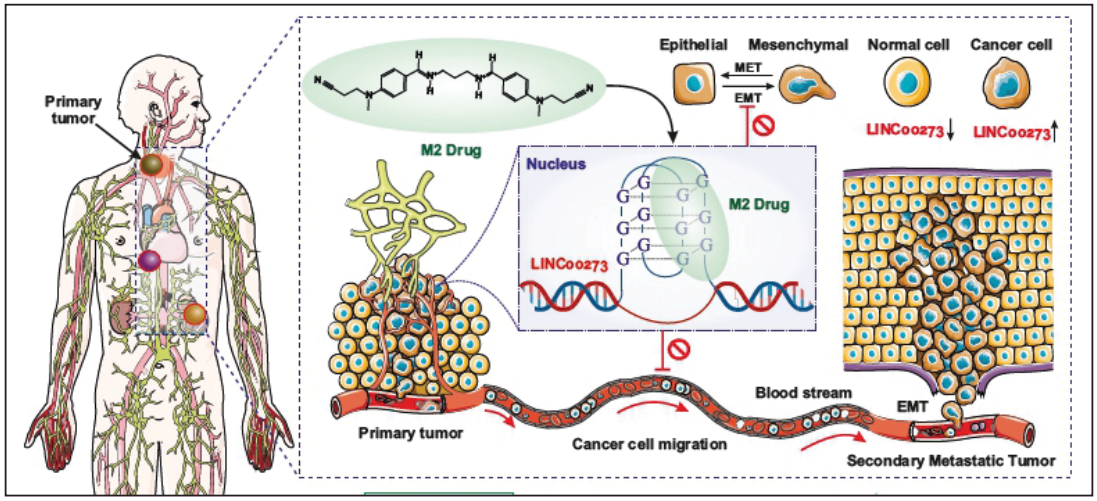
Group Members :
Meghomukta Mukherjee, *SRF, Inspire Fellow*
Pallabi Sengupta, *CSIR-SRF*
Nilanjan Banerjee, *Instititute Fellow, SRF*
Suman Panda, *CSIR-SRF*
Anindya Dutta, *Institute Fellow, SRF*
Ananya Roy, *CSIR-SRF*
Debopriya Bose, *Institute Fellow, JRF*
Laboni Roy, *CSIR-JRF*

Collaborators :
Prof.Tanya Das, *Professor, Bose Institute*
Prof. Gaurishankar Sa, *Professor, Bose Institute*
Dr. Deba Prasad Mandal, *Associate Professor, WBSU*
Dr. Shamme Bhattacharjee, *Assistant Professor, WBSU*
Dr. Partha Chakrabarti, *Scientist E2, IICB*
Dr. Samit Chattopadhyay, *Ex-Director, IICB*
Dr. T. Govindraju, *Associate Professor, JNCASR*

Scientific Report

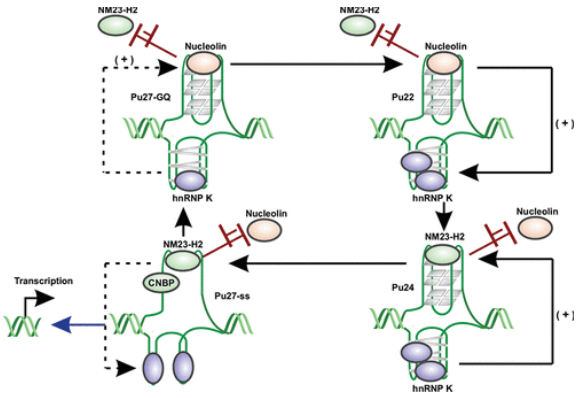
Background and Vision :

The main focus of my research is to find out the existence of G-quadruplex and i- motif structures in the oncogene coding and promoter regions and their control in the transcriptional fate of those oncogenes. We also try to cultivate the essence of theses said scaffolds in the development of epigenetic landscapes of the oncogenes like *c-MYC, BCL2, MAPK12, KRAS, VEGF, ZEB-1* etc. We have tried to cultivate the transcriptional circuitry of c-Myc oncogene. For the first time, we have cultivated the key function of a long intergenic non coding RNA 00273 (LINC00273). This RNA helps in inducing Epithelial to Mesenchymal transition for driving metastasis in malignant carcinoma and sarcoma. We have cultivated a molecules which suppresses the expression of this RNA to reduce metastasis (US and AU patents on this molecule are granted). Our motto is to invent specific G-quadruplex targeting anticancer drugs.



Summary of Research Work :

We have cultivated the transcriptional circuitry of c-Myc oncogene. **Biochemistry**. 2019 58(15):1975-1991.



We also found that Andrographolide can bind to ATP binding pocket of VEGFR2 receptor to suppress angiogenesis in malignant carcinoma (**Sci Rep.** 2019 9(1):4073). We have designed a very short peptide which arrests Insulin in its dimeric form and make it thermostable and functional (the work will be submitted soon).We have designed short dimeric peptides which arrest NHE_{III} element of c-Myc oncogene and repress the transcription of c-Myc oncogene (work underway).

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	05	NIL	NIL	01	01	NIL

DR. SMARAJIT POLLEY
Associate Professor

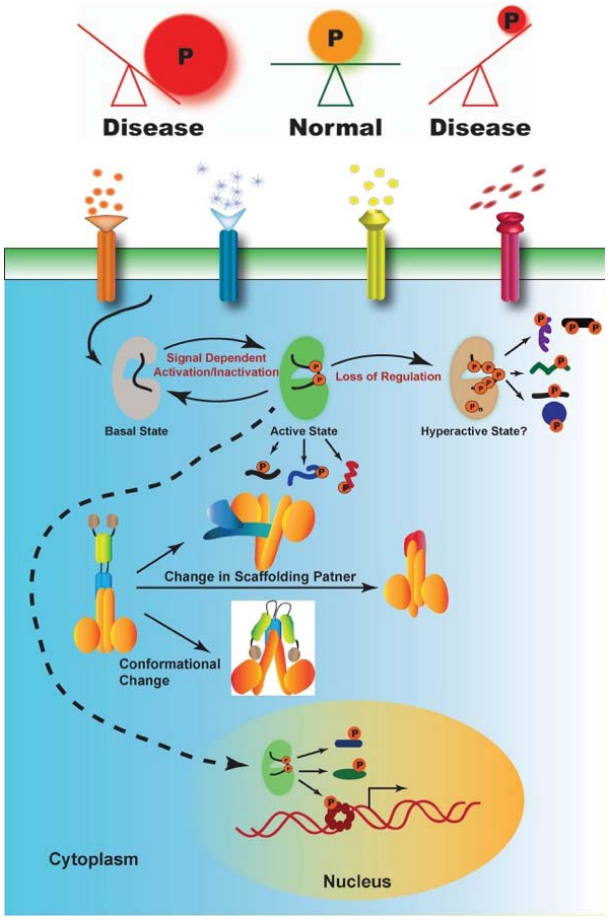
Group Members :
Dr. Trina Dutta, *RA*; Dr. Dwijit Guha Sarkar, *RA*
Prateeka Borar, *SRF*; Samrat Mitra, *JRF*
Deeparna Sutradhar, *JRF*; Pranita Ray, *JRF*

Scientific Report

Background and Vision :

The main focus of the laboratory is to understand cellular phenomenon at highest possible resolution. Protein kinases being the major interest. Multicellularity is the most complex form of life. Well-being of multicellular organisms depend upon delicate balance and fine-tuned regulation of inter- and intra-cellular signalling pathways. We primarily use biochemical, chemical and structural biology tools to understand the mechanistic details of a few key signalling pathways at highest resolution. Protein kinases and transcription factors are at the centre of attention in the laboratory. More than 500 protein kinases are encoded in the human genome. Protein kinases provide the regulatory framework for most signaling pathways in eukaryotic cells. They add phosphate groups to amino acid residues and create modified chemical entities that provide altered functionality to protein substrates. Stringent regulation

of their activities is critical to proper functioning of cellular processes, which often make them interesting point of intervention in many pathological scenarios. Many eukaryotic kinases show signaling modularity entailing distinct outcomes, both beneficial and harmful in a context dependent manner. Indiscriminate inhibition of these activities often has deleterious effect. Signaling modularity is dictated by choice of substrates, cognate-binding partners, subcellular localization and post-translational modifications of the kinase itself. We investigate the mechanistic details of their activation and spatio-temporal regulations to fully realize the scope of modulating them in a manner beneficial for the organism. We work primarily on two model kinase systems: a) Inhibitor of kappaB Kinases (IKK), gateway to NF-kB activation and b) Dual Leucine Zipper Kinase 1 (DLK1), a major player in axonal regeneration.



I want to develop and establish multidisciplinary research themes to understand the signaling modularity of eukaryotic protein kinases in their biological contexts.The other themes of the lab include, but not limited to:

- Understanding the Structural basis of cancer promoting function of p53 GoF (Gain of Function) mutants.
- Enzymatic remediation of environmental pollutants using directed evolution of proteins.

I am developing workflows in the laboratory that depend upon truly cross-disciplinary experimental approaches including: *In vitro* and cellular biochemistry, cellular and chemical genetics, chemical biology, omics studies and analytical studies using mass spectrometry, structural biology using X-ray crystallography and CryoEM.

Summary of Research Work :

We have been able to set up large scale expression Sf9 expression system in the laboratory that was previously elusive in the institute. We have purified a number of eukaryotic protein kinases as well as other proteins to near homogeneity from soluble fractions using this system. We were able to establish the *analogue sensitive* kinase workflow in the laboratory that informs about the hitherto unknown substrates of a kinase of interest. We have established this workflow for IKK2. Similar approach has been adopted for other kinases including IKK1. We were also able to reconstitute mononucleosomes from in-house purified components and optimized its interaction with IKK1. Structural analyses of a number of kinase-signaling complexes using CryoEM at national facilities have begun. On a different theme, we obtained crystals for at least two enzymes that degrade polluting dyes. We are also working on directed evolution of these enzymes to broaden their substrate repertoire.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	01	NIL	05	01	NIL	NIL

SCIENTIFIC REPORT
DEPARTMENT OF CHEMISTRY

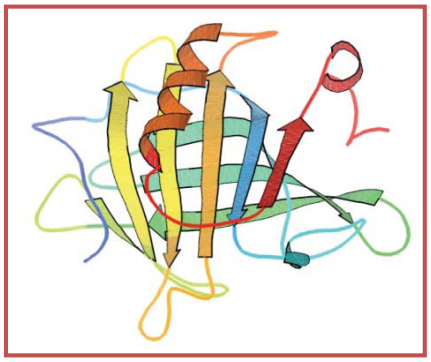
Department of Chemistry

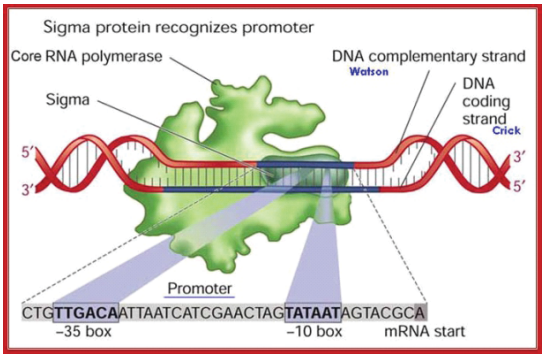
OVERVIEW

The Department of Chemistry was established in 1917, at the time of inception of the Institute. A major part of Shambhu Nath Dey's seminal work on the discovery of Cholera toxin was performed in this department for which he was nominated for the Nobel Prize. Over the course of time the department has adopted interdisciplinary research using the application of chemical principles to explore biological phenomena.

Present research activities of the department are

- Host-pathogen interaction: *Mycobacterium tuberculosis and Helicobactor Pylori*
- Stress response and signaling in *Mycobacterium tuberculosis*
- Recombinant approach to prokaryotic transcription
- Mathematical modeling of signaling pathway.





LIST OF PERSONNEL

Faculty Members : Prof. Suman Kumar Banik, Dr. Jayanta Mukhopadhyay.

Senior Scientists : Prof. Joyoti Basu, J. C. Bose National Fellow; Prof. Manikuntala Kundu, CSIR Emeritus Scientist.

Students : JRF/SRF/Project Assistant : Suruchi Lata, Amar Chandra Mahatha, Madhurima Chatterjee, Shreya Bagchi, Debayan Majumder, Tuhin Subhra Roy, Ritu Jaiswal, Sourajit Saha, Aniruddha Tewary, Thurbu Tshering Lepcha, Pankaj Jankiram Birari, Arkajyoti Datta, Ayan Biswas, Soumya Mal, Soumya Mukherjee, Md. Sorique Aziz Momin, Nilanjana Hazra. RA : Arun Kumar Sharma.

Staff Members : Dipak Ch. Konar, Gaurab Kumar Roy, Mrityunjoy Kundu, Sachchidanand Ram, Asoke Kr. Maity.

DR. JAYANTA MUKHOPADHYAY
Associate Professor

Group Members :
Dr. Soumya Mukherjee, *DBT-NPDF*
Arkojyoti Dutta, *Institute Fellow-SRF*
Ritu Jaiswal, *CSIR-JRF*
Sourajit Saha, *CSIR-JRF*
Aniruddha Tewari, *CSIR-JRF*
Madhumita Chatterjee, *DST Inspire Fellow*
NilanjanaHazra, *Institute Fellow, JRF*

Scientific Report

Background and Vision :

Fundamental Mechanism of transcription and gene regulation in bacteria.

Transcription is the first step in gene expression where most regulation occurs and is one of the most important targets for antibacterial therapy. RNAP core enzyme together with sigma factor(s) and/or numerous regulator(s) orchestrates the gene expression in bacteria. Our lab seeks to characterize the interactions among RNAP, sigma factors, and regulators required for various gene expressions in prokaryote, e.g. *Escherichia coli, Bacillus subtilis* and *Mycobacterium tuberculosis*. We use integrated biophysical, biochemical and genetic approaches, along with a recombinant *in vitro* transcription system to address the following specific aims:

- Mechanism of gene regulation by various transcriptional factors and sigma factors in prokaryote.
- Identify and characterize inhibitors of *M. tuberculosis* gene expression.
- Identify new target for anti-tuberculosis agents.

Summary of Research Work :

Our laboratory is currently involved in characterizing of delta factor of *B. subtilis* and understanding the nature of sigma release of *B. subtilis* and *M. tuberculosis* during the transition from transcription initiation to elongation. We observed that the affinity of delta factor to DNA significantly increases when RNAP is present at the promoter. The interactions of a-CTD of RNAP with delta factor is responsible for this enhanced DNA binding affinity. In another project, using a synthetic circuit, we have shown the output of MprAB, a TCS of *M. tuberculosis*, is robust when the concentration of the response regulator is above a threshold value. We have also identified an inhibitor for Mtb RNA polymerase from plant extract..

Future Plans :

- Study the mechanism of σ-release in *B. subtilis* and *M. tuberculosis*
- Indentify and characterizethe inhibitors of (MDR) *M. tuberculosis* transcription
- SELEX based approach to identify promoters of the sigma factors of *M. tuberculosi*.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	01	NIL	01	01	NIL	NIL

PROF. SUMAN KUMAR BANIK
Professor

Group Members :
Ayan Biswas, *SRF*
Tuhin Subhra Roy, *SRF*
Md Sorique Aziz Momin, *JRF*

Collaborators :
Prof. Pinaki Chaudhury, *Calcutta University*
Mintu Nandi, *SRF, Calcutta University*

Scientific Report

Background and Vision :

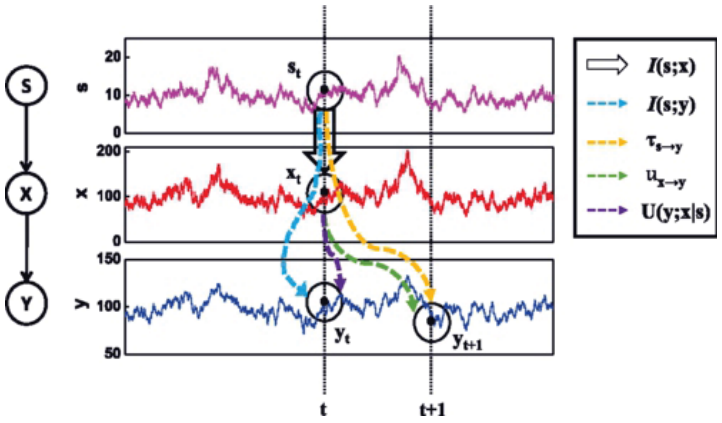
A living system survives in a continuously changing environment. In order to respond to the changes made in the surroundings, each living species has developed specialized gene regulatory networks (GRNs). One of the major functions of a GRN is to efficiently transduce the incoming signal. The inherent noisy interactions in the biochemical system make signal transmission stochastic and can be understood using the formalism of non-equilibrium processes

Aims and Objectives:

Our lab aims to develop theoretical frameworks to study signal transduction in GRNs using the tools of information theory. The broad focus of our research group is to understand the basis of signal transduction in biochemical networks within the purview of fluctuations in a single cell.

Work Achieved:

We studied a generic two-step cascade containing three regulatory proteins S, X, and Y connected as S→X→Y. The intermediate node X being a stochastic variable, acts as an obstacle, impedes the information flow from S to Y. We quantify the information restricted by X using the tools of information theory and term this as restricted information. We also propose two experimentally measurable quantities, restricted efficiency and information transfer efficiency. The former determines how efficiently X restricts the upstream information coming from S, while the latter computes the efficiency of X to pass the upstream information toward Y. Theoretical analysis shows that under low signal strength S the intermediate X can carry forward the upstream information reliably, thus acting as a better source of information, and increases the fidelity of the network.



Left: Schematic diagram of a generic two-step cascade S→ X→Y.
Right: Time series of S, X, and Y at steady state. These time series are obtained by numerical simulation of chemical Langevin equations using stochastic simulation algorithm.

Future Research Plans:

We aim to study information processing in other gene regulatory networks, e.g, feed-forward loop. In addition, we also plan to develop theoretical formalism in the context of information transfer in biochemical motifs.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	04	NIL	NIL	NIL	NIL	NIL

SCIENTIFIC REPORT
ENVIRONMENTAL SCIENCES SECTION

Environmental Sciences Section

OVERVIEW

Environmental sciences section was established in 1992. The research is focused to understand the different aspects of atmosphere contributing to the climate change with a special emphasis on the Eastern Himalayan climate change. The observational centres are located at Darjeeling in Eastern Himalaya along with Kolkata, Shyamnagar and Falta in the Indogangetic lanes. ESS serves as the nodal analytical facility for the ongoing atmospheric research with the above mentioned observatories.

Summary of Research :

- A novel and unique approach was taken to identify the chemical reactions between the polluted inorganic acids transported from long distant regions and the fresh marine sea-salt aerosols. The chemical reactions were identified between polluted HNO_3 (g) and H_2SO_4 (g) transported through biomass burning plume from Eastern Ghat and NaCl (s) aerosols over the north-east coast of Bay of Bengal. Such reactions help understand the effect of transported pollutants on the marine ecosystem of Sundarban biosphere.

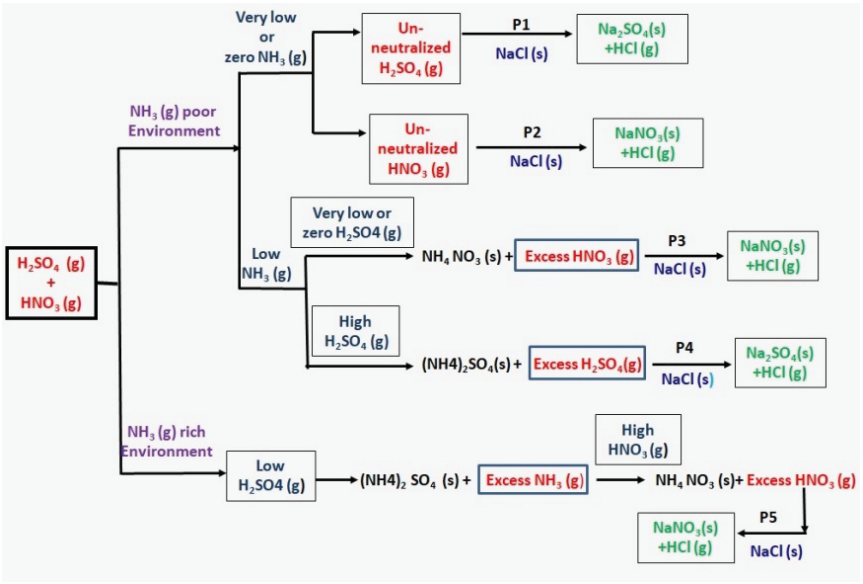
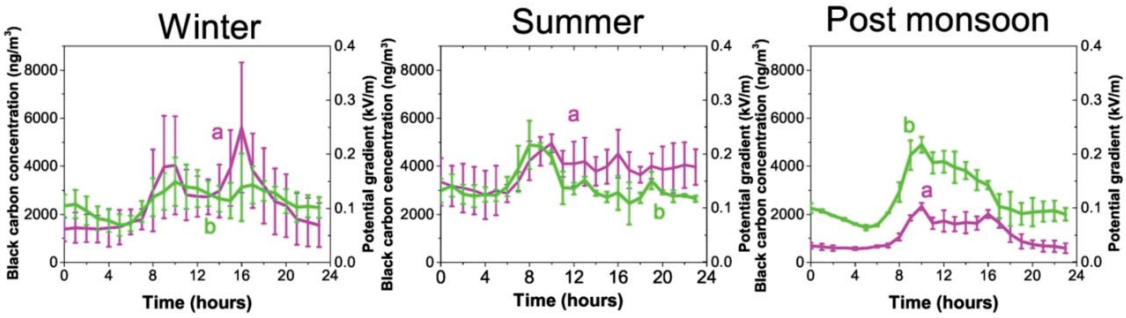


Fig 1: Chemical reactions identified between NaCl aerosols and polluted acids

- A study was conducted on the atmospheric electricity under fair weather conditions over eastern Himalaya for the first-time. Variation of (a) BC and (b) fair weather PG for winter (DJF), Summer (MAM) and postmonsoon (SON) with LT is shown below; error bars correspond to standard deviation showing spread over all the fair weather days.



- Regional and long-distance transport of organic and elemental carbonaceous aerosols over eastern Himalayan high altitude station Darjeeling was studied. The most important contributory regions were found to be Indo-Gangetic Plain during the dry seasons whereas southern part of West Bengal during monsoon.

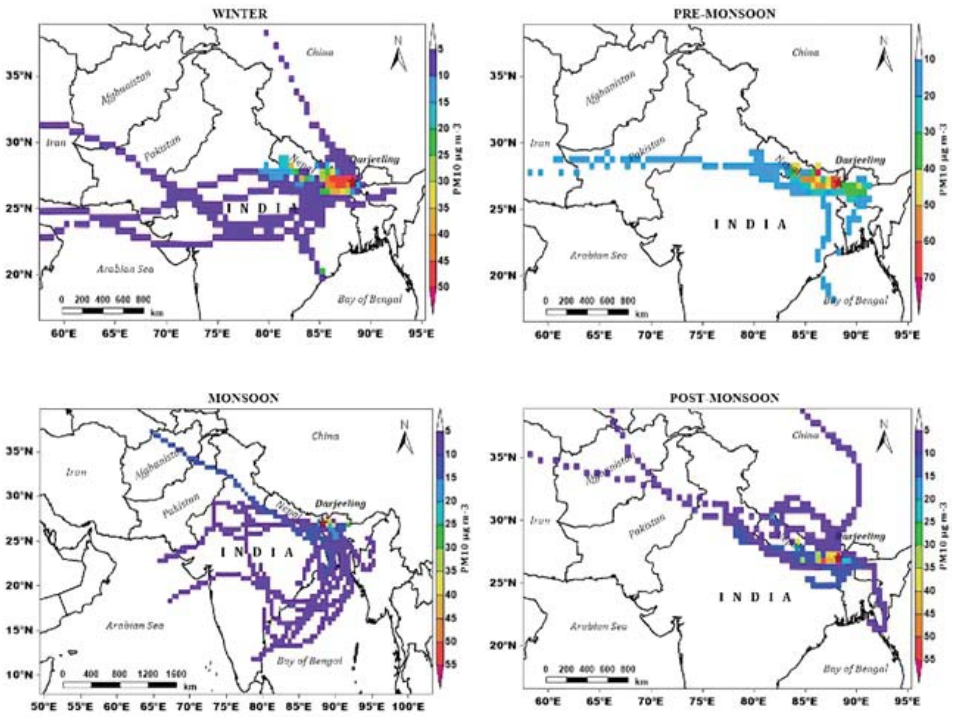


Fig 3: Regional and long-range transport of carbonaceous aerosols over eastern Himalaya

➢ A study was conducted on the aerosol-rain interaction over eastern Himalaya. Relative efficiencies of different types of rain events with different physical characteristics in scavenging different types of aerosols of different sizes were studied. Aerosol scavenging was studied under different pollution loads in the atmosphere and the effect of aerosol wash-out on the rainwater acidity was investigated.

➢ A comprehensive study was conducted to understand the impacts of local sources, meteorology, boundary layer dynamics, and long-range transport, on the size-specific particulate PAHs over Kolkata. The Concentration Weighted Trajectory model has identified the middle IGP and the Eastern Ghats as the potent PAH source regions for the receptor site. Source apportionment by positive matrix factorization model identified unburned petroleum, incineration, fossil fuel and coal burning as possible major sources of size-specific PAHs. Additionally, based on benzo(a)pyrene equivalent concentrations, the incremental lifetime cancer risk (ILCR) values were estimated for four human age groups.

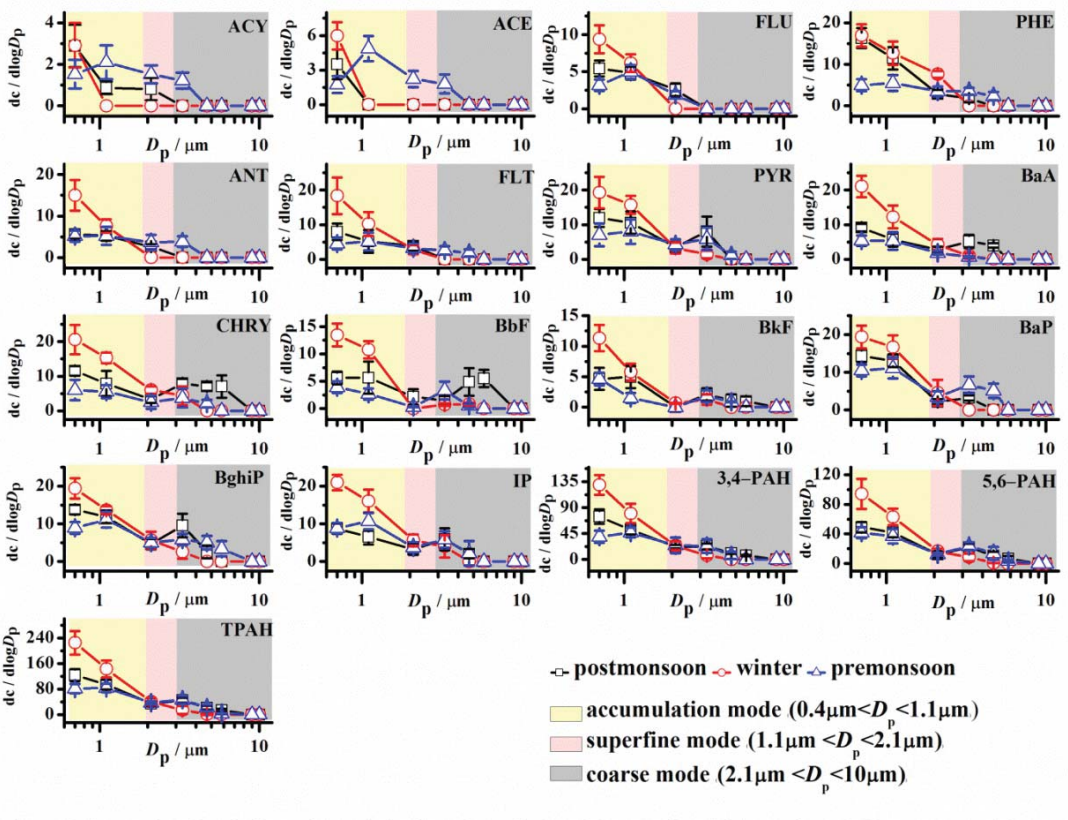
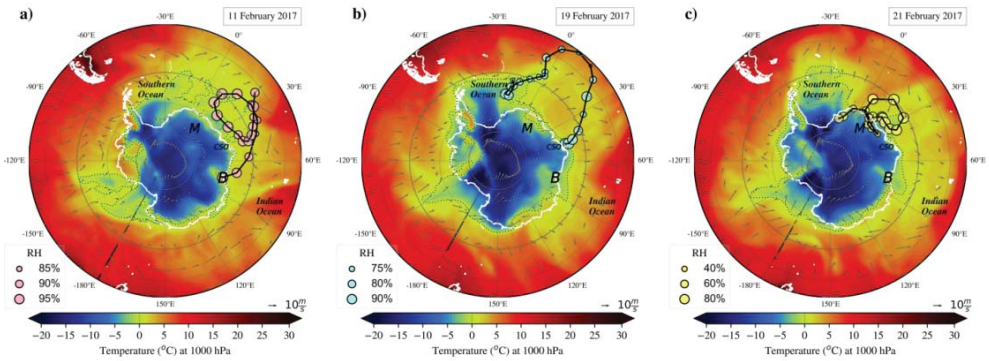


Fig 4: Mass-size distribution of Polynuclear Aromatic Hydrocarbons over Kolkata

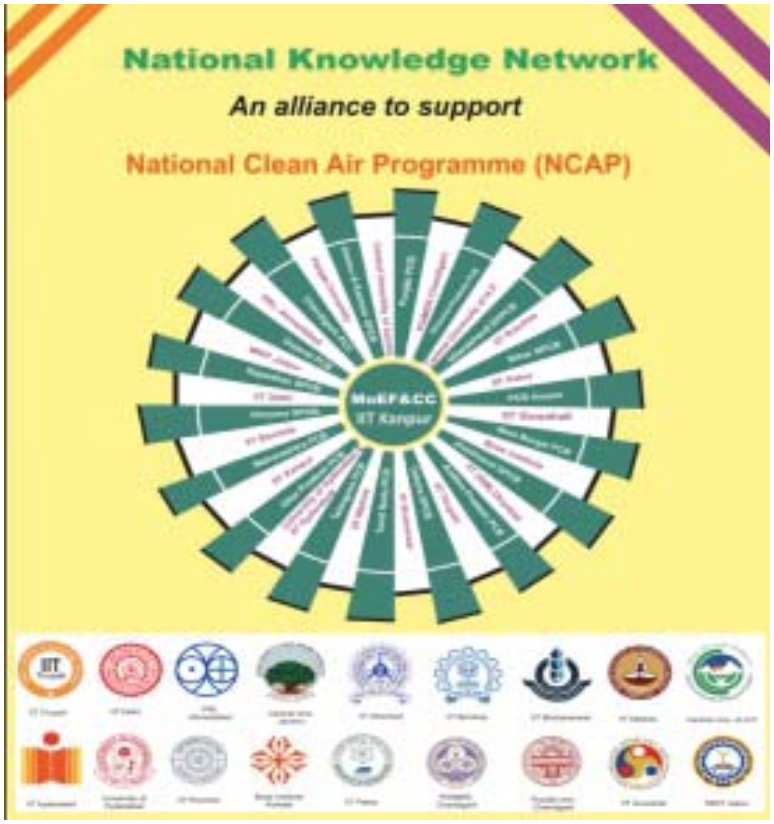
- *Investigation of Air Quality over Sundarban, representing background condition of Indo-Gangetic Plain*
- *Increasing occurrences of liquid precipitation over East Antarctica in Austral Summer: Observed during 36th Indian Expedition to Antarctica*



Other Achievement

National Clean Air Program

Bose Institute has been selected as the Nodal Institute (Knowledge Partner) and Dr Abhijit Chatterjee of Environmental Sciences Section has been selected as the Nodal Faculty for the state of West Bengal under NCAP of Govt of India. The main focus is building the action plans for mitigating air pollution over Kolkata and other metropolis.

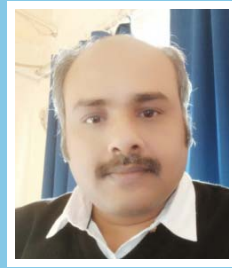


LIST OF PERSONNEL

Faculty Members : Prof. Sanjay K. Ghosh (Chairman), Dr. Abhijit Chatterjee and Dr. Sanat K. Das,.

Students : RA : Dr. Debajyoti Ray. **SRF/JRF :** Sauryadeep Mukherjee, Monami Dutta, Abhinandan Ghosh, Arindam Roy, Durba Das.

Staff Members : Dr. Anandamay Adak, Saral Ch. Das.



DR. ABHIJIT CHATTERJEE
Associate Professor

Group Members :
Arindam Roy, *SRF*; Abhinandan Ghosh, *SRF*
Mrs Monami Dutta, *JRF*; Mr Sauryadeep Mukherjee, *JRF*
Miss Durba Das, *Jr. Project Associate*

Collaborators:
Dr. Tuhin Kumar Mandal, *Principal Scientist, NPL, New Delhi*
Dr. Sudhir Kumar Sharma, *Senior Scientist, NPL, New Delhi*
Dr. Supriyo Chakraborty, *Scientist-F, IITM, Pune*
Prof. Chandra Venkataraman, *IIT, Bombay*
Dr. Chaithanya D Jain, *Sci./Engineer 'SD', NARL, Gadanki*
Dr. Neeraj Rastogi, *PRL, Ahmedabad*

Scientific Report

Background and Vision :

Background: The research activities are based on the "Air Quality and Climate Change" especially over the Indian regions vulnerable to human health as well as climate change and extreme weather events. Air quality studies are mainly carried out over the regions of high population density, for example, urban metropolis in eastern India, the entire Indo-Gangetic Plain, etc. The characterization, temporal variability, atmospheric changes, sources etc of the gaseous and particulate air pollutants like C_0, O_3, NO_2, SO_2, VOC, $PM_{2.5}$, PM_{10} are studied. Climate change studies are mainly focused on the geographgically and ecologically sensitive regions like eastern

Himalaya, Sundarban mangrove ecosystem etc. The major questions addressed are: How aerosols interact with the clouds and rain? How aerosols and gases are exchanged between the different spheres of our environment? How aerosols and gases affect the atmospheric radiation and modify radiative budget and hence affect ambient temperature? Consolidating, how aerosol and gases play role in the context of regional climate change?

Vision: Accurate determination of the quantitative contributions of various sources of air pollutants and building strategic action plans towards their mitigation over Indian urban regions; Long-term chemical characterization of aerosols and gases for refining and tuning of existing regional climate models.

Summary of Research Work :

A) Chemical reaction pathways between marine aerosols and polluted acid vapors were identified for the first-time in India in the real ambient atmospheric conditions.

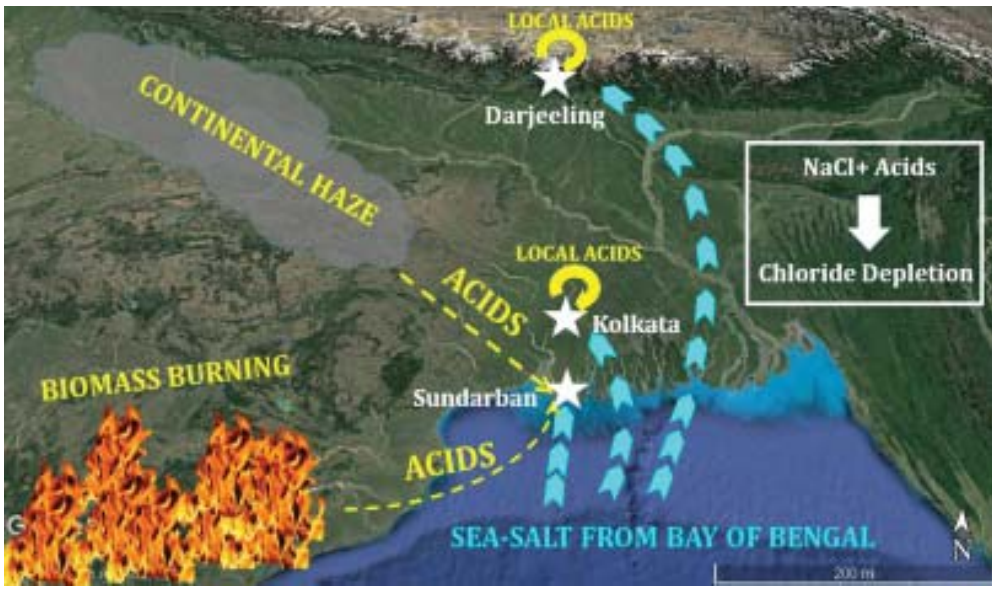


Fig 1: Sea-salts (NaCl) arriving from Bay of Bengal interact with polluted inorganic acids (from Eastern Ghat) over Sundarban, Kolkata and Darjeeling.

B) Atmospheric electric field was studied for the first-time over Indian Himalaya and the role of aerosols was determined.

C) Various types of carbonaceous components of aerosols over eastern Himalaya were characterized with the contributions from distant polluted regions.

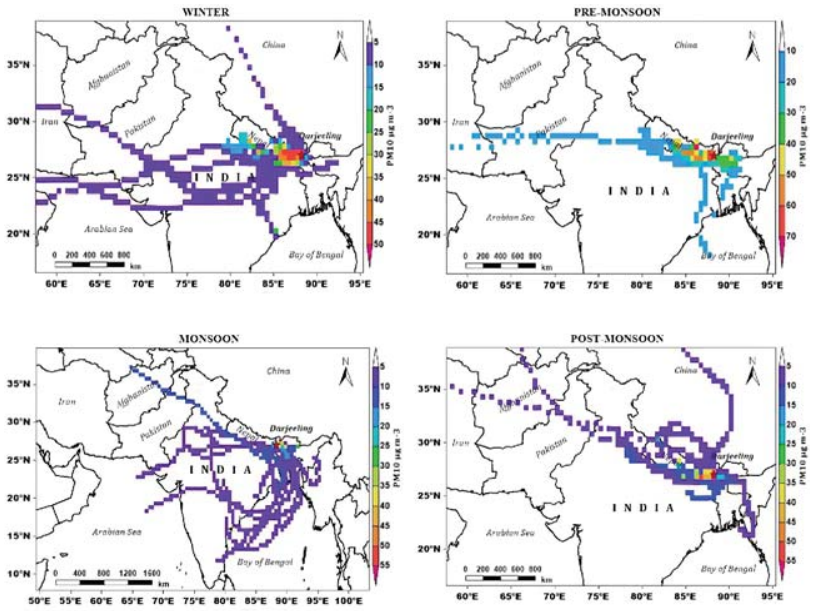


Fig 2: Transport of carbonaceous aerosols from various urban regions and arriving at Darjeeling in different seasons

D) Studies on the interactions between aerosols of different sizes and rains of different rates and durations were conducted over eastern Himalaya. Predictions of aerosols wash-out by rain have been modeled with the real-time data.

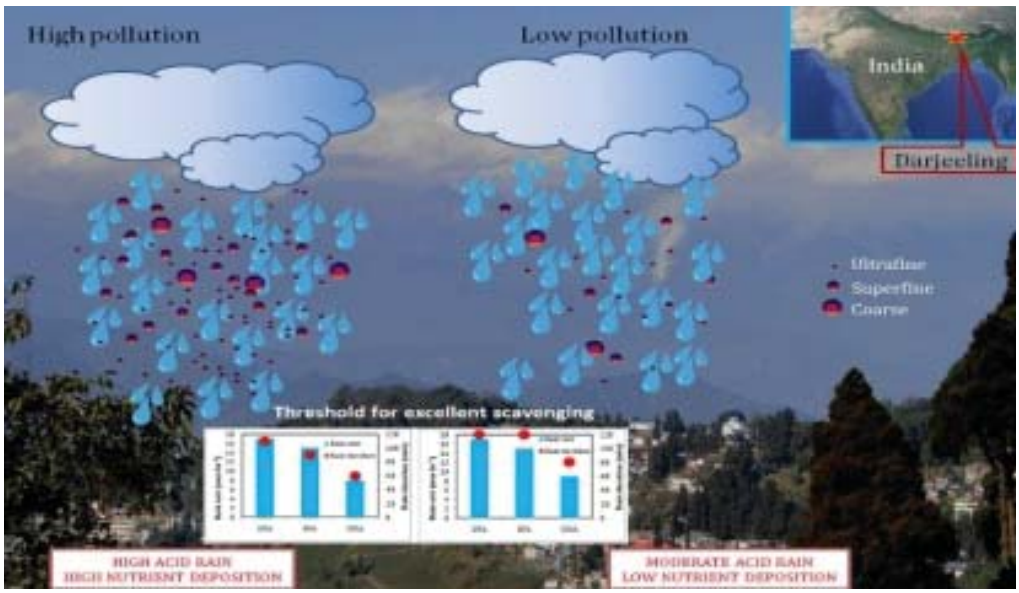


Fig 3: Aerosol wash out by rains under different pollution events over eastern Himalaya

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
01 (Thesis submitted)	05	13	04	NIL	NIL	01

DR. SANAT KUMAR DAS
Assistant Professor

Scientific Report

Background and Vision :

Vision: Impact of Aerosols on Environment and Human Society

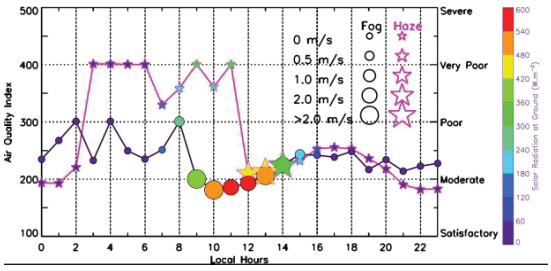
Background : My research works involve in investigations on optical and physical properties of aerosols, and their impact on perturbation in Earth's radiation budget and alteration in cloud formation and thereby, changes in precipitation. The investigations are mainly included different types of ground-based instruments and space-borne sensors using different measurement techniques and innovative methodologies in various atmospheric conditions. A few aerosols like desert dust, biomass plume, winter haze can travel long distances and produce higher warming effects over downwind regions. On the other hand, they also participate in cloud formation processes and changes rain drop size distribution. Over Antarctica, a pristine region of our globe, rainrate has decreased vertically down due to warmed lower atmosphere, indicating a signature of global warming. However, scenario becomes complicated due to changes in hygroscopicity characters of aerosols. Fog is one such example of extreme weather, which makes significant changes in not only radiation budget and cloud formation, but also impact strongly on human health due to drastically deteriorating breathing airquality. While long-range traveling, aerosols also carry a few living microbiomes having large impact of environmental as well as societal aspect, initiated recently at our lab.

Summary of Research Work :

1. *Deterioration of Air Quality over Indo-Gangetic Plaindue to Winter Haze and Fog*

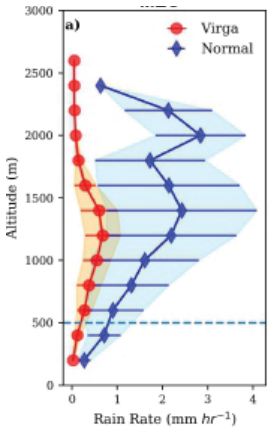
Deterioration of background air quality aggravates public health by increasing risk of cardiovascular morbidity and mortality. Five major pollutants were measured in a winter campaign (11-16 January 2014) at Kalas Island, the southern-most region of Sundarban mangrove forest and downwind of the Indo-Gangetic

Plain (IGP). The appearance of fog over Sundarban pauses the movement of pollutants, which pushes AQI from moderate to poor. The background air worsens further when dense fog occurs over central IGP and a haze comes out from dense fog areas and spreads towards Sundarban. Such a high AQI in extreme pollution event over IGP region deteriorates the quality of inhaled air over IGP in winter and increases the risk of cardiac strokes and mortality in a hazy environment.



2. *Identification of Virga type of precipitation over East Antarctica: Signature of Global Warming*

Precipitation is a prime parameter for assessing the surface mass balance of the Antarctic glaciers, which have been melting recently at a rapid pace. The present study focuses on the vertical structure of polar summer time precipitation observed during the 36th Indian Scientific Expedition to Antarctica using a ground-based Micro Rain Radar (MRR) installed on a research vessel. The precipitation profiles have been observed foremost at the coast of Bharati (CB) (69.40°S, 76.18°E), along the east coast (EC), and at the coast of Maitri (CM) (70.01°S, 12.51°E). The summer time polar precipitation was mostly dominated by liquid precipitation (75%). A very interesting feature, virga is observed over East Antarctica, which is very unique and unexpected over Antarctica. Our investigations suggest that the occurrence of virga over East Antarctica poses a possible threat to the existence of coastal glaciers and thereby, future sea-level rise globally.



3. *Migrating and Non-Migrating Tides Observed in the Stratosphere from FORMOSAT-3/COSMIC Temperature Retrievals*

Formosa Satellite-3/Constellation Observing System for Meteorology, Ionosphere and Climate (FORMOSAT-3/COSMIC) temperature data during October 2009 to December 2010 are analysed for tides in the middle atmosphere from ~10 to 50 km. COSMIC is a set of six micro satellites in near Sun synchronous orbits with 30° orbital separations and provides good phase space sampling of tides. Short term tidal variability is deduced by considering ±10 days' data together. The migrating diurnal tide is found to peak over the equator at 30 km. It maximises and slightly shifts

poleward during winters and thus is attributed to ozone absorption., Our numerical experiments show that non-migrating diurnal tides over mid and high latitudes could be a result of aliasing as they are found to occur at times of steep rise or fall in the mean temperature, particularly during the sudden stratospheric warming (SSW) of 2010. Analysis of COSMIC data show that aliasing between stationary planetary wave and non-migrating tides is reduced and thus results in the large amplitudes of the former.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	04	NIL	04	07	NIL	06

SCIENTIFIC REPORT
DEPARTMENT OF MICROBIOLOGY

Department of Microbiology

OVERVIEW

The Department of Microbiology, founded in 1942 being the first of its kind in India. Since inception, work was done primarily on agricultural microbiology, industrial Microbiology with a special emphasis on the production of antibiotics. However, with time, while being engaged both in applied and basic research, this department had addressed various problems in the area of parasitic and bacterial infections, drug design and detoxification apart from plant-microbe and mineral-microbe interactions. Currently this department is devoted to understand various aspects of microbiological processes in planetary health, environmental restoration and pathogenesis.

- Strategic combating approaches in the management of *Mycobacterium tuberculosis* with the perception of the molecular biology and metabolism of the TB pathogen, using its phages and plasmids as model systems, tools and probes.
- Biochemical and molecular investigations on the bacterial metabolism of health hazard organic compounds, development of biosensors and bioprospecting of novel compounds from plant and microbe besides gut and environmental metagenomics samples.

➢ Investigating the molecular biology and evolutionary dynamics to reveal opportunities and constraints of *in situ* metabolisms, and geochemical manifestations of the microorganisms of the Carbon-Sulfur-cycle within microbiomes that have active interfaces with the Earth's geological processes.

LIST OF PERSONNEL

Faculty Members : Prof. Sujoy Kr. Das Gupta, Prof. Tapan Dutta (Chairman), Dr. Wriddhiman Ghosh.

Students : JRF/SRF : Arindam Dutta, Shrestha Ghosh, Satamita Deb, Sabyasachi Bhattacharya, Apurba Sarkar, Subhrangshu Mandal, Moidu Jameela Rameez, Moushumi Bhattacharyya, Poulami Ghosh, Madhu Manti Patra, Saikat Deb, Megha Chakraborty, Rahul Shaw, Anik Barman, Mriganka Munshi Karmakar, Nibendu Mondal, Suman Basu, Rinita Dhar, Jagannath Sarkar, Sumit Chatterjee. **RA :** Dr. Debarun Acharya, Dr. Avijit Das, . **Women Scientist :** Dr. Madhumita Roy, Dr. Shreya Sengupta.

Staff Members : Saifullah Gazi, Prabir Kumar Haldar, Debashis Sarkar, Rabin Paul, Narayan Patali, Helper.

PROF. SUJOY KR DAS GUPTA
Professor

Group Members :
Dr. Shreya Sengupta, *DST Woman Scientist*
Shrestha Ghosh, *SRF*; Apurba Sarkar, *SRF*
Madhumanti Patra, *SRF*; Poulomi Ghosh, *SRF*
Anik Barman, *SRF*; Rahul Shaw, *SRF*

Scientific Report

Background and Vision :

My lab is focused on understanding the molecular biology of mycobacteria, the causative agent of TB, its phages, and plasmids. In previous years we had worked extensively on the molecular biology of mycobacteriophages. Our focus has been mainly on one such Phage named D29. This Phage can not only infect mycobacteria but also inactivate it immediately after infection. We hypothesize that if we can understand how this inactivation process occurs, it should be possible to identify novel strategies to kill *Mycobacterium tuberculosis*. This approach we refer to as 'Phage inspired antibiotics for mycobacteria.' It has led us to several exciting discoveries, including a recent finding that plumbagin a medicinal compound inhibits the growth of mycobacteria by specifically inhibiting ThyX, an enzyme involved in the synthesis of thymidylic acid (Sarkar et al. Plos One 2020, 15(2):e0228657).

We are continuing our investigation in this area by performing detailed transcriptomics and proteomics experiments using

D29 phage infected cells. Our studies with D29 - mycobacteria interactions have also led us to the finding that the DNA repair enzyme DinB2 of mycobacteria plays a crucial role in repairing DNA damage. Based on specific initial results, we hypothesized that DinB2 might play a role in conferring antibiotic resistance to mycobacteria. We are currently investigating this possibility using molecular tools. Besides, we are also investigating how glycerol metabolism plays a crucial role in the growth of these bacteria. Using CRISPR-Cas9 based systems, we are probing how down regulation of genes encoding enzymes involved in glycerol turnover affects mycobacteria's growth.

In the ultimate analysis, all our efforts are focused on devising new strategies to inhibit the growth of mycobacteria. We expect that all these efforts will lead us to a new drug or procedure to combat TB.

Summary of Research Work:

a) **Glycerol dependent Glucose 6-phosphate homeostasis plays a key role in the maintenance of mycobacterial cell growth and viability**. Species belonging to the genus Mycobacterium, *Mycobacterium tuberculosis*, for example, cause deadly diseases like TB. Mycobacteria are known for their ability to use glycerol as a nutrient efficiently. Although this observation was known for long, the reason behind it remains unclear. In this study, we provide an understanding of this phenomenon. Using **M. smegmatis** as the model organism, we show here that the level of glucose 6-phosphate (G6P), a crucial intermediate in the central carbon metabolism pathway, plays a vital role in controlling the growth of mycobacterial cells. We further show that glycerol serves as an efficient precursor for G6P production, and hence its use is preferred by mycobacteria for its growth.

b) **A TtgR family transcription factor (MSMEG_2295) regulates the expression of the gene encoding the *Mycobacterium smegmatis* DNA repair enzyme DinB2**. DNA damage repair has a crucial role to play in drug resistance of pathogens. In species belonging to the genus *Mycobacterium*, including the TB pathogen *M. tuberculosis*, the enzyme DinB2 functions as an error-prone DNA polymerase that could contribute to drug resistance. We reveal a novel mechanism of induction of expression from the dinB2 operon involving a repressor that can be modulated by benzopyran-one class chemicals, such as the plant flavonoid quercetin and the amino-coumarin antibiotic novobiocin. When we knocked out the gene encoding DinB2, we encountered higher novobiocin sensitivity. Increased synthesis of DinB2 in mycobacteria, therefore, may have a role to play in resistance to novobiocin in particular and antibiotics in general.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	01	NIL	05	01	NIL	NIL

PROF. TAPAN K. DUTTA
Professor

Group Members :
Rinita Dhar, *JRF*; Suman Basu, *JRF*
Mriganka Munshi Karmakar, *SRF*; Megha Chakraborty, *SRF*
Mousumi Bhattacharyya, *SRF*; Satamita Deb, *SRF*
Arindam Dutta, *SRF*; Avijit Das, *RA*
Dr. Debarun Acharya, *RA* ; Dr. Madhumita Roy, *RA (DST-WOSA)*

Collaborators :
Dr. Kannan Pakshirajan, Professor, IIT-Guwahati
Dr. Tapas K. Sengupta, Professor, IISER-Kolkata
Dr. Subrata K. Das, Scientist F, ILS, Bhubaneswar
Dr. Darren Reynolds, Professor, University of West England, Bristol, UK
Dr. Robin Thorn, Associate Professor, University of West England, Bristol, UK

Scientific Report

Background and Vision :

Due to greedy human activities, thousands of health hazard man-made chemicals are released into the ecosystem leading to a massive environmental insult. Management of environmental pollutants being one of the most significant and sustainable areas in contemporary research, exploitation of bacterial potential is considered to be the most desirable option due to their catabolic robustness and evolutionary plasticity. Moreover, microbiological processes regarding biomolecular evolution, regulation, and potentiality to

remediate the deleterious effects of anthropogenic activities and biosensor-based monitoring on environment are important to understand these key areas in this field of research.In addition, to comprehend the exceptional ecology and torrents of possibilities that lies in the distinct microbial niches, it is important to emerge with sustainable schemes for the betterment of humanity and also to understand host-pathogen relationships in a deeper way with a possible development of contemporary therapeutic strategies.

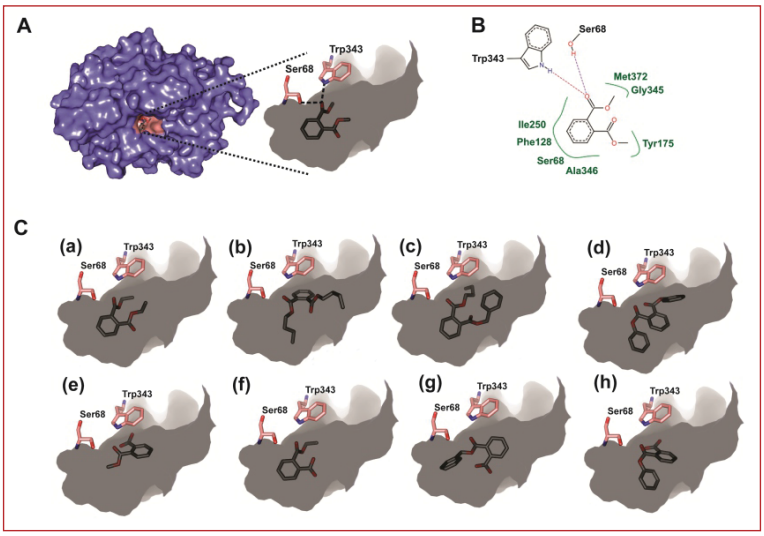
Summary of Research Work :

Currently, our lab is working on the exploration of catabolic potential and metabolic versatility of Endocrine Disrupting Chemicals (EDC)-degrading bacterial strains, isolated in our lab utilizing enrichment culture technique. Growth profile of each of these strains was studied for different EDCs while the metabolic pathways involved in assimilation of different EDCs by different isolates have been studied using methodologies involving respirometric, spectrophotometric, LC-MS and GC-MS analyses. On the basis of the pathway information, *de-novo* whole genome sequencing has been conducted for some of the isolates to identify the gene clusters and associated regulatory elements responsible for the assimilation pathway.

In one of our studies on the degradation of 2-, 3-, and 4-hydroxybenzonitriles (cyanophenols) and naphthalene in *Burkholderia* sp. strain BC1, the metabolic cross-talk between the catabolic pathways of these two compounds was hypothesized based on the finding of common intermediates in both the pathways. To justify our hypothesis induction profiles of respective catabolic pathway enzymes of individual pathways and cloning and expression studies of some of the oxidative enzymes *vis-a-vis* substrate specificities are being investigated.

Extensive studies on the promoter region controlling naphthalene degrading gene clusters (nag- and nah-type) revealed the existence of a divergently oriented promoter site overlapping its -35 box and this newly found promoter was found to control the expression of the wild type regulator protein, NagR. Sequential deletion and activity analysis explored the existence of a 36 bp short core promoter region towards the direction of the *nagR* gene and categorized it to be a member of the '-10 promoters'.

Functional screening of a soil metagenomicfosmid library, followed by transposon mutagenesis led to the identification of a 1179 bp esterase gene, estM2, that encodes a 392 amino acids long protein (EstM2) belonging to the family VIII esterases with a translated molecular weight of 43.12 kDa. Overproduction, purification and biochemical characterization of the recombinant protein demonstrated carboxylesterase activity. Guided by molecular docking analysis, EstM2 was shown to hydrolyze a wide range of di- and monoesters of alkyl-, aryl- andbenzyl-substituted phthalates. Thus, EstM2 displays an atypical hydrolytic potential of biotechnological significance within family VIII esterases.



(A) Surface topology of EstM2 showing the binding of dimethyl phthalatewithin the catalytic pocket (pink) via electrostatic interaction with active site residues Ser68 and Trp343 based on docking analysis; (B) Lucid view showing hydrophobic interactions of dimethyl phthalate with different residues at the catalytic pocket of EstM2; (C) Alignment of other phthalate esters within the catalytic pocket of EstM2, as obtained from docking studies: diethyl phthalate (a), di-n-butyl phthalate (b), butyl benzyl phthalate (c), diphenyl phthalate (d), monomethyl phthalate (e), monoethyl phthalate (f), monobenzyl phthalate (g) and monophenyl phthalate (h)

Suaedanudiflora, an ethno-medicinal herb of Indian Sundarbans, was investigated as a promising source of bioactive compounds. A total number of 128 phytochemicals having antioxidant, anti-inflammatory, anti-insecticidal, mosquitocidal, antibacterial potential were identified from the plant. Besides this, antimicrobial property exhibited by a soil isolate, characterized as *Pseudomonas aeruginosa*, was investigated and the trypsin digestion of active culture supernatant confirmed the proteinaceous nature of the causative antimicrobial agent secreted by the bacterium. Partial purification of the culture supernatant using Sephadex G-25 column and various molecular weight cut-off membrane revealed that the molecular weight of the targeted antimicrobial agent is less than 2 kDa in size.

In another endeavour, Next-generation Sequencing (NGS) analysis of genomic DNA isolated from the gut of hilsa *(Tenulosailisha)* was carried out to identify the diversity of various culturable and non-culturable microbial species. Later, functional annotation of the NGS data was performed using PICRUStbioinformatic tool.

Molecular dynamics simulation (MD-simulation) of crystal structures of the α-subunits of the wild type and mutant forms of naphthalene dioxygenase (NDO) and Nitrobenzene Dioxygenase (NBO) enzyme systems was conducted as well as compared to identify significant changes in their dynamical property and finally, a correlation of the observed changes with the alteration in their configuration of residual network was established.

The interspecific protein-protein interaction (PPI) network of human and bacteria was explored. The network features revealed a preferential enrichment of intraspecific hubs and bottlenecks for both the human and bacterial pathogens and few human proteins were found to have more connections with bacterial proteins in comparison to other human proteins. These proteins are called party hubs and their structural features revealed existence of domains capable of forming vast array of interspecific domain-domain interactions.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	01	NIL	NIL	03	NIL	NIL

DR. WRIDDHIMAN GHOSH
Professor

Group Members :
Nibendu Mondal, *JRF*; Jagannath Sarkar, *JRF*
Sumit Chatterjee, *JRF*; Moidu Jameela Rameez, *SRF*
Sabyasachi Bhattacharya, *SRF*; Subhrangshu Mandal, *SRF*

Scientific Report

Background and Vision :

Our Geomicrobiology Group explores the biosphere for novel molecular mechanisms (pathways) of the evolutionarily ancient metabolism called sulfur-chemolithotrophy, which supposedly originated in the high temperature, reducing environments of the early Earth.

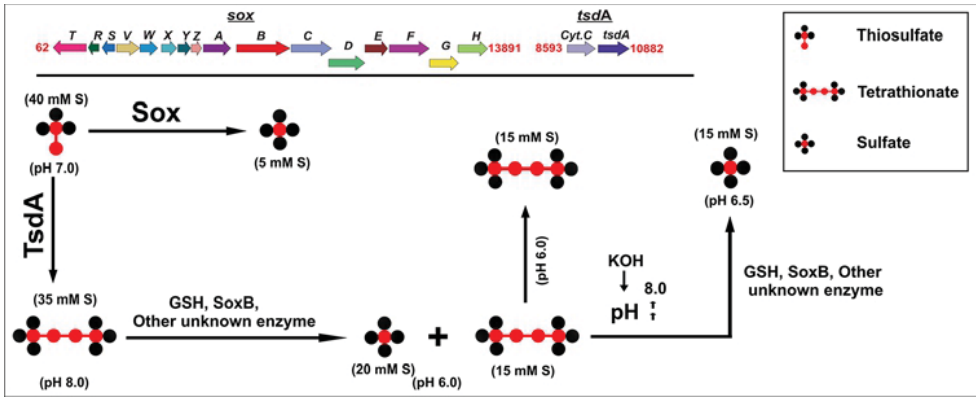
Our laboratory also tries to reveal the *in situ* metabolisms, opportunities and constraints, and geochemical manifestations of the microorganisms of the Carbon-Sulfur-cycle within microbiomes that have active interfaces with the Earth's geological processes. Of the various microbiomes explored, the following biophysically-extreme habitats are under special attention.

- The geochemically-peculiar (neutral pH, silica-poor, but boron-, sulfide-, sulfate- and thiosulfate-rich) hot spring systems of the Trans-Himalayas (Eastern Ladakh, India), where our in situ studies have hypothesized that native geochemical and microbial factors can act as potent determinants of the high microbial habitability of these high temperature environments; this hypothesis is currently being tested on pure culture isolates.

➢ The hypoxic territories of the deep sea (namely, the perennial and seasonal oxygen minimum zones of the Arabian Sea), where we are specifically focused on the sedimentary microbiome, and its geological drivers and manifestations.

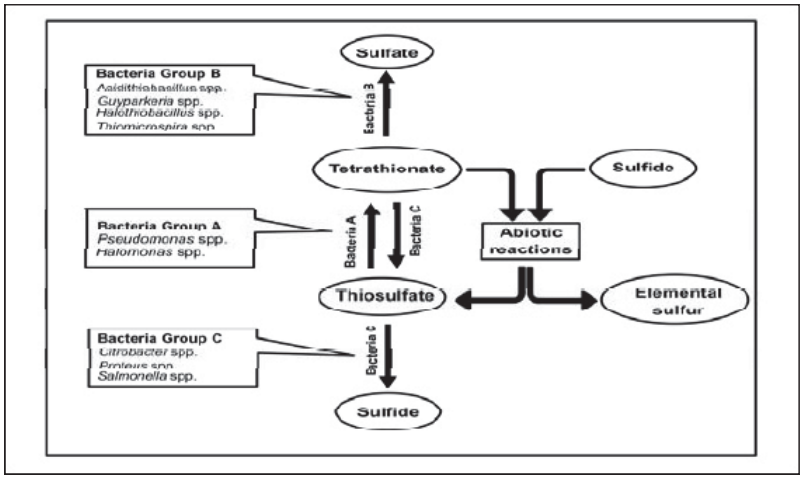
Summary of Research Work :

Searching for novel pathways of sulfur-chemolithotrophy, we reported unique molecular mechanisms of thiosulfate and tetrathionate oxidation from two taxonomically distinct bacteria *Pusillimonas ginsengisoli and Paracoccus thiocyanatus.*



Two parallel pathways were found to be there for thiosulfate oxidation in the alphaproteobacterial chemolithotroph Paracoccus thiocyanatus SST.

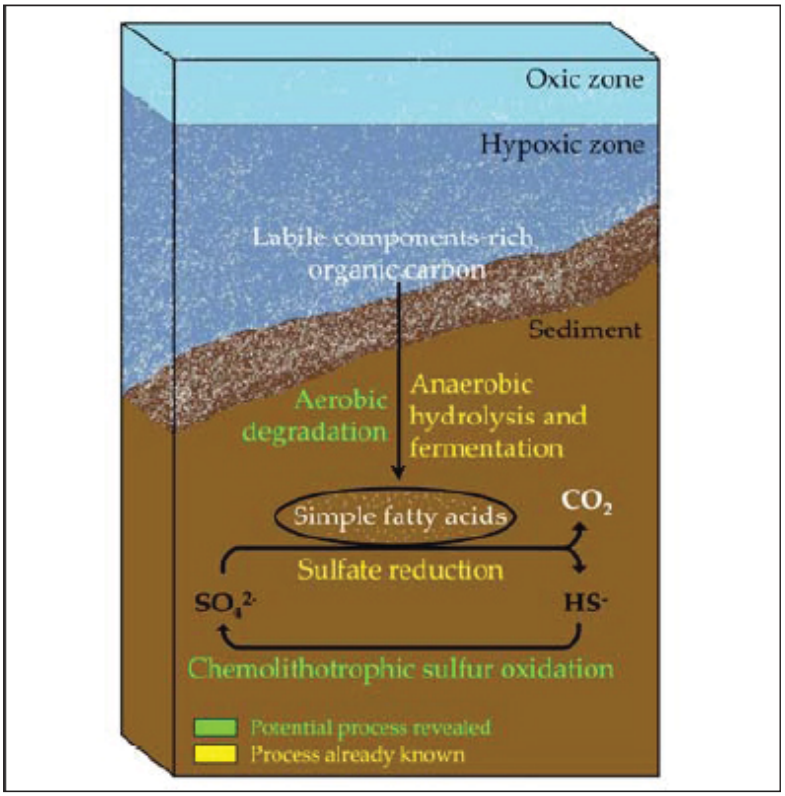
Working on the geomicrobiology of Trans-Himalayan sulfur-borax hot spring systems, we revealed that natural bacterial populations are more heat-resilient than their laboratory counterparts and environment-guided thermotolerance develop in natural popuations of mesophilic bacteria that are stochastically introduced into such extreme environments.



Cryptic roles of tetrathionate in the sulfur cycle of marine sediments: Microbial drivers and indicators

In the sedimentary biogeochemistry front of the Arabian Sea oxygen minimum zone, our microbiological explorations, without the intervention of geochemistry, discovered a cryptic role of tetrathionate in the sulfur cycle.

Our metagenomic, metatranscriptomic and culture-based studies further showed that aerobic chemolithotrophy and chemoorganoheterotrophy are active in the sulfidic and highly O2-scarce sediments of the OMZ, so can influence the benthic carbon-sulfur sequestration/cycling in an hitherto unexpected and unappreciated way.



The hitherto-unknown aerobic microbial ecology of marine oxygen minimum zone (OMZ) sediments was revealed in two ~3-m-long sediment-cores from the eastern Arabian Sea OMZ using metagenomics, pure-culture-isolation, genomics and metatranscriptomics.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	03	NIL	NIL	01	NIL	NIL

SCIENTIFIC REPORT
DIVISION OF
MOLECULAR MEDICINE

Division of Molecular Medicine

OVERVIEW

The primary mission of this Division is to understand the molecular architecture of different cellular functions related to vital life processes, and also to unravel the complexities of a disease process. To achieve this, multidirectional approaches have been initiated by various faculties of this Division to understand the fundamental aspects of cancer, protein mis-folding-related neurodegenerative disorders and pathophysiology of diseases both at the cellular and molecular levels, as well as to identify and manipulate targets using immunotherapy, natural products, repurposed drugs, synthetic molecules, nanoparticle-mediated drug and gene delivery. The key basic areas of research are Cancer, Immunotherapy of cancer Cell Growth and Proliferation, Neurodegenerative Disorders, Patho-physiology of Diseases, Chemical Biology, Translational Animal Research. Cutting edge basic research will generate knowledge and provide original insights into biological processes vital for normal cellular function, as well as translate this knowledge into understanding the molecular mechanisms of a disease process. This will in turn result in high quality publications with high scientific impact and global visibility. In-depth understanding of vital cellular processes and their perturbations in causing a disease will open up new avenues to strategize novel therapeutic approaches towards blocking a disease process. Identification of bioactive natural as well as synthetic molecules and repurposing of drugs may provide novel therapeutic leads, which may result in national as well as international patents.

LIST OF PERSONNEL

Faculty Members : Prof. Gaurisankar Sa (Chairman), Prof. Anup K Misra, Prof. Mahadeb Pal, Dr. Atin K Mandal, Dr. Kaushik Biswas, Dr. Kuladip Jana, Prof. Subrata Majumder (Superannuated), Prof. Paramesh C. Sil (Superannuated), Prof. Tanya Das (Superannuated)

Students : JRF/SRF : Abhisek Sarkar, Abhishek Das, Abhishek Dutta, Ananya Dutta, Anirban Manna, Ankita Mandal, Ansupriya Si, Aparajita Das, Apoorva Bhattacharya, Apratim Dutta, Arin Guchhait, Arnab Karmakar, Asif Ali, Baijayanti Ghose, Barun Mahata, Chirantan Majumdar, Debanjana Mitra, Dia Roy, Suman Mukherjee, Dwaipayan Chakraborty, Elora Khamrui, Hossainoor Rahman Sareng, Ishani Bhaumik, Junaid Jibran Jawad, Madhuparna Chakraborty, Monalisa Kundu, Mousumi Kundu, Naibedya Dutta, Noyel Ghosh, Poulami Sarkar, Pradip Shit, Pramit Bhattacharjee, Pritam Sadhukhan, Saikat Dutta, Samhita De, Sarmistha Banerjee, Satyajit Haldar, Sayanta Dutta, Sayantan Bose, Sendge Anil Khusal Rao, Shabina Parveen, Sharmistha Chatterjee, Shibjyoti Debnath, Shruti Banerjee, Somesh Roy, Sounak Banerjee, Sourav Panja, Sourio Chakraborty, Subha Roy, Subhadip Pati, Subhanki Dhar, Sukanya Saha, Sumit Ghosh, Sushweta Mahalanobish, Suvranil Ghosh, Swastika Paul, Sweta Ghosh, Tania Sarkar, Tapasi Manna, Tapasree Basu Mallik, Uday Hossain, Udit Basak. RA : Dr. Aharna Guin, Dr. Arijit Bhowmik, Dr. Ayan Mandal, Dr. Debjyoti Paul, Dr. Deblina Guha, Dr. Debomita Sengupta, Dr. Dipanwita Mukherjee, Dr. Kabirul Islam, Dr. Manjari Kundu, Dr. Nivedita Roy, Dr. Papri Basak, Dr. Poulami Khan, Dr. Prasanta Saini, Dr. Ranjita Das, Dr. Rishila Ghosh, Dr. Sarita Sarkar, Dr. Shravanti Mukherjee, Dr. Soumita Mukherjee, Dr. Subir K. Juin, Dr. Suchandra Majumdar, Dr. Supriya Chakraborty, Dr. Swatilekha Ghosh, Dr. Utsab Debnath. ***Women Scientist :*** Dr. Ranjita Das.

Staff Members : Prabal Gupta (Retired), Uttam Kr Ghosh, Arindam Basu, Debasish Majumder, Dr. Nilanjana Bhattacharya, Sanghamitra Das, Sourav Samanta, Kalyan Das, Amartya Sen, Ranjit Das, Sankar Prasad Bari, Purnendu Manna, Bijoy Munsi (Retired).

PROF. ANUP KUMAR MISRA
Professor

Group Members :
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Tapasi Manna, *UGC-SRF*; Monalisa Kundu, *CSIR-SRF*
Pradip Shit, *CSIR-JRF*; Dr. Kobirul Islam, *N-PDF*
Dr. Utsab Debnath, *N-PDF*; Debashis Mazumder, *SLA*

Scientific Report

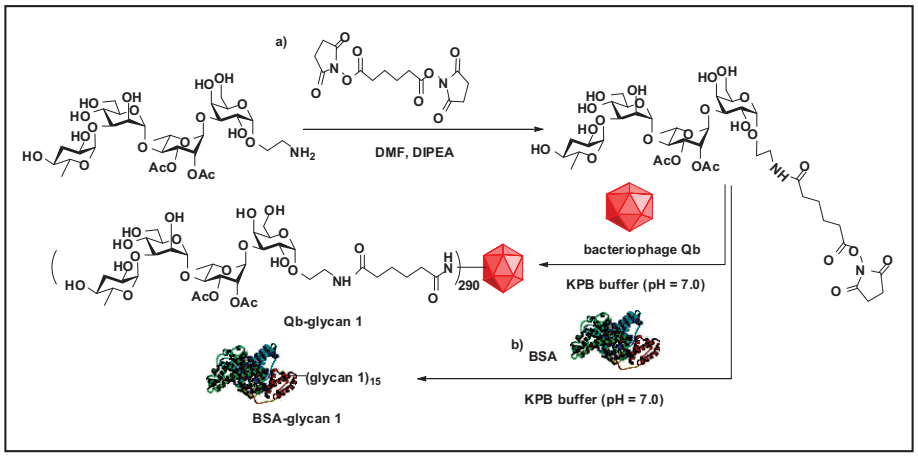
Background and Vision :

Development in the glycobiology research amplified the demands for well-defined oligosaccharide motifs for various biological studies. Naturally derived bacterial capsular polysaccharides have been the basis for effective anti-bacterial vaccines, but little is known about the protective glycotopes for many serotypes. Since natural source cannot provide the large quantity of oligosaccharides with homogeneity and adequate purity, it is essential to develop chemical synthetic approaches for getting access to the complex oligosaccharides. Stereoselective glycosylation reaction is the key component for assembling of monosaccharides towards the synthesis of complex oligosaccharides. Cell wall oligosaccharides corresponding to the repeating units and sub-units of polysaccharides, differing in chain length and monosaccharide composition help to identify antigenic determinants for the creation of semi-synthetic glycoconjugate vaccine candidates.

Aims and Objectives :

- Development of novel reaction methodologies for the stereoselective chemical glycosylations.
- Conjugation of oligosaccharides with suitable proteins to form glycoconjugates and their evaluation for possible antibacterial vaccine candidates.
- To develop natural products inspired small molecules having pharmaceutical potential.

Work Achieved :



- Stereoselective synthesis of a series of complex oligosaccharides corresponding to the pathogenic bacterial cell wall polysaccharides.
- Preparation of a number of glycoconjugate derivatives and their immunochemical studies towards the development of vaccine leads against *Salmonella* and *meningococcal* infections.
- Design and synthesis of natural products inspired small molecules having anti-cancer, anti-filarial and anti-inflammatory activities..

Future Research Plans :

- Unveiling the untold mysteries of stereoselective chemical glycosylations.
- Extending the immunological studies of the glycoconjugate derivatives using animal models.
- Development of novel reaction methodologies relevant to the synthetic organic chemistry.
- Synthesis and biological evaluation of sugar conjugated natural products.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
01	17	01	01	01	NIL	NIL

DR. ATIN KUMAR MANDAL
Associate Professor

Group Members :
Nilanjan Gayen, *SRF*; Baijayanti Ghosh, *SRF*
Pramit Bhattacharjee, *SRF*; Somesh Roy, *JRF*
Madhuparna Chakraborty, *JRF*; Dhiman Saha, *JRF*
Soumita Mukherjee, *SERB-NPDF*

Collaborators :
Dr. Anirban Bhunia, Bose Institute, Kolkata
Dr. Dhandapany Perundurai, InStem, Bangalore
Dr. Mohit Prasad, IISER, Kolkata

Scientific Report

Background and Vision :

Protein quality control (PQC) maintains homeostasis of proteome at physiological or stress condition. Molecular chaperones and degradation system are integral part of PQC machinery. Chaperones binds to non-native polypeptides to prevent aggregation and to facilitate the folding of proteins, and transfermisfolded proteins to degradation systems – the ubiquitin-proteasome and autophagy – to degrade abnormal or damaged proteins. These components of PQC system act in concert to prevent the accumulation of misfolded proteins and/or to facilitate their elimination which is critical for cell survival. However, the efficiency of the PQC system is often perturbed by environmental, cellular or genetic factors which generate stable toxic conformations having gain-of-function or aggregation prone cell toxic conformations. Generation of

these toxic protein conformations are the causal reason for various diseases including cancer, diabetes, hypertrophy and late-onset neurological diseases. My lab is focused to understand the mechanism of cellular PQC and how the PQC is altered for mutant proteins having gain-of-function activity or aggregation prone proteinsmisfolding of which accumulates as toxic aggregates inside the cell.

Summary of Research Work :

Praja1 ubiquitin ligase facilitates degradation of polyQ proteins

Aggregation of expanded polyQ proteins causes late onset neurological diseases. Spinocerebellar ataxia-3 is developed due to the polyQ expansion of ataxin-3 protein. The cellular quality control system is altered in disease condition and modulation of the quality control system could be an effective way to remove the aggregates. Emphasized has been given to identify ubiquitin ligases those are responsible for removing SCA3 aggregates in early life and hence delayed disease manifestation. We have identified and characterized the function of RING finger ubiquitin ligase named, Praja1 which is highly expressed in brain tissue. We found that Praja1 level (mRNA/protein) is downregulated upon overexpression of polyQ proteins (Ataxin3/Huntintin) in mammalian cell (HEK293T/Neuro2A) resembling the disease condition. Praja1 interacts with polyQ proteins and co-localizes with their aggregates. Overexpression of Praja1 efficiently reduces the number of polyQ protein aggregates (ataxin-3 and huntingtin), but unable to do so when its RING domain is deleted suggesting involvement of its ubiquitin ligase activity. Praja1 reduces ataxin-3 protein level by facilitating ataxin-3 degradation via autophagy. Conversely, downregulation of Praja1 by siRNA/shRNA increases ataxin3/huntintin protein level and also their aggregates. We also found that overexpression of Praja1 reduces the toxicity of Ataxin-3 in yeast and transgenic Drosophila model.

Hsp70/Hsp90 organizing protein HOP regulates RAF1 kinase activity by recruiting Hsp90 during MAPK activation

We elucidated the function of HOP (Hsp70/Hsp90 organizing protein) a co-chaperone of Hsp90, in maintaining CRAF kinase activity. Our results suggest that HOP is essential for maintaining CRAF kinase activity, but in contrast to chaperones Hsp90 or Cdc37, it does not affect S621 phosphorylation of CRAF, necessary for CRAF stability and activity. We identified the critical domain of HOP responsible for its function. The functionality of HOP in regulating CRAF activity is mediated by its TPR2A-2B-DP2 domain. This domain of HOP enhances the interaction between Hsp90 and CRAF, and disruption of this interaction by site directed mutagenesisblocks activation of CRAF kinase, hence MAPK pathway. We also found that overexpression of HOP enhances recruitment of Hsp90 to CRAF which in turn regulates actin-dependent translocation of the kinase during MAPK signaling. Conversely, down-regulation of HOP by small interfering RNA (siRNA) reduces MAPK signaling mediated by CRAF kinase.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	03	NIL	03	02	NIL	NIL

Ms. Sweta Ghosh
Winner of Sir Nilratan Sirkar Prize for the year 2019

PROF. GAURISANKAR SA
Professor

Group Members :
Suman Mukherjee, *JRF*; Saikat Dutta, *JRF*; Sayantan Bose, *SRF*
Dia Roy, *SRF*; Dwaipayan Chakraborty, *SRF*; Subhadip Pati, *SRF*
Subhanki Dhar, *SRF*; Dr. Shravanti Mukherjee, *RA*
Dr. Debomita Sengupta, *RA*; Dr. Ranjita Das, *RA*
Dr. Aharna Guin, *RA*; Arindam Basu, *SLA*

Scientific Report

Background and Vision :

Anticancer immunotherapies involving the use of immune-checkpoint inhibitors (e.g., anti-CTLA4/-PD1) has emerged as new therapeutic pillars. While often many patients have innate-/acquired-resistance to immunotherapies. Avoidance of immune system is one of the major hallmarks in cancer progression that successively transforms immune-surveillance (tumor-eradication) to immune-tolerance (tumor-progression). Modulation of immune cells to harness the power of effective immune responses has been long-term goals for promising strategies of cancer immune therapy. However, long-term follow-up in a pooled meta-analysis exhibited long-term survival in approximately 20% of patients treated with immune checkpoint inhibitors, and a large fraction of patients experience aggressive disease progression after treatment. Earlier we reported that FOXP3^{+} Treg cells augmentation in cancer patients causes immunosuppressio, neo-angiogenesis and metastasis. Recent research has thus focused on the development of effective immunotherapeutic strategies that target tolerogenic-immune cells to become immunogenic and restore cancer immune surveillance to bypass the innate or acquired resistance to immunotherapies.

Aims and Objectives :

- To determine the status of the immune system in patients with different types of cancer.
- Unravelling the immune landscape of tumor microenvironment to understand the reason for development of innate or acquired resistance to immunotherapies.
- Improving the treatment outcome with additional modalities to overcome the failure of immunotherapy.
- To develop suitable combinations of chemotherapy, immunotherapy and rejuvenation-therapy to determine the efficacy of such therapy modules through clinical trials.

Work Achieved :

- Identification of a novel $CD4^{+}CD25^{+}CD127\text{-}CTLA4^{+}FOXP3^{+}$ T-regulatory (Treg) cells in tumor micro-environment.
- Presence of high-level of tumor-associated $CD4^{+}$ Treg cells (tTregs) in the tumor-site results in poor prognosis of cancer patient.
- This tTregs use altered energy metabolisms to survive and expand in highly competitive tumor microenvironment.
- This tTregs exploit several immunosuppressive strategies such as induction of T-effector cell death, dysfunction of dendritic cells, and modulation of anti-tumorigenic (M1) macrophages towards tolerogenic (M2) macrophages which prevents the natural immune system to act against tumor and thus develops the resistance to immunotherapies.
- This tTregs secrets high-level of VEGF to instigate endothelial cells to undergo tumor-angiogenesis.
- CD8+ Tregs in tumor microenvironment synergise CD4+ Tregs immunosuppressive power.
- Identification of a micro-RNA (miR-325) that controls the development and function of tumor-associated Treg cells.
- Lentivirus clone containing miR-325 can successfully generate an immunogenic response against tumor by restricting the immuno-suppression that is caused by tTregs in tumor-bearer.

Future Research Plans :

- Determination of the status of the immune system in cancer patients for logistic application of immunotherapy.
- Development of adeno-associated virus-mediated *in-vivo* delivery system for miR-325 for clinical trials
- Development of engineered exosome-mediated *in-vivo* delivery system for targeted-delivery of hsa-miR-325-3p.
- To develop combinatorial therapy modules of chemotherapy, immunotherapy and miR-325 therapy for clinical trials.

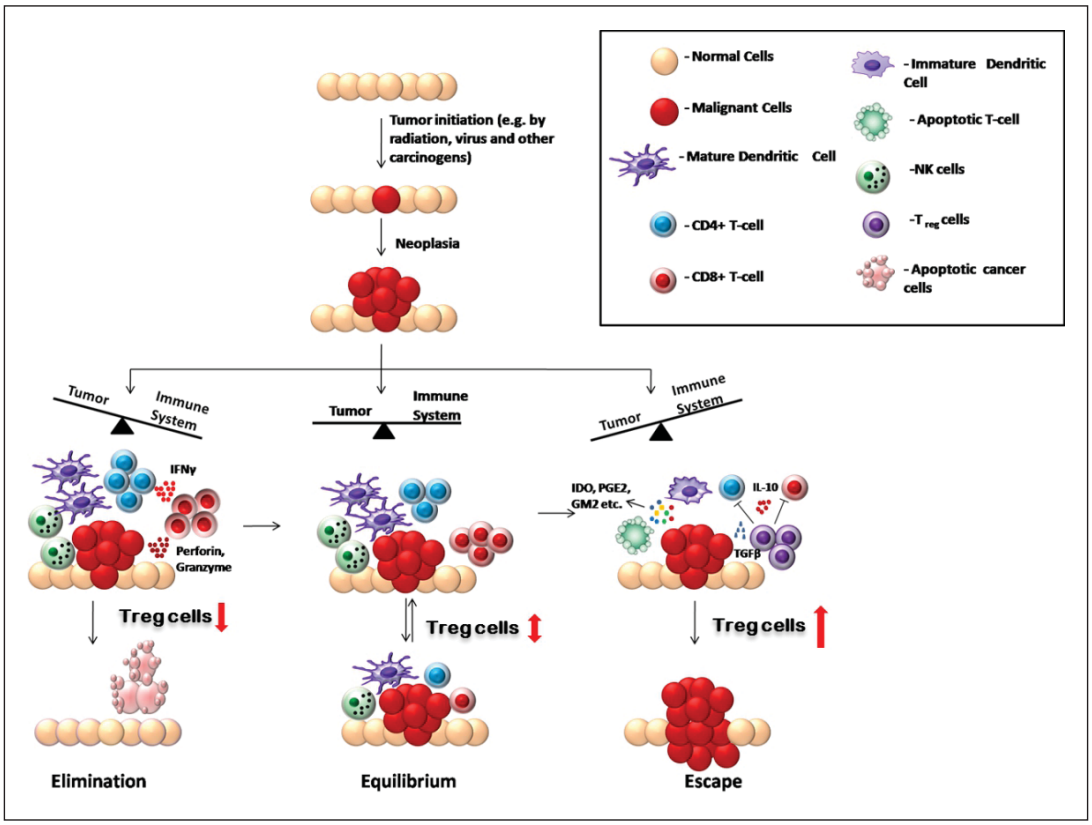


Figure: Tumor-associated T-regulatory cells exploit several immunosuppressive strategies which prevents natural immune system to act against tumor and thus escape anti-tumor immunity.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	04	NIL	19	06	NIL	02

DR. KAUSHIK BISWAS
Associate Professor

Group Members :
Dr. (Mrs.) Dipanwita Chakraborty, *DBT RA*
Shibjyoti Debnath, *SRF-UGC Adhoc*
Abhisek Sarkar, *SRF-UGC Adhoc*
Elora Khamrui, *JRF-CSIR Adhoc*
Sounak Banerjee, *JRF-UGC Adhoc*
Subha Ray, *JRF-UGC Adhoc*

Scientific Report

Background and Vision :

Over-expression of glycosphingolipids are found to be associated with a large number of cancers. However, neither the precise role of these glycolipids in the process of tumorigenesis, or the underlying basis of their over-expression in many cancers is known. Detailed mechanistic studies aimed towards understanding their precise mode of action in modulating tumor growth, progression or metastasis are also lacking. Our laboratory is engaged in defining the functional role of some of these glycosphingolipids, particularly gangliosides in tumorigenesis, and identifying the mechanism by which they do so. On the other hand, our laboratory is also focused in understanding how some of these gangliosides are at all over-expressed in certain cancers.

Aims and Objectives:

a) The consequence of such an over-expression in tumors.

- Functional role of tumor derived gangliosides in inducing EMT leading to tumor growth, development and metastasis.
- Ganglioside induced modulation of miRNAs and its implication in tumorigenesis.

b) The basis of over-expression of select glycosphingolipids in cancer.

- Transcriptional regulation of ganglioside synthase genes.
- Mapping the proteome associated with the transcription start site (TSS) of ganglioside-synthase genes in cancer.

Work Achieved :

a) Identification of a novel role of ganglioside GM2 in inducing EMT changes through modulation of HIPPO-YAP/TAZ transcriptional program.

b) Identified a possible role of ganglioside GM2 in regulating miR-615-5p function in controlling tumorigenesis.

c) Eriodictyol mediated selective targeting of the TNFR1/FADD/TRADD axis in cancer cells induce cancer cell apoptosis and inhibits tumor progression and metastasis.

d) Defined a novel role of ganglioside GM2 in inducing DNA damage response and repair pathways in cancer cells.

Future Research Plans :

a) Delineating the mechanism of GM2-mediated epithelial-mesenchymal transition (EMT) – understand the role of HIPPO-YAP/TAZ signaling axis in GM2-mediated EMT and metastasis.

b) Identification of the molecular machinery (proteome) involved in the epigenetic regulation of the GM2-synthase gene - extend the applicability of the genome editing tool, CRISPR, by using CRISPR-dCas9 for an "en-ChIP" assay which will help pull down the entire proteome associated with the TSS of the GM2-synthase gene.

c) Identifying how ganglioside GM2 modulates expression of tumor suppressor miR-615-5p, towards a pro-tumorigenic outcome.

d) Elucidation of the mechanism behind ganglioside GM2-mediated promotion of DNA damage response and repair, that may lead towards generation of chemo-resistance in cancer.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
01	02	NIL	03	02	NIL	NIL

PROF. MAHADEB PAL
Professor

Group Members :
Hossainoor R Sareng, *JRF*; Samhita De, *SRF*
Suvranil Ghosh, *SRF*; Soumyadip Paul, *SRF (PhD awarded)*
Naibedya Dutta, *SRF*; Asif Ali, *SRF (PhD awarded)*
Chirantan Majumder, *SRF*; Anirban Manna, *SRF*
Shivani Chandel, *SRF-NIPER*; Vinod Nelson, *SRF (PhD awarded)*
Joyita Hazra, *SRF (PhD awarded)*; Papri Basak, *RA*

Scientific Report

Background and Vision :

A normal cell removes toxicity associated with protein mis-folding through activating proteotoxic stress response (PSR). PSR works through up-regulation of inducible protein chaperones (HSPs), proteasome and/or autophagy pathway using heat shock factor 1 (HSF1) as a central regulator. HSF1/PSR is activated upon sensing mis-folded protein and/or protein aggregate. However under neurodegenerative and cancer conditions cells lose standard control over their HSF1 function. A cell with Parkinson's disease dies due to its inability to sense a mis-folded protein that it accumulates, and up-regulate HSF1 function. In fact, forced up-regulation of HSF1 ameliorates the protein mis-folding associated toxicity in cell and animal model. Yet, no specific small molecule activator of HSF1 has reached the clinic. In cancer, cells also lose standard control over HSF1 function; Cancer cells require constitutively

activated state of HSF1 for sustained survival and proliferative potential; HSF1 has been lately observed to control expression of various oncogenes. Therefore, understanding these processes at the molecular level should help develop strategy to intervene cancer with better efficacy. A small molecule inhibitor of HSF1 would also carry a great anticancer therapeutic potential. Inhibition of critical oncogenes and activation of tumor suppressors and/or associated regulatory pathway are being extensively pursued for potential therapeutic ends.

Aims and objectives :

Major Objectives

- Study mechanism of actions of HSF1-activator, azadiradione to obtain insights into its cellular function in protein quality control as well as to evaluate its therapeutic potentials for Parkinson's disease and lifespan extension.
- Understand mode of action of andrographolide in cellular protein quality control.
- Understand molecular basis of HSF1 induced TNFα expression to control cellular inflammation.
- Isolate and mechanistic functional analysis of anti-prostate and colon cancer activities from *Bergenia ligulata* and *Ervatamia coronaria*, respectively to evaluate their therapeutic potentials.

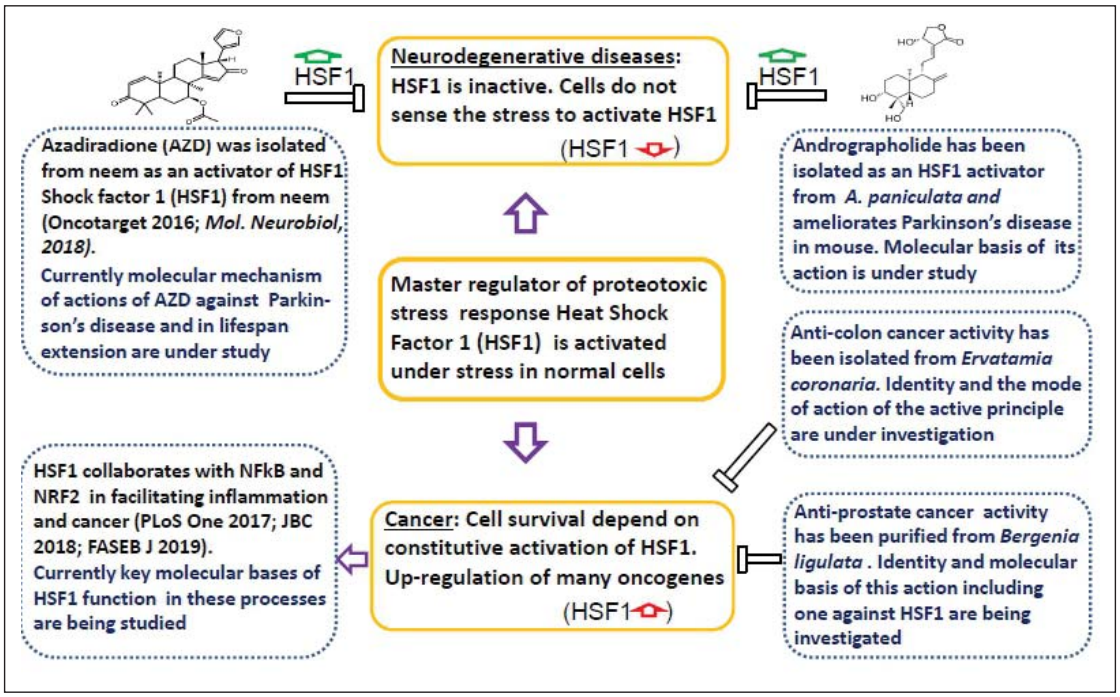
Work Achieved :

Identified for the first time

- That azadiradione significantly ameliorates Parkinson's disease in mice and underlying mechanisms. (Background ref: Nelson, V. et al Oncotarget 2016; Singh, B. et al Mol. Neurobiol 2018).
- A molecular interaction key to HSF1-driven expression of TNFα responsible for pioneering signal for inflammation in human cells (Background ref: Ali, A. et al FASEB J 2019).
- Purification and understand the molecular basis of action of anti-colon and anti-prostate cancer activity from *Ervatamia coronaria and Bergenia ligulata,* respectively.
- That andrographolide regulates cellular protein quality control and Parkinson's disease with unique mechanism

Future Research Plans:

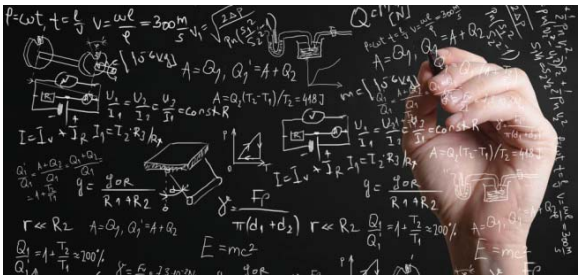
I) Study azadiradione to obtain deeper insights on it molecular basis of action in cellular protein quality control. ii) Understand the active principle/molecule(s) in *Bergenia ligulata* and *Ervatamia coronaria* for their anti-prostate- and anti-colon cancer activity, respectively. iii) Study molecular basis of action of andrographolide to obtain deeper insight into its function in cellular protein quality control. iv) Understand HSF1-controlled expression of human TNFα implicated in cellular inflammation for possible therapeutic intervention.



Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
01	02	02	02	02	NIL	01

SCIENTIFIC REPORT
DEPARTMENT OF PHYSICS



Department of Physics

OVERVIEW

Department of Physics has been an integral part of the Institute from the very beginning and evolved along with the Institute. Though founder himself was involved mainly in his biological experiments, the Physics Department was involved in both theoretical as well experimental studies of different aspects, such as, propagation of radio waves in the ionosphere, propagation of supersonic wave in different media, study of nuclear disintegration, radioactivity and Cosmic Rays. Presently the research in the department is focused mainly in five areas namely, (a) Complex Systems and Statistical Physics (b) Nanoscience and advanced materials (c) Quantum Information and Foundation (d) Nuclear Physics and (e) High Energy and Astroparticle Physics.

LIST OF PERSONNEL

Faculty Members : Prof. Swapan Kumar Saha, (Superannuated on 31.01.2019); Dr. Sanjay Kr. Ghosh, (Chairman); Dr. T.P. Sinha, Dr. Somshubhro Bandyopadhyay, Dr. Rajarshi Ray, Dr. Dhruba Gupta, Dr. Supriya Das, Dr. Sidharth Kr. Prasad, Dr. Saikat Biswas, Dr. Achintya Singha, Dr. Soumen Roy.

Senior Scientists :

Prof. Probir Roy, INSA Senior Scientist; Prof. Sushanta Dattagupta, INSA Senior Scientist; Prof. Sibaji Raha, DAE-Raja Ramanna Fellow, Prof. Dipankar Home, NASI Senior Scientist, Prof. Barun Kr. Chatterjee, CSIR Emeritus.

Research Scientist : Dr. Subhasis Roy, Research Scientist (Assistant Professor of C.U.)

Students : RA : Dr. Prasenjit Deb, Dr. Susnata Seth, Dr. Alo Dutta, Dr. Mandira Sinha. **SRF/JRF :** Rathijit Biswas, Pratapaditya Bej, Sananda Raychaudhuri, Som Kanjilal, Abhishek Banerjee, Sumana Bhattacharyya, Souradeep Sasmal, Pooja Bhattacharjee, Pracheta Singha, Deeptak Biswas, Debarshi Das, Trishna Bhattacharyya, Arkaprabha Ghosal, Kaushik Naskar, Md. Asif Bhatt, Debjani Banerjee, Arindam Sen, Shreya Roy, Pratik Ghosal, Prottoy Das, Sayak Chatterjee, Abhi Modak, Md. Sariful Sheikh, Ram Awadesh Kumar, Moumin Rudra, Tushar Kanti Bhowmik, Sreyan Raha, Kabita Kundalia, Sk. Mustak Ali, Ranjan Sutradhar, Sumana Gope, Himadri Sekhar Tripathi, Deep Nath, Subhankar Maity, Sahanaj Aktar Banu, Chumki Nayak, Suvadip Masanta, Saswata Halder, Sanjoy Mukherjee, Saptarshi Sinha, Arup Roy, Dr. Abhishek Atreya, Shib Shankar Singha, Tara Shankar Bhattacharyya..

Staff Members : Dr. Subhasis Banerjee, Subrata Das, Sujit Kr. Basu, Kaushik Maiti, Kanak Baran Hazra, Shyam Sundar Mallick, Manas Datta, Rita Chakrabarty, Raj Kumar Mourya, Amar Nath Hela, Ranjit Das.

DR. ACHINTYA SINGHA
Associate Professor

Group Members :
Shib Shankar Singha, Guest Researcher
Tara Shankar Bhattacharya, Guest Researcher
Sreyan Raha, SRF; Chumki Nayak, JRF; Suvadip Masanta, JRF

Scientific Report

Background and Vision :

In the past few decades, there has been an enormous development of research on low dimensional systems. Nanostructures materials act as a laboratory to study the fascinating phenomenon in the sub-micron regime. The basic research on low dimensional systems not only meets the desire of scientists but also generates the foundation for future technological applications. Raman and photoluminescence spectroscopy have emerged as powerful tools for probing the lattice dynamics and electronic properties of materials. The techniques provide immense information such as the interaction of phonon with various other quasiparticles (e.g., electrons, magnons, orbitons, etc.), phase transition, thermal property, defects, carrier concentration, strain etc. Our research focuses on the study of electronic and vibrational properties of nanoscale materials and understanding the interplay between phonons/electrons and other quasiparticles in low dimensional materials using Raman and optical spectroscopy and investigating their applications in sensing and storage devices.

Our current research involves:

- Study of lattice dynamics in low dimensional systems
- Understanding interplay between phonons and other quasiparticles
- Light matter interaction at low dimension
- Surface Enhanced Raman Scattering (SERS)
- Development of energy storage devices

Summary of Research Work :

- Tailoring light-matter interaction in 2D-0D hybrid system

Recently, considerable attention has been paid to tune the emission using hybrid systems composed of layered transition-metal dichalcogenides and metal nanoparticles (NPs) since metal NPs have the ability to enhance and localize the incident electromagnetic field. Furthermore, these hybrid systems show great interest from the standpoint of fundamental science as it constitutes an atomic scale prototype of charge-transfer complexes.

Here, we realized WS_2–gold (Au) NPs hybrids by chemically growing Au NPs at the edges of the mechanically exfoliated bilayer WS_2. The Au NPs significantly increase the light-matter interaction which has been studied through Raman and photoluminescence (PL) spectroscopy. A substantial enhancement of the PL intensity in the WS_2–Au composite concerning the pristine WS_2 has been observed, and it increases as the number and size of the Au NPs on WS_2 is increased. Geometry-dependent modification of plasmon resonance energy of Au NP alters the coupling strength between the emission pathways of WS_2 and the plasmon which is manifested by a change in relative intensity between trion (X–) and exciton (X) emissions.

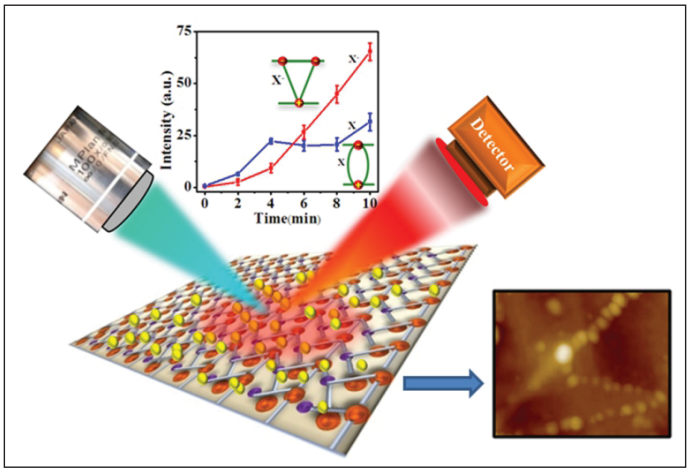


Fig.1: Schematic representation of the light matter interaction study in 2D-0D hybrid system

We probe the mechanism of the PL intensity modulation through polarization-dependent measurements and simulation. We have demonstrated that, in WS_2, the internal quantum efficiency increases and activation energy decreases due to coupling with Au NPs. Compared to pristine WS_2, a faster change in optical band gap with temperature in WS_2–Au may be due to enhancing electron-phonon interaction and lattice expansion in the latter. The work indicates the possibility to develop high performance transition-metal dichalcogenide-based photonic devices **[T. S. Bhattacharya et al., Physical Review B 100, 235438 (2019)].**

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
01	07	NIL	04	02	NIL	NIL

PROF. DHRUBA GUPTA
Professor

Group Members :
Dr. Mandira Sinha, *RA*; Sk. Mustak Ali, *SRF*
Kabita Kundalia, *SRF*; Subhankar Maity, *JRF*
Sahanaj Aktar Banu, *JRF*
Sumana Singh, *Senior Technical Associate*; Manas Datta

Scientific Report

Background and Vision :

I work in nuclear astrophysics. In recent times, with the development of new and upgraded accelerators worldwide, one can carry out sophisticated experiments with unstable exotic nuclei or the rare isotopes of the stable nuclei. This opens up immense opportunities to pursue pressing problems in nuclear astrophysics, which may lead ultimately to a comprehensive understanding of the nuclear force and the origin of elements in the universe. In this area of research, we encounter strange structures like nuclear halos, nuclear skins and even new magic numbers as we move away from the line of stability towards the drip lines. For a systematic study of the stable isotopes and their radioactive counterparts, the lithium and beryllium isotopic chains are specially attractive as they play an important role in studying abundance of light elements in Big Bang Nucleosynthesis (BBN). The BBN theory is consistent with observation for the abundance of light nuclei except for 7Li, where an anomaly by a factor of four is observed and is known as the Cosmological Lithium problem, unsolved for decades. Other interesting issues involve radioactive capture reactions in relation to the transit from Carbon-Nitrogen-Oxygen (CNO) cycle to the hot CNO cycle occurring in several astrophysical

situations and also inhomogeneous nucleosynthesis. Since exotic unstable/unbound nuclei would pervade this field in the coming years, it is also necessary to develop robust theoretical frameworks exclusively to study such nuclei, thus complementing experimental findings.

Summary of Research Work :

The *cosmological lithium* problem is at present a widely studied and yet unresolved problem in nuclear astrophysics. We continued the data analysis of the experiment that we carried out earlier at CERN to study this problem. The analysis shows higher excitations of ^{8}Be apparent from the energy *(E)* vs scattering angle (θ) plot of the protons detected in coincidence with the alphas from dissociation of ^{8}Be (Fig. 1). In particular, the 16.63 MeV state of ^{8}Be has been confirmed from detailed analysis. Further work is in progress to separate other nearby excited states. The α-cluster transfer reactions and breakup of ^{7}Be and their astrophysical significance are also being investigated from the data. The NPTool package is extensively used in simulations and analysis of the *data*

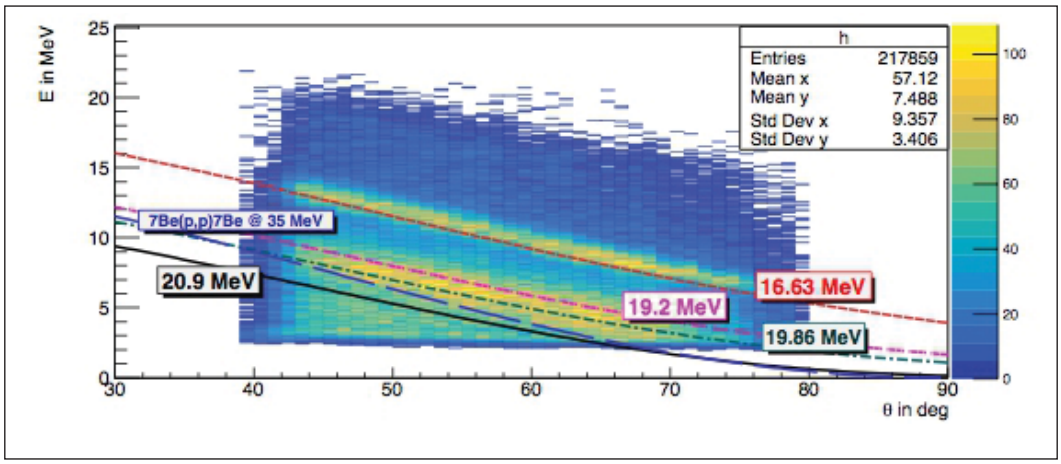


Figure 1: E vs θ plot of the protons from the 7Be(d,p)8Be* reaction.

Earlier, we also developed a robust theoretical framework using supersymmetric quantum mechanics (SQM) to generate the resonant states and their wave functions for unstable and unbound nuclei with excellent results. While working on the lithium problem, we see that an important clue is the resonance enhancement through a high-lying state in the ^{9}B nucleus. Therefore, we used the SQM framework to study the high-lying resonance of ^{9}B. We identified the resonance at 16.84 MeV with a width of 69 keV (Fig. 2). In future, we also plan to carry out the decay properties of such resonances which are relevant to the context of nuclear astrophysics.

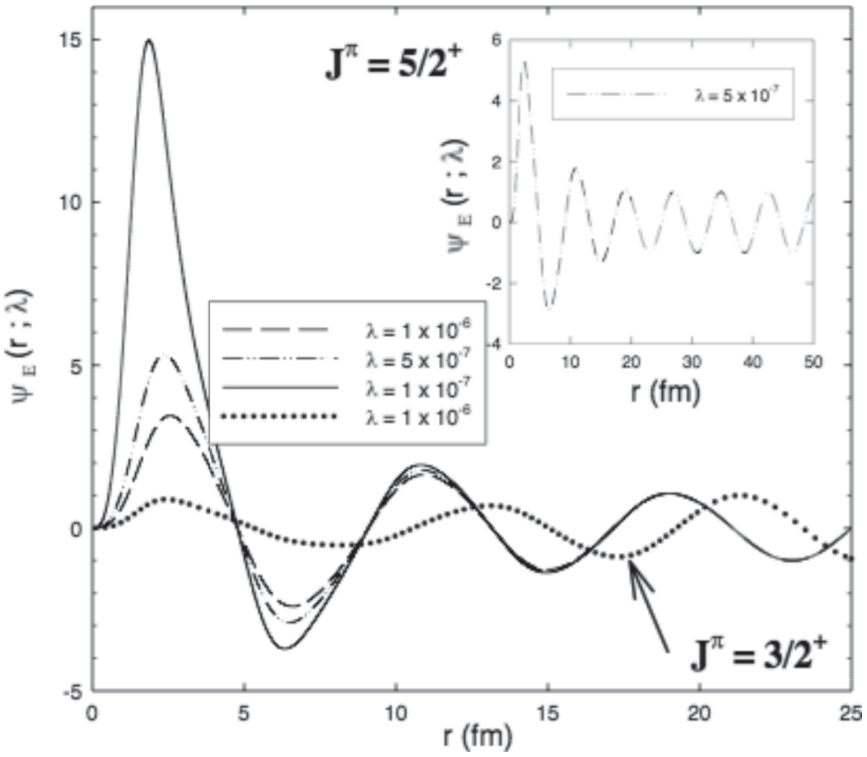


Figure 2: Wave function (in arbitrary units) at the excitation energy of 16.84 MeV for λ=1x10^{-6}, 5x10^{-7}and 1x10^{-7}for the 5/2+ state of ^{9}B.The inset shows the wave function plot for λ = 5x10^{-7}in an expanded scale up to 50 fm.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	04	NIL	01	01	NIL	NIL

PROF. RAJARSHI RAY
Professor

Group Members :
Sumana Bhattacharyya, *SRF-CSIR*
Pracheta Singha, *SRF-INSPIRE*; Pratik Ghoshal, *JRF*
Abhishek Atreya, *NPDF*; Sreyan Bhowmick, *Summer Intern*

Scientific Report

Background and Vision :

The elementary particles undergoing interactions under the fundamental strong force are the quarks and gluons. They are bound within femtometer distances due to the elastic-like confinement of the intrinsic charges of strong force, known as 'colour' charges. At temperatures ~ 10^12 K and / or at matter densities ~ 10^17 Kg/m^3, the strong interactions become Coulombic, and colour charges flow over macroscopic distances. This state of matter is known as Quark Gluon Plasma. Such high temperatures possibly existed in the early universe and such high densities may now exist in the core of super-massive stars like the neutron stars. Exploration of this unknown teritory of possible phases of strong interactions is being undertaken at various high energy particle laboratories around the world.

The first principle theory of strong interactions is Quantum Chromodynamics. If the interaction strength is not so strong one can perform analytic perturbative analysis. But the interesting phenomenon of transition of colour confined hadronic matter to the deconfined quark gluon matter occurs when the interaction is really strong. From first principles it is an

extremely complicated, involved and time consuming problem to solve in the so called lattice formulation. It would therefore be useful to build a model system that mimics the relevant physics of the system and yet remain light on the required resources. This is the direction that we have been pursuing in our group.

Aims and Objectives :

Our aim was to study the general thermodynamic properties for strong interactions from theoretical models, as well as contrasting the theoretical results with experimental data.

- Studied the limitations of Polyakov Loop enhanced Nambu-Jona-Lasinio model by contrasting them with certain available first principle results as well as by confronting with the experiments. The limitations were two-fold. One is that the hadronic features in the low temperatures regime were not manifested. Second is that the quasiparticle picture of the gluons were not giving physically acceptable results.
- To address the first issue we are building up a reliable model that can accommodate a higher number of physical features of strong interactions vis-à-vis the expectations from first principles. For that we have been motivated by the beyond mean-field analysis of the quark part of the model.
- For the second issue again we are working on the beyond mean-field analysis of the gluon part of the model.
- We further used the Hadron Resonance Gas (HRG) model for the study and characterization of strongly interacting systems formed in the ultra-relativistic heavy-ion collision experiments.

Summary of Research Work :

Role of Conserved Charges In Determining The Freeze-out Hypersurface In Heavy-ion Collision Experiments.

- HRG model to be used for analyzing the hadronic yield data in heavy-ion collision experiments, by equating conserved charges, and observe the extent of chemical equilibration at the freeze-out.
- The quantities to be further analyzed with the experimental data using the chi-squared analysis. The parameters so obtained will be contrasted against the parameters obtained in the above method.
- The various hadron yield ratios to be predicted and compared with the data.
- We are to further test the equilibration by predicting the various fluctuations and correlations of the conserved charges of strong interactions

We have partially addressed the first three objectives. The estimation of the chemical equilibrium parameters from the experimental data at the freeze-out were extracted from a novel technique we proposed in this project. This has been reported in second item in the list of publications.

Thereafter the usual techniques of chi-square tests were performed in first item in the list of publications, along with the novel estimate of systematic uncertainties for the first time in the literature. The various parameters and hadron yields from both the methods agreed to a good extent. This seems to indicate that the gross features of equilibration of strong interactions are present in the experimental data.

Future Research Plans :

There are however some crucial observables that are left to be predicted and verified from the data. One of them is the set of various fluctuations of the conserved charges of strong interactions. This is the work that we intend to carry on in the coming financial year. There are in principle two approaches. One is that using the parameters already obtained by us from the hadron yields, we predict the fluctuations and compare them with the data. The other is to use a combination of yield and fluctuation data to extract the chemical paramters and then predict the others. Both these approaches will be taken up using the chi-squared approach as well as our novel charge equation methods.

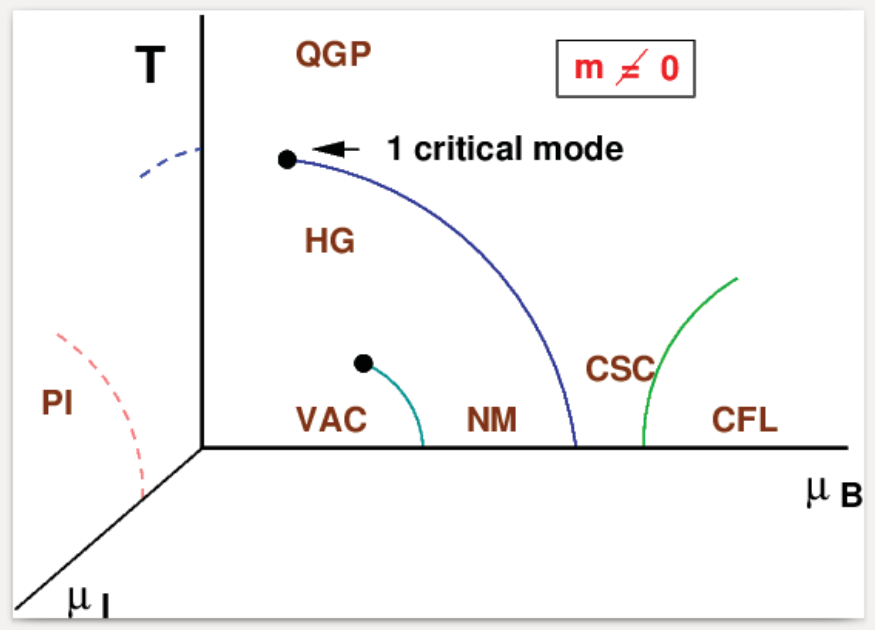


Figure illustrating the essence of our research work

The figure illustrates the phase diagram of strongly interacting matter. T is the temperature axis and the other two are the baryon and isospin chemical potential axis respectively. The phase structure is quite rich with different phases and phase boundaries, crossover regions, critical end points as has been investigated in various models. Here HG denotes the hadron gas phase and QGP denotes the quark gluon plasma phase discussed previously.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	03	NIL	06	NIL	NIL	NIL

DR. SAIKAT BISWAS
Associate Professor

Group Members :
Sayak Chatterjee, *JRF*; Arindam Sen, *JRF*; Shreya Roy
Shubham Jaiswal; Rituparna Banerjee, *IIT-ISM, Dhanbad*
Krishna Nivedita G, *IISER Thiruvananthapuram*
Aayushi Paul, *University of Calcutta*
Abhisek Roy, *Central University, Jharkhand*
Debonita Saha, *St. Xavier's College*; Subrata Das

Scientific Report

Background and Vision :

I am working on the Physics of the particle detectors, specifically on the research of gaseous detectors and the scintillation detector.

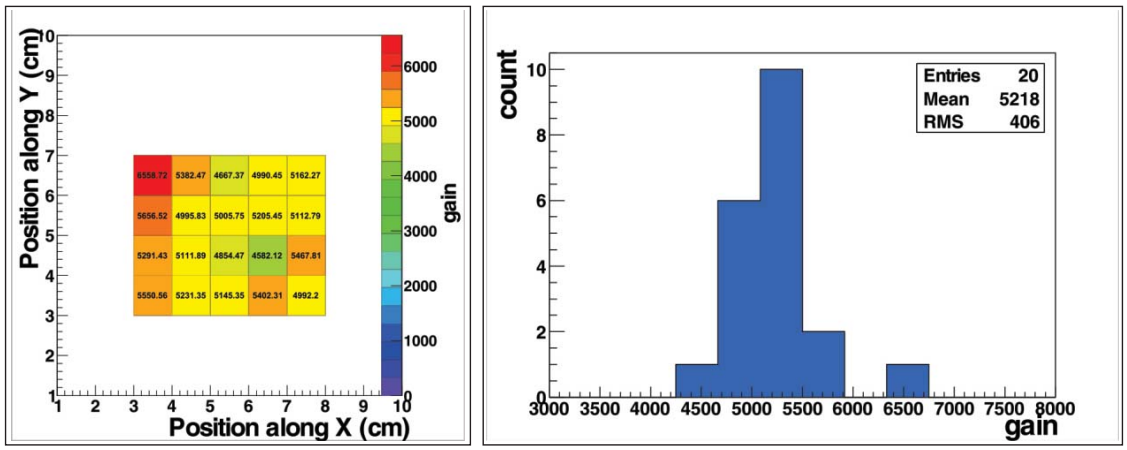
Bose Institute is contributing to the research program of up-gradation of the ALICE Time Projection Chamber (TPC) with Gas Electron Multiplier (GEM) at CERN, Geneva and on the Muon Detection System (CBM-MUCH) of CBM experiment at FAIR, Germany. The goal of the ALICE experiment is to study the physics of Quark-Gluon Plasma (QGP) at low baryonic density and high temperature, whereas that of CBM is to study the QGP physics at low temperature and moderate to high baryon densities. As both these detection systems will use GEM based chambers, we are working on the R&D of these detectors in the High Energy Physics detector laboratory. This R&D program includes research on Resistive Plate Chamber (RPC), Gas Electron Multiplier (GEM), Straw tube detector and Scintillation detector (for cosmic ray study).

Summary of Research Work :

(Collaboration with Supriya Das, Sanjay K. Ghosh, Sidharth K. Prasad, Sibaji Raha)

A systematic study on stability of the gain and energy resolution of a triple GEM detector in long term operation under a high rate of X-ray irradiation is performed with Ar/CO_2 gas mixture in 70/30 ratio, using conventional NIM electronics. The prototype under test did not show any significant degradation in performances in a continuous operation of > 1200 h under a high rate of X-ray radiation.

To check the uniformity in performance, the gain, energy resolution and count rate are measured at 20 places on the active area of the triple GEM detector prototype moving a Fe^{55} X-ray source manually. Over the measured area the gain fluctuation is found to be ~10% while the fluctuation of energy resolution and count rate is ~20%.

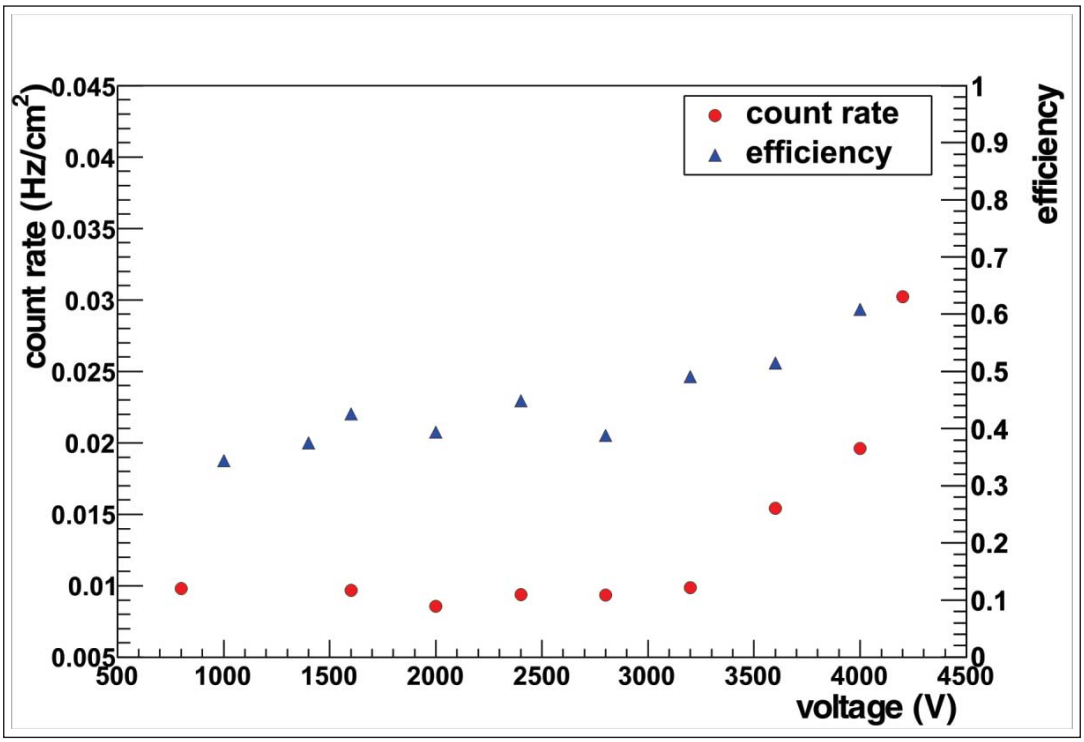


Variation of gain at different points of the detector and their distribution

Quadruple GEM detectors have distinct advantages over the triple GEM for their low IBF (Ion Back Flow) capability and low discharge rates. A quadruple GEM is operated with standard and IBF field settings using Ar/CO_2 90/10 and 70/30 gas mixtures. The gain and energy resolution of the detector are measured for both the field configurations. It is found that in the IBF setting, the gas gain is lower compare to the standard setting at same $\Delta V_{GEM-tot}$. The reason is understood as lower electron multiplication in individual GEM foils. The IBF setting has poorer energy resolution, which may be caused by the low gain in the GEM.

A systematic study on the basic characteristics of the straw tube detector is performed using conventional NIM electronics. In this study, Ar/CO_2 gas mixture is used both in 70/30 and 90/10 volume ratio. The gain and energy resolution are measured from the energy spectrum obtained using Fe^{55} X-ray source. In this study, the variation of gain and energy resolution of the straw tube detector with X-ray rate are measured for the first time in a laboratory. The gain and the energy resolution remain constant up to a rate of about $2x10^4$ Hz/mm and $3.2x10^4$ Hz/mm for Ar/CO_2 70/30 and 90/10 respectively. Beyond these quoted values, gain decreases, and the energy resolution increases with the increase of rate because of the space charge effect.

A single gap RPC (Resistive Plate Chamber) prototype is fabricated with very low resistive carbon-loaded PTFE plate commonly known as Teflon, to improve the rate capability. The detector is tested in avalanche mode using 100% R-134a as the sensitive gas. A charge sensitive preamplifier with gain 2 mV/fC and shaping time 300 ns is used for signal collection. The V–I characteristics, variation of noise rate and efficiency as a function of voltage are studied. At a voltage of 4 kV an efficiency ~60% is achieved.



Noise rate and Efficiency Vs. voltage for RPC

An array of seven plastic scintillator detectors is operational at an altitude of about 2200 m above the sea level in the Himalayas at the Centre for Astroparticle Physics & Space Sciences, Darjeeling campus of Bose Institute, for detection of cosmic ray air showers since the end of January 2018. From this array it is found that at an altitude of about 2200 m the average air shower rate is ~1.54 Hz with a sigma of 0.22.

Mr. Sayak Chatterjee receiving the Best Poster Award in Workshop on DQCD at NISER

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	09	NIL	06	01	NIL	01

PROF. SANJAY KR. GHOSH
Professor

Group Members :
Deeptak Biswas, *SRF*; Trishna Bhattacharyya, *SRF*

Scientific Report

Background and Vision :

- Unraveling the mysteries of neutron stars – looking for exotic components such as strange quark matter inside neutron stars - experiments and effective model studies
- Understanding of regional climatic variability – observation analysis and mode.

Summary of Research Work :

- In order to study the hadron- quark phase transition in an unified way, a switching function has been introduced to interpolate between quark sector (PNJL model) and hadronic sector (HRG model). Equation of state and the fluctuations and correlations obtained in this hybrid model agree satisfactorily with the lattice QCD data in the low temperature regime.
- A new prescription for obtaining the chemical freeze-out parameters in the heavy-ion collision experiments using the Hadron Resonance Gas model. The scheme is found to reliablyestimate the freeze-out parameters and predict the hadron yield ratios, which themselves were neverused in the parametrization procedure.

- A novel image processing technique based on convolution is developed for analyzing the etch-pit images inNuclear Track Detectors (NTDs). The outcomesof the application of the proposed method on the different types of NTDs (e.g.,CR-39, PET) containing etch-pit openings of different sizes and shapes (circular and elliptical) is presented. Promising results have been obtained for bothidentifying and counting the etch-pits in NTDs.
- Atmospheric electric field has been studied for the first time for high altitude site in eastern-HimalayasAustauch effect may be playing a role in summer. Planetary boundary layer dynamics seem to be a major factor.

Project Title :

- Comprehensive study of urban heat island condition (UHI), its response during heat wave conditions and interdependence on local climatic variability over Kolkata urban agglomeration using surface and satellite observations and numerical simulations using WRF coupled with Urban Canopy Model (UCM).

Project Summary :

- In the present project we would like to study the UHI effect in Kolkata along with its interaction with heat waves and its dependence/effect on regional climatic variability. For this purpose we would measure weather parameters such as temperature, humidity, rain, solar radiation etc. at different suitably chosen points in and around the city limits. In addition we would also need the land surface temperature. These parameters will be then compared with the WRF model output for validation of the model and to understand the basic mechanism. The satellite retrieved land surface temperature will be used to generate the land surface temperature map of the city and to compare with the observed value.

Aims and Objectives :

- Understanding of Urban heat island (UHI) in association with heat wave conditions and local climatic variability over Kolkata urban agglomeration.

Work Done :

- In the present time span we have mainl concentrated on having an idea about the heat island effect using satelite data. The UHI intensity for the megacity Kolkata has been derived using satellite derived land surface temperature (LST) product. Since the LST can be very different from the near surface atmospheric temperature the UHI intensity derived from LST can be defined as Surface Urban Heat Island Intensity (SUHII). In the present study SUHII was derived using Moderate Imagery Spectroscopy (Modis) Terra and Aqua satellites which passes over the Indian region during Terre - 10:30 am, 10:30 pm and Aqua - 1:30 am,1:30 pm.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
01	04	NIL	NIL	01	NIL	NIL

DR. SIDHARTH KUMAR PRASAD
Associate Professor

Group Members :
Abhi Modak, *JRF, Institute Fellow*
Prottoy Das, *JRF, Institute Fellow*
Debjani Banerjee, *JRF, DST Inspire Fellow*

Collaborations:
A Large Ion Collider Experiment (ALICE) at CERN, Geneva
Compressed Baryonic Matter (CBM) experiment at GSI, Germany

Scientific Report

Background and Vision :

One of the main goals of our research is to characterize a novel/new state of matter with partonic degrees of freedom known as Quark Gluon Plasma (QGP), produced in heavy ion collisions. Understanding and precise measurements of various properties of QGP such as viscosity, thermal conductivity, diffusion/transport coefficients etc are some of the open questions to be addressed through the study of QGP.
Several probes and scientific methods are applied to characterize the QGP. Our research mainly focuses on the study of hard probes and photon production using ALICE experiment at Large Hadron Collider. Instrumentation, detector development, development of computing algorithms and Monte Carlo simulations for detection and reconstruction of particles produced in these collisions are also integral part of our research program.

Aims and Objectives :

- Characterization of a new state of matter QGP: Performing experiments through the participation and contributions in the largeinternational experimental collaborations such as ALICE at CERN, Geneva and CBM at FAIR, GSI, Germany to study and explore the QGP.
- Development of in-house facilities and expertise for detector R&D, instrumentation and computational techniques for big data analysis.
- Physics publications in journals about understanding of heavy ion collisions through formation and characterization of QGP.
- Development of a cooling system for the CBM-MUCH detector.

Work Achieved :

- Study of jet production and its properties in proton-proton and proton-lead collisions is being carried out using ALICE at LHC.
- Measurements of photon multiplicity and pseudorapidity distributions in proton-lead collisions at 5.02 TeV are being performed and intermediate results are reported as conference proceedings.
- Investigation of jet-medium interactions using JEWEL Monte Carlo model is performed in Pb-Pb collisions at LHC energy.
- Quality checks and reconstruction of PMD proton-lead data and Monte Carlo simulations are obtained within ALICE.
- Water based cooling system is developed for individual modules of CBM MUCH and used in the mini-CBM experiment at GSI, Germany.

Future Research Plans :

- Physics analyses and publications of the LHC data to explore the Physics of strongly interacting matter at extreme energy density through characterization of QGP properties.
- Production, tests and quality assessment of a Gas Electron Multiplier (GEM) based Muon Chamber (MUCH) detector for the CBM experiment at FAIR, GSI, Germany.
- R&D and commissioning of a cooling system for the full station of the MUCH detector in the CBM experiment.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	34	NIL	03	02	NIL	NIL

PROF. SOMSHUBHRO BANDYOPADHYAY
Professor

Group members:
Prasenjit Deb, Arup Roy, Pratapaditya Bej,
Abhishek Banerjee, Arkaprabha Ghosal

Collaborators:
Debarshi Das *(Bose Institute),*
Saronath Halder *(IISER Berhampur, Saptarshi Roy (HRI),*
Tomasz Paterek *(NTU, Singapore)*

Scientific Report

Background and Vision :

Information encoded in quantum systems is quantum information, and therefore, quantum information processing must obey the laws of quantum physics. The discovery of this simple idea has led to novel communication protocols including secure cryptography primitives, exceptionally fast algorithms and many applications in quantum many-body problems.
While quantum information and computation has been the cornerstone of cutting edge research in physics, mathematics, and computer science for many years now, especially because of the promise of revolutionizing the existing technology, our research, however, is mostly aimed at addressing fundamental problems in the resource theory of entanglement, entanglement distribution, quantum state discrimination, quantum channels, quantum protocols and interpretation of quantum mechanics.

Aims and Objectives :

The broad focus of our research group is to understand the role of quantum entanglement in distributed information processing tasks, and properties of quantum many-body systems within the paradigm of Local Operations and Classical Communication (LOCC). Specifically,

- Understanding the strengths and limitations of LOCC protocols—the protocols that play a fundamental role in distributed quantum information processing—in quantum state discrimination problems.
- Understanding quantum entanglement as a resource within the paradigm of LOCC but often enlarging the set of allowed quantum operations.
- Understanding quantum correlations in quantum many-body systems.

Achievements :

- Obtained an exact computable formula for fidelity deviation in quantum teleportation with an arbitrary two-qubit state.
- Characterized optimal two-qubit states for quantum teleportation in relation to the state properties.
- Showed that the no-superposition theorem is, in fact, related to known no-go theorems in quantum theory.

Future Plans :

- To obtain the exact entanglement cost and the corresponding optimal resource states in quantum state discrimination problems using LOCC.
- To understand the emergence of nonlocal properties in a two-body system, parts of which never interacted in the past, in the setting of entanglement swapping using weak measurements.
- To completely characterize quantum information processing tasks such as quantum teleportation, super-dense coding, quantum cloning, etc. in terms of fidelity and fidelity deviation.

To develop a theory based on the techniques of quantum information to address the information paradox in black holes.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
01 (Ph.D. viva completed, February, 2020)	02	NIL	02	01	NIL	NIL

DR. SOUMEN ROY
Associate Professor

Group Members :
Deep Nath, *JRF*; Saptarshi Sinha, *SRF*; Sumana Gop, *SRF*

Scientific Report

Background and Vision :

Diverse natural, engineered and economic systems are composed of many constituents and subconstituents interacting non-trivially amongst themselves and perhaps even with the environment. Numerous examples of such systems can be found in the physical as well as the living world. Networks often successfully capture the architecture of the underlying complexity in these systems.

We employ a fully interdisciplinary approach using tools from physics, mathematics, statistics, network science, computation and experiments. Non-linear dynamics and game theory are some other useful tools to study such systems. Almost all of our published work is based on empirical or experimental data.

Summary of Research Work :

a) Phage–bacteria interaction is a classic example of competitive coevolution in nature. Mathematical modeling of such interactions furnishes new insight into the dynamics of phage and bacteria. Besides its intrinsic value, a somewhat underutilized aspect of such insight is that it can provide beneficial inputs toward better experimental design. Monte Carlo simulations and

differential equations (both ordinary and delay differential equations) can be used to successfully model phage–bacteria dynamics in well-mixed populations. The presence of spatial restrictions in the interaction media significantly affects the dynamics of phage–bacteria interactions. For such cases, techniques like cellular automata and reaction-diffusion equations can be used to capture these effects adequately. In a recently published work, we have demonstrated with specific examples as to how the above modeling techniques can shed valuable insight.

b) PSMD10^{Gankyrin}, a proteasome assembly chaperone, is a widely known oncoprotein which is associated with many distinctive features of cancer. However, except proteasome assembly chaperon function its role in normal cell function is undetermined. To address this, we induced PSMD10^{Gankyrin} overexpression in HEK293 cells and the resultant large-scale changes in gene expression profile are studied. We constituted networks from microarray data of these differentially expressed genes and carried out extensive topological analyses. The overarching yet consistent theme that became visible throughout these analyses using varied network metrics is that all genes and interactions identified as important seem to be strongly associated with neurogenesis and neuronal development. We therefore tested the prospect of PSMD10^{Gankyrin} being strongly incorporated with cell fate decisions that commit neural stem cells to differentiate into neurons. Overexpression of PSMD10^{Gankyrin} in human neural progenitor cells facilitated neuronal differentiation via β-catenin Ngn1 pathway. Thus, network studies have guided us to publish preliminary yet compelling experimental evidence for the first time on the involvement of the potential oncoprotein PSMD10^{Gankyrin}, in neuronal differentiation.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	02	NIL	02	02	NIL	01

DR. SUPRIYA DAS
Assistant Professor

Group Members :
Md. Asif Bhat, *JRF*; Shreya Roy, *SRF*; Rathijit Biswas, *SRF*

Scientific Report

Background and Vision :

Study of matter at extreme condition:

For a long time now scientists all over the world are trying to know about the state of the matter that existed just after the big bang that is believed to have created this universe. The only way to study and characterize this state of the matter is to create it in the laboratory. To achieve this goal a number of high energy accelerators are engaged to collide heavy ions moving in relativistic speed. In these collision a temperature similar to that existed during the time of the big bang is obtained. Theoretical understanding tells us that at this temperature the hadrons melt liberating the quarks and gluons, which forms a soup of deconfined state of matter. However, the temperature soon decreases and the quarks and gluons get confined again to form normal nuclear matter. But the particles formed carry certain signatures, which reveal the features of the matter from which they are generated.

Another extreme condition exists inside the core of neutron stars where the density is very high (~10^{14} times the density of the Sun). It is again believed that the matter at such densities is a soup of deconfined quark and gluons rather than normal nuclear matter. Facilities are being built to create the matter at such high densities inside laboratory to characterize that.

Cosmic rays are high-energy charged particles (~90% of them are protons) that enter into our atmosphere from different sources. They can be detected in direct method by putting detectors in balloons or satellites. But these particles produce hadronic /electromagnetic showers while travelling through the atmosphere and employing ground-based detectors is another way of detecting them.

Aims and Objectives :

i) Characterize matter at extreme conditions using different probes.

ii) Development of new particle detectors to study matter at extreme conditions.

iii) Detect and study properties of cosmic ray air shower at mountain altitude.

Summary of Research Work :

Study of photon production:

Photons are detected at the forward rapidities in the hadron-hadron, hadron-nucleus and nucleus-nucleus collisions at LHC energies using the Photon Multiplicity Detector (PMD). This is the only detector within the ALICE experimental setup. PMD consists of two detector planes covered with tiny hexagonal gas based proportional counters with Ar/CO_2 as active gas, arranged in a honeycomb structure. A 3 x_0 (radiation length) lead converter is sandwiched between these two layers. Highly energetic photon emerging from the collision without producing any signal while passing through the first plane (charged particle veto or CPV) enters into the converter and produces electromagnetic showers by means of pair production and bremsstrahlung. This shower of charged particles hits several cells on the second plane (preshower) and produces signals in those. Whereas any energetic charged particle hits mostly one cell on each of the two planes producing signal in both cases. Moreover, as the shower produced by the photon hits several cells, the total energy deposition on the preshower plane in case of a photon is also more than that for a charged hadron. These information are utilized to distinguish the photons from charged hadrons. The number of photons and spatial distribution of those are studied event by event to characterize the system created in the collision.

In this work we have studied the photon production in pPb collision at center of mass energy of 8.16 TeV. Preliminary results have been obtained and compared to those from physics motivated Monte Carlo models. Detailed correction and estimation of uncertainties are under progress.

(Collaborators: Md. Asif Bhat, Abhi Modak, Sidharth K. Prasad; External collaborator: Sudipan De, NISER)

Performance study of straw tube detector:

Straw tubes are single wire proportional counters with aluminized carbon walls. This detector is used in many high-energy physics experiments and suitable as particle trackers especially because of its low material budget. In this work we have studied the rate capability of a small straw tube prototype. We also studied the long-term stability and time resolution for the same prototype. The results are encouraging for the feasibility of use of this type of detector for future experiments such as CBM that deals with extra ordinary high particle rate.

(Collaborators: Shreya Roy, S. Chatterjee, A. Sen, R P Adak, S. Biswas, S. K. Ghosh, S. Raha; External collaborators: N. Nandi, Raja Peary Mohan College; S. Jaiswal, IITK; V. M. Lysan, G. D. Kekelidze, V. V. Myalkovsky, LHEP-JINR, Dubna)

Study of gamma ray flux during solar eclipse:

It has been reported earlier that the atmospheric gamma ray flux changes during solar eclipse. Na(Tl) detector has been used to record the atmospheric gamma ray flux during a total solar eclipse which happened in August 21, 2017 and was visible in most parts of North America. The significance of this work is to study the effect at a place where the eclipse was not visible.

Results obtained from this suggest that there is a suppression of the gamma-ray flux at a later time compared to the totality of the eclipse. A manuscript has been communicated with a journal.

(Collaborators: Shreya Roy, S. Biswas, S. K. Ghosh, S. Raha)

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	37	01	05	02	NIL	NIL

Mr. Rathijit Biswas
Winner of Prof. Shyamadas Chatterjee Outstanding
Student Award for the year 2019

SCIENTIFIC REPORT
DIVISION OF PLANT BIOLOGY

Division of Plant Biology

OVERVIEW

Originally conceived by Sir J.C. Bose as Department of Botany, the present day Division of Plant Biology works towards realization of his concepts of plant research as an interdisciplinary science that helps understand plants better for sufficing the very basic but essential needs of human population. In this era of population outburst and shrinkage of agricultural land- generating high yielding plants with increased competence in terms of yield and combating environmental stress is a major present day challenge. Plant system offers a unique opportunity to explore properties like totipotency- the plant equivalent feature of stem cell, stress resilience and biodiversity. The unified mission of scientists of this division is therefore directed towards achieving advanced knowledge in fields of plant stress biology, development biology, plant-pathogen interaction and genomics-assisted molecular breeding. The goal of the division will remain to understand the plant system to the extent that will benefit human race and help preserve the balance of nature.

LIST OF PERSONNEL

Faculty Members : Prof. Debabrata Basu (Superannuated), Prof. Shubho Chaudhuri (Chairman), Prof. Gaurab Gangopadhyay, Dr. Pallob Kundu, Dr. Anupama Ghosh.

Research Scientist : Prof. A. N. Lahiri Majunder, INSA Senior Scientist; Prof. Sampa Das, INSA Senior Scientist; Prof. Amita Paul; Prof. Swati Gupta Bhattacharya; Prof. Samir Ranjan Sikdar.

Students : RA : Dr. Swagata Ghosh, Dr. Sathi Paul, Dr. Alka Kumari, Dr. Sambit Datta, Dr. Arpita Basu Chowdhuri, Dr. Jayanti Jodder, Dr. Anindya Kundu, Dr. Mrinmoy Majumder, Dr. Supriyo Chowdhury, Dr. Gourav Sircar, **SRF/JRF :** Rahul Dutta, Dibya Mukherjee, Udita Acharya, Aishee De, Surbhi Shriti, Subhasish Mukherjee, Shreya Chowdhury, Rohit Das, Jinia Chakrabarty, Shrabani Basak, Pratiti Dasgupta, Sanghamitra Adak, Sayantan Ghosh, Amrita Mukherjee Ganguli, Banani Mandal, Rwitie Mallik, Srimoyee Banarjee, Amit Paul, Debabrata Dutta, Bijaya Karmakar, Sangita Roy, Moumita Bhowmik, Moumita Biswas Sarkar, Koyel Sengupta, Sourav Bose, Anisha Roy, Aroni Mitra, Ruby Biswas, Trisha Bhattacharyya, Sonal Sachdev, Sayan Mal, Himadri Das, Ananya Mukherjee, Vivek Awon, Diptasree Kumar, Soumili Pal, Trisha Bhattacharya, Shubham Bhakta, Sukhendu Maity, Pankaj Kumar Sing, Anamika Pal, Abhishek Mukherjee, Soumya Subhra Gupta, Rajat Kanti Sarkar, Tanusri Gayen, Sayani De.

Staff Members : Dr. Chaitali Roy, Subal Basak, Ashim Kumar Nath, Jadab Kumar Ghosh, Kaberi Ghosh, Binoy Krishna Modak, Jayasish Ghosh, Bipul Kumar Nag, Sanjib Kumar Das, Arup Kumar Dey, Nadiram Kayal, Birendra Kumar Bari, Siddhartha Roy, Moumita Mondal, Mr. Tapas Chakraborty.

DR. ANUPAMA GHOSH
Assistant Professor

Group Members :
Rahul Datta, *SRF, Institute Fellow*
Dibya Mukherjee, *SRF, Institute Fellow*
Udita Acharya, *SRF, Institute Fellow*
Subhasish Mukherjee, *SRF, UGC Adhoc*
Aroni Mitra, *DBT-JRF*; Anisha Roy, *DBT-JRF*
Alka Kumari, *CSIR-RA*

Scientific Report

Background and Vision :

We work on various aspects of plant microbe interactions. In particular the primary focus of our research involves exploring the molecular cross talks between a fungal phytopthogen *Ustilago maydis* and its host *Zea mays* that leads to establishment of biotrophic interaction between them. The primary focus of the lab is to understand the molecular strategies of disease establishment by fungal phytopathogens involving a huge array of secreted effector proteins most of which are orphan proteins with no known functions.

Aims and objectives :

- Deciphering the biological functions of secreted effector proteins of *Ustilago maydis.*
- Understanding the apoplastic defence response of host plants against pathogen infection.
- Identifying the effectors of extracellular defence in host plants.

Work Achieved :

- Roles of extracellular ribonucleases Nuc1 and Nuc2 of *Ustilago maydis* in scavenging of extracellular RNA as a phosphate source.
- Role of a secreted aspartyl protease in the sporulation of *U. maydis*.
- Extracellular defence response of rice towards infection with *Rhizoctonia solani* AG1IA through apoplastic proteome study.

Future Research Plans :

- Investigating the host targets for different classes of *Ustilago maydis* effector proteins.
- Investigating the molecular cross talks between model rhizobacterium and maize plants using transcriptome analysis.
- Identifying the components of extracellular defence response of host plants against pathogen invasion.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	NIL	02	01	01	NIL	NIL

PROF. GAURAB GANGOPADHYAY
Professor

Group Members :
Debabrata Dutta, *SRF-UGC*
Soumili Pal, *SRF- INSPIRE*
Vivek Awon, *JRF-UGC*
Diptasree Kumar, *JRF-WBDBT project*
Sananda Bhattacharya, *PhD student*
Shinjini Sengupta, *Botany Department, CU, PhD student*

Collaborators :
Prof. S K Datta, Botany Department, CU
Prof. S K Datta, Botany Department, CU

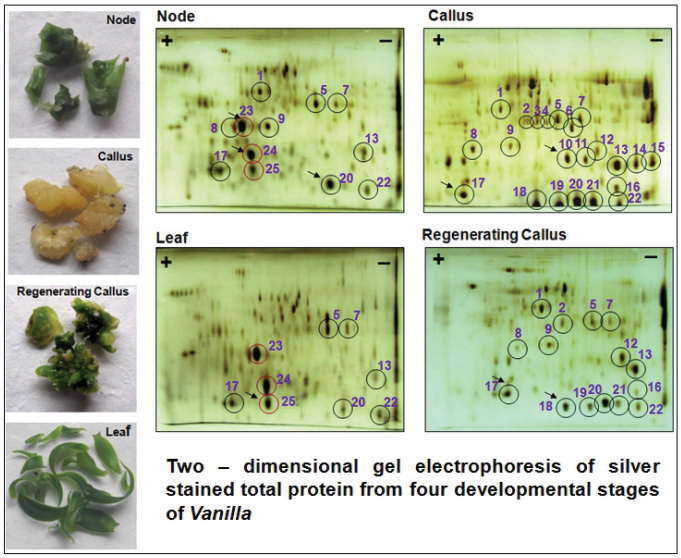
Scientific Report

Background and Vision :

A plant scientist, having a 'feel' for the minute details of the plants - and a belief that understanding the molecular basis of subtle variations can enhance a plant's performance in the field against biotic and abiotic stress.

Summary of Research Work :

- Vanilla is an orchid adored for vanillin, a unique flavouring principle. We have identified a few developmental stage specific-proteins during in vitro morphogenesis in this orchid. The in-silico structural analysis and ligand-binding predictions of these proteins answer some hitherto unresolved questions behind the differentiation of a callus.



Two – dimensional gel electrophoresis of silver stained total protein from four developmental stages of *Vanilla*

- The NBS-LRR class resistance genes (R-genes) play an essential role in the innate immunity of plants. The N-terminal NB-ARC domain of these R proteins contains evolutionarily conserved amino-acid motifs, including the Phosphate binding loop (P-loop) and GLPL, which plays a critical role in the direct interaction of ADP. We have identified a few significant amino acid substitutions in the conserved motifs of a hypothetical R-protein in sesame, which imparts a considerable effect on ADP binding position and hydrogen bond interaction. We correlated the expression of the R-gene encoding the Hyp-R protein by inducing charcoal-rot infection in three sesame genotypes after inoculating *Macrophomina phaseolina*. In conclusion, the amino acid substitutions within P-loop or adjacent to the GLPL motif significantly affected the ligand affinity, binding position, and hydrogen bond interactions in sesame.

- Phytic acid is the primary source of phosphorus and other mineral bound compounds in rice seeds. During germination, phytase enzyme degrades phytic acid, and bound phosphate and minerals are released. The monogastric animals, including human, cannot digest phytate due to lack of the phytase enzyme in the gut. Considering that, we have developed low phytate rice by over-expressing *appA* gene cloned from *E. coli* under the aleurone-specific promoter of maize *zein* gene. Molecular analysis confirmed the stable integration of transgene, and plants were grown up to T_3 generation. The T_3 seeds showed a 45% decrease in seed phytate content with a four-fold increase of inorganic phosphorus (Pi) level. The enhanced iron and zinc was two-fold and three-fold respectively in polished seeds of the transgenic plants (It is a collaborative work with Prof. S K Datta, Department of Botany University of Calcutta).

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	02	NIL	12	01	NIL	02

DR. PALLOB KUNDU
Associate Professor

Group Members :
Sayani De, *SRF*; Rohit Das, *SRF*; Shreya Chowdhury, *SRF*
Shrabani Basak, *SRF*; Sayan Mal, *SRF*; Himadri Das, *SRF*
Ananya Mukherjee, *SRF*; Raghubir Singh, *SRF*
Sushmita Talukdar, *SRF*
Akash Shaik, *Short term trainee*
Ritabrata Basak, *Short term trainee*

Scientific Report

Background and Vision :

Unravelling the active gene-regulatory circuit during pathogen stress in tomato plant: possible applications in engineering crops for enhanced stress tolerance

Major focus of plant biology research has been on understanding the molecular nature of the plant response to thrive a stressful situation. Continuing research in this field has uncovered many genes with direct and indirect role in stress adaptation process. However, further studies are essential to gain better understanding of stress response pathway, specifically plant-pathogen interaction modules, and applications of the knowledge in genetic improvement for stress resilience.

Using tomato plant and various pathogens, and utilizing genomics, molecular biological and plant biotechnological tools my current research programmes are:

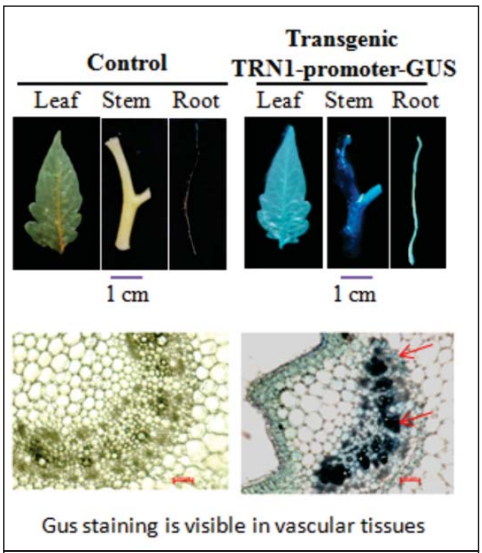
- Mechanisms of regulation of Alternaria stress-responsive microRNA expression and significance of specific miRNA-mRNA interaction in the disease biology.
- Investigating the role of mediators of cell death, such as NB-LRRs and metacaspases, in disease development.
- Mechanisms of regulation of expression and biological functions of membrane bound NAC transcription factors in tomato (NAC MTFs)
- Generation of stress resilient crops of the future by biotechnological approaches.

Vision: Unravelling the gene-regulatory circuit activated during a plant-pathogen interaction and confirming key regulatory nodes that distinguishes between resistance and susceptible interaction. Additionally, mapping the dynamic modulations in the regulatory circuit while the plant is exposed to the changing climatic conditions would be carried out. Thus, a guideline and methodologies can be developed for generating multi-stress resilient crop via fast forward genetics approaches, or seamless genetic modifications using genome editing/regulatory tools.

Summary of Research Work :

Fungal-stress responsive mRNA and miRNA transcriptome of tomato: In genome wide integrated analyses we have profiled Alternaria-stress responsive tomato transcriptome, small RNA transcriptome, miRNAome, mRNA-miRNA interaction pairs, and novel miRNAs. These analyses facilitated identification of key miRNAs exerting regulatory influence on stress-response pathways. Accordingly, we have selected candidate miRNAs and carrying out in depth analyses for elucidating their patho-physiological significance.

The relevance of interaction between a miRNA and mRNA target during Alternaria stress: Our results indicate that miR6024 over expression in tomato leads to heightened immune response or hyper accumulation of ROS. Genome wide analysis confirmed immune response pathways remain in an 'alert' stage in the transgenic. Further experimentations are in progress to better understand role of the miRNA.



GUS-staining of TORNADO1 (TRN1) promoter-GUS reporter transgenic plants showing promoter activity is limited to vascular bundles.

Functional characterization of tomato membrane–bound NAC transcription factors: All NAC domain containing transcription factors encoded in tomato genome have been identified. Among these, membrane anchored NAC transcription factors (MTFs) are characterised. We have proved that these MTFs are indeed activated during stress and have regulatory roles in biotic and abiotic stress response in plant. Some aspects of the molecular mechanism of tomato NACMTF3 activation have been uncovered and in depth analyses are in progress.

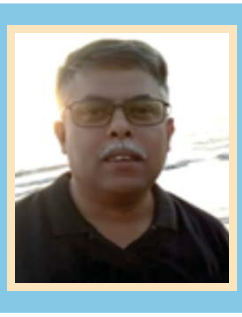
A key molecular factor for leaf curling in tomato leaf curl virus infection has been unveiled: We have shown that tomato leaf curl virus infection causes altered epigenetic regulation of the TORNADO1 gene, an essential component for vein development, resulting in mis-regulation of expression and distorted leaf venation.

CRISPR-Cas based new tools for genome regulation: We are developing 'scafold RNA based' multiplexing tools for plant genome regulation and inducible Cas containing vectors.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	NIL	01	04	05	NIL	NIL

Mr. Dibya Mukherjee
Joint winner of Prof. B. B. Biswas Outstanding Student Award
for the year 2019



PROF. SHUBHO CHAUDHURI
Professor

Group Members :
Rwitie Mallik, *SRF*; Pratiti Dasgupta, *SRF*
Jinia Chakrabarty, *SRF*; Sonal Sachdev, *SRF*
Ruby Biswas, *JRF*; Dr. SambitDatta, *RA, DBT-NWO*

Scientific Report

Background and Vision :

The highly complex structure of chromatin imparts resistance to several nuclear processes. It is still an unsolved mystery as to how several genes whose sequence might be buried in the complex chromatin structure is accessed by nuclear factors during their expression in response to endogenous and exogenous cues. Post-translation modification of histones (epigenetic mark) as well as active chromatin remodelling guided by either ATP dependent chromatin remodeler or histone chaperones play an important regulatory role in activating or repressing gene expression by generating 'open' or 'closed' chromatin configuration inside the cell. Such dynamic changes in the chromatin organization are essential for almost all cellular events like transcription, replication, repair and DNA recombination. The focus of my lab is to study the mechanism of chromatin remodelling in plants to understand the transcription regulation of genes that are regulated by endogenous and exogenous cues.

The small architectural proteins which belongs to High Mobility Group superfamily is involved in changing the topology of DNA to provide appropriate structure for the binding of nuclear proteins, especially transcription machinery. We have been characterizing ARID-HMG group of proteins that are highly plant specific. Since plant genome does not code for HMGN type of proteins and HMG-box group is highly diverse in plants, we believe that this diversity of HMG-box compensate the role of HMGN and is involved in many developmental as well as environmental transcription for proper specio-temporal expression of genes.

Objectives:

- Characterization of plant specific nuclear architectural proteins and investigating its role in plant development
- Investigating the role of epigenetic regulation during plant development and stress response

Major Achievements:

Investigating the role of nuclear architectural protein AtHMGB15 in pollen development

Knockout mutant of ARID/HMG protein AtHMG15 (Arabidopsis HMG15) shows mutant pollen morphology and retarded pollen tube germination. NGS-based analysis between flowers of wild-type and mutant plants about 757 genes are shown to be up-regulated and about 905 genes are down-regulated in athmgb15 which are involved in several biological processes like metabolism, cell organization and biosynthesis, transcription, transport, developmental and signal transduction pathways. Some of these genes are specifically responsible for floral development particularly the pollen development, organization, wall formation and pollen tube growth.

Analysis of RNA seq data shows that major pathways that were affected in pollen developmentin athmgb15 mutant plants belongs to a) Jasmonic acid biosynthesis and signalling; b) Program cell death (PCD); c) Pollen development and d) Cell wall synthesis. These observations are the stepping stone to understand the role of AtHMGB15 regulated hormonal cross talk in pollen developmental process.

Identification of genome-wide targets and DNA recognition sequence of the Arabidopsis HMG-box protein during cold stress response

Using ChIP-chip approach, we have identified 6128 and 4689 significantly enriched loci having AHMGB15 occupancy under control and cold stressed conditionrespectively. GO analysis shows genes belonging to abiotic stress response, cold response and root development were AtHMGB15 targets during cold stress. DNA binding and foot printing assays further identified A(A/C)–ATA–(A/T)(A/T) as AtHMGB15 binding motif. Further, the expression of cold stress responsive genes decreased in *athmgb15* knockout plants compared to wild-type. Taken together, binding enrichment of AtHMGB15 to the promoter and upstream to stress loci suggest an unexplored role of the protein in stress induced transcription regulation.

Understanding the early cold response mechanism in IR64 indica rice variety through comparative transcriptome analysis

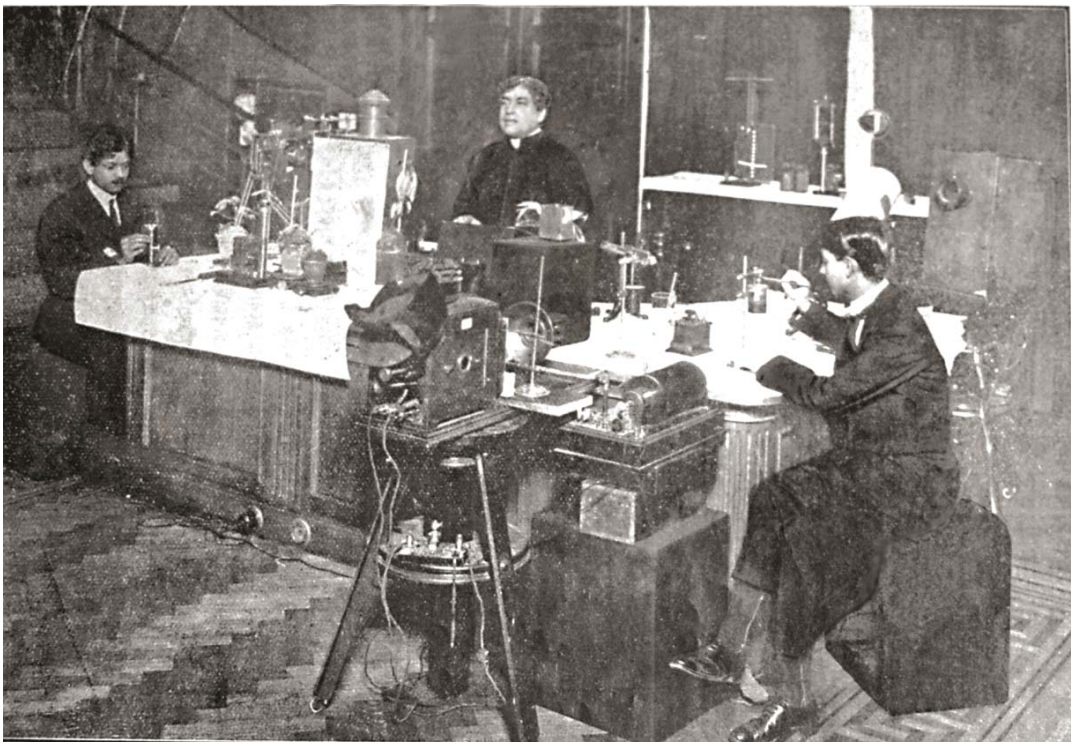
Oryza sativa L. ssp. *Indica* being a tropical crop is highly sensitive to low-temperature stress leading to impaired growth and massive losses in grain productivity. Substantial work has been done to understand cold induced changes in gene expression in rice plants. However, adequate information is not available for early gene expression, especially in *indica* variety. A transcriptome profile was generated for cold shock treated seedlings of IR64 variety to identify early responsive genes. The results show the onset of cold response is associated with upregulation of stress responsive TFs, hydrophilic proteins and signaling molecules, whereas, the genes coding for cellular biosynthetic enzymes, cell cycle control and growth-related TFs are downregulated. This study reports that the generation of ROS is integral to the early response to trigger the ROS mediated signaling events during later stages.

Future Research Plans :

- Genome-wide analysis of Histone H3K27 modifications changes will be carried out to understand the regulation of transcription network of cold response both genetically and epigenetically.
- Investigate the role of AtHMGB15 mediated hormonal crosstalk involved during pollen development.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
NIL	NIL	NIL	03	03	NIL	NIL



Sir Jagadis Chandra Bose, assisted by Basiswar Sen and Jyotiprakash Sarkar demonstrating his experimental work on Plant Autographs and their Revelations at the Evening Discourse, Royal Institution, London (1914)

SCIENTIFIC REPORT
SENIOR SCIENTISTS

PROF. A.N.LAHIRI MAJUMDER
INSA Honorary Scientist
(01.03.2019 to 29.02.2020)
INSA Senior Scientist
(Since 02.03.2020)

Abiotic stress tolerance in plants : Regulation of salinity tolerance by intrinsic factors and inositol / phosphoinositide metabolism.

The work in the laboratory has centered around the regulation of salinity tolerance in rice in reference to several intrinsic factors and metabolic events. Such work envisioned the transgenic introgression of identified salt tolerance genes of inositol and phosphoinositide metabolism; one salt-tolerant Fructose bis phosphatase (FBPase) related to photosynthetic performance under salt stress and other factors having co relationships between salinity and mechanical impedance.

- While transgenic PcINO1 and PcIMT1 introgressed homozygous rice lines have been reported, similar transgenic homozygous T4 to T6 rice lines have been established with the PcFBPase gene earlier characterized in this laboratory.
- Two phospholipase C genes, isolated and characterized from *indica* rice are now being used to bring in salt-cum-drought tolerance through transgenic introgression in IR64 *indica* rice.
- 64 *indica* germplasms, collected from different agro-climatic and edaphic zones of West Bengal, from the Himalayan foothills down to the southern saline belt were screened for salt tolerance by physiological and molecular parameters. Twenty-one SSR markers, some associated with the Saltol QTL and others being candidate gene based SSR (cgSSR) were used to study the polymorphism of collected germplasm. A wide diversity was detected among the collected germplasms at the phenotypic as well as molecular level. The study shows that apart from the established salt tolerant lines, landraces like Bonkanta, Morisal, Ghiosh, Patni may be the source of salt tolerance gene donor(s) in future breeding programs.

- A quantitative measurement coefficient termed Stress Adaptation Coefficient (SAC), dependent on root responses to stress was worked out and applied to study the effect of mechanical vs salinity stress on roots of various *indica* rice genotypes. The responses of roots to mechanical and salinity stress are overlapping. Analysis shows that many of the salt tolerant varieties also perform better in mechanical stress while the opposite is not always true. Transcriptome analysis through cDNA microarray of stress sensitive variety IR64 shows about 6000 common transcripts to be differentially regulated among the two stresses. Quantitative real time expression analyses of salt sensitive and known salt tolerant varieties reveal an important commonality of gene expression during salt and mechanical stress.

Publications :

1. Mukherjee R, Mukherjee A, Bandyopadhyay S, Mukherjee S, Sengupta S, Ray S and Majumder A L (2019) Selective manipulation of the inositol metabolic pathway for induction of salt-tolerance in *indica* rice variety. *Scientific Reports*, 9:5358 . doi: 10.1038/s4159A- 019-41809-7.

2. Adak S, Roy A, Das P, Mukherjee A, Sengupta S, Majumder A L (2019). Soil salinity and mechanical obstruction differentially affects embryonic root architecture in different rice genotypes from West Bengal. *Plant Physiol*. Rep. 24: 192–209.

3. Adak S, Datta S, Bhattacharya S, Ghose T K, Majumder A L (2020). Diversity analysis of selected rice landraces from West Bengal and their linked molecular markers for salinity tolerance. *Physiol Mol Biol Plants*. 26: 669–682.

PROF. DIPANKAR HOME
NASI Senior Scientist
Platinum Jubilee Fellow

1. **Background:** In view of the considerable advantages provided by high dimensional entangled states for ensuring efficient and robust applications in quantum communication and information processing, certification and quantification of high dimensional entanglement is acquiring considerable importance.

   Objective: To develop a novel scheme for characterizing entanglement of high-dimensional states using the statistical measure of correlation given by the Pearson Correlation coefficient.

   Work achieved: Against the above backdrop, the present work initiates a novel direction of study by demonstrating the efficacy of an entanglement characterizing scheme for a range of bipartite qutrit states in terms of empirically measurable Pearson Correlation Coefficients, through suitable relationship with Negativity as an entanglement measure. Extension of this scheme for a wider class of higher dimensional entangled states is a potentially promising area of research with multifold applications in Quantum Information.

2. **Background:** In the context of evaluating the efficacy of a given entangled state in its wide-ranging uses as a resource for quantum communication and information theoretic applications, a key question is to quantitatively assess as to what extent a given state is distant from the maximally entangled state which, in general, corresponds to optimal efficiency of any given application of quantum entanglement.

   Objective: To investigate the non-equivalence between different entanglement measures in terms of determining the extent to which any given prepared state is separated for the maximally entangled state by considering two-qubit pure states.

   Work achieved: It is the study of the above-mentioned question in the present paper, in terms of different entanglement measures, complemented by relevant

empirical results obtained from a suitably planned experimental study, that has revealed the hitherto unexplored feature of an appreciable amount of quantitative non- equivalence between the entanglement measures for two-qubit pure states. Implications of this finding call for further studies towards identifying an appropriate quantifier of entanglement for addressing the operationally important question such as the one considered in the present work.

3. **Background:** One of the key quantum fundamental issues concerns the emergence of classicality from quantum physics. In this context, the question as to whether quantum mechanics is compatible with the everyday notion of macrorealism in the macroscopic limit is of central importance. In particular, for multilevel spin systems, the question reduces to that of the compatibility of quantum mechanics with the notion of macrorealism in the limit of large spin.

Objective: To investigate using the Leggett-Garg inequality test of macrorealism whether the quantum mechanical predictions violate such inequality for the large spin system even by taking into account the fuzziness or coarsening involved in the registration of measurement outcomes.

Work achieved: For multilevel spin systems, our present work demonstrates the incompatibility of quantum mechanics with macrorealism persisting in the limit of large spin even under coarsening of measurement times, coupled with the coarsening of measurement outcomes, arising from the fuzziness of individual outcomes as well as of the instants of measurement. This counterintuitive feature entailing that classicality for large spin does not emerge from quantum mechanics, whatever be the unsharpness of measurement, has fundamental implications concerning the wider issue of the classical limit of quantum mechanics.

Publications:

1. Jebarathinam C, Home D, Sinha U (2020) Pearson correlation Cofficients as a measure for certifying and quantifying high dimensional entanglement; Physical Review A 101, 022112.
2. Singh A, Ahamed I, Home D (2020) Revisiting comparison between entanglement measures for two-qubit pure states; *Journal of the Optical Society of America* B 37, 157.
3. Mukharjee S, Rudra A, Das D, Mal S and Home D (2019) Persistence of quantum violation of Macrorealism for large spins even under coarsening of Measurement Times; *Physical Review* A 100, 042114.

Grants-in-Aid Schemes:

(a) Co-investigator of the Research Project titled “Applications of Quantum Information”, under the "Quantum Enabled Science & Technology" initiative of the Dept. of Science and Technology, Govt. of India; jointly with Prof. Archan S. Majumdar of S N Bose National Centre of Basic Sciences, Kolkata as Principal Investigator.

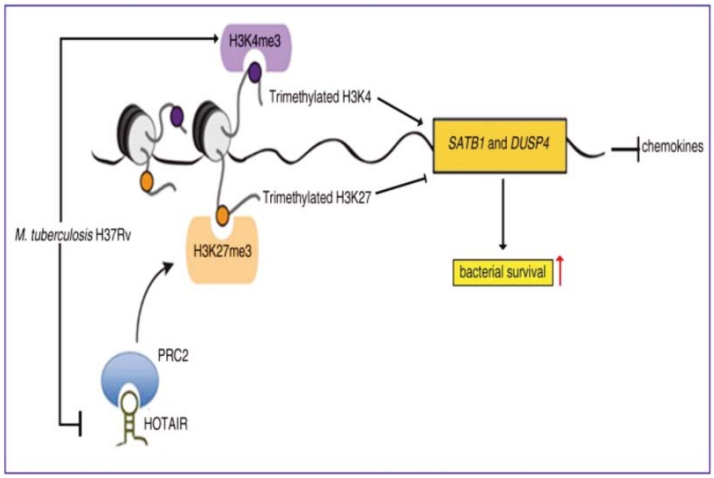
(b) Co-investigator of the India-Trento Programme for Advanced Research titled “A cheap, light, compact source for QKD based on intraparticle entanglement in an integrated photonic circuit” funded by the Dept. of Science and Technology, Govt. of India; jointly with Prof. Urbasi Sinha of Raman Research Institute, Bangalore as Principal-investigator.

PROF. JOYOTI BASU
J. C. Bose National Fellow

The role of histone modifications and long non-coding RNA HOTAIR in the response of macrophages to *Mycobacterium tuberculosis* infection *(in collaboration with Prof. Manikuntala Kundu and Dr. Zhumur Ghosh)*

The outcome of *M. tuberculosis* infection depends upon the balance between the host immune system and the ability of the bacteria to overcome it to ensure its survival inside the host. It is necessary to understand the complex interactions between the host and the pathogen during the early stages of infection for finding out suitable host-directed approaches to manipulate the balance of the host-pathogen interactions in favor of the host.

The role of post-transcriptional mechanisms in the immune response of the macrophage and the ability of virulent *M. tuberculosis* to dampen this response, is incompletely understood. We have tested whether histone modifications differ in macrophages infected with a virulent vs. an avirulent strain of *Mycobacterium tuberculosis*. Genome-wide deposition of the H3K4 trimethylation mark was observed to differ between macrophages infected with either the virulent strain H37Rv or the avirulent strain H37Ra. H3K4me3 marks were observed at the SATB1 and DUSP4 loci at levels higher in macrophages infected with H37Rv than with H37Ra. This correlated with higher levels of their expression in H37Rv-infected macrophages. The expression of DUSP4 and SATB1 is



controlled by the dynamics of the association of H3K4me3 and H3K27me3 mark at their promoters. H3K4 trimethylation depends on a H3K4me3 specific methyltransferase complex of which ASH1L is a regulatory component. We observed that ASH1L associates at the SATB1 and DUSP4 loci, and regulates H3K4me3 association, during infection. On the other hand H3K27 trimethylation is a repressive mark and is

dependent on a H3K27me3 methyltransferase EZH2. EZH2 association at the SATB1 and DUSP4 loci, decreased in H37Rv-infected as opposed to uninfected macrophages. *M. tuberculosis* survival inside macrophages could be correlated with the SATB1-dependent lowering of gp91phox (a subunit of NADPH oxidase), which is directly linked to the generation of reactive oxygen species. SATB1 and DUSP4 also repressed expression of the chemokines CXCL1, CXCL2 and CXCL3 in infected macrophages, a phenomenon that was specific to H37Rv- but not H37Ra-mediated infection. Finally, we showed that the long non-coding RNA HOTAIR associates with EZH2 and regulates the association of H3K27me3 marks at the SATB1 and DUSP4 loci. The above observations are specific to virulent H37Rv-infected macrophages, but not to H37Ra-infected macrophages.

The role of the sensor kinase MtrB and the response regulator RegX3 in Mycobacterium tuberculosis* infection *(collaboration with Prof. Manikuntala Kundu and Dr. U. D. Gupta, National Jalma Institute of Leprosy and Other Mycobacterial Diseases, Agra).

We collaborate with Prof. Manikuntala Kundu in understanding the role of two component signal transduction systems (TCSs) in the pathogenesis of tuberculosis. The TCSs of *Mycobacterium tuberculosis* sense and respond to the external milieu enabling the bacterium to survive within its host. We have demonstrated that the sensor kinase MtrB of the TCS MtrAB, is a central regulator of the the hypoxic response, central carbon metabolism, energy homeostasis and biofilm formation in *M. tuberculosis*. It is required for subversion of trafficking of *M. tuberculosis* to host autophagosomes and lysosomes and bacterial survival in macrophages. We have also shown that the response regulator RegX3 of the TCS SensX3-RegX3, is a regulator of transcription of WhiB3, another transcriptional regulator. The RegX3/WhiB3 axis is instrumental in enabling the bacterium to withstand acid stress.

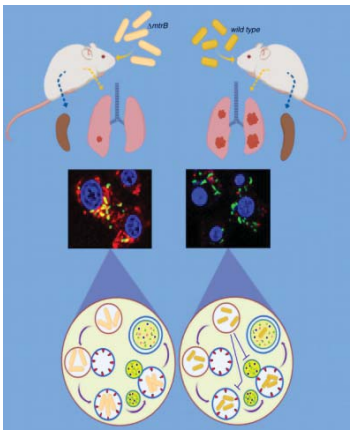
Publications

1. Kumar M, Majumder D, Mal S, Chakraborty S, Gupta P, Jana K, Gupta U D, Ghosh Z, Kundu M, Basu J (2020) ATF3 modulates the macrophage immune response to *Mycobacterium tuberculosis* infection via reciprocal regulation of inflammatory genes and lipid body formation. *Cell Microbiol* 22(3), e13142.doi: 10.1111/cmi.13142.

2. Banerjee S K, Lata S, Sharma A K, Bagchi S, Kumar M, Sahu S K, Sarkar D, Gupta P, Jana K, Gupta U D, Singh R, Saha S, Basu J, Kundu M. (2019) The sensor kinase MtrB of *Mycobacterium tuberculosis* regulates hypoxic survival and establishment of infection. *J. Biol. Chem.* 2019 294, 19862-19876.

PROF. MANIKUNTALA KUNDU
CSIR Emeritus Scientist

MtrB is a central regulator of *the response of Mycobacterium tuberculosis* to hypoxia *(in collaboration with Prof. Joyoti Basu, Dr. Sudipto Saha and Dr. U. D. Gupta, National Jalma Institute of Leprosy and Other Mycobacterial Diseases, Agra)*



Bacterial two component systems (TCSs) play an important role in pathogenesis. The TCSs of *Mycobacterium tuberculosis* (Mtb), sense and respond to the external milieu enabling the bacterium to survive within its host. Paired TCSs have a sensor kinase (SK) and a cognate response regulator (RR) usually in the same operon. Although transcriptional activation of the paired MtrABTCS has been reported during Mtb infection of phagocytic cells, its role in infection remains poorly understood. Genetic disruption of MtrB compromises the hypoxic response, central carbon metabolism, energy homeostasis and biofilm formation in Mtb. Additionally we observed that the absence of MtrB attenuated the expression of cell division, peptidoglycan and mycolic acid synthesizing genes compromising cell wall homeostasis and altering cell morphology. We also demonstrate that MtrB is required for subversion of trafficking of Mtb to host autophagosomes and lysosomes and bacterial survival in macrophages. Most importantly, it is required for establishing infection in mice. Together, these findings underscore the hitherto unknown, novel function of MtrB as a global regulator that is central to the ability of Mtb to withstand stress, survive in the host environment and enable disease progression.

The sensor kinase MtrB of *Mycobacterium tuberculosis* is required for establishing infection. Infection of with *M.tuberculosis* wild type (on the right) or the mutant deficient in mtrB (ΔmtrB, on the left) shows that unlike the wild type, ΔmtrB could not form granulomas or enlargement of the spleen. Fluoresecence imaging showed that a higher proportion of ΔmtrB (green) trafficked to the lysosomal (red) compartment due to its inability to prevent fusion of the autophagosome with the lysosome, a characteristic of the wild type (depicted in the bottom panel on the right).

Regulation of WhiB3 by the response regulator RegX3 of *Mycobacterium tuberculosis. (in collaboration with Prof. Joyoti Basu and Dr.Sudipto Saha)*

We have focused on attempting to understand the role of the response regulator RegX3 a partner in the paired TCS SenX3-RegX3, in mycobacterial physiology. We show that RegX3 is required for *M. tuberculosis* to withstand low pH, one of the challenges encountered by the bacterium in the host environment, and that it activates the cytosolic redox sensor WhiB3 to launch an appropriate response to acid stress. We show that the whiB3 promoter of *M. tuberculosis* harbors a RegX3 binding motif and that phosphorylated RegX3 (RegX3-P) (but not its unphosphorylated counterpart) binds to this motif, whereas a DNA binding mutant, RegX3(K204A) fails to do so. Mutation of the putative RegX3 binding motif on the whiB3 promoter, abrogates the binding of RegX3-P. Using a whiB3 promoter construct fused to GFP,we further confirm the requirement of RegX3 for the activation of the whiB3 promoter. A regX3-inactivated mutant is compromised in its ability to survive under acid stress, whereas complementation with either regX3 or whiB3 partially overcomes this defect. This suggests that the RegX3-WhiB3 axis is important for the survival of under acid stress. Further investigations are under way to understand the importance of this axis in mycobacterial physiology.

Understanding host cell immune signalling during infection of macrophages with *Mycobacterium tuberculosis (in collaboration with Prof. Joyoti Basu and Dr. Zhumur Ghosh)*

We collaborate with Prof. Joyoti Basu to understand how host macrophages respond to challenge with M. tuberculosis (Mtb). In recent studies we have shown that the histone modification-dependent gene expression changes that occur in macrophages, differ between macrophages infected with either virulent (H37Rv) or avirulent (H37Ra) Mtb. We show that the extent of deposition of activating (H3K4Me3) or repressive (H3K27Me3) marks at the promoters of two genes, *SATB1* and *DUSP4*, compared to uninfected macrophages, correlate directly with their levels of expression. This is specific to H37Rv- but not H37Ra-infected macrophages. We also link *SATB1* and *DUSP4* expression to the suppression of generation of reactive oxygen species and expression of chemokines such as CXCL1. These results suggest that the differential regulation of histone modifications in macrophages infected with virulent Mtb, benefit the pathogen enabling its survival in the host.

Publications

1. Banerjee S K, Lata S, Sharma AK, Bagchi S, Kumar M, Sahu S K, Sarkar D, Gupta P, Jana K, Gupta U D, Singh R, Saha S, Basu J, Kundu M (2019) The sensor kinase MtrB of *Mycobacterium tuberculosis* regulates hypoxic survival and establishment of infection. *J. Biol. Chem.* 2019 294, 19862-19876

2. Kumar M, Majumder D, Mal S, Chakraborty S, Gupta P, Jana K, Gupta U D, Ghosh Z, Kundu M, Basu J (2020) ATF3 modulates the macrophage immune response to *Mycobacterium tuberculosis* infection via reciprocal regulation of inflammatory genes and lipid body formation. *Cell.Microbiol.* 22(3), e13142. doi: 10.1111/cmi.13142.

PROF. PINAKPANI CHAKRABARTI
J. C. Bose Fellow

Scientific Report

Identification of structural motifs, involving weak non-covalent interactions, in proteins

Macromolecules are characterized by typical arrangement of hydrogen bonds. Different patterns of hydrogen bond give rise to distinct and stable structural motifs. We have characterized N–H···N(p_z) interaction involving two adjacent peptide groups, in which the N–H group of a peptide group interacts with the preceding peptide N, being perpendicular to the its plane. We have shown that this interaction can give rise to by far the largest number of γ-turns, which remained unidentified till date as the role of N–H···N interaction went unappreciated. The three-reside γ-turns have traditionally been identified based on the occurrence of hydrogen bonding between the CO and NH groups of the two terminal residues. To distinguish between the two categories of γ-turns we now designate them as (NHN) and (NHO) γ-turns. We find that the (NHN) γ-turns occur at the helix N-terminus and constitute an important N-terminal capping motif in α-helices.

Protein-nanoparticle interaction

We have been interested in antimicrobial and anti-proliferative activities of different types of nanoparticles, namely gold nanoparticles of different shape and size, ZnO nanoparticles and graphene oxide. We have also synthesized gold nanoparticles with ligands to prevent the growth and virulence of pathogens, such as *Vibrio cholerae*. We have also looked at how the cage-like structure of large assemblies of ferritin can be be used as drug delivery vehicle, contributing to the field of nanobiology.

Publications

1. Dhar J, Kishore R and Chakrabarti P (2020). Delineation of a new structural motif involving NHN γ-turn. *Proteins*, 88, 431-439.
2. Chakraborti S and Chakrabarti P (2019). Self-assembly of ferritin: Structure, biological function and potential applications in nanotechnology. In S Perrett et al. (eds.), *Biological and Bio-inspired Nanomaterials*, Advances in Experimental Medicine and Biology 1174, pp 313-329. https:/doi.org/10.1007/978-981-13-9791-2_10.

Group Member :

Dr. Tanaya Chatterjee, DST Women Scientist

The role of isoaspartate in fibrillation and its prevention by Protein-L-isoaspartyl methyltransferase

A hexapeptide, Val-Tyr-Pro-(isoAsp)-His-Ala (VA6), a substrate of Protein-*L*-isoaspartyl methyltransferase (PIMT), has been shown to form fibrils, while the normal Asp-containing peptide does not. Interestingly, two antiepileptic drugs (AEDs), valproic acid and stiripentol, were found to enhance the activity of PIMT. Studies with PC12 derived neurons showed that PIMT and PIMT/AEDs exerted neuroprotective effect against anti-NGF induced neurotoxicity. This was further validated against neurotoxicity induced by Aβ42 in primary rat cortical neurons. Furthermore, Aβ42, implicated in Alzheimer's disease, undergoes β-sheet to α-helix transition in presence of PIMT. Furthermore, Aβ42, implicated in Alzheimer's disease, undergoes b-sheet to α-helix transition in presence of PIMT. IsoAsp, with an additional C atom in the main-chain of polypeptide chain, may make it more susceptible to fibrillation. PIMT alone, or in association with AEDs may prevent this. Presently, work is being pursued to investigate if the activity of PIMT in reducing the Aβ42 fibrillation can be enhanced in presence of gold nanoparticles (spherical in shape, and of different sizes).

Publication

1. Chatterjee T, Das G, Chatterjee B K, Dhar J, Ghosh S and Chakrabarti P (2020) The role of isoaspartate in fibrillation and its prevention by Protein-L-isoaspartyl methyltransferase. *Biochim. Biophys. Acta - General Subjects*, 1864, 129500 https://doi.org/10.1016/j.bbagen.2019.129500.

PROF. SAMPA DAS
INSA Senior Scientist

The important grain legume crop plant, chickpea earns global importance for its unique nitrogen fixing ability. Unfortunately the crop suffers from various pests and pathogens attack. Wilt disease caused by *Fusarium oxysporum* f.ciceri Race 1 (Foc1) imparts severe damage to this valuable crop. Resistance development in chickpea is difficult due to non-availability of appropriate resistant gene(s). Global transcriptomic approach to understand defense response mechanism in chickpea against this pathogen identified a specific defense related MYB transcription factor (TF). Over expression of this particular MYB TF down regulated key genes of flavonoid biosynthesis pathway in chickpea resulting to impeded anthocyanin pigmentation. Additionally, CaABR18, a member of defense related PR10 family proteins was found to be up regulated in resistant chickpea line upon Foc1 stress. Further analyses confirmed the presence of glycine rich P-loop motif and Betv1 domain with significant RNase and DNase activity of this newly identified protein. Expressed CaABR18 exhibits Foc1 resistance in chickpea by degrading RNA and DNA of the infected host cells resulting into programmed cell death (Chatterjee et al 2019).

Group Members :

Ms. Surbhi Shriti, UGC SRF,

Dr. Akansha Jain has been working as DST Women Scientist (SR/WOS-A/LS-377/2018) on a project entitled "Seed priming with Allium sativum leaf agglutinin (ASAL) for increasing *Bacillus subtilis* rhizospheric colonization and enhancing resistance against *Rhizoctonia solani,* the sheath blight pathogen of rice."

Biocontrol microorgasms often protect plants from various pathogens by either directly restricting the growth of pathogens or inducing systemic resistance. Bacterial strain, Bacillus, WB174 isolated from rhizosphere exhibited significant antagonistic activity against deadly pathogen of rice, *Rhizoctonia solani.* Increase in growth of *Bacillus subtilis* as well as strong biofilm formation was observed when the bacteria treated with Allium sativum leaf agglutinin (ASAL). Real time PCR analyses detected up-regulation of genes involved in biofilm formation in ASAL treated bacteria compared to untreated ones.

Dr. Sathi Paul is continuing as CSIR Associate (since 01.05.18) on a project entitled "Efficacy of monomeric mutant variant of *Allium sativum* leaf agglutinin (mASAL) against wilt causing root pathogen *Fusarium oxysporum* f. sp. ciceri (Foc) of chickpea (*Cicer arietinum* L.)"

Dr. Papri Nag is working as DST Women Scientist (SR/WOS-A/LS-377) on a project entitled " Exploring Biological Nitrogen Fixation in Rice ".

Culture-independent analyses of rice rhizospheric bacteria show cultivar specific recruitment of microbes by the plants. Through this project two putatively novel bacterial strains of genus *Paraburkholderia* and *Microbacterium* were identified from several presumptive nitrogen fixing bacteria isolated from different rice cultivars. The two identified members have been characterized on the basis of phenotypic features, 16S rRNA and Average Nucleotide Identity analyses.

Publications

1. Chatterjee M, Chakraborty J and Das S (2019) Abscisic acid-responsive 18 (CaABR18) protein from Chickpea inhibits the growth of the Wilt causing *Fusarium oxysporum* f.ciceri Race 1. *Plant Mol Biol Reporter* 37 : 170-185 https://doi.org/10.1007/s11105-019-01146-5 [IF 1.907].

2. Ghosh Swagata, Mazumder M, Mondal B, Mukherjee A, De A, Bose R, Das S, Bhattacharyya S, Basu D (2019) Morphological and SSR marker-based genetic diversity analysis of Indian mustard (*Brassica juncea* L.) differing in Alternaria brassicicola tolerance. *Euphytica* 215:206 https://doi.org/10.1007/s10681-019-2523-1 [IF1.527].

3. Jain A, Chakrobarty J and Das S (2020) Underlying mechanism of plant –microbe crosstalk in shaping microbial ecology of the rhizosphere. *Acta Physiologiae Plantarum* 42:8 https://doi.org/10.1007/s11738-019-3000-0 [IF 1.820].

4. Nag P, Shriti, S, and Das S (2020) Microbiological strategies for enhancing biological nitrogen fixation in non-legumes. *Journal of Applied Microbiology*, 129 (2) :186-198 https://doi.org/10.1111/jam.14557 {IF2.683].

Book Chapters

1. Jain A and Das S (2020) Regulatory requirements for nanopesticides and nano fertilizers. In : Advances in nano-fertilisers and nano-pesticides in Agriculture, 1st Edition : A smart delivery system for crop improvement. Jogaiah S., Singh HB., Farnandes I. Lima FR (eds) *Elsevier*, ISBN: 9780128200926.

2. Shriti S, Jain A, Das S (2019) Evergreening: An Equivocal Affair in Pharmaceutical Industries. In Intellectual Property Issues in Microbiology, Singh H., Keswani C., Singh S. (eds). *Springer*, Singapore. https://doi.org/10.1007/978-981-13-7466-1_17

PROF. SUSHANTA DATTAGUPTA, FNA
INSA Senior Scientist

During the year under consideration, I carried on research in the area of Quantum Effects in Solids, with particular attention to Nano-Science. Some of the research work have already been published during this period (with details given below) while others are being either submitted or being written up.

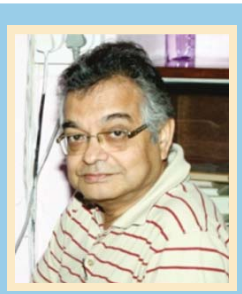
PUBLICATIONS :

A. In pipeline

1. Observation of Shubnikov-de Haas oscillation, non-trivial Berry phase, planar Hall and anisotropic magneto resistance at the conducting interface of EuO-KTaO3 , N. Kumar, N. Wadhera, R. Tomar, Y. Singh, Dattagupta and S. Chakraverty, *Advanced Materials* (Under consideration; also, ArXiv: 1908, 04977).
2. Stochastic Thermodynamics, S. Dattagupta, *Resonance* (in Press).
3. Anderson and Line Shapes, S. Dattagupta, Resonance (in Press).
4. Effect of noise on quantum transport of a charged particle in a tight-binding lattice, M. Bandyopadhyay, S. Dattagupta and A. Dubey, to be published, in *Physical Review B.*

B. Published

5. Planar Hall effect and anisotropic magneto resistance in a polar-polar interface of LaVo3 – KTaO3 , with strong spin-orbit coupling, N. Wadhera, R. Tomar, R. K Gopal, Y. Singh, S. Dattagupta and S. Chakraverty, Nature Communications, published on line February 2020, *Nat. Commn.* 11, 874, 2020 (also, ArXiv: 1908, 06636).
6. Carbon Hybridization to Tight-Binding to Dirac Solid, S. Dattagupta, *Resonance*, March 2020.
7. Pattern Formation in Nonlinear Reaction-Diffusion Systems, S. Dattagupta and Manas K. Roy, *Pramana, Indian Academy of Sciences*, September, 2019.
8. 'Ageing of Academic Institutions', Guest Editorial, *Current Science* 117(3), 10 August 2019.EstM2



PROF. SIBAJI RAHA

DAE – Raja Ramanna Fellow

Collaborators: (Within Bose Institute) Sanjay K. Ghosh, Rajarshi Ray, Debapriyo Syam, Supriya Das, Saikat Biswas, Sidharth Kumar Prasad, Abhijit Chatterjee, Sanat Kumar Das, Debajyoti Ray. (External): Abhijit Bhattacharyya (University of Calcutta), Shibaji Banerjee (St. Xavier's College), Sunil K. Gupta (TIFR, Mumbai), Horst Stoecker (FIAS, Frankfurt, Germany).

Prof. Raha has a very wide range of research interests, covering High Energy Particle and Nuclear Physics, Astrophysics and Cosmology andAstroparticle Physics, with special emphasis on Cosmic Rays and Solar Terrestrial Weather as well as the detection of heavy nuclear fragments in cosmic rays using passive detectors..Prof. Raha is also active in the broad area of Aerosols and Cosmic Rays in the context of Atmospheric Sciences and Climate Change as an integral part of Global Change. He spends a lot of effort to study the basic principles which drive Global Change. During the period under report, Prof. Raha has worked in all of these areas in collaboration with the various collaborators (and their associates) listed above. Considerable progress has been achieved in each of these topics, while the results obtained in the study of the secondary cosmic rays during the Great American Eclipse of August 2017 are worthy of special mention. A publication detailing these findings is in the pipeline now. Another notable achievement is the formulation of a convolution-based image analysis technique in passive detectors, the first application of artificial intelligence methods in the analysis of particle tracks in passive detectors.

As a Raja Ramanna Fellow of the Department of Atomic Energy, Government of India, Prof. Raha has, in addition to pursuing independent research on any topic of his choice, the task of carrying out certain duties and responsibilities (listed below). These responsibilities include, among others, advising DAE/VECC/Bose Institute on:

- Data Analysis with regards to ALICE (CERN) experiments.
- Detector development for ALICE Upgrade as well as the forthcoming CBM experiment at FAIR.
- Investigation of the Cosmic Ray – Aerosol – Cloud connection in the context of regional climate change.
- Development of a cheap polymer as passive Nuclear Track Detector.

He also has the mandate to

- Deliver lectures/invited talks to School/College/University students for popularization of science, and
- Write books/monographs.

During the period under report, Prof. Raha has devoted substantial time and effort to these tasks. He has delivered a number of lectures to school children in rural Bengal, in addition to the professional seminars to expert colleagues. One particular outreach programme that deserves mention was a seminar organised by the German Embassy and the German Academic Exchange Service (DAAD) in New Delhi in March 2020, where Prof. Raha and a senior scientist from Germany were invited to tell the huge audience about India's participation at the FAIR accelerator in Germany.

Publications in peer-reviewed journals:

- More than 35 papers have been published during the year 2019-20 by the ALICE and the CBM collaborations, in which Prof. Raha and colleagues are co-authors. They have been listed collectively and hence, not included here.
- Ray Debajyoti, Ghosh Abhinandan, Chatterjee Abhijit, Ghosh Sanjay K. and Raha Sibaji (2019) Size-specific PAHs and associated health risks over a tropical urban metropolis: role of long-range transport and meteorology. *Aerosol & Air Quality Research* 19, 2446 – 2463.
- Mehta Shyam, Singh Soumendra, Mitra Amitabha, Ghosh Sanjay K and Raha Sibaji (2019) Diurnal Variation of the Lower Tropospheric Water Vapor Observed Using Microwave Radiometer Over Darjeeling (27.05°N, 88.26°E). *Indian Journal of Remote Sensing* 47, 619 – 628.
- Ray Debajyoti, Singh Soumendra, Ghosh Sanjay K and Raha Sibaji (2019) Dynamic response of light absorption by PM2.5 bound water-soluble organic carbon to heterogeneous oxidation. *Aerosol Science & Technology* 53, 1404 – 1414.
- Palodhi Kanik, Chatterjee Joydeep, Bhattacharyya Rupamoy, Dey S, Ghosh Sanjay K, Maulik Atanu and Raha Sibaji (2020) Convolution based hybrid image processing technique for microscopic images of etch-pits in Nuclear Track Detectors. *Radiation Measurements* 130, 106219.
- Ray Debajyoti, Ghosh Sanjay K and Raha Sibaji (2020) Impacts of some co-dissolved inorganics on in-cloud photochemistry of aqueous brown carbon. *Atmospheric Environment* 223, 117250.

Conference Proceedings (Peer-reviewed):

- Roy Shreya, Chakraborty S, Chatterjee S, Biswas Saikat, Das Supriya, Ghosh Sanjay K, Maulik Atanu and Raha Sibaji (2019) Plastic scintillator detector array for detection of cosmic ray air shower. Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment 936, 249 – 251.
- Chakraborty S, Chatterjee Sayak, Roy Shreya, Roy A, Biswas Saikat, Das Supriya, Ghosh Sanjay K, Prasad Sidharth K and Raha Sibaji (2019) A new type of RPC with very low resistive material. Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment 936, 424 – 426.
- Roy Shreya, Rudra S, Shaw S, Chatterjee S, Chakraborty S, Adak Rama Prasad, Biswas Saikat, Das Supriya, Ghosh Sanjay K, Prasad Sidharth K and Raha Sibaji (2019) Stability study of gain and energy resolution for GEM detector. Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment 936, 485.
- Roy S, Nandi N, Adak R P, Biswas S, Das S, Ghosh S K, Prasad S K and Raha Sibaji (2019) Study of performances of a straw tube detector with high rate. Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment 936, 488 – 490.
- Chatterjee S, Chakraborty S, Roy Shreya, Biswas Saikat, Das Supriya, Ghosh Sanjay K, Prasad Sidharth K and Raha Sibaji (2019) Study of uniformity of characteristics over the surface for triple GEM detector. Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment 936, 491 – 492.
- Bhattacharyya Rupamoy, Dey Sandhya, Ghosh Sanjay K, Maulik Atanu, Raha Sibaji and Syam Debapriyo (2019) Empirical relationship between detection thresholds and physical parameters of different Nuclear Track Detectors. Perspectives in Science 12, 100404.

CENTRES / FACILITIES

CENTRAL INSTRUMENT FACILITY (CIF)

The new CIF facility at the Unified Academic Campus being readied for occupation and future operation

OVERVIEW

The Central Instrument Facility (CIF) has played a pivotal role in supporting research activities at Bose Institute, mainly in biological and chemical sciences. Research in science and technology these days depend on sophisticated equipment which has to be operated collectively and not individually. The CIF at Bose Institute fosters an ideal ecosystem for scientists and students to develop skills and implement their ideas through cooperation and with a partnership spirit.

Beginning with a small facility to train postdoctoral fellows in the late '80s, the CIF has grown in size and complexity. The facility provides an opportunity for researchers from this institute but also from neighboring ones to use not just high-end equipment such as a Confocal Microscope, NMR and Mass Spectrometers, but also basic ones such as documentation systems, PCR, and UV-vis Spectrophotometers.

One of the more recent additions in the CIF is the LC/MS/MS system. This system has generated a significant amount of interest among internal as well as external users for proteomic and metabolomic studies. In recent times, AYUSH, the Govt of India's organization that deals with ayurvedic and traditional medicine research, has shown keen interest in using the LC/MS/MS and has started analyzing their samples here.

The CIF has also been successful in functionalizing its first ngs platform. a series of novel bacteria and bacterial metagenomes have been sequenced, leading to several important publications in microbiology and geomicrobiology. Apart from this two equipment, the NMR facility has contributed immensely towards the institute's scientific output. It has been used extensively to design novel peptides with biological activity and understand the structure-function relationship of peptides and proteins.

The herculean task of moving the entire CIF to the new campus has been initiated. We expect to procure more sophisticated equipment to be placed in the cif labs in the new campus. the list includes an advanced Confocal Microscope, an X-RAY generator for studying proteins' structure. in the future, CIF in the new campus will also house equipment related to research in physical and environmental sciences. One such example is the state of the art tip-enhanced Raman Spectrometer which is in the process of procurement.

The CIF generated more than RS. 7 Lakhs of revenue from external sources during this period. the number of external requisitions reached 120, which is an all-time high.

LIST OF PERSONNEL

Management Committee : Prof. Sujoy Kumar Das Gupta In-charge CIF(CB), Dr. Jayanta Mukhopadhyay, In-charge CIF (MC), Dr. Abhijit Chatterjee, Dr. Abhrajyoti Ghosh, Dr. Achintya Singha, Dr. Ajit Bikram Datta, Dr. Anirban Bhunia, Dr. Atin Kumar Mandal, Prof. Gaurisankar Sa, Prof. Gautam Basu, Dr. Kaushik Biswas, Dr. Pallob Kundu, Prof. Shubho Chaudhuri, Prof. Srimonti Sarkar, Prof. Tapan Kumar Dutta, Dr. Zhumur Ghosh, Mrinal Das, Ranjan K. Dutta, Dr. Wriddhiman Ghosh (Convener).

Staff Members : TanimaModak Dhar, Ranjan Kumar Dutta, Smriti Ranjan Maji, Mrinal Das, Swaroop Biswas, Sheolee Ghosh Chakraborty, Amarandra Nath Biswas, Pallab Chakraborty, Souvik Roy, Alpana Chattopadhaya

Website:http://www.jcbose.ac.in/cif

CENTRE FOR ASTROPARTICLE PHYSICS & SPACE SCIENCE

OVERVIEW

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. The main objectives of this center are to understand the interaction characteristics of Cosmic Ray at low and high energy, search for exotic phenomena in Cosmic Rays, studies of the changing Airspace Environment in Eastern Himalayas in the context of regional climate change along with the studies to understand the connection between the cosmic Ray and Cloud. In order to fulfil these objectives observational facilities for monitoring the various aspects of Cosmic Ray and atmospheric phenomena have been created at Darjeeling.

- Commercially available polymer polyethylene terephthalate (PET) has been standardized and calibrated for use as Nuclear track detector. These have also been deployed at Darjeeling along with Ooty and Hanley for cosmic ray measurements.
- An Air Shower array using active detectors is being developed to study the energy spectrum and components of primary cosmic rays. Infra structural facilities like detector tanks and metal frames have been designed and fabricated in-house at the Bose Institute workshop.

- Vertical profile of rain rates, drop size distributions, radar reflectivity, fall velocity of hydro meteors and other rain parameters are being measured using Micro Rain radar (MRR).
- Vertical profile of water vapour mixing ratio and many other aerosol and cloud related quantities are being measured using Raman Lidar.
- Several automated online atmospheric trace gas analyzers e.g. SO , NO , CO, O etc have been running to study the gaseous pollutants in the atmosphere.
- Particulate matter present in the atmosphere are being studied using high volume sampler, online particulate matter monitor for number and mass concentrations and condensation particle counter to study the ultrafine particulate matter.
- Black carbon or soot particle in the atmosphere over Darjeeling is being studied using Aethelometer.
- Cloud Condensation Nuclie counter is being run for the study of finer aerosol particles which forms cloud.
- Sunphotometer is being run for the study of Aerosol Optical Depth i.e. the attenuation of incoming solar radiation due to loading of aerosol particles in the atmosphere.
- Automatic weather station is installed to collect meteorological data along with a sonic anemometer for different components of wind velocity
- Lightning detector and electric field monitor has been installed to study the variation of atmospheric electric field
- Organic and elemental carbon in the ambient atmosphere are being monitored continuosly.
- The size-segregated cloud condensation nuclei is being monitored under different ambient conditions in different seasons.
- The scattering coefficients of aerosols are being monitored under different humid conditions
- Atmospheric electricity is being studied under fair weather conditions covering all the seasons
- Chemical characterization of wet precipitation is being studied during monsoon.

FALTA EXPERIMENTAL FARM

In Charge:
Prof. Debabrata Basu (till December 31, 2019);
Prof. Pallob Kundu (January 2020 onwards)

OVERVIEW

The Falta Experimental Farm (FEF) has been an important center for scientific and outreach activities of Bose Institute. Additionally, multiple crops are raised throughout the year, utilizing the modern cultivation technologies for further studies and selling the excess at a reasonable cost. This year, we have cultivated rice, maize, sugarcane, cucumber, cauliflower, green cabbage, red cabbage, broccoli, and pointed gourd. The selling of these produces generated a significant amount of revenue. Our wholehearted effort in pisciculture, including Rohu and Katla fish spawn production via artificial breeding, and chicken rearing, also yielded much income. We have continued medium scale production of mushroom spawn for in house cultivation and supply to enthusiastic farmers. Similarly, the successful cultivation of earthworm ensured enough supply for in house vermicomposting units as well as to farmers.

During this period, we have also taken a major initiative to wrap up the works of now-defunct schedule tribe specific rural biotechnology programmes sanctioned by the DST. Total financial and field auditing of the said project have been completed and some of the documents have already been submitted to the DST. A new project proposal was developed and sent to the DST for funding consideration. The project entitled **"Improvement and broad-scale implementation of different biotechnology-oriented programmes for the socio-economic upliftment of Scheduled Tribe community of West Bengal"**, PI: Dr. Pallob Kundu; Co-PI: Dr. Gaurab Gangopadhyay; Co-PI: Dr. Shubho Chaudhuri, Division of Plant Biology, has been recommended in principle under Tribal Sub

Plan of DST SEED programme. This project will allow us to continue our biotechnology-based outreach activities and bring the knowledge of modern agricultural practices to the marginal people of West Bengal, Dr. Debabrata Basu participated in an awareness programme regarding DST, SEED activities organized at the Sidho-Kanho-Birsha University, West Bengal. Prof. Uday Bandyopadhyay, the Director, Bose Institute, and Dr. Pallob Kundu participated in a similar awareness programme held at Vivekananda Institute of Biotechnology, Sri Ramkrishna Ashram, Nimpith, West Bengal. Dr. Pallob Kundu, along with Mr. Achintya Mukherjee, Account Officer, Bose Institute, attended a meeting convened at DST, New Delhi, for reporting the activities conducted under the schedule tribe specific rural biotechnology programme. Later Dr. Pallob Kundu attended another meeting at New Delhi, convened by the DST, to defend the new project and share ideas about biotechnology-based outreach activities with other experts in the field.

Maize cultivation at the Falta Experimental

Mushroom cultivation at the Falta Experimental Farm.

Prof. Gautam Desiraju and Prof. Uday Bandyopadhayay are in conversation with faculties and staff members of Bose Institute at the Falta Experimental Farm.

J C BOSE CENTRE (PUBLICATION AND MUSEUM)

Prof. Joachim Frank, Nobel Laureate (Chemistry, 2017) at J.C. Bose Museum

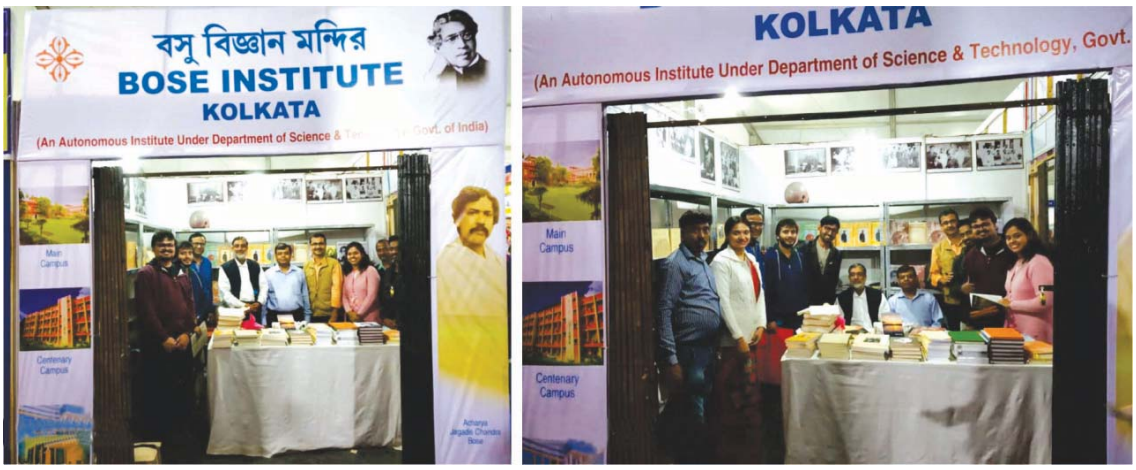
The Hon'ble Minister of Communication, Science and Technology, Maldives visited the J.C. Bose Museum on November 8, 2019

OVERVIEW

Marion Geddes, grand daughter of Sir Patrick Geddes, J.C. Bose's first biographer visited Bose Institute and J.C. Bose Museum on October 14, 2019

J C Bose Centre comprises the Museum dedicated to J.C. Bose and the Publication unit. The museum is a special attraction in the Main Campus. It nestles a permanent exhibition on the life, research contributions and works of Acharya Jagadis Chandra Bose. Presently the Museum is a repository of the significant scientific instruments designed by J.C. Bose, commemorative items, and rare and significant archival documents. Guided tours are conducted on special occasions for group visits of school/college/university students. New acquisitions from various Libraries, Institutes and other Museums from both India and abroad are undertaken every year. The Museum takes part in different National-level Science Fairs and Exhibitions. Detailed information on J.C. Bose is available in the archives which are helpful for researchers/ professionals for any sort of academic work in this field. A large number of original Laboratory/ College notebooks have been digitized and kept on display during important occasions. Further development of our museum is under progress. Distinguished delegates have visited Bose Institute and J.C. Bose Museum during this period. This includes Marion Geddes, grand daughter of Sir Patrick Geddes, Bose's first biographer on October 14, 2019. The hon'ble Minister of Communication, Science and Technology, Maldives visited the Museum on November 8, 2019. Prof. Joachim Frank, Nobel Laureate (Chemistry, 2017) visited the J.C. Bose Museum on January 22, 2020, following his Special Centenary Lecture.

Since its inception in 1980, the Publication Section has been entrusted with the responsibilty of bringing out publications of Bose Institute on a regular basis. The Annual Report (both English & Hindi Versions) and Bose Institute Newsletter (BI News) are published each year. The Orientation Booklet provides a detailed account of the Ph.D. Course Work mandatory for the scholars entering



Participation of Bose Institute in the 44th Kolkata International Book Fair 2020

Bose Institute for their doctoral research work. Posters, pamphlets are regularly published as per the requisition during different Symposia, Seminars and Training Programmes. Bose Institute has been participated in the 44th Kolkata International Book Fair from January 9- February 9, 2020 with a huge sale of its publications. The following publications are presently available for sale : J. C. Bose and Microwaves – A Collection Rs.200.00; Science and Society – Reflections Rs.1050.00; Acharya 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.350.00; Acharya Jagadis Chandra Bose (Bengali) Rs.12.00; Abyakta (Bengali book written by Sir J.C. Bose) Rs.50.00; Acharya Jagadis Chandra Bose (Bengali Combined) Rs.325.00; Bose Institute-Myself & Ribosome Rs. 200.00; In the Realm of Bose (the diary of a teenager's brief sojourn at Bose Institute) Rs. 180.00; An Appraisal of J. C. Bose – In the context of Sociology of Science Rs. 350.00; Nivedita Commemoration Volume Rs. 500.00; D.M. Bose-A Scientist Incognito Rs. 350.00; Basu Vigyan Mandir –o-Amar Karmojibon Rs. 200.00.

LIST OF MEMBERS

Prof. Gautam Basu (Chairman), Prof. Gaurab Gangopadhyay, Prof. Somshubhro Bandyopadhyay, Dr. Achintya Singha, Tarun Kumar Maji, Dr. Ishani Chatterjee, Chandra Kanta Sasmal.

MADHYAMGRAM EXPERIMENTAL FARM (MEF)

OVERVIEW

Madhyamgram Experimental Farm (MEF) is the translational research hub of Bose Institute. Its main component is the agricultural fields where the plant scientists grow their experimental crops in different seasons for seed multiplication, collection of specific plant parts other than seeds, selfing and to raise selfed seeds, hybridization between desired parents, the study of agro-morphology, etc. The J C Bose Innovation Centre in MEF comprises of Transgenic Plant Research Laboratory and Greenhouses. The Greenhouses are presently fourteen in number, some of which are dedicated to transgenic plant research, while the rest are for routine hardening and transplantation of tissue culture plantlets. The laboratory is a fully equipped one with standard biotechnology and molecular biology research.

The on-going research programmes of the plant scientists of DPB at MEF are as follows:

Prof. Debabrata Basu: Inter-varietal hybridization of Brassica *juncea* for imparting tolerance against *Alternaria brassicicola.*

Prof. Gaurab Gangopadhyay: Inter-specific hybridization of Sesame for fungal stress tolerance, synchrony in pod maturation, and a better oil profile.

Prof. Pallob Kundu: Maintenance of VIGS-mediated knocked down and other transgenic lines of tomato in the transgenic green-houses in connection to the research programme on the "Investigating gene-regulatory circuit active during biotic stress response in tomato".

Prof. Shubho Chaudhuri: Screening of the mutant lines and generation of mutant seeds of *Arabidopsis* at dedicated green-house (21°C-23°C) in connection to the research programme on "Role of nuclear architectural protein in modulating chromatin structure during pollen development". Growing of transgenic lines of rice at dedicated green-house (28°C-30°C) in connection to the research programme on "Understanding the regulatory role of rice epigenome during abiotic stress (salinity and cold)".

Dr. Anupama Ghosh: Deciphering host-defence responses against specific pathogen effectors proteins – Zea mays against Ustilago maydis causing corn smut disease, and Oryza sativa against Rhizoctonia solani causing sheath blight disease of rice.

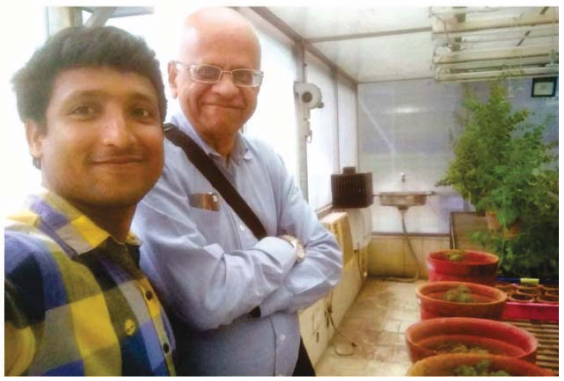
LIST OF PERSONNEL

In Charge: Dr. Shubho Chaudhuri (present Scientist-in-charge), Dr. Gaurab Gangopadhyay was the in-charge up to 05.09.2019)

Staff members : Pulak Kr Roy, Asis Kumar Dalal, Sk Inal Ali, Mahesh Dasgupta, Laxmi Kanta Pradhan, Bhanu Kisku

Research personnel (project) : Dr. Sambit Datta, RA



Prof. Gautam R Desiraju, the Hon'ble Chairman of the BI Council, visited MEF on 10.07.2019 and interacts with the plant scientists.

LIBRARY

Members of the Library Committee:
Prof. Srimonti Sarkar, Dept. of Biochemistry, Chairperson
Dr. Pallob Kundu, Div of Plant Biology, Member
Dr. Jayanta Mukhopdhyay, Dept. of Chemistry, Member
Dr. Atin Kr. Mandal, Div of Molecular Medicine, Member
Dr. Shubhra Ghosh Dastidar, Div of Bioinformatics, Member
Dr. Achintya Singha, Dept. of Physics, Member
Mr. Achintya Mukherjee, Accounts Officer, Member
Mr.Vikas Kumar, Audit and Finance Officer, Member
Dr. Arun Kumar Chakraborty, Librarian & Convener

Staff Members :
Ms. Ananya Raha
Ms. Sumita Dey
Ms. Tanusri Bhattacharyya

OVERVIEW

The Institute Library system is one of the best 'Science Reference' Libraries in Eastern India, set-up in the main campus in 1917 by Acharya Jagadish Chandra Bose and a wing at the 'Centenary Building' was opened in 1983. In the year 2007, a small library was set-up in the Salt Lake Campus of the Institute. Library provides the latest information to the BI faculty, researchers, staff members, and students of the Integrated M.Sc.-Ph.D. programme on Life Sciences and Physical Sciences. The Library extends its physical Library facilities as well as online resources access to other Institutions /Universities /R&D organizations in and around Kolkata. Library also regularly provides document delivery services and other services to Faculty/researchers/students of the Institute as well as faculty/scholars/researchers of DST and CSIR Institutes in India as a mandate of National Knowledge Resource Consortia (NKRC), Govt of India.

The total library collection of reading materials is 45110 as of 31.03.2020 and subscribed to more than 5000+ online journal packages from more than 50 Publishers. Library also subscribed to online-only full–text journals/databases of different academic societies and national and international publishers. Library subscribed to e-books packages. All subscribed e-journals can be accessed from 1997 onwards. The Library is also having an ancient rich print collection of important science journals.

Library Activities:

Collection Development:

- Books
- Bound Volumes of Journals
- Theses
- Online Journals subscribed
- Online journals through National Knowledge Resource Consortia (NKRC)
- Scientific Software
- Back Volume Journals (online)
- Sir J.C. Bose Collection
- Reports, Newsletters, Annual Reports of other Institute(s),
- Publication of Bose Institute etc.

1. Access Management of Resources

Library resources are accessible for the Institute's faculty/scholar from all campuses of Bose Institute. Library also provides Off-Campus Access to its resources to Institute faculty members. Library uses open source software KOHA for Web-OPAC and D-Space for IDR. For access management library maintains servers.

2. Resources of Bose Institute Library

Resources of BI Library can be accessed from Bose Institute Library Portal (www.jcbose.ac.in/library).

A. Journals Resources

Library subscribed to major publishers journals such as ASM, ACS, Life Sciences Reviews, Cell Press journals of Elsevier, Science Direct, Nature Journals, John Wiley & Sons, Inc, IOP, AIP, APS, 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, Springerlink, Landes Bioscience, Microbiology Research Foundations, National Academy of Sciences, Physical Society of Japan, Portland Press, Rinton Press, Rockefeller University Press, Royal Society of Chemistry / Turpin Distribution UK, Thieme, Landes Bioscience, Karger. Current Protocols (Online) of John Wiley / Blackwell, Annual Reviews Online (Back volume), Methods in Enzymology (Online) etc.

B. Back Volume Journals:

Elsevier Backfiles in ScienceDirect

1. Biochemistry, Genetics and Molecular Biology
2. High Energy Physics
3. Cell Press

Wiley Blackwell Journal Backfiles

1. Biotechnology, Biochemistry, and Biophysics
2. Physics
3. Immunology
4. Microbiology

C. E-Books Collection :

Library also has few E-books collection.

D. Databases:

Library also subscribed to different databases such as :

- SCOPUS the largest abstract and citation database of research literature and quality web sources of Elsevier.
- Clarivate Analytics Web of Science Core Collection: Citation database in the Sciences, Social sciences, Arts, and Humanities.
- SciFinder®: a research discovery tool that allows us to explore the comprehensive and authoritative CAS databases.
- The Arabidopsis Information Resource (TAIR): a database of genetic and molecular biology data

E. Scientific Softwares services by Library:

Sl. No.	Software	Publishers
1.	ENDNOTE X8 Multi-User Download-Research Software	Clarivate Analytics
2.	MatInspector and MatBase 1-year	Genomatix-Precigen Bioinformatics Germany GmbH
3.	QIAGEN CLC Genomics Workbench.	QIAGEN India Pvt. Ltd. (New-2020)
4.	IPA(Ingenuity® Pathway Analysis) Software	QIAGEN India Pvt. Ltd.
5.	Upgradation of Sigmaplot 11 Software to Sigmaplot version 14	Starcom Information Technology Limited
6.	Grammarly Writing Support	Bridge people
7.	iThenticate- Anti-plagiarism Software	Turnitin
8.	Adobe Acrobat Professional.	Adobe
9.	Adobe Photoshop	Adobe

F. Resources through NKRC (http://nkrc.niscair.res.in/indexpage.php):

The Library has joined with the National Knowledge Resource Consortia (NKRC) since 2008, which is joint consortia of CSIR and DST Institutes for accessing online resources. Through this consortia, faculty members/scholars of this Institute can access more than 5000+ online resources, SciFinder of ACS, Web of Science, Patent databases, etc. The 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 even other institutes in India.

G. New Addition(s) in 2019-2020:

- Book(s) added in 2019-2020 : 43 nos.
- Thesis added:35nos.

3. Services :

Reader's Service	The Library is open to all faculty members, research scholars, students of Integrated M.Sc.-Ph.D. programme and staff members of BI for reading and consultation during institute working hours. 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). Faculty/Scholars from different Universities/Institutes in and around Kolkata can access BI library resources from CB Campus and MB campus Library.
Lending Service	Faculty members, scholars, students, staff can access library resources during Institute working hours.
Technical Query Service	Library responds to any query related to information regarding research insights, reference management, database(s) access, Software services, or any access-related issues of subscribed content or using Library OPAC/IDR, etc.
Document Delivery Service	Library provides article resources to all faculty/ scholars of DST / CSIR Institutes and also other institutes in India.
Inter-Library Loan Service	The Library provides 'Inter-Library Loan' facility to the users of other libraries, mostly research institutes who have Inter-Library Loan arrangement(s) with Bose Institute Library. Library also get the book through an inter-library book loan. Library provides article request service to BI faculty/scholars. Library also provides article services to faculty members /scholars across India.
Institutional Membership	The Library used to have a membership of various National and International organization(s) –(i) Biomed Central (BMC) up to March 2020(ii) Public Library of Science (PLoS), (iii) *International Federation of Library Associations and Institutions (IFLA), (iv) Indian Association Of Special Libraries And Information Centres (IASLIC), (v) Indian Science Congress Association (ISCA) Membership etc.*
e - Journals Access	The Library provides access to electronic journals subscribed by Library as well as subscribed through National Knowledge Resource Consortia (NKRC).

User Awareness Programme	The Library conducts user orientation programmes time to time for the benefit of users and optimal utilization of subscribed resources. The user orientation programme also includes "Reference management" for publications, citing references in the thesis, using databases, citation reports, h-index compilation, using different scientific Software, using of anti-plagiarism Software, grammar checking software, etc.
Reprographic Service	The Library provides reprography services to its users. Photocopy services are provided to all its users of the Institute and outside users also.
Plagiarism Checking Service	Library provides plagiarism checking service of articles, book chapters, MSc. Ph.D. Dissertations. Library also provides service of Thesis plagiarism checking for research scholars of the Institute.
Bibliographic & Full-text Search Services	Library provides Bibliographic and full-text search services from various databases like Web of Science, Scopus, SciFinder, PubMed, etc. for its users and also outside users.
Scientific Software Services	Library provides access to various Scientific Softwares (mentioned above in F.) from its different campuses.
WEB-OPAC	Online access to Library holdings data is available through WEB-OPAC (Online Public Access Catalouge). Users have the facility to browse and search the Library database and view the status of a document.
Institutional Repository	The Library has created an Institutional Repository using Dspace Software, which is an open Access initiative. It is a digital repository of Thesis Collections of the Institute, Publication of Faculty members, Annual Reports of the Institute, J C Bose Collection, D.M. Bose Collection, Transactions, etc.
New Initiatives	The Library has become the participating Library in the NDL (National Digital Library) project, initiated by MHRD, Govt of India. The Library has also taken other initiatives for implementing RFID (radio-frequency identification) tagging for its collection.

Further Academic Activities:

Library also provides training to library school students like the Internship programme to LIS school students, training to Library professionals, advising different libraries for developing modern automated Library, organizing training programmes/workshops for LIS professionals, etc.

Prof. (Dr.) Uday Bandyopadhyay, Director, BI inaugurated the Conference on "Reorienting Information Literacy in the LIS" during the 75th Year Celebration of DLIS, University of Calcutta, on 12.02.2020.

Scientific Activities :

Student Awarded Ph.D.	Publication	Book Chapter / Invited Review	Participation in Conference / Symposia / Workshop and Delivered Invited Talk	Extramural Funding	Patent Applied / Granted	Award / Honour / Membership
01	02	NIL	17	NIL	NIL	NIL

WORKSHOP

OVERVIEW

The Workshop is the nucleus of the maintenance activities including the proposed projects at the seven campuses of the Bose Institute. Workshop is situated at Main Campus and its branches are i) Machine Shop ii) Carpentry section iii) Store iv) Transport & v) Electrical unit at Main Campus and at Centenary Campus. The activities of the said units are as follows.

i) **Machine Shop** – The shop consists of a few nos. of lathe, shaping, drill, grinding machine etc. This shop is actually named as mechanical section because under the umbrella of this section there are some other units like fabrication wing, the wing where the prototype models of the instruments (using which Sir J.C. Bose conducted his various famous experiments) as well as various types of instruments like gradient mixtures, gel tray etc. are being manufactured against the requisitions of internal Scientist and Officers.

ii) **Carpentry Section**- This section deals with all furniture manufacturing, repairing jobs etc. as per the requirements of Scientists, officers etc.

iii) **Store**- Workshop store maintains the materials (civil, electrical, mechanical ,plumbing, building and furniture related materials etc) required for all seven campuses.

iv) **Transport** :- Workshop Superintendent personally deals with the allocation of internal transports as per requirement of Scientists, different internal offices, outside guests etc. Except this outside transports are being utilized as per requirement when internal transports are not affordable.

v) **Electrical Unit**:- This section attains all the electrical related problems specifically of Main Campus & Centenary Campus. Except the above this unit also deals with the breakdown problems and execution of new project in other five nos. campuses.

The remarkable jobs as well as other maintenance job of Workshop in the year 2019-20:-

i) Study & monitoring of all the electrical drawings of Unified Campus including planning for execution of substation etc. are being done to give a proper shape of the electrical system.

ii) Study & day to day monitoring of HVAC & other related issues including various civil part of Unified Academic Campus to ensure that the building should be completed within the stipulated time frame.

Monitoring of the Electrical Installations of the seven campuses

LIST OF PERSONNEL

Staff Members : Raju Chandra Paul ,Workshop Superintendent.

Main Campus: Bholanath Saren, Abdul Rahaman Molla, Sk. Md. Farruck, Rajkumar Das, Pranab Banerjee, Brahmdeo Prasad (Superannuated), Subrata Basak, Sanjoy Santra, Kodan Das.
Centenary Campus: Baidya Nath Murm.

OUTREACH
&
MAN POWER DEVELOPMENT

OUTREACH & MAN POWER DEVELOPMENT

OVERVIEW

Dissemination of knowledge has been an integral part of the charter of Bose Institute as proclaimed by J. C. Bose in his foundation speech in 1917. In recent years many outreach programmes has been undertaken to acquaint the school children with the wonders of science and encourage them to pursue a career in science. Hands-on training of students from North-East states has become an annual event of Bose Institute for last nine years. Training programmes for the school students of Darjeeling is held regularly at the Darjeeling campus of Bose Institute. The faculties working at Darjeeling campus interact with the school students in regular intervals. Moreover, school students participating in the children's science congress interact with our faculties for their project work. Bose Institute also collaborates with other organizations for organizing science camps for school students in and around Kolkata. Hands-on training camps has also been organized for the school teachers of North-Eastern states as well as Darjeeling to help them in integrating the experiment based teaching with their regular class room teaching.

In order to extend the benefit of the advancement of our knowledge to rural sector Bose Institute has initiated a rural biotechnology programme. Under this programme the people from rural sector are given training for Mushroom cultivation, Pisciculture, Sericulture and Apiculture.

A major step for the development of trained man power was taken in 2006 when Bose Institute started M.Sc courses in Physical and Biological sciences. Physical Science course was initiated in collaboration with St. Xaviers College, Kolkata, Calcutta University being the degree granting Institute. Biological Science course was started in collaboration with Calcutta University. The success of both of these courses was encouraging. So keeping in view the Institute's objective of creating man power for research, new plans were formulated to initiate M.Sc-Ph.D integrated course and subsequently M.Sc-Ph.D integrated course in life sciences was started in 2011 and Physical Science course was initiated in 2012.

HAND-ON TRAINING PROGRAMMES:

(a) NESST-BASE 2019: June 3 – 15, 2019.

The **13th North-East Students' Summer Training on BAsic SciEnces (NESST-BASE)** was held at Darjeeling during 3-15 June 2019. 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 state authorities selected the students. These students were given hands-on training on physical, chemical and biological sciences. There were also sessions with the aim to introduce the students with the fun of mathematics. This year popular lectures were delivered by Dr Debiprasad Duari, Director, Research & Academic of M. P.Birla Institute of Fundamental Research, M. P. Birla Planetarium, Kolkata and Prof Gautam Basu, Department of Biophysics, Bose Institute, Kolkata. The popular lecture was held on 8th June 2019 when the students from various schools of Darjeeling district attended the lecture. Dr Duari delivered a lecture on "Astronomy & Astrophysics: Concepts & Challenges" and Prof Basu delivered a lecture on "Art in Science". The program was jointly co-ordinated by Dr Abhijit Chatterjee, Associate Professor of Environmental Sciences Section and Dr Abhrajyoti Ghosh, Assistant professor, department of Biochemistry, Bose Institute, Kolkata."

(b) Rural Biotechnology programmes:

Scheduled Tribe Specific Rural Biotechnology Programme has started its journey in the year 2014 which is financed by Department of Science & Technology, Government of India for the development of Socio-economic status of Scheduled Tribe community people throughout the West Bengal. The major objectives of this programme is socio-economic upliftment, generation of awareness, empowerment of women of the Scheduled Tribe people in West Bengal through various programmes viz Sericulture, Agriculture, Orchard, Mushroom cultivation, Vermicompost production, Fishery, Apiculture, Piggery, Food Processing, Goat rearing, Rainwater harvesting for agriculture as well as drinking purpose, Country chicken rearing, Betel Leaf Cultivation, Crab Culture etc.

Integrated M.Sc – Ph.D programme

The M.Sc. - Ph.D. course has been formulated as a combination of two year (four semester) Postgraduate M.Sc. Curriculum and a four year (approximately) Ph.d. programme with the objective to develop human resource with expertise in the broader areas of research interests and to motivate students to choose a career in basic and applied sciences.

The admission in the M.Sc course is based on written test followed by interview of the candidates short listed on the basis of their marks obtained in the secondary examination onwards. The intake of students, depending on the performance, varies between 6-10 in Physical Sciences and 14-20 in biological sciences.

STATEMENT OF ACCOUNTS FOR THE YEAR 2019-20

STATEMENT OF ACCOUNTS FOR THE YEAR 2019-20

INDEPENDENT AUDITOR'S REPORT

To the Members of the Council

Qualified Opinion

We have audited the accompanying financial statements of BOSE INSTITUTE (the entity), which comprise the Balance Sheet at March 31st 2020, and the Income & Expenditure account, Receipts & Payment Account for the year then ended, and notes to the financial statements, including a summary of significant accounting policies and other explanatory information. In our opinion and to the best of our information and according to the explanations given to us, except for the effect of the matter described in the Basis for Qualified Opinion section of our report, the accompanying financial statements give a true and fair view of the financial position of the entity as at March 31st, 2020, and of its financial performance for the year then ended.

Basis for Qualified Opinion

1. Unidentified credits to the tune of Rs. 536478 /- pertaining to UBI Bank (A/c No: 416602010003355) as per Bank statement resulting in incorrect reflection of income or debtors balance in financial statement.

2. The Institute has accounted for expenses on cash basis in the financial statements in few cases which is contrary to the fundamental accounting assumptions as per AS 1 notified by the Institute of Chartered Accountants of India.

3. Irregular grant of pay & allowances of Rs. 53.93 lakhs due to promotion with retrospective effect.

4. Observation on Projects for FY 2019-20

    a. Non submission of Project Completion reports in respect of 86 projects. Out of this , 15 projects are terminated in FY 2019-20 and 71 projects have been terminated upto FY 2019-20)

    b. During the period FY 2013-14 to FY 2019-20, in respect of 11 projects, expenditures incurred are in excess of Rs. 842295 /- of total funds received from funding agencies. Status of recovery of excess expenditures is yet to be confirmed by Bose Institute.

    c. In the same period, we have found in 71 projects, unutilized amount to the tune of Rs. 16921264.26 /- has not been refunded by Bose Institute even after completion of respective projects.

5. Intangible assets in the form of books and journals are not amortised over the licence period and are being carried forward and depreciated even after expiry of their licence period which is not in accordance with the requirement of AS 26 notified by the Institute of Chartered Accountants of India. The amount of such expired licences is presently not ascertainable

STATEMENT OF ACCOUNTS FOR THE YEAR 2019-20

6. Fixed Asset register has been updated till 31st March, 2017 and for the period 1st April, 2017 to 31st March, 2020 is under preparation. Details related to location of asset, description of asset, life of asset and asset coding are yet to be prepared. Periodic physical verification of fixed assets and impairment testing are not performed. In view of this it is not possible to opine on correctness or otherwise of fixed assets.

7. Employee related advances & other advances remaining unsettled for more than 1 year to the tune of Rs. 254010/-.

8. Liability towards gratuity and leave encashment is not ascertained as per actuarial valuation and the same are accounted for on cash basis contrary to the requirement of AS 15 notified by the Institute of Chartered Accountants of India.

9. The institute does not have internal audit system commensurate with the size and nature of its activity resulting in poor internal financial control.

10. Asset acquired from development and modernisation fund amounting to Rs. 666.57 lacs has been held under 'Investment Under Earmarked Fund' and has not been capitalised thereby understating the fixed assets to that extent. Consequential impact on depreciation and current year's profitability is not ascertainable.

11. Capital WIP to the tune of Rs. 24.07 lakhs has no movement since last Balance Sheet date as on 31.03.2019. Current status of work and consequential impact on the books of accounts is not ascertainable at this stage.

12. The Institute does not follow the practise of obtaining balance confirmation for receivables or payables accounts. Consequential impact on the books of accounts is not ascertainable at this stage.

13. As explained by management current liability of TDS Pension of Rs. 16000 /- appearing in Pension Fund Accounts for FY 2019-20 is a long outstanding amount which was previously remitted to respective tax consultant for payment of TDS dues however the same has not been adjusted or recovered from the tax consultant till date. The amount of Rs. 16000 /- is actually not a liability and recovery to be made by the earliest.

14. Current liability of Payable to Pensioner of Rs. 366830 /- appearing in Pension Fund Accounts for FY 2019-20 is a long outstanding amount the details of which were not available to us. Hence the effect of the same on books of accounts cannot be determined.

15. With respect to Contributory Provident Fund Account for FY 2019-20 details in relation to Payable to staff (Rs. 202160/- Cr.), Receivable from Bose Institute (Rs. 702696 /- Dr.), Receivable from GPF (Rs. 264300 /- Dr.) and respective contra entry in GPF Accounts as on 31.03.2020 are long outstanding amount the details of which were not made available to us. Consequential impact on the books of accounts is not ascertainable at this stage.

16. We observed mismatch of Interest earned & TDS on interest under Section 194A of Income Tax Act, 1962 between amount as per26 AS and Bank Certificate and books of accounts for FY 2019-20 and the same have not been reconciled as per table below.

STATEMENT OF ACCOUNTS FOR THE YEAR 2019-20

Details of deductor	Details	26 AS	Bank Certificate	Books of accounts
UBI Maniktala	TDS on interest	Rs. 208333 /-	Rs. 350097 /-	Rs. 350097 /-
	Interest	Rs. 2083330 /-	Rs. 3500970 /-	Rs. 3500970 /-
TCG Life Sciences Pvt. Ltd.	Interest	Rs. 66000 /-	NIL	NIL
KPC Life Sciences Pvt. Ltd.	Interest	Rs.4000 /-	NIL	NIL
SBI (MUMS86183G)	Interest	Rs. 95476 /-	NIL	NIL
	TDS on interest	Rs. 9550 /-	NIL	NIL

17. We could not verify brought forward balances of 11 Nos of current assets to the tune of Rs.332.57 Lakh and current liabilities to the tune of Rs.58.58 Lakh.

We conducted our audit in accordance with the Standards on Auditing (SAs) issued by ICAI. Our responsibilities under those standards are further described in the Auditor's Responsibilities for the Audit of the Financial Statements section of our report. We are independent of the entity in accordance with the ethical requirements that are relevant to our audit of the financial statements in India, and we have fulfilled our other ethical responsibilities in accordance with these requirements. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our qualified opinion.

Emphasis of Matter

We draw attention to the following matters:

1. Non realisation of refund of Service Tax amounting to Rs. 202.83 lakhs.
2. We observed mismatch of GST paid as per Form 3B for the period April, 2019 to Feb, 2020 amounts to Rs. 191740 /- and GST paid as per ledger amounts to Rs. 172956 /-. The difference was not reconciled.
3. Bank Guarantee register not maintained for FY 2019-20.
4. As per Accounting Policy and Notes to Accounts, Schedule 24 clause 3.2, Institute has charged depreciation on Written Down Value Method as per prescribed rates irrespective of dates of putting the same to use.
5. Stale cheque to the tune of Rs. 1438485/- has been appearing in books of accounts since long.
6. Matters related to Terminated and Ongoing Projects
   a. Found mismatch of expenditure between books of accounts and returns like Statement of Expenditure (SOE)/UC
   b. Fund is utilised other than the intended use as specified in order

Our opinion is not modified in respect of these matters.

STATEMENT OF ACCOUNTS FOR THE YEAR 2019-20

Key Audit Matters

Key audit matters are those matters that, in our professional judgment, were of most significance in our audit of the Financial Statements of the current period. These matters were addressed in the context of our audit of Financial Statements as a whole, and in forming our opinion thereon, and we do not provide a separate opinion on these matters. In addition to the matters described in the Basis for Qualified Opinion and Emphasis of Matter sections, we have determined the matters described below to be the key audit matters to be communicated in our report:

Key Audit Matter	Auditors' response to Key Audit Matter
Funded Projects : The Institute receives and utilises Funds for various projects and needs to comply the terms and conditions of the relevant order and has to submit certificates and documents time to time to the concerned authority.	We performed an understanding and evaluation of system of internal control over the receipt and utilisation of Fund and accounting thereof as per terms and conditions of the sanctioned order of respective Grants and the compliances laid down in the terms of the Grant.
Fixed Assets (including Capital Work in Progress): The carrying amount of Fixed Assets of the Institute is Rs 856829796.87 /-, which represents about 17.88 % of the total assets of the Institute. Due to the significance of the value of the Fixed Assets, we have considered the same to be significant to our overall audit strategy and planning.	We assessed the controls in place, evaluated the appropriateness of capitalization process, performed tests of details on costs capitalized, the timeliness of the capitalization of assets and the derecognition criteria for assets retired from active use. We reviewed the judgments made by management including the nature of underlying costs capitalized; determination of realizable value of the assets retired from active use; the appropriateness of asset live applied in the calculation of depreciation; useful lives of assets as per the technical assessment of the management.

STATEMENT OF ACCOUNTS FOR THE YEAR 2019-20

Responsibilities of Management and Those Charged with Governance for the Financial Statements

Management is responsible for the preparation and fair presentation of the financial statements in accordance with the aforesaid Accounting Standards, and for such internal control as management determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error. In preparing the financial statements, management is responsible for assessing the entity's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless management either intends to liquidate the entity or to cease operations, or has no realistic alternative but to do so. Those charged with governance are responsible for overseeing the entity's financial reporting process.

Auditor's Responsibilities for the Audit of the Financial Statements

Our objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion.

Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with SAs will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

Place: Kolkata

Date: 29.09.2020

For SPAN & Associates
Chartered Accountants
FRN: 302192E

CA Amlan Kusum Mandal
Membership No: 064631
UDIN: 20064631AAAABD3794

STATEMENT OF ACCOUNTS FOR THE YEAR 2019-20

BOSE INSTITUTE
KOLKATA
BALANCE SHEET AS ON 31st MARCH 2020

	Schedule	2019-20 (₹)	2018-19 (₹)
Corpus/Capital fund and liabilities			
Corpus/Capital fund	**1**	2,95,78,18,095.66	2,94,01,85,863.66
Reserves and surplus	**2**		
Earmarked/Endowment funds	**3**	55,18,41,128.61	54,92,84,812.41
Secured loans and borrowings	**4**		
Unsecured loans and borrowings	**5**		
Deferred credit liabilties	**6**		
Current liabilities and provisions	**7**	1,28,07,36,363.51	69,13,85,263.47
Total		**4,79,03,95,587.78**	**4,18,08,55,939.54**
Assets			
Fixed Assets	**8**	85,68,29,796.87	89,55,49,811.15
Investments-others	**9**	35,65,80,569.72	35,69,26,095.28
Investments -from earmarked/ endowment Funds	**10**	13,51,35,214.80	13,25,14,044.04
Current assets, loans,advances etc.	**11**	3,44,18,50,006.39	2,79,58,65,989.07
Miscellaneous expenditure (to the extent not written off or adjusted)			
Total		**4,79,03,95,587.78**	**4,18,08,55,939.54**
Significant accounting policies	**24**		
Contingent liabilities and notes on accounts	**25**		

Place : Kolkata
Date : 29/09/2020

Signed in terms of our separate Report of even date.
For SPAN & Associates
Chartered Accountants
Firm Registration No. 302192E

Amlan Kusum Mandal
Partner
Membership No. 064631

Sd/-
Shaubhik Ghosh
UDC

Sd/-
Kamal Sing
Accountant (Cash)

Sd/-
Vikash Kumar
Audit & Finance Officer

Sd/-
Achintya Mukherjee
Accounts Officer

Sd/-
Prof. Rajarshi Ray
Registrar(O)

Sd/-
Prof. (Dr.) Uday Bandyopadyay
Director

STATEMENT OF ACCOUNTS FOR THE YEAR 2019-20

BOSE INSTITUTE
INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31.03.2020

	Schedule	2019-20 (₹)	2018-19 (₹)
INCOME			
Income from Sales and Services	12	73,97,904.43	71,86,260.00
Grants/Subsidies	13	1,17,48,44,000.00	97,00,19,000.00
Fees/Subscriptions	15		
Income from Investments (Income on Investment, from earmarked/ endowment Funds transferred to Funds)	14	4,02,67,427.65	4,05,90,558.04
Income from royalty, publication etc.	16		
Interest Earned	17		
Other Income	18	63,45,186.01	29,36,164.52
Increase/ (decrease) in stock of Finished goods and work-in-progress	19		
Total (A)		**1,22,88,54,518.09**	**1,02,07,31,982.56**
EXPENDITURE			
Establishment Expenses	20	48,41,93,241.00	57,19,87,086.00
Other Administrative Expenses	21	24,82,54,854.65	22,85,78,525.81
Expenditure on Grant, Subsidies etc.	22	30,00,000.00	
Interest	23		
Fund for capital Expenditure	23A	1,09,01,254.00	5,00,94,223.64
Depreciation (Net Total at the year end corresponding to Schedule 8)		5,54,21,949.28	6,31,38,498.64
Total (B)		**80,17,71,298.93**	**91,37,98,334.09**
Balance being excess of Income over Expenditure (A-B)		42,70,83,219.16	10,69,33,648.47
Transfer to Special Reserve (Specify each)			
Last Year Unspent Balance/overspent balance		-9,58,34,948.16	-20,27,68,596.63
Balance of Unspent Balance After Adjustment		-9,58,34,948.16	-20,27,68,596.63
Balance being Surplus/(deficit) carried to corpus/capital fund		33,12,48,271.00	-9,58,34,948.16
Significant accounting policies	24		
Contingent liabilities and notes on accounts	25		

Place : Kolkata
Date : 29/09/2020

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Firm Registration No. 302192E

Amlan Kusum Mandal
Partner
Membership No. 064631

Sd/-	Sd/-	Sd/-	Sd/-
Shaubhik Ghosh	Kamal Sing	Vikash Kumar	Achintya Mukherjee
UDC	Accountant (Cash)	Audit & Finance Officer	Accounts Officer

Sd/-
Prof. Rajarshi Ray
Registrar(O)

Sd/-
Prof. (Dr.) Uday Bandyopadyay
Director

STATEMENT OF ACCOUNTS FOR THE YEAR 2019-20

BOSE INSTITUTE

Receipt and Payment accounts for the year ended 31-03-2020 (COUNCIL A/C)

Receipts	Schedule no	Amount (₹)	Payments	Schedule no	Amount (₹)
Opening Balance	1	18,58,23,427.83			
Receipt against Establishment Expenses	2	9,96,576.00	Establishment Expenses	2	48,91,39,945.00
Receipt against Laboratory Expenses	3	3,00,365.00	Laboratory Expenses	3	5,85,91,065.78
Receipt Against Other Adminstrative Expenses	4	13,42,987.00	Other Adminstrative Expenses	4	12,50,00,433.81
Receipt from Current Assets	5	3,60,02,686.75	Payments for the current assets	5	3,46,87,347.00
Receipt from other Assets	6	1,01,724.00	Payments for the Fixed assets	6	2,30,90,963.00
Receipts from Statutory Liabilities	7	8,38,77,826.34	Payment for Current Liabilties & Statutory Liabilities	7	8,49,26,790.00
Receipts from Current Liabilties & other Liabilities	8	2,29,31,436.00	Payment for other Liabilities	8	4,36,10,555.40
Receipt from Indirect Income	9	2,33,66,629.79	Payment for other income	9	16,000.00
Fixed Deposit Darjeeling	10	1,93,106.00			
Inter Unit Account	11		**Inter Unit Account**	11	
			FAIR Scheme/Project Grant in _aid		
Scheme/Project		-	Scheme/Project		22,65,451.00
Scheme/Project Grant in _aid		73,00,00,000.00	St_Rural		18,16,314.00
St_Rural		4,62,179.00	Governing Body		32,600.00
Governing Body		-	Closing Balance	1	22,22,21,478.72
		1,08,53,98,943.71			**1,08,53,98,943.71**

Place : Kolkata
Date : 29/09/2020

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Firm Registration No. 302192E

Amlan Kusum Mandal
Partner
Membership No. 064631

Sd/-	Sd/-	Sd/-	Sd/-
Shaubhik Ghosh	Kamal Sing	Vikash Kumar	Achintya Mukherjee
UDC	Accountant (Cash)	Audit & Finance Officer	Accounts Officer

STATEMENT OF ACCOUNTS FOR THE YEAR 2019-20

BOSE INSTITUTE
KOLKATA
Receipts & Payment Account for year ended 31/03/2020 (Projects)

Receipts	Schedule no	Amount (₹)	Payments	Schedule no	Amount (₹)
OPENING BALANCE	1	**86,52,45,005.41**	Payment from Projects	2	10,72,63,612.26
Receipt from projects	2	10,87,07,443.06	Payment from Adhoc/RA/PDF	3	1,89,69,751.23
Receipt from projects from Adhoc /Ra / Pdf	3	2,12,56,963.00	Payment for other than Project	4	53,22,219.80
Receipts from Other Than Scheme / Projects	4	2,00,36,558.20			
Receipts from IFCC	5	32,25,98,559.63	Payment OF IFCC	6	20,82,13,361.77
			Payment OF ST Rural	8	58,97,024.57
Receipts from ST Rural	7	82,93,990.07			
			Receivable From Scholors		
Receivable From Scholors		1,266.00			
Branch / InterUnit			**Branch / InterUnit**		
Bose Institute		1,21,42,18,787.57	Bose Institute		73,67,43,123.38
			IFCC		80,00,000.00
			CLOSING BALANCE	1	1,46,99,49,479.93
		2,56,03,58,572.94			**2,56,03,58,572.94**

Place : Kolkata
Date : 29/09/2020

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For SPAN & Associates
Chartered Accountants
Firm Registration No. 302192E

Amlan Kusum Mandal
Partner
Membership No. 064631

Sd/-
Vikash Kumar
Audit & Finance Officer

Sd/-
Achintya Mukherjee
Accounts Officer

STATEMENT OF ACCOUNTS FOR THE YEAR 2019-20

BOSE INSTITUTE
KOLKATA

Bose Institute Employees' Pension Fund
For the year ended on 31st March, 2020

Income & Expenditure Account

For the year ended 31st March 2019	Expenditure	For the year ended 31st March 2020	For the year ended 31st March 2019	Income	For the year ended 31st March 2020
12,55,35,025.00	To Pension Account	15,43,44,567.00	20,21,83,678.00	By Contribution from Bose Institute For Pension & Gratuity	15,82,55,000.00
4,10,90,165.00	To Gratuity Account	68,37,497.00			
				By Contribution from Other Organisation	
4,16,53,612.00	To Pension Commutation	1,62,23,104.00		For Pension & Gratuity	
				By Interest	
-	To Bank Charges	-	88,39,755.56	Fixed Deposit with Bank	57,78,894.44
56,324.00	To Loss on Fixed deposit	-	2,61,210.00	Savings Bank Account	39,050.00
	To Excess of Income over Expenditure				
Rs.29,49,517.56		**(1,33,32,223.56)**			
Rs.21,12,84,643.56		**16,40,72,944.44**	**Rs.21,12,84,643.56**		**16,40,72,944.44**

Place : Kolkata
Date : 29/09/2020

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For SPAN & Associates
Chartered Accountants
Firm Registration No. 302192E

Amlan Kusum Mandal
Partner
Membership No. 064631

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Kamal Sing
Accountant (Cash)

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Vikash Kumar
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Prof. Rajarshi Ray
Registrar(O)

Sd/-
Prof. (Dr.) Uday Bandyopadyay
Director

STATEMENT OF ACCOUNTS FOR THE YEAR 2019-20

BOSE INSTITUTE
KOLKATA

Bose Institute Employees' Pension Fund
Balance Sheet as at 31st March, 2020

As at 31st March 2019 (₹)	Liabilities	As at 31st March 2020 (₹)	As at 31st March 2019 (₹)	Assets	As at 31st March 2020 (₹)
14,63,38,351.05	Balance As per last Account	14,92,87,868.61	13,52,85,611.19	Fixed Deposit	13,00,02,738.00
Rs.29,49,517.56	Add: Excess of Income over Expenditure	(1,33,32,223.56)			
			14,01,411.56	Accrued Interest (F.D)	9,22,818.00
3,66,830.00	Payable to Pensioner	3,66,830.00	1,04,890.00	Bank Balance With S.B.I Savings bank Account	1,09,510.19
			1,56,46,257.86	Receivable from Bose Institute Council	1,57,70,253.86
Rs.0.00	TDS PENSION	-	(13.00)	RECEIVABLE FROM EMPLOYEES	(47,358.00)
			16,000.00	TDS PENSION	16,000.00
Rs.0.00	Payable to BOSE INSTITUTE	(2,00,949.00)			
	Payble to Staff	2,50,000.00			
27,99,459.00	Liability towards 30% 7cpc	1,04,02,436.00			
Rs.15,24,54,157.61		**14,67,73,962.05**	**Rs.15,24,54,157.61**		**14,67,73,962.05**

Place : Kolkata
Date : 29/09/2020

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For SPAN & Associates
Chartered Accountants
Firm Registration No. 302192E

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Membership No. 064631

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Registrar(O)

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Prof. (Dr.) Uday Bandyopadyay
Director

STATEMENT OF ACCOUNTS FOR THE YEAR 2019-20

BOSE INSTITUTE
KOLKATA

Bose Institute Employees General Provident Fund
Income & Expenditure for the year Ended 31/03/2020

31-03-2019 Amount in (₹)	Expenditures	31-03-2020 Amount in (₹)	31-03-2019 Amount in (₹)	Income	31-03-2020 Amount in (₹)
1,36,62,420.00	Interest Paid to Members	1,32,61,153.00	1,53,74,714.00	Interest on Fixed Deposit	1,46,43,656.00
1,27,471.00	Loss on Fixed Deposit				
17.70	Bank Charges		3,86,471.00	Interest on savings Bank Accounts	11,545.00
19,71,276.30	Excess of Income Over Expenditure	13,94,048.00			
1,57,61,185.00		**1,46,55,201.00**	**1,57,61,185.00**		**1,46,55,201.00**
			1,58,77,232.64	Excess of Income over Expenditure Brought forward from previous year	1,78,48,508.94
1,78,48,508.94	Excess of Income over Expenditure transferred to Balance Sheet	1,92,42,556.94			
			19,71,276.30	Excess of Income over Expenditure Brought forward from current year	13,94,048.00
1,78,48,508.94		**1,92,42,556.94**	**1,78,48,508.94**		**1,92,42,556.94**

Place : Kolkata
Date : 29/09/2020

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For SPAN & Associates
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Firm Registration No. 302192E

Amlan Kusum Mandal
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Prof. Rajarshi Ray
Registrar(O)

Sd/-
Prof. (Dr.) Uday Bandyopadyay
Director

BOSE INSTITUTE
Employees General Provident Fund
Balance Sheet as at 31st March, 2020

31/3/2019 Amount in Rs.	Expenditure	31/3/2020 Amount in Rs.	31/3/2019 Amount in Rs.	Income	31/3/2020 Amount in Rs.
203,076,706.31	"GPF Accumulation Capital Fund Balance Brought Forward "	168,011,563.31	191,174,741.00	"Fixed Deposit with State Bank of India "	197,298,315.00
			1,849,335.00		1,190,505.00
31,460.00	Add: Refund Of Advance Adjusted with Accumulated profit	-	31,460.00	Advance Outstanding from Members Add: Refund Of Advance Adjusted with Accumulated profit	- 1,190,505.00
28,125,773.00	"Add: Subscription by members during the year "	22,787,280.00	1,880,795.00		
13,662,420.00	Add:Interest Paid to members	13,261,153.00	1,385,479.00	"Interest Accrued but not received from on Fixed Deposit "	1,311,201.00
244,896,359.31		204,059,996.31			
			106,562.25	Bank Balance with SBI	108,472.25
76,884,796.00	Less:Withdrawal	32,563,613.00			
168,011,563.31		171,496,383.31	6,005,296.00	Receiavable from Bose Institute	6,010,591.00
17,848,508.94	"Add:Excess of Income over Expenditure	19,242,556.94			
14,428,501.00	Payable to Bose Institute	14,915,844.00			
264,300.00	Payable to CPF	264,300.00			
200,552,873.25		**205,919,084.25**	**200,552,873.25**		**205,919,084.25**

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Chartered Accountants
Firm Registration No. 302192E

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Prof. (Dr.) Uday Bandyopadyay
Director

STATEMENT OF ACCOUNTS FOR THE YEAR 2019-20

BOSE INSTITUTE
KOLKATA

Bose Institute Employees' Contributory Provident Fund
Balance Sheet as on 31st March, 2020

Previous Year Amount in (₹)	Liability	Current Year Amount in (₹)	Previous Year Amount in (₹)	Assests	Current Year Amount in (₹)
29,07,491.75	Capital Fund	29,07,491.75	26,00,000.00	Fixed Deposit	26,00,000.00
	Add:Interest to members	1,09,846.00			
	Less : Withdrwal Atanu Mallick	3,55,469.00			
		26,61,868.75			
7,80,071.00	Profit & Loss as per Income & Expenditurte	9,07,971.00	3,31,782.75	Bank Balance at SBI	3,00,241.75
2,02,160.00	Payble to staff	2,02,160.00	14,244.00	Accured Interest	14,244.00
23,300.00	Loans	1,09,482.00	7,02,696.0	Receivable from staff	7,02,696.00
			2,64,300.00	Receivable from GPF	2,64,300.00
39,13,022.75		**38,81,481.75**	**39,13,022.75**		**38,81,481.75**

Place : Kolkata
Date : 29/09/2020

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For SPAN & Associates
Chartered Accountants
Firm Registration No. 302192E

Amlan Kusum Mandal
Partner
Membership No. 064631

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Director

STATEMENT OF ACCOUNTS FOR THE YEAR 2019-20

BOSE INSTITUTE
KOLKATA

Bose Institute Employees' Contributory Provident Fund
Income and Expenditure for the year ended 31st March, 2020

31-3-2019 Amount in (₹)	Expenditure	31-3-2020 Amount in (₹)	31-3-2019 Amount in (₹)	Income	31-3-2020 Amount in (₹)
2,05,569.00	Interest credited to Members:	1,09,846.00	5,34,393.00	Interest earned on Investment CPF	2,37,746.00
3,28,824.00	Balance	1,27,900.00			
5,34,393.00		2,37,746.00	5,34,393.00		2,37,746.00
3,28,824.00			3,28,824.00	Balance c/f	1,27,900.00
4,51,247.00	Profit & Loss	9,07,971.00	4,51,247.00	Excess of Income over Expenditure	7,80,071.00
7,80,071.00		**9,07,971.00**	**7,80,071.00**		**9,07,971.00**

Place : Kolkata
Date : 29/09/2020

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For SPAN & Associates
Chartered Accountants
Firm Registration No. 302192E

Amlan Kusum Mandal
Partner
Membership No. 064631

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Accounts Officer

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Registrar(O)

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Prof. (Dr.) Uday Bandyopadyay
Director

SIGNIFICANT ACCOUNTING POLICIES & NOTES TO ACCOUNTS:

Schedule: 24

1.0 Change in Accounting Policy:

The Statement of Accounts has been drawn in the specified form applicable to Central Autonomous Bodies (NPOs) and Similar Institutions from the Financial Year 2013-14. To adopt the changes some account heads are clubbed or splitted and represented differently to suit the requirements of new format. 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. In case of Governing Body, Pension Fund, and Indo FAIR Coordination Centre, since no format was prescribed for Annual Accounts, they are maintained in the same format as before. The accompanying financial statements have been prepared on historical cost convention and conform to the fundamental accounting assumptions.

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

The Institute has taken initiatives to prepare a comprehensive Fixed Asset Register with the help of an agency. The process is almost in the completion stage. This initiative will also cover the assets acquired in the year 1991-92 from “Institute Development and Modernisation Fund” (provided by Planning Commission). As the Fixed Asset Register will become ready after the finalisation of accounts for the financial year 2019-20, therefore the nomenclatures and order mentioned in Schedule 8 (old form schedule 4) is taken into account.

2.3 Work-in-Progress

The particulars of fixed assets, under construction/installation are given in Schedule 8 (old form schedule 4).

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 2019-20 is in progress and will be included in the Fixed Asset Register.

c. The identification of assets, impaird if any, as required in AS-28 (Ind AS-36)

3.0 Depreciation:

3.1 As per the requirement of new format depreciation for the year 2019-20 and is charged to Income & Expenditure Account.

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:

1. Building – 10%
2. Equipment – 15%
3. Books & Journals – 10%
4. Furniture – 10%
5. Vehicles – 15%
6. Air Conditioner – 10%
7. Electric Installation – 10%
8. Internet – 60%

4.0 Revenue Recognition & Grant in Aid:

4.1 During financial year 2019-20, 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. 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, Stipend payable to Research Scholars under Sponsored Project Account, Gratuity, Leave Salary, Rates & Taxes etc. on cash basis. Liabilities for amount payable to suppliers for materials, services and other expenses are accounted for on accrual basis.

4.3 Consumable Stores are charged to expenditure for purchases.

4.4 Revenue expenditure on Scheme/Project and on specific grant are recognised in the accounting period in which the corresponding expenditure and grant arise. Net excess of receipts over expenditure of grants-in-aid schemes, sponsored by various agencies are represented in bank balances.

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 and Staff Benefits:

5.1 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.

5.2 The Institute has General Provident Fund, Contributory Provident Fund and Pension Schemes.

5.3 Leave encashment, Gratuity, Provident Fund Contribution and Pension are accounted for on cash basis.

6.0 System of Fund Accounts

6.1 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.

6.2 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 GPF and CPF are maintained in New prescribed format.

7.0 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 it charged to the relevant Earmarked Fund.

8.0 Foreign Currency Transactions:

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

9.0 Research and Development Costs:

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

10.0 Advances:

A sum is included under "Advance Council" is shown in the Balance Sheet under the head Advances (Schedule-11) which include a sum of pending recovery/adjustment prior to.

11.0 Contingent Liability:

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

12.0 Previous year's Figures:

The previous year's figures have been re-grouped and re-arranged in conformity with the figures of current year. Expenses incurred in connection with the Scheduled Tribe Specific Rural Biotechnology Programme and IRHPA Project for the Accounting Year 2013-14 and 2014-15 has been shown separately in Income and Expenditure Account is now adjusted with the Income and Expenditure Account balance 2015-16 of Bose Institute Council Account.

13.0 General Provident Fund:

GPF figures have been reconciled and properly incorporated in accounts having discussion with Statutory Auditor.

14.0 Long Un-Reconciled Balance:

This is well known that Bose Institute is a century old organisation so as its accounts. After a long and good deal of deliberation manual accounts were replaced by computerised accounting system in 2010-1011, but still there are lot of unreconciled balances appearing in the accounts. All-out efforts are given to reconcile all old and pending balances and make the Balance Sheet more lucid and presentable. It is expected that during 2020-21, all pending items will be reconciled. Sheet. ed if any, as required in AS-28 (Ind AS 36) issued by ICAI, has not been done

INDEPENDENT AUDITORS REPORT

To the Member of Council

Opinion

We have audited the accompanying financial statement of BOSE INSTITUTE, Indo-Fair coordination centre (entity), which comprises the Balance sheet as at MARCH 31st 2020 & Statement of expenditure for the year ended on 31st March, 2020 and notes to the financial statement, including a summary of significant accounting policies and other explanatory information. In our opinion and to the best of our information and according to the explanations given to us, the accompanying financial statement give true and fair view of the financial position of the entity as at march 31st, 2020 and of its financial performance for the year then ended.

BASIS FOR OPINION

We have conducted our audit in accordance with the standards on Auditing (SAs) issued by ICAI. Our responsibilities under those standards are further described in the auditor's responsibilities for the audit of the financial statements section of our reports. We are independent of the entity in accordance with the ethical requirement that is relevant to our audit of the financial statement in India, and we have fulfilled our other ethical responsibilities in accordance with these requirements. We believe that audit evidence we obtained is sufficient and appropriate to provide the basis for our qualified opinion.

Key Audit Matters

Key audit matters are those matters that, in our professional judgment, were of most significance in our audit of the Financial Statements of the current period. These matters were addressed in the context of our audit of Financial Statements as a whole, and in forming our opinion thereon, and we do not provide a separate opinion on these matters. In addition to the matters described in the Basis for Qualified Opinion, we have determined the matters described below to be the key audit matters to be communicated in our report:

Responsibilities of management and those charged with governance for the financial statement

Management is responsible for the preparation and fair presentation of the financial statement in accordance with the aforesaid accounting standards, and for such internal control as management determines is necessary to enables the preparation of the financial statements that are free from material misstatement, whether due to fraud and error.

In preparing the financial statement management is responsible for assessing the entities ability to continue as going concern, disclosing as applicable, matters related to going concern and using the going concern basis of accounting unless management either intend to liquidate the entity or to cease the operation, or has no realistic alternative but to do so. Those charged with governance are responsible for overseeing the entity's financial reporting process.

Auditor's responsibilities for the audit of the financial statements

Our objective are to obtained reasonable assurance about whether the financial statement as a whole free from material misstatement, wheather due to fraud error, and to issue and auditor's report that includes our opinion. Reasonable assurance is the high level of assurance but is not guarantee that an audit conducted in accordance with SAs will always detects material misstatement when it exists. Misstatement can arise from fraud or error and are consider material if, individually or in aggregate, they could reasonably be expected to influence the economic decisions of the user taken on the basis of these financial statement.

Place: Kolkata
Date :29/09/2020

For SPAN & ASSOCIATES
Chartered Accountants
FRN:302192E

CA Amlan Kusum Mondal
Membership No: 064631
UDIN: 20064631AAAABC9750

BOSE INSTITUTE (IFCC)
NOTES ON ACCOUNTS

1. The facility for Anti-Proton and Ion Research (FAIR) is a global facility being created in Darmstadt, Germany under a multi-country partnership. FAIR project is managed by FAIR company (FAIR GmbH). FAIR will be one of the largest accelerator facilities in the world and also one of the mega science projects recommended by the Steering Committee on Science & Technology set up by the Planning Commission for the 11th Five Year Plan. FAIR project is taken up as part of DAE & DST joint collaboration under a MoU signed between DAE & DST.

   A joint declaration was signed on 07.02.2007 by the Minister for Science & Technology and Earth Sciences, Govt. of India and the Federal Minister for Education & Research, Federal Republic of Germany concerning the participation in construction and operation of the international facility for Anti-proton and Ion research. A joint statement was issued by the Chancellor of Republic of Germany and Prime Minister of India on 30.10.2007 in this regard. On 04.10.2010, the international agreement on the construction of FAIR was signed by nine countries, namely Germany, Finland, France, India, Poland, Romania, Russia, Slovenia and Sweden. Latter on United Kingdom also joined as a partner. India's contribution to the FAIR consortium has been estimated at 42.79 million Euro at July 2010 prices which is equivalent to Rs. 260.00 Crore (Approximately). According to the MoU between DAE & DST, the overall cost of Rs. 260.00 Crore is to be borne equally by DAE & DST.

   Bose Institute, Kolkata has been designated as the Indian shareholder in the FAIR Company and the Nodal Indian institution for management of the FAIR programme in India. The assets created from Indian participation will not come under the purview of Bose Institute and they will also not be shown in its Balance Sheet. Keeping in mind all the above accounting of FAIR project is unique and it is maintained in the old format as before, without changing in format for Central Autonomous Institutes.

2. Department of Science & Technology (DST), under the Ministry of Science & Technology, Govt. of India vide its Memo No. SR/MF/PS-01/2011 dated 04/03/2011 mentioned under clause 11 that "financial aspect will be issued in due course" but the same has not been received till date. However the present executive council takes both operational and financial decision.

STATEMENT OF ACCOUNTS FOR THE YEAR 2019-20

BOSE INSTITUTE (IFCC)

KOLKATA

BALANCE SHEET AS AT 31ST MARCH, 2020

As at 31st March 2019 Amount in (₹)	Liabilities	As at 31st March 2020 Amount in (₹)	As at 31st March 2019 Amount in (₹)	Assets	As at 31st March 2020 Amount in (₹)
3,26,946.00	Fund for Creation of Asset	3,26,946.00	54,732.00	Shares in FAIR GmbH	54,732.00
			2,72,214.00	Office Equipment	
				Furniture : ₹ 98,530.00 Equipment : ₹ 1,73,684.00	2,72,214.00
	Unspent Grant				
20,06,73,845.34	Grant from Department of Science and Technology (**Schedule-1**)	10,38,49,326.77	1,94,000.00	Advance	
2,44,25,975.04	Grant from Department of Atomic Energy (**Schedule-2**)	22,03,45,771.47	79,67,510.00	Receivable From Bose Institute	
1,75,37,744.00	Interest Earned (**Schedule-3**)	2,46,59,804.00		**Cash Balance** Cash in Hand	10,336.00
				Bank Balances	
88,500.00	Audit Fees Payable	59,000.00		Union Bank of India	
			67,07,683.38	S.B. A/c -	33,94,940.24
-	Payable to Bose Institute	35,850.00	22,78,56,871.00	Fixed Deposits	34,55,44,476.00
24,30,53,010.38		**34,92,76,698.24**	**24,30,53,010.38**		**34,92,76,698.24**

STATEMENT OF ACCOUNTS FOR THE YEAR 2019-20

BOSE INSTITUTE (IFCC)
KOLKATA
Statement of Expenditure for the year ended on 31st March, 2020

For the year ended on 31st March, 2019 (₹)	Particulars	For the year ended on 31st March, 2020 (₹)
-	Advertisement Expenses	-
-	Ad-hoc Bonus	-
88,500.00	Audit Fees	59,000.00
1,449.82	Bank Charges	-1.23
50,775.00	Contingency Expenses	40,844.00
1,01,394.00	Meeting Expenses - IFCC	94,911.00
-	Honorarium Expenses	-
-	Fellowship (JRF)	-
8,91,443.00	Salary	6,24,600.00
-	Student Support	3,79,276.00
8,72,729.68	Travelling Expenses	10,01,861.37
-	Overhead Charges	-
-	Workshop	7,95,160.00
20,06,291.50		**29,95,651.14**

Place : Kolkata
Date : 29/09/2020

Signed in terms of our separate Report of even date.
For SPAN & Associates
Chartered Accountants
Firm Registration No. 302192E

Amlan Kusum Mandal
Partner
Membership No. 064631

Sd/-
Admin / Accounts Officer
Bose Institute (IFCC)

Sd/-
Achintya Mukherjee
Accounts Officer

Sd/-
Prof. Rajarshi Ray
Registrar(O)

Sd/-
In-charge Fair Project

Sd/-
Prof. (Dr.) Uday Bandyopadyay
Director

STATEMENT OF ACCOUNTS FOR THE YEAR 2019-20

BOSE INSTITUTE (IFCC)

KOLKATA

Receipt & Payment Accounts for the year ended on 31 March, 2020

Particulars	Amount (₹)	Particulars	Amount (₹)
Opening Balance			
Cash in Hand	-		
S.B A/c Union Bank of India	67,07,683.00		
Fixed Deposits	22,78,56,871.00		
GRANT FROM D.S.T	-		
GRANT FROM D.A.E	26,50,00,000.00		
GRANT FROM D.S.T (IFCC Exp.)	-		
Interest on SB A/c	25,79,912.00		
Interest on FD (Term Deposits)	2,20,79,892.00		
Advance	5,17,500.00	Advance	3,23,500.00
Profession Tax	3,360.00	Profession Tax	3,360.00
TDS (Salary: ? 20004.00 + Party:? 2681641.00)	27,01,645.00	TDS (Salary: ₹ 20004.00 + Party: ₹ 2681645.00)	27,01,645.00
TDS on GST (IGST)	20,68,081.00	TDS on GST (IGST)	20,68,081.00
Travelling Expenses	13,19,488.63	Travelling Expenses	23,21,350.00
Workshop	7,08,000.00	Workshop	15,03,160.00
Bank Charges	1,970.00	Bank Charges	1,968.77
Honorarium Expenses	37,236.00	Honorarium Expenses	37,236.00
		Meeting Expenses - IFCC	94,911.00
		Audit Fees (for 2018-19)	88,500.00
		Contingency Expenses	40,844.00
		Overhead Charges	-
		Salary	6,24,600.00
		Student Support	3,79,276.00
		Advertisement Expenses	-
		Office Equipment	-
		Power Converter (In-Kind)	13,50,22,606.00
		Detector (FAIR Experiment)	5,22,200.00
		Vaccum Chamber (In-Kind)	67,38,046.00
		Beam Stopper (In-Kind)	4,750.00
		GRANT FROM D.S.T (IFCC Exp.) (Return of Bank Interest for the Year 2018-19)	18,629.00
		GRANT FROM D.S.T (For FAIR) (Return of Bank Interest for the Year 2016-17, 2017-18 & 2018-19)	3,81,40,584.00
Inter Unit Account		**Inter Unit Account**	
Bose Institute (Council)	3,360.00	Bose Institute (Council)	-
Scheme/Project	80,00,000.00	Scheme/Project	-
		Closing Balance	
		Cash in Hand	10,336.00
		S.B A/c : Union Bank of India	33,94,940.24
		Fixed Deposits	34,55,44,476.00
	53,95,84,998.63		**53,95,84,999.01**

Sd/-
Administrative / Accounts Officer
Bose Institute (IFCC)

Sd/-
Accounts Officer
Bose Institute

INDEPENDENT AUDITOR'S REPORT

To the Member of Council

Qualified Opinion

We have audited the accompanying financial statements of **BOSE INSTITUTE Governing Body** (the entity), which comprise the Balance Sheet at March 31st 2020, and the Income & Expenditure account and notes to the financial statements, including a summary of significant accounting policies and other explanatory information. In our opinion and to the best of our information and according to the explanations given to us, except for the effect of the matter described in the Basis for *Qualified Opinion* section of our report, the accompanying financial statements give a true and fair view of the financial position of the entity as at March 31st, 2020, and of its financial performance for the year then ended.

Basis for Qualified Opinion

1. No Fixed Asset register was provided for our verification. The Institute has not carried out test of impairment, if any, in accordance with the requirement of AS 28 notified by the I.C.A.I.
2. No cash balance certificate as on 31st March, 2020 was provided for our verification.
3. Share certificate for the investment in 7.5% Preference share of C.E.S.C Ltd. was not available for our verification.

We conducted our audit in accordance with the Standards on Auditing (SAs) issued by ICAI. Our responsibilities under those standards are further described in the Auditor's Responsibilities for the Audit of the Financial Statements section of our report. We are independent of the entity in accordance with the ethical requirements that are relevant to our audit of the financial statements in India, and we have fulfilled our other ethical responsibilities in accordance with these requirements. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our qualified opinion.

Key Audit Matters

Key audit matters are those matters that, in our professional judgment, were of most significance in our audit of the Financial Statements of the current period. These matters were addressed in the context of our audit of Financial Statements as a whole, and in forming our opinion thereon, and we do not provide a separate opinion on these matters. In addition to the matters described in the Basis for Qualified Opinion, we have determined the matters described below to be the key audit matters to be communicated in our report:

Key Audit Matter	Auditors' response to Key Audit Matter
Fixed Assets: The carrying amount of Fixed Assets of the Institute is Rs 23,74,713/-. Due to the significance of the value of the Fixed Assets, we have considered the same to be significant to our overall audit strategy and planning.	We assessed the controls in place, evaluated the appropriateness of capitalization process, performed tests of details on costs capitalized, the timeliness of the capitalization of assets and the derecognition criteria for assets retired from active use. We reviewed the judgments made by management including the nature of underlying costs capitalized; determination of realizable value of the assets retired from active use; the appropriateness of asset live applied in the calculation of depreciation; useful lives of assets as per the technical assessment of the management.

Responsibilities of Management and Those Charged with Governance for the Financial Statements

Management is responsible for the preparation and fair presentation of the financial statements in accordance with the aforesaid Accounting Standards, and for such internal control as management determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error. In preparing the financial statements, management is responsible for assessing the entity's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless management either intends to liquidate the entity or to cease operations, or has no realistic alternative but to do so. Those charged with governance are responsible for overseeing the entity's financial reporting process.

Auditor's Responsibilities for the Audit of the Financial Statements

Our objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion

Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with SAs will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if,

individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

Place: Kolkata
Date :29/09/2020

For SPAN & ASSOCIATES
Chartered Accountants
FRN:302192E

CA Amlan Kusum Mondal
Membership No: 064631
UDIN: 20064631AAAABD7217

STATEMENT OF ACCOUNTS FOR THE YEAR 2019-20

BOSE INSTITUTE (GOVERNING BODY)

93/1, ACHARYA PRAFULLA CHANDRA ROAD, KOLKATA – 700009

BALANCE SHEET AS AT 31ST MARCH 2020

	Schedule No.	As on 31/03/2020	As on 31/03/2019
FUNDS & LIABLITIES		₹	₹
CAPITAL FUND			
AS PER LAST ACCOUNT		23,17,833.36	23,17,833.36
ACHARYA JC BOSE CENTENARY FUND			
AS PER LAST ACCOUNT		15,99,768.40	15,99,768.40
SPECIAL FUND			
AS PER LAST ACCOUNT	1	29,62,629.96	29,72,629.96
DEPOSITS & OTHER LIABILITIES	2	11,98,291.66	12,16,616.66
	TOTAL	**80,78,523.38**	**81,06,848.38**
PROPERTIES & ASSETS			
FIXED ASSETS			
AS PER LAST ACCOUNT	3	23,74,712.85	23,74,712.85
INVESTMENTS			
AS PER LAST ACCOUNT	4	63,19,249.67	63,19,249.67
RECEIVABLE & DEPOSITS			
AS PER LAST ACCOUNT	5	11,07,066.00	7,01,177.00
CASH & BANK BALANCES	6	12,13,341.34	11,99,762.34
INCOME & EXPENDITURE A/C			
EXCESS OF INCOME OVER EXPDITURE		(29,35,846.48)	(24,88,053.48)
	TOTAL	**80,78,523.38**	**81,06,848.38**

INCOME & EXPENDITURE STATEMENT FOR THE YEAR ENDED 31ST MARCH 2020

	As on 31/03/2020	As on 31/03/2019
INCOME		
INTEREST ON TERM DEPOSIT	4,65,142.00	4,36,123.00
INTEREST ON SAVINGS BANK	-	-
TOTAL	**4,65,142.00**	**4,36,123.00**
EXPENDITURE		
SALARY & WAGES	10,800.00	21,600.00
ACCOUNTING CHARGES	-	-
AUDIT FEES	5,900.00	11,800.00
BANK CHARGES	649.00	649.00
EXCESS OF INCOME OVER EXPENDITURE FOR THE YEAR	4,47,793.00	4,02,074.00
TOTAL	**4,65,142.00**	**4,36,123.00**
INCOME BROUGHT DOWN AND ADJUSTED WITH LAST YEAR	4,47,793.00	4,02,074.00
BALANCE BROUGHT DOWN FROM LAST A/C	24,88,053.48	20,85,979.48
BALANCE TAKEN TO BALANCE SHEET	**29,35,846.48**	**24,88,053.48**

Place : Kolkata
Date :

Signed in terms of our separate Report of even date.
For SPAN & Associates
Chartered Accountants
Firm Registration No. 302192E

Amlan Kusum Mandal
Partner
Membership No. 064631

Sd/-	Sd/-	Sd/-	Sd/-	Sd/-
Kamal Sing	Vikash Kumar	Achintya Mukherjee	Prof. Rajarshi Ray	Prof. (Dr.) Uday Bandyopadyay
Accountant (Cash)	Audit & Finance Officer	Accounts Officer	Registrar(O)	Director

COMPLIANCE REPORT

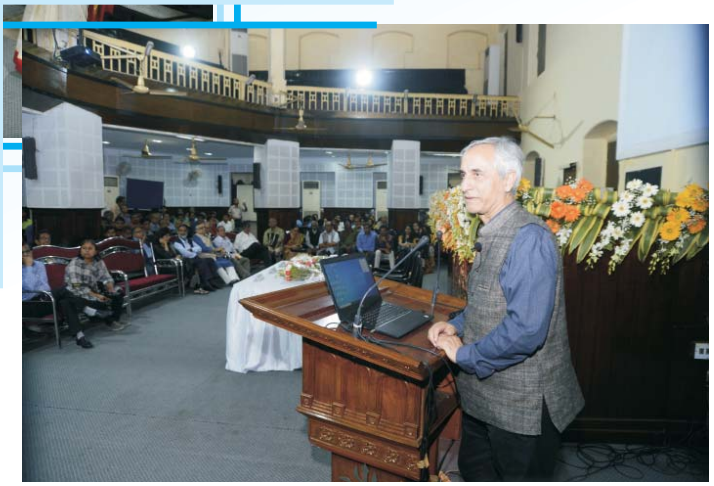
Statutory Audit Observation for the year 2019-20 & comments of Bose Institute

Sl. No.	BI Statutory Audit Observations 2019-20	BI Comments
1.	Unidentified credits to the tune of Rs. 536478 /- pertaining to UBI Bank (A/c No: 416602010003355) as per Bank statement resulting in incorrect reflection of income or debtors balance in financial statement.	Necessary action will be taken in future.
2.	The Institute has accounted for expenses on cash basis in the financial statements in few cases which is contrary to the fundamental accounting assumptions as per AS 1 notified by the Institute of Chartered Accountants of India.	Necessary action will be taken in future.
3.	Irregular grant of pay & allowances of Rs. 53.93 lakhs due to promotion with retrospective effect.	Detailed due drawn statement is prepared and send to DST for further course of action.
4.a	Non submission of Project Completion reports in respect of 86 projects. Out of this , 15 projects are terminated in FY 2019-20 and 71 projects have been terminated upto FY 2019-20)	Project completion report will be submitted for all the projects completed in future.
4.b	During the period FY 2013-14 to FY 2019-20, in respect of 11 projects, expenditures incurred are in excess of Rs. 842295 /- of total funds received from funding agencies. Status of recovery of excess expenditures is yet to be confirmed by Bose Institute.	Recovery process is started and will be informed to the next audit.
4.c	In the same period, we have found in 71 projects, unutilized amount to the tune of Rs. 16921264.26 /- has not been refunded by Bose Institute even after completion of respective projects.	Recovery process is started and will be informed to the next audit.
5.	Intangible assets in the form of books and journals are not amortised over the licence period and are being carried forward and depreciated even after expiry of their licence period which is not in accordance with the requirement of AS 26 notified by the Institute of Chartered Accountants of India. The amount of such expired licences is presently not ascertainable.	Suitable entries will be given for such expired licences for books and journals

Sl. No.	BI Statutory Audit Observations 2019-20	BI Comments
6.	Fixed Asset register has been updated till 31st March, 2017 and for the period 1st April, 2017 to 31st March, 2020 is under preparation. Details related to location of asset, description of asset, life of asset and asset coding are yet to be prepared. Periodic physical verification of fixed assets and impairment testing are not performed. In view of this it is not possible to opine on correctness or otherwise of fixed assets.	Preparation of Fixed Asset Register up to 20-21 financial year is going on and will be presented to the next audit.
7.	Employee related advances & other advances remaining unsettled for more than 1 year to the tune of Rs. 254010 /-.	All unsettled advances will be settled by 21-22
8.	Liability towards gratuity and leave encashment is not ascertained as per actuarial valuation and the same are accounted for on cash basis contrary to the requirement of AS 15 notified by the Institute of Chartered Accountants of India.	Actuarial valuation process is going on.
9.	The institute does not have internal audit system commensurate with the size and nature of its activity resulting in poor internal financial control.	Efforts will be given to strengthen the internal audit wing of the Institute.
10.	Asset acquired from development and modernisation fund amounting to Rs. 666.57 lacs has been held under 'Investment Under Earmarked Fund' and has not been capitalised thereby understating the fixed assets to that extent. Consequential impact on depreciation and current year's profitability is not ascertainable.	The matter will be settled with the preparation of updated Fixed Asset Register.
11.	Capital WIP to the tune of Rs. 24.07 lakhs has no movement since last Balance Sheet date as on 31.03.2019. Current status of work and consequential impact on the books of accounts is not ascertainable at this stage.	The matter will be settled with the preparation of updated Fixed Asset Register.
12.	The Institute does not follow the practise of obtaining balance confirmation for receivables or payables accounts. Consequential impact on the books of accounts is not ascertainable at this stage.	The practice of obtaining balance confirmation for receivables or payables accounts will be started from 21-22
13.	As explained by management current liability of TDS Pension of Rs. 16000 /- appearing in Pension Fund Accounts for FY 2019-20 is a long outstanding amount which was previously remitted to respective tax consultant for payment of TDS dues however the same has not been adjusted or recovered from the tax consultant till date. The amount of Rs. 16000 /- is actually not a liability and recovery to be made by the earliest.	The matter will be taken up with the tax consultants for recovery or adjustment with the tax authorities.

Sl. No.	BI Statutory Audit Observations 2019-20	BI Comments
14.	Current liability of Payable to Pensioner of Rs. 366830 /- appearing in Pension Fund Accounts for FY 2019-20 is a long outstanding amount the details of which were not available to us. Hence the effect of the same on books of accounts cannot be determined.	The matter will be identified and will be presented to the next audit.
15.	With respect to Contributory Provident Fund Account for FY 2019-20 details in relation to Payable to staff (Rs. 202160/- Cr.), Receivable from Bose Institute (Rs. 702696 /- Dr.), Receivable from GPF (Rs. 264300 /- Dr.) and respective contra entry in GPF Accounts as on 31.03.2020 are long outstanding amount the details of which were not made available to us. Consequential impact on the books of accounts is not ascertainable at this stage.	The CPF account will be closed during 21-22 and all reconciliation will be done and will be presented to the next audit.
16.	We observed mismatch of Interest earned & TDS on interest under Section 194A of Income Tax Act, 1962 between amount as per26 AS and Bank Certificate and books of accounts for FY 2019-20 and the same have not been reconciled	Reconciliation process is going on and will be presented to the next audit.
17.	We could not verify brought forward balances of 11 Nos of current assets to the tune of Rs.332.57 Lakh and current liabilities to the tune of Rs.58.58 Lakh.	Will be presented to the next audit for verification.

103RD FOUNDATION DAY CELEBRATION



The 103rd Foundation Day of Bose Institute was celebrated on November 30, 2019. Prof. Subhash Kak, Regents Professor Emeritus, Oklahoma State University, Stillwater, USA delivered the 81st Acharya J. C. Bose Memorial Lecture on "Computation, Indian Scientific Tradition, and Artificial Intelligence". Prof. Samit K Ray, Director, S N Bose National Centre for Basic Sciences presided over the programme. Sir Nilratan Sirkar Prize 2019 was awarded to Ms. Sweta Ghosh, SRF, Division of Molecular Medicine. Prof. B. B. Biswas Outstanding Student Award 2019 were presented to Ms. Humaira Ilyas, SRF, Department of Biophysics and Mr. Dbya Mukherjee, Guest Worker, Division of Plant Biology. Department. Prof. Shyamadas Chatterjee Outstanding Student Award (in the area of Physical and Environmental Science) was awarded to Mr. Rathijit Biswas, SRF, Department of Physics.

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