Biophysical Sciences Group

(Group-A)

Self-Report

for

External Scientific Review of SINP 2023

Tofayel Ahmed
Associate Professor-E

Research and Development

Our laboratory attempts to understand how the 3D-structure of a macromolecule is related to its function. Ribosomes, especially organellar ribosomes from eukaryotic cells, are our favorite samples for imaging. Organellar ribosomes, due to their historical connection with bacterial cells according to the endosymbiotic theory, are similar to bacterial ribosomes in overall morphology but addition and deletion of protein and rRNA components are readily observed once the structure is determined at a high resolution. These modifications arise from the need for adaptation during their evolution in the eukaryotic cellular environment. We want to deduce organellar ribosomal structures at high-resolution so that we can deduce the structure and localization of these changes at high precision. Our pipeline will involve native-source purification of organellar ribosomes by sucrose density gradient ultracentrifugation, imaging by cryo-EM, and image processing to generate structures of different conformational states of such ribosomes. A subsequent extension of this work will be to image the structure and mode of interaction of various translation factors along with ribosome. Taken together, we hope to generate important data regarding the translation machinery and the regulation of translation in the organellar context inside eukaryotic cells.

Another research theme in the lab involves over-expression, purification and structure determination of different chaperones that are involved in protein biogenesis pathway of pathogenic bacteria. Due to their small size, such proteins by themselves are difficult targets for structural elucidation by cryo-EM. We will make use of their ribosome binding property to form chaperone-ribosome complexes that will be suitable for cryo-EM imaging. Upon establishing the purification and cryo-EM freezing protocol, we will strive to determine the chaperone structures in apo form at high-resolution. The structures will be further used to computationally screen small molecule libraries and this knowledge will be useful in the development of different drug compounds that specifically bind these chaperones with high efficacy.

Post M.Sc. Teaching

Advanced course: Structure determination of biological macromolecules and their complexes using cryo-electron microscopy (cryo-EM) and cryo-tomography (cryo-ET); tentatively starting from Jan 2024.

Subhabrata Majumder
Associate Professor-E

Research & Development

The research done in our laboratory is loosely based on the topic of "Modulation of key protein-protein interactions for therapeutic interventions". While structural details of a protein can be gleaned from high resolution X-ray crystallography, the latter presents a static picture. Protein-protein interactions could be governed by structural changes in the protein which could be transient and difficult to detect. To this end we apply nuclear magnetic resonance methods to probe the correlation of protein dynamics with its function. The proteins, of interest, are functionally diverse e.g. enzymes, kinases or chaperones. A proof-of-principle study of our methodology in case of L-asparaginase (anti-cancer protein drug) have been recently published: https://doi.org/10.1021/jacs.3c02154 . For our purposes, we employ standard molecular biology tools for cloning, overexpression of target proteins and appropriate protein purification techniques. In a closely related objective, we are implementing our methodology to probe structure-function aspects of therapeutic monoclonal antibodies, which are recalcitrant to existing high resolution structural methods.

Post M.Sc Teaching

In the basic course I teach principles of NMR spectroscopy and its application in studying protein structure. In the advanced courses, I have taught course entitled (a) Drug discovery with an emphasis on allied biophysical methods and (b) Spectroscopic Techniques (co-teach).

Subhendu Roy
Associate Professor-E

Research and Development

We study the structure, function and dynamics of proteins using various levels of computational and theoretical methods like Molecular Dynamics (MD) simulations, Quantum Mechanics (QM), QM/MM and Coarse-Grained methods. Currently, we are investigating highly-efficient artificial enzymes containing multiple mutations that are randomly introduced by 'directed evolution' methods to understand the mechanism and origin of catalysis using classical and multiscale QM/MM simulations. Our results unravel the mechanistic pathway and the underlying physical principles behind the remarkable efficiency of these artificial enzymes. Alongside, we are also studying natural membrane proteins, which are involved in biofuel productions and in various diseases. Multiscale simulation of membrane enzymes within a QM/MM framework reveals unprecedented insights about the electronic structure and mechanism of these complex biological systems, which are not accessible to any experimental methods. Our present work deciphers the intricate mechanism of O_2 activation and the catalytic steps of a chemically challenging C–H bond breaking reaction in the biofuel-producing membrane-bound non-heme di-iron enzyme, UndB. Indeed, this work provides guidelines to modulate the activity of UndB and will prove as a breakthrough in understanding how such enzymes work in a membrane environment in atomistic details.

A systematic study of highly-efficient artificial and natural enzymes is planned to understand the mechanism and the underlying physical principles of their extraordinary efficiency, specifically of a multi-step catalytic reaction. Our ultimate target is to capitalize on these major factor(s) revealed by our multiscale simulation studies to formulate a rational enzyme design method, which remains an unsolved problem in spite of groundbreaking protein structure prediction methods, Alphafold, RoseTTafold and ESMfold. Our work aims specifically at designing artificial enzymes employing our in-house enzyme design methods and modulating drug-target proteins to address some of the burning issues in health, energy and environmental sectors. The multiscale model developed for membrane-bound enzyme UndB will be further fine-tuned and applied to understand structure-function correlation in drug-target, bioenergetic, photo proteins and ion channels.

Post M.Sc. Teaching

I teach the parts 'Introduction to quantum mechanics' and 'Nucleic acids' of the following two courses: Principles of Physical Chemistry (Course code: PPC, Credit: 6) and Structural & Computational Biology (Course code: SCB, Credit: 6). These courses are conducted in semester I during the August – December term every year. The duration of the course is approximately 14 hours of classes and tutorials (1 hour each week) and 1.5 hours of examination. I teach the course syllabus, conduct tutorial classes and give assignments to clarify the concepts. The students are evaluated on their performances in the final examination and assignments.

Soumen Kanti Manna
Associate Professor-F

Research and Development

Dr. Manna is working on elucidation of the impact of gene-environment interaction on health and diseases using mass spectrometry-based metabolomic and lipidomic analysis in tandem with cell and molecular biological approaches. One of the major focuses of his lab has been to understand the role of metabolic reprogramming in response of cancer cells to nutritional, redox and therapeutic stress. His lab has identified novel aspects metformin-induced metabolic reprogramming that may aid in personalizing combinatorial treatment of liver cancer. The analysis of the contribution of different metabolic pathways to the steady state metabolome is currently underway using stable isotopes. The biochemical basis of protection of cancer cells against doxorubicin treatment by betaine was also identified, which contraindicated the use of the dietary supplement in such patients. His lab has also identified peculiarities of metabolic reprogramming during adaptation of cancer cells to nutrient deprivation. He has developed a more affordable MS-based method to simultaneously analyze multiple RNA modifications, identified reorganization of RNA methylation in response to metformin and is working to understand the role of RNA methylation in stress response. His lab is also developing fluorescence-based sensor for reactive carbonyl metabolites. In addition, he is involved in several collaborations with hospitals including TMH, SSKM, IMS-BHU, CMSDH to identify biomarkers for cancer, diabetes, PCOS and infectious diseases with intramural and extramural support. His lab has also identified effects of mask use on salivary metabolome. In future, he would like to continue to work on understanding the evolution of therapeutic resistance in cancer with special focus on the role of metabolism, RNA modification and cross-talk with cells and microbes in the tumor microenvironment in modulating stemness and therapeutic resistance using 3D cultures. He also plans to identify the roles of atypical metabolic pathways and post-translational modifications in the process to find novel therapeutic targets. Eventually, he aspires to examine the scope of combining them with dietary interventions to improve the outcome in collaboration with clinicians. On the other hand, he plans to develop dried blood spot and urine spot -based methods for remote diagnosis and monitoring of nutritional status, cancer, metabolic diseases and therapeutic compliance together with clinicians. In this context he would like to assess the robustness of disease biomarkers against variability of habitat, life-style and food habits as well as to analyze the impact of the 'Exposome' on quality of life, disease susceptibility and progression.

Post-MSc Teaching

Dr. Manna is extensively involved in post-MSc teaching. He delivers the mandatory *Principles of Biochemistry* course covering concepts of pH, acidity, basicity in the context of biological molecules and their implications in biological processes including information transfer, macromolecules, chirality, metabolism, metabolic derangements in diseases and disorders. He also delivers lectures on *Introduction to Biostatistics* including types of data and their distribution, principles of error analysis and hypothesis testing. In addition, he also offers the elective course of *Chromatography and Mass Spectrometry* that covers principles and applications of different chromatography techniques, principles and applications (including structural analysis, interaction studies, proteomics, metabolomics, lipidomics, nucleic acid modification and mass spectrometry-based imaging) of different mass spectrometry techniques used in biological sciences.

Montu K. Hazra
Associate Professor-F

Research and Development

New ozone depletion mechanism, stratospheric ozone and global warming related International Agreements or Protocols, ozone depletion associated with the Geo-engineering scheme in controlling the global warming/climate and beyond through the sulfuric acid decomposition chemistry above Junge layer in Earth's atmosphere concerning ozone depletion and healing, while no stratospheric ozone layer represents no human action on the Earth. Moreover, the theoretical interpretation of the excitation wavelength dependent multicolor fluorescence emission spectra to establish that the small molecular organic nanocrystals resemble carbon nanodots in terms of their properties, while carbon dots are expected to have huge potential in field of bioimaging, molecular sensors, optoelectronics and photovoltaics. Currently, the research work is going in the direction of searching for new chemical reactions of potential atmospheric and environmental significance.

The infrastructure of the Molecular Beam Spectroscopy Laboratory at SINP has been developed in 2018 with two optical tables to perform experiments in the cold environment of supersonic jet in near future. I am waiting for the multiple laser systems and related instruments.

Post MSc. Teaching

Introduction to Quantum Mechanics

In this course, various topics related to Quantum Mechanics are introduced to the students so that they can understand the molecular level of science behind the existence of potential energy surfaces or landscapes of small molecules to relatively larger molecules.

Advance Course on Laser Spectroscopy/Molecular Spectroscopy (ACLS).

In this course, various experimental methods related to spectroscopy including mass spectroscopy in the clod environment of supersonic jet are introduced to the students so that they can learn various discrete energy levels of electronic state and photo-physical processes among the electronic states of small molecules.

H. Raghuraman
Associate Professor-F

Research and Development

Our lab is focused on understanding the structural dynamics of membrane proteins in general, and ion channels, in particular. We work on several ion channels, namely the voltage-gated K^+ channels, inward-rectifying K^+ channels, and Mg^{2+} channels with a long-term goal of deciphering the molecular mechanisms of ion channel gating and permeation using a combination of functional and sophisticated biophysical approaches. We have comprehensively characterized the moving part of the voltage sensing domain of the KvAP K^+ channel in membranes of varying lipid composition to get molecular insights into the lipid-dependent gating of KvAP. Further, we have characterized gating-related structural dynamics novel MgtE Mg^{2+} channel homologs extensively in micelles and physiologically-relevant membrane environment utilizing fluorescence-based Mg^{2+} transport assay and site-directed labeling methods. Since membrane protein purification is challenging and very expensive, we have recently developed a "dual-detergent strategy" for the cost-effective purification of various classes of membrane proteins in a pure, stable and functional form. In addition, we are also in the process of developing a fluorescence-based assay for determining the binding of Mg^{2+} ions to Mg^{2+}-binding proteins, and also characterize the optimum reconstitution of ion channel proteins into Nanodiscs with defined lipid composition for structural studies using cryo-EM.

Post M.Sc. Teaching

I teach both basic and advanced courses for our Post M.Sc. coursework every year. The basic courses include "*Circular dichroism spectroscopy*" (~5 classes) and "*Applications of site-directed spin labeling and electron paramagnetic resonance (SDSL-EPR) in proteins*" (~5 classes). The advanced courses I teach every year are "*Membrane biophysics and structural dynamics of membrane proteins*" (~20 classes) and "*Time-resolved fluorescence*" (~6 classes).

Padmaja Prasad Mishra
Associate Professor-F

Research and Development

DNA is under constant threat of damage from a variety of chemical and physical insults, such as ultraviolet rays produced by sunlight and reactive oxygen species produced during respiration or inflammation. Because damaged DNA, if not repaired, can lead to mutations or cell death, multiple DNA repair pathways have evolved to maintain genome stability. We develop and employ single-molecule techniques to study the inner workings of protein machines involved in DNA repair processes and the maintenance of chromosome structures. We also study the mechanical properties of nucleic acids and their interaction with proteins, using novel single-molecule approaches based on fluorescence resonance energy transfer (sm-FRET), Optical tweezer and atomic force microscopy (AFM). The methods are used to extensively capture the structural intermediates and draw out valuable fathomable information about the transition dynamics and energy of the state. Knowledge about the details of conformational dynamics and their variable degree of stability in different microenvironments acts as a cue for extracting the mechanical processivity, biochemical functions, and physical properties of the system, for example, speed, step size, and directionality paving the way towards the new area of ‘dynamic structural biology. The smFRET based tools (two color smFRET, three color smFRET, smFRET anisotropy, etc) are the instruments developed in the laboratory. Some of the outcomes of the research includes establishing the mechanism of helicase activity in deciding and controlling the mode of translocation along the DNA during the repair of stalled-replication fork.

A key aspect of our research is developing fluorescence microscopy techniques to visualise molecular events in real-time within living cells to record individual molecules' localization and movement, such as DNA repair enzymes or transcription factors. Microfluidic devices shall be employed for imaging single cells, which will allow us to decipher how molecular events inside cells determine long-term cell fates.

Post M.Sc. Teaching

The Post M.Sc course curricular is an integral part of our PhD Programme that offers courses across multidisciplinary subject areas. My involvement there is from introducing the scalars with the fundamental of Spectroscopic methods, Thermodynamics and Chemical Kinetics to a journey towards the advance microscopic and imaging techniques. The advance course offers the students to a hands-on training and exposers to the microscopic tools that help them to utilize it in their research work.

Dulal Senapati
Associate Professor-F

Research and Development

Though the continuous effort of our laboratory is to design, characterize, and assemble highly isotropic and anisotropic plasmonic nanomaterials for multidirectional applications in the field of nanomedicine, catalysis, highly specific and ultrasensitive sensing (NSET-based sensing, SERS-based sensing, Electrochemical Ion-Current-regulated chemical sensing; Tag and tag-free Electrochemical and Optical biological sensing; and Functional materials-induced Surface Potential Modulation (SPM)-based biochemical sensing), cost-effective and highly efficient fuel cell (direct alcohol & polyol fuel cell, hydrogen fuel cell, ammonia fuel cell, etc.) construction, nanoparticle-based prevention of non-specific protein aggregation to restrict neurodegenerative disorders, regulation of cellular differentiation programs for cancer therapeutics, and high throughput drug delivery; last one year was a decisive and encouraging time for the laboratory in shaping up for the future, especially after tough period due to COVID-19 pandemic. By looking toward DAE's core mandate, we have initiated several materials science-induced basic and applied research activities to target the future applications of nuclear and radiation power for mankind.

Our recent collaboration with **Prof. Biswajit Karmakar**, **CMP Division, SINP** has empowered us to apply (on 15th June 2023) for a new patent with **Title: A Highly Sensitive H_2 Sensor based on CVD Graphene - Indian App. No. 202331040958 dated 15-Jun-2023 - SINP.**

Post M.Sc. Teaching

In the last year, I taught one basic course: **Principles of Physical Chemistry (PPC)** and one advanced course: "Nanobiomaterials" under the course title: **Topics in Modern Biology (OPT3)** for PostMSc students. Approximate workload and contact hours: 17+17 classes in 4+4 months.

Kaushik Sengupta
Associate Professor-F

Research and Development

My laboratory tries to understand the biology and physics of mechanical force transduction from the Extracellular Matrix (ECM) to the nucleus of a cell in the context of laminopathies and neoplastic transformations. We principally focus on muscular dystrophy and dilated cardiomyopathy as models to unravel how the impairment of nuclear lamin A/C perturbs myogenesis and responds to mechanical cues. As lamins are closely related to maintaining chromosome architecture and function, we also investigate the role of differential expression of lamins in modulating DNA damage and telomere maintenance in gynaecological carcinomas. We are interested in developing better imaging techniques to gain deeper insights into the nuclear architecture and its associated functions. We thereby employ a plethora of multidisciplinary approaches involving biophysics, biochemistry, bioengineering, mechanobiology, cell biology and imaging to understand the nuclear response to mechanical forces concomitantly with chromosome repositioning events and gene expression. As an outcome of the research in my lab, two patents have been filed in 2022 which are given below:

1. A System for Carrying out Active Microrheology to Probe Viscoelasticity of Protein(Indian App. No. 202231030594)

2. System for Executing Nuclear Morphology based Analytics for Accurate Diagnosis / Prognosis of Cancer including Ovarian Cancer (Indian App. No. 202231061023)

Post M.Sc Teaching

My teaching at the Saha institute of Nuclear Physics **(2020 – present)** includes one module of Principles of Biochemistry (PBC), one module of Advanced Laboratory practices (ALP) in the first semester, and Mechanobiology and Tissue Engineering in Advanced Courses-Topics in Cell Biology-I (AC-TCB-I)in the second semester of 1-Year Post-M.Sc curriculum of Saha Institute of Nuclear Physics. PBC (**18 contact hours**) covers Prokaryotic genome organization, operons, Eukaryotic genome organization, Transcription, RNA processing, knock-out and knock-down technologies, Histone biology, Euchromatin vs. Heterochromatin, DNA methylation, Epigenetics. ALP- Biochemical and Molecular biology techniques (**16 contact hours**) introduces Separation techniques like PAGE, EMSA, capillary electrophoresis, isoelectric focusing, HPLC, FPLC, PCR, DNA detection, RNA detection, cloning, mutagenesis, protein expression and detection, different protein staining methodologies. AC-TCB-I (**12 contact hours**) is about introductory biomechanics, cell motility, mechanotransduction, extracellular matrix engineering, experimental mechanobiology, introduction to the physics of mechanobiology and modelling, diseases and Mechanobiology. Along with these, Macromolecular Structure or MMS-I (**16 contact hours**) consisting of Basics of NMR, product operators, chemical shift calculations, introduction to 1-D, 2-D & 3-D experiments, steps in structure determination, relaxation experiments, NOE, Molecular dynamics was also taught by me till **2019**.

Sangram Bagh, FRSC
Associate Professor-F

Research and Development

Building biocomputers and artificial intelligence (AI) with synthetically engineered cell: We use molecular biology parts as the hardware to implement computational devices in living cells. Our lab is developing new rules and systems to build cell based 'computers', and 'AI'. We have created the first artificial neural network (ANN) with genetically engineered cells, where engineered bacteria work as artificial neuro-synapses. Here we adapted the basic concept of artificial neural networks (ANNs) and experimentally demonstrated a broadly applicable single-layer ANN type architecture with molecular-engineered bacteria to perform complex irreversible computing like multiplexing, de-multiplexing, encoding, decoding, majority functions, and reversible computing like Feynman, double Feynman and Fredkin gates. This work has been published as front cover page of Chemical Science and highlighted in Nature India (Tweaking Bacterial Cells to Make Artificial Neural Network https://www.nature.com/articles/d44151-021-00081-3). We expanded the capability of bacterial ANN and built bacterial computational devices, demonstrated A double Feynman Gate, which was published as a front cover page of ACS Syn. Bio. Further, we created a distributed biocomputer with engineered bacteria to solve a set of computational/mathematical maze problems. This is the first time we are showing engineered bacteria can solve abstract mathematical/computational problems. (Sarkar, et al ACS Syn Bio, 2021). The work has been featured in MIT Technology Review. https://www.technologyreview.com/2021/11/09/1039107/e-coli-maze-solving-biocomputer/. We reprogram microbial cells as 'robots' (biobots) to sense varieties of extracellular signals similar to a cancer microenvironment, to decode those signals, to co-ordinate with other cells and decide to invade cancer cells. We apply those 'bio-bots' for programmed delivery of therapeutic genes and RNAi into the cancer cells. See our recent publication (Srivastava R. et al, ACS Synthetic Biology, 2022, 11, 3, 1040–1048 https://pubs.acs.org/doi/abs/10.1021/ acssynbio.1c00392. This work is highlighted in Nature India (Engineered Bacteria Can Silence Genes in Cancer Cells) https://www.nature.com/articles/d44151-022-00032-6. We are first to integrate microgravity as a physical signal within cellular processes in a human designed way and built the microgravity cellular sensor (Mukhopadhyay and Bagh, Biosensor and Bioelectronics, 2020). Those systems have potential in bio-robotics, novel therapeutics, programmed materials and space technology.

The ANN approach we created a new approach of building synthetic genetic circuits. In near future we expand our systems to demonstrate application in developing cellular cryptography. Further, we are building synthetic genetic circuits to program neural like cells for building neural networks. Our goal is to control such networks in a human designed way.

Post M.Sc. Teaching

I have developed and teach a full advanced course on synthetic biology to the post M.Sc students. I further teach basic post M.Sc course module on application of thermodynamics and chemical kinetics in biological systems.

Chandrima Das, FNASc
Professor-G

Research and Development

Present Research Achievements: The broad research focus of our laboratory is to understand the diverse function of the *epigenetic regulators* in the context of human disease. Here we are delineating the role of a family of chromatin '*readers/effectors*' in difficult to prognose cancers, metabolic disorders as well as infectious diseases. (I) We are elucidating the molecular mechanisms governing the transcriptional regulation of the glucose and lipid metabolic pathway by the '*chromatin readers*' which has a direct implication in metabolic disorder, type1/2-diabetes or NAFLD. The epigenetic readers have emerged as a novel insulin-responsive factor that modulates histone post-translational modifications to regulate *metabolic homeostasis during glucose-mediated stress situations*. We are also delineating a *lipid accumulation mechanism in a high-fat diet-mediated stress*. (II) We are investigating the novel mechanism employed by the Hepatitis B virus (HBV) to evade the host immune response. We have identified how the virus hijacks epigenetic regulators to repress the *innate immune response* and promote *metabolic rewiring*. We have observed that HBV infection regulates *gluconeogenesis pathway* directly affecting glucose production. We are investigating the role of the chromatin readers in maintaining the dynamics of *lipid metabolism*. This work not only enhances our understanding of viral infections but has also led to the identification of a promising target for anti-viral therapy. (III) We have made significant strides in unravelling the critical role of chromatin readers in regulating *Epithelial-Mesenchymal Transition* (EMT) programs. Present research from our laboratory also unveils novel mechanisms including the modulation of critical signalling pathways, *extracellular matrix (ECM) remodelling*, and regulation of tumour-promoting/suppressing genes, regulated by the chromatin readers. These functional discoveries shed light on the intricate molecular processes underlying Triple Negative Breast Cancer (TNBC) proliferation, metastasis, therapeutic resistance, and cellular plasticity. These findings hold immense potential in combating breast tumorigenesis, particularly in alleviating the challenges posed by therapy resistance. Our research has also uncovered *novel targets for retinoid-based therapy*, paving the way for innovative approaches in treating cancer.

Future Research Focus: (I) Epigenetic dysregulation plays a crucial role in the pathogenesis of various human diseases, including aggressive and therapy-resistant cancers. We have identified the role of the chromatin readers in other specialized cellular programs including *anoikis resistance* and *ECM remodelling* to regulate metastatic potential and therapy resistance. Interestingly, these reader family proteins modulate *cellular differentiation events* leading to altered expression of *long non-coding RNA* pools, providing new avenues to counteract the aggressive cancers. Notably, breast tumors exhibit remarkable *heterogeneity*, necessitating a comprehensive understanding of the underlying molecular mechanisms driving their *distinct spatial regions*. The spatial distribution of oxygen and nutrients within solid tumors creates distinct regions, with the tumor core experiencing deprivation and the periphery exhibiting abundance due to limited vasculature penetration. We are focussing to understand the epigenetic mechanism that are fine-tuned by the chromatin readers for *metabolic* and *immune regulation* in *3D-perspective*. (II) Maintaining metabolic homeostasis is crucial for cellular physiology, as cells continuously respond to a wide range of endogenous and exogenous stresses that can influence their physiological state. In this context, we are investigating the role of physico-chemical stress like *hyperthermia* which invokes *nucleic acid biosynthesis/metabolism*. The epigenetic readers can cause *metabolic rewiring* leading to a cellular adaptation to the heat stress. (III) We are also understanding the role of the chromatin readers in *trans-differentiation of adipocyte* pools and maintenance of *liver/adipocyte cross-talks*.

Post M.Sc. Teaching

Involved in teaching Principles of Biochemistry (PBC) in the Basic Course and Topics in Cell Biology-Chromatin and Epigenetics (TCB) in the Advanced Course at the Post M.Sc. programme at SINP.

Oishee Chakrabarti, FNASc
Professor-G

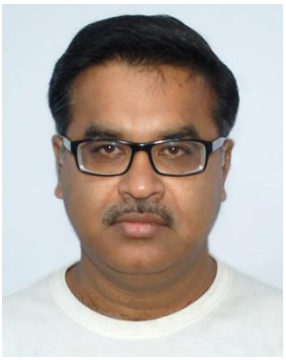
Research and Development

We aim at understanding the cell biological phenomena that govern extensive cellular dysfunction in gliomas and death in late-onset neurodegenerative diseases. While studying this, we have unravelled some of the basic mechanisms that regulate organellar biogenesis, inter-organellar dynamics (like the cross-talk between ER-mitochondria, autophagosome-amphisome-lysosome) and function. From a socio-economic point of view, diseases of the brain, including cancers, neuropathies and neurodegenerative diseases are on the rise globally and in India. Hence multidimensional basic research, as highlighted in our studies is an absolute necessity for better therapeutics to alleviate the pain, suffering and associated social stigma.

My laboratory has made significant contributions to the regulation of autophagosomal-lysosomal degradation, ERAD tuning, maintaining intracellular calcium homeostasis, mitophagy and mitochondrial hyperfusion (***Cell Death and Disease, 2015***; ***Journal of Cell Science, 2015***; ***Traffic, 2019***; ***FASEB J, 2019***; ***Autophagy, 2020***; ***Journal of Cell Science, 2022***). We have detected and characterized that destabilized mitochondria generated due to ER stress are almost devoid of the outer membrane – hence establishing the formation of "mitoplasts" *ex vivo*. "Mitoplasts" had so far been generated only *in vitro*. These get cleared by a new pathway of autophagy, termed "reticulo-mito-phagy" or dual turn-over of ER and mitochondria (***Autophagy 2020***). Further, my group has demonstrated that lack of ubiquitination of the ESCRT-I protein, TSG101, blocks vesicular fusion between late endosomes/autophagosomes/amphisomes and lysosomes (***Cell Death and Disease, 2015***; ***Biochemistry and Cell Biology, 2016***; ***Molecular Neurobiology, 2017***). At present we are looking at mitochondrial quality control at different levels – protein import into the organelle, maintenance of mitochondrial DNA, regulation of fission-fusion homeostasis and crosstalk with the endoplasmic reticulum quality control pathway, to name a few.

Post M.Sc. teaching

I have been teaching in the institute's graduate programme since my joining in SINP. I teach a basic and an advanced course in cell biology. In the basic course, the emphasis is on the understanding the cellular organelles; how their structure, function, interconnectivity are crucial in defining normal cellular activities, including cell cycle and effect of their alterations on diseases. The advanced course takes this further to analyse some of the molecular pathways that are crucial in the maintenance of the normal cellular machinery and its activities. During both these courses, scholars are encouraged to read new literature, critically assess and deliberate on their understanding of cellular homeostasis, including technical advances in measuring biological phenomena through writing and presentations. Besides, Post M.Sc. teaching, my laboratory acts as an incubation ground for students from varies backgrounds – bachelor's and master's (physics, chemistry and biology), B.Tech., M.Tech, etc. I am also actively involved in creating scientific awareness and generating enthusiasm for basic sciences among school students, medical professionals, college- and university-level teachers.



Debashis mukhopadhyay
Professor-G

Research & Development

Alzheimer disease (AD), prominent among Neurodegenerative disorders (NDDs) in India, is progressive, fatal and commonly characterized by the intracellular or extracellular presence of abnormal protein aggregates. Induction of several pathways in neurodegenerative diseases depends on Receptor Tyrosine Kinases (RTKs) that are activated upon ligand binding, and these signaling pathways have the potential to become prime targets for therapy. Our work aims to provide an overview about the involvement of several RTKs (both canonical and non-canonical) in neuronal pathways, most frequently encountered mutations/ alterations and the pathogenesis that results from such changes. We propose an integrated network approach to investigate the extent of perturbations in the molecular signaling pathways driven through Receptor Tyrosine Kinases (RTKs) in the event of deposition of brain β-amyloid or AICD (APP Intracellular Domain) *(Molecular and cellular biochemistry (2019) 459, Dis Model Mech. 2017 May 1)*. While the alterations of protein coding genes are well studied in AD, those of the non-coding RNAs is novel *(RNA Biol. 2018;15)*. We are gathering evidence to implicate linked sets of RTKs-miRNAs-lncRNAs that could possibly change the way we look at AD *(Curr Alzheimer Res. 2020;17(6), Gene Reports, 2021, 23, Biochem J. 2021 Sep 17;478(17), Sci Rep. 2021 Sep 28;11(1), Life Sci. 2022, May 19;302)*. We intend on further investigating the roles of specific miRNAs in AD encompassing the receptors and develop an axis with relevant lncRNAs. Besides neurodegeneration, primary central nervous system demyelinating disorders are a group of inflammatory diseases affecting only the brain, the spinal cord and the optic nerves. This group includes multiple sclerosis (MS) and neuromyelitis optica (NMO). In the current scenario, further understanding of similarities and differences between NMO and MS and those between sero-negative and sero-positive variants of NMO is required. The biological cascade upstream and downstream of anti-AQP4 production is being investigated in the project. In case of NMO, we could show that upon exposure to NMO sera containing AQP4 and MOG auto-antibodies, the glioma cells undergo morphological alterations and shrinkage. Post rituximab therapy, the levels of p-ERK is significantly altered whereas that of miRNA-145 declined and the nuclear occupancy of FOXO3A added to the increased transcription of Aqp4 *(J Neuroimmunol. 2021 Dec 15;361, Neuroimmunology Reports 2, 2022)*. To understand the underpinning regulation in a more realistic backdrop, we have established a differentiated glioma disease model and Next Generation Sequencing (NGS) is done to determine the differential expression profiles of microRNAs.

Malignant gliomas are a family of primary brain cancers that collectively represent the leading cause of brain cancer-related death in both children and adults. Incidentally, “Chemo brain” or “Chemo fog” is a debilitating side effect of brain cancer and its treatment, and includes cognitive deficits and memory problems. Understandably glial malignancies subvert normal mechanisms of neurodevelopment and myelin plasticity. This heightens the importance to fully understand the signaling mechanisms of myelin plasticity during glioma proliferation and calls for a neuroscience-based approach to understand brain cancers. Our collective technical expertise and the scientific wisdom in the field will help us address these issues in future. More specifically, A) we intend to study the RTK mediated juxtracrine signaling mechanisms and their ncRNA mediated molecular regulations through the establishment of 3D co-culture of glioma cells with neurons and, B) would like to understand the events like autocrine/paracrine signaling at the synapse, glioma synaptogenesis, membrane depolarization and potentiation.

Post MSc teaching

Pedagogy on Genetic basis of Diseases / Molecular interaction & network/ Basic Biophysics /Advanced courses on Neurosciences / RNA structural Biology/ Research methodology in the PMSc Biophysical Sciences Course since 2006. PMSc project and review of 7 students since 2017, out of 18 career total.

Sampa Biswas
Professor-G

Research and Development

Since 2017, our group is mainly involved in two focused area of research. **Inhibitor design of falcipain-2, a potential drug target for malarial chemotherapy:** Emergence of ACT-resistant *Plasmodium falciparum* has escalated global concerns and emphasizes on the identification of novel malarial drug-targets. Hemoglobinolytic protease falcipain-2 (FP2) has long been proposed as a promising drug-target for being instrumental in parasite survival. Off target specificity is a major bottleneck for small molecular inhibitors of drug targets having host homologous proteins. Proteinaceous inhibitors, on the other hand, cover greater canonical/exo sites surface area of interactions with stronger binding credibility and thus generate possibility of designing better selectivity for the target with reduced off-target specificity. With an endeavour of specific inhibitor design of FP2, we first have determined the crystal structure of the target FP2 from *P. falciparum* 3D7 strain having four strain specific mutations in its catalytic domain and cover a comprehensive aspect of structure-guided functional characterization and understanding druggability of FP2. We have chosen two human proteinaceous inhibitors, SerpinB3 and Stefin-A (STFA) in our study as templates, with an idea of immune compliance in host system. Our study reports for the first time that both the human inhibitors efficiently inhibit FP2 with *Ki* values in nM range. However STFA forms a stable complex with FP2 compared to SerpinB3 as evidenced from structural and other biophysical characterisation. The FP2-STFA complex crystal structure, determined in this study, is the **first reported structure of a malarial drug target with a human indigenous protein.** Subsequent a designed a mutant STFA- K68R has amplified its selectivity garnering 3.3 fold lower *Ki* value. The FP2-STFAK68R crystal structure has shown stronger electrostatic-interaction between Arg68 and Asp109 of FP2. Comparative structural and MD-simulation studies further confirm higher buried surface area, better interaction-energy and consistency of the newly developed electrostatic-interaction. STFA-K68R also shows higher *Ki* values against human cathepsin-L and papain, **a step towards eliminating off target specificity**. Further optimization to render them more potent and selective is necessary. **Structural and functional analysis of collagenase activity of human cathesins:** Lysosomal Cathepsin-K, an endo-collagenase, is an integral part of ECM remodeling and implicated in different pathological conditions. Mutation in *CTSK* gene is associated with an autosomal recessive bone disorder called pycnodysostosis. We have generate disease-state mutants and characterized *in vitro* to understand the alteration of collagenase activity and the **first crystal structure of a pycnodysostotic mutant** of CTSK reported in our study. Structure, along with simulation, biophysical analyses as well as collagenolytic enzymatic characterization provides critical information that may pave new avenues towards understanding the disease at molecular level. Our study further identified the key factors responsible for collagenase activity by systematic protein engineering of the non-collagenase human cathepsin L to be a potential collagenase. The crystal structure of engineered cathepsin L with collagenase property and molecular docking studies at its generated GAG binding and proline specific sub sites with corresponding GAG and substrate model enable us to identify the key factors responsible for imparting collagenase activity in a non-collagenase enzyme. In the trailing study we have also altered specificity by mutating pro-domain residues; the effect has been imprinted in the catalytic activity of active protease. The alteration of catalytic activity and specificity of an enzyme is the central issue in protein biochemistry and biotechnology. Our structure-based protein-engineering approach as a whole throw light in this aspect with publications during the period in peered reviewed journals like **FEBSJ, Biochemistry, BBRC, BBActa** to name only a few along with recognition from '**International Proteolytic Society (IPS)**' by presenting our work in their 2023 meeting as invited speaker. Further studies on identification of allosteric site in FP2 with implications in ligand dependent hemoglobinase activity is going on and expected to be completed within the time frame of my superannuation.

Post MSc teaching

Besides teaching in Post-M.Sc classes of Biophysical Sciences at SINP, on the topics of 'Macromolecular Crystallography', I also offered laboratory training course to these students every year.

Rahul Banerjee
Professor-G

Research and Development

Application of surface complementarity in Protein Folding, Validation & Design: According to the "jigsaw puzzle" model of protein folding, the isomorphism between sequence and structure is substantially determined by the specific geometry of side-chain interactions, within the protein interior. This idea has been utilised effectively in protein fold recognition to identify the native fold of a polypeptide sequence amidst a set of decoy sequences, protein structure validation and redesign of a protein hydrophobic core. (Biswas et al.. Can the jigsaw puzzle model of protein folding re-assemble a hydrophobic core? *Proteins: structure, function, and bioinformatics* (2022) 90(7) C1,1365-1506).

Computational and experimental approaches to repurpose known drugs for the treatment of Leishmaniasis: Leishmaniasis, a broad spectrum of diseases caused by several sister species of protozoa belonging to family *trypanosomatidae* and genus *leishmania* generally affects poorer sections of the populace in third world countries. Using a combination of computational and (*in vitro/in vivo*) experimental approaches an effort was made to repurpose known drugs to combat the disease and best results were obtained for the drug suramin, in terms of antileishmanial activity.(Khanra et al. *In vivo* experiments demonstrate the potent antileishmanial efficacy of repurposed suramin in visceral leishmaniasis. *PLos Negl Trop Dis* (2020) 14(8):e0008575).

Crystallography and biophysical characterization of leishmanial proteins: A series of leishmanial proteins were selected for biophysical characterization and crystal structure solution which play an important role in the life cycle of the parasite. The crystal structure of phosphoglucomutase (LmPGM) was solved at 3.5 Å resolution and the unfolding transitions of the peptidyl prolyl cis-trans isomerases cyclophilin and PIN1 were biophysically characterized. (Biswas et al. Probing conformational transitions of PIN1 from L. Major during chemical and thermal denaturation. *International Journal of Biological Macromolecules*(2020) 154, 904-915).

Studies and Applications of Indian philosophical models of consciousness: The study explored the changes in brain cortical thickness as a consequence of meditation in dementia patients.(Dwivedi et al. Effects of meditation on the structural changes of the brain in patients with mild cognitive impairment or alzheimer's disease dementia.*Front Hum Neurosci* (2021)15:728993.)

Indian Philosophy and Meditation: Perspectives on Consciousness. Rahul Banerjee & Amita Chatterjee. Routledge, Oxon and New York, 2018.

Post M.Sc. Teaching

Crystallography and Structural Biology in Post M.Sc. of Saha Institute of Nuclear Physics up to 2018

Udayaditya Sen
Professor-H

Research and Development

Determination of macromolecular structures and their correlation with biological functions is the focus of current structural biology laboratories where interdisciplinary research often strengthens structural findings. Therefore, I have developed a combinatorial approach of X-ray crystallography with knowledge based protein engineering, biochemical/biophysical studies and bioinformatics to better explain the structure function correlations. I have targeted ***Vibrio cholerae***, the pathogenic organism responsible for diarrhea, since it is less well studied in India although the disease is prevalent in this part of the world. During the assessment period I worked on Rho-dependent transcription termination inhibition, Biofilm formation/dispersal, proteins involved in phosphorylation/dephosphorylation and small heat shock proteins.

Rho-dependent transcription termination is a well-conserved process in bacteria. Psu and YaeO are two known Rho inhibitor so far. We have earlier solved the structure of Psu by Hg-SAD data which exhibited a novel fold and knotted dimeric architecture *(J. Biol. Chem 2012)*.Along with various biophysical studies and modeling we deduced its mechanism of inhibition *(Nucleic Acids Res 2013, Bacteriophage 2013)*. Our work on *V. cholerae* YaeO (VcYaeO) shows for the first time that, it is capable to disrupt the functional hexameric assembly of Rho. Structure of VcYaeO coupled with pull-down, ITC, SEC, cross-linking, ATPase and growth assay helped us to address the mechanism of its Rho inhibition (*J. Mol. Biol 2019).* These results could be used to design Rho-specific inhibitors that would kill bacterial infections without affecting human, since Rho has no human counterpart. Our recent studies shows that in contrast to VcYaeO, *E. coli* YaeO (EcYaeO) forms a stable adduct with its Rho implying that the mode of inhibition of YaeO with their respective Rho is quite different. No cross-species inhibition, between these Rho/YaeO pairs, adds a new puzzle to it.

The ability of *V. cholerae* to disseminate and persist in aquatic reservoirs and to be transmitted to a new human host is significantly influenced by its ability to form **biofilms-**a state difficult to invade by conventional antibiotic therapies. Cyclic dinucleotides (CDNs) have emerged as the central molecules in bacterial systems that dictate the formation of '**Biofilm**'. So, tight regulation of intracellular CDN concentration by counteracting action of dinucleotide cyclases (DNCs) and phosphodiesterases (PDEs) is critical in this regard. Series of structural/mutagenesis/growth assays conducted on a standalone PDE (**VcEAL**) significantly enriched our understanding of CDN binding specificity and degradation mechanism. Besides, identification of a fourth metal ion near the catalytic loop helped us to propose the catalytic cycle of CDN degradation (*Biochemical Journal 2019*). HDGYP proteins also degrade CDN but through three metal cluster. We have cloned/purified VcHDGYP and determined its metal binding abilities through ITC. Its CDN binding and ability of various metal ions in CDN degradation is assessed by bis-PNPP. The master regulator of biofilm formation **VpsR** is an atypical bacterial enhancer binding protein (bEBP). VpsR structure unveiled distinctive REC domain orientation leading to novel dimeric association and atypical ATP/GTP binding. We have demonstrated that c-di-GMP convert it to functional dimer regulates its transcription (*J. Mol. Biol 2022)*.

Atomic resolution structures of *V. cholerae* **Fructokinase** in various ligated form coupled with kinetic studies highlights why K^+/Cs^+ but not Na^+ is the monovalent metal of choice for its allosteric activation and implications of opening/closing of large ATP loop for substrate trapping and product release (*Scientific Reports 2018*). The cage-like structure of **VcACP** is novel and we have shown that this cage is capable of encapsulating several important small molecules (BBRC 2020). Low molecular weight PTP (**LMWPTP**) of V. cholerae (VcLMWPTP2) exhibits idiosyncratic grooves and charge on its surface that could be utilized to design specific inhibitor (BBA 2018, BBRC 2020). Finally work on several small heat shock (sHSP) proteins (Hsp31, Hsp15, GrpE and DnaK) have been undertaken. Among them VcHsp31 exhibits a deep negatively charged canyon and huge hydrophobic surface utilized for unfolded substrate binding (*Plos One 2017)*. VcHsp15 shows a trimeric assembly and we have demonstrated its DNA binding abilities (*BBRC 2018).*

Post M.Sc. Teaching

I am teaching Protein Structure, protein crystallization methods and techniques, Macromolecular Crystallography and Structure Function Relationship to the Post M. Sc. Students at SINP.

Partha Saha
Senior Professor-H

Research and Development

Regulation of eukaryotic cell cycle progression by post-transcriptional and post-translational modes of gene regulation is the primary research focus of the lab. An important regulatory step of cell proliferation is the control of DNA replication at the initiation step via a licensing mechanism involving activity modulation of several protein factors through reversible post-translational modification. Ku, a heterodimer protein well-known for its role in DNA repair, is also involved in other important cellular processes including replication initiation. The study in the laboratory has established the role of Ku70 subunit in prevention of re-replication during S, G2 and M-phases when it is phosphorylated by cyclin-Cdks. Interestingly, Ku70 is also ubiquitinated in a cell cycle-dependent manner - at G1-phase and again at early S-phase. Taking into consideration that Ku binds to replication origin during early G1-phase and S-phase, we hypothesize that temporary ubiquitination of Ku70 during G1 and early S-phases removes Ku from replication origin after its licensing-related function in initiation. Experiments are ongoing to investigate the possibility of such a mechanism. The protein abundance during cell cycle progression and other cellular processes is also modulated at translational level which can be regulated by various *cis*-elements present in untranslated regions (UTRs) of transcripts. RNA G-quadruplex (rG4) structure is one such element that can influence the fates and functions of mRNAs, especially the translation process. The presence of rG4 structures in 5′-UTRs of mRNAs generally represses translation. However, rG4 structures can also promote internal ribosome entry site (IRES)-mediated translation as one of its determinants. We have identified an evolutionarily conserved rG4-forming sequence motif at the extreme 5′-end of the unusually long 5′-UTR (1.7 kb) in the transcript of human *cIAP1* gene encoding the **c**ellular **i**nhibitor of **a**poptosis **p**rotein-**1** (cIAP1) that promotes cell survival by suppressing apoptosis and is overexpressed in various cancer cells. Using various biophysical and chemical biological approaches, the formation of a potassium ion-dependent intramolecular and parallel rG4 structure at the sequence stretch is confirmed *in vitro* and in cell. Interestingly, the rG4 structure enhances translation in an IRES-independent manner contrary to many earlier reports. Regulation of periodic expression at post-transcriptional level during cell cycle is also observed for δ-tubulin - a member of tubulin superfamily having a role in centriole maturation. It is established that a 90-base long conserved region including a consensus 9-mer motif in the 5′-UTR of δ-tubulin has an inhibitory effect on translation. Moreover, microtubule-associated protein (MAP4) is found to interact specifically with the conserved region in the 5′-UTR and possibly responsible, at least partially, for the translation inhibitory activity of the UTR. Remarkably, MAP4 interacts with δ-tubulin at protein level as well, suggesting the role of MAP4 in modulation of both abundance and function of δ-tubulin. In another study, the genome-wide comparison of *Leishmania donovani* strains from Indian visceral leishmaniasis and para-Kala azar dermal leishmaniasis (PKDL) patients reveals a possible correlation between the development of sodium stibogluconate resistance and the transition towards the manifestation of PKDL.

Post M.Sc. Teaching

I teach DNA replication as a part of basic courses in Biochemistry and Cell Biology and cell cycle regulation in eukaryotes as a portion of Topics in Cell Biology in advanced courses.

Staff Profiles – Biophysical Sciences Group (Group A)

Name	Desgn	Responsibilities
Shri Abhijit Bhattacharyya	SA F	Assistance in data collection in X-ray Crystallography; routine official jobs of Crystallography Lab and Group-A; member, Technical Team responsible for development and procurement of in-house software.
Shri Arijit Pal	Sr SA E1	Routine operation, calibration and maintenance of BD FACS Aria II Flow Cytometer, epi-fluorescence microscope, incubators, mammalian cell-culture hoods; Convener, Cosmetic Maintenance Committee; Member, committee to look into matters related to MSA-II Housing, Students' hostel and Guest House; official jobs; Secretarial help in the formation of Institute Bioethics and Animal Ethics Committees.
Shri Saikat Mukherjee	SA E	Operation and maintenance of Nextgen sequencer; Scientific Research; maintenance of cell lines in cell culture facility.
Dr. Bikram Nath	SA E	Official job related to Procurement of instruments, consumables; Scientific research: structure-function relation of proteins
Dr. Sushanta Debnath	SA E	Maintenance and prime facilitator of fluorescence microscope and cold room; Scientific Research on protein-nano particle interaction; Chairman, Committee for Physical Verification of Fixed Assets and Precious Metals; Member, Tender Opening Committee, House Building Advance Committee and Cosmetic Maintenance Committee; Incharge, Disposal Sub-Committee; Office job; Account keeping of BARBMS 4002 project for Group A.
Shri Avijit Shome	SA D	Maintenance and operation of Circular Dichroism, ICP-OES, Zetasizer; Office job
Shri Mahendar Mpati	SA C	Maintenance & operation Super-resolution Microscope with Fluorescence Correlation Spectroscope attachment
Shri Bablu Ram	Tech F	Laboratory maintenance; autoclaving; operation of two stage water distiller
Smt Mahuya Dutta	UDC	Official job including purchase procedures; maintenance of inventory and stock register; Handling Extra-Mural fellowship projects; maintenance of Divisional contingency; Leave entry related job.
Shri Raju Dutta	Tech. D	Maintenance & propagation of mammalian cell lines; Qualitative analysis of GCMS data; regular maintenance of liquid nitrogen cylinders; operation of autoclaves.
Shri Deepak Kumar Ram	Tech C	Cleaning and maintenance of laboratories; Official jobs; running autoclaves; operating copier machine
Shri Jitendra Nath Roy	Tech B	Cleaning and maintenance of laboratories; Official jobs; Autoclaving.
Shri Sakal Dev Ram	WA E	Cleaning and maintenance of laboratories; Official jobs; autoclaving; operating copier machine
Shri Sanjoy Show	WA C	Preparation of cell culture media; Washing of lab-wares; Autoclaving; Operation of Quartz distillation system; Official jobs.
Shri Shyamal Chandra Digar	WA C	Official jobs; Autoclaving.
Shri Madhusudan Samal	Cook	Official jobs

List of Instruments and Facilities

Sl No	Instrument name	Responsible faculty	Location	Working/ Nonworking	No of User
1	FACS Aria II	Sangram Bagh	3101	W (Partially)	20
2	Akta Purifier 10 FPLC	Kaushik Sengupta	3126	W (Intermittently)	8
3	Refrigerated centrifuge	Chandrima Das	3119	W	30
4	AKTA Start FPLC	Subhabrata Majumder	3108	W	4
5	Appl. Bio Sys. Step One Plus	Chandrima Das	3119	W	15
6	Azure Bio System	Chandrima Das	3119	W	25
7	Benchtop Orbital Shaker	Kaushik Sengupta	3118	W	15
8	Cell culture microscope	Sangram Bagh	3122	W	5
9	Centrifuge 5810R	Subhabrata Majumder	3108	W	10
10	Chemiluminiscence Scanner	Sangram Bagh	3122	W	5
11	CO2 incubator	Sangram Bagh	3122	W	10
12	DeNovix DS-11 Spectrophotometer	Oishee Chakrabarti	Ph. IV	W	10
13	Extracellular Flux analyzer	Chandrima Das	3119	W	10
14	Gas Chromatograph	Soumen Kanti Manna	3103	W	5 + external users
15	Imaging system	Chandrima Das	3119/3120	W	15
16	Low Volume UV Vis-Spectrophotometer	Chandrima Das	3119	W	15
17	Mass Spectrometer with Ei Source	Soumen Kanti Manna	3103	W	5 + external users
18	Microbial Shaker Incubator	Sangram Bagh	Ph. IV	W	20
19	Multi Detection Microplate Reader	Sangram Bagh	Ph. IV	W	30
20	Nikon Super resolution Microscope	Kaushik Sengupta	3110	W	30
21	Orbital Shaker	Kaushik Sengupta, Chandrima Das	3118	W	15
22	Precellys Evolution Tissue Homogenizer	Soumen Kanti Manna	3105	W	2
23	Proflex PCR System	Kaushik Sengupta	3106	W	15
24	Protean 112IEF	Debashish Mukhopadhyay	Ph. IV	W	2
25	QuantStudio 5 REPCR	Kaushik Sengupta	3106	W	15
26	Real Time PCR machine	Debashish Mukhopadhyay	Ph. IV	W	12
27	Refrigerated Centrifuge	Chandrima Das	3121	W	15
28	Refrigerated Centrifuge REMI	Soumen Kanti Manna	3105	W	15
29	Rotary Cell Culture System - microgravity	Sangram Bagh	3122	W	3 + external users
30	Sorvall STIR Plus Centrifuge	Kaushik Sengupta	3126	W	5
31	SPR - Biacore X100	Kaushik Sengupta	3126	W	15
32	Typhoon Trio	Debashish Mukhopadhyay	3105	W	3
33	Uvisave Q9 Gel Doc system	Oishee Chakrabarti	Ph. IV	W	10
34	Motorized Inverted Microscope Axio Observer Z.1	Partha Saha	3314	W	10 + external users
35	NexGen Ion Torrent Sequencer	Partha Saha	3314	W	6 + external users
36	NanIon Port-A-Patch Setup	H Raghuraman	303	W	3
37	Cryostream Cooler	Sampa Biswas	304	W	2

Sl No	Instrument name	Responsible faculty	Location	Working/ Nonworking	No of User
38	X-Ray Diffraction Syatem (Incoatec)	Udayaditya Sen	304	W	2
39	Automated Protein Purification System	H Raghuraman	303	W	5
40	Refrigerated Centrifuge	Tofayel Ahmed	325	W	10
41	Speedvac Concentrator	Tofayel Ahmed	325	W	12
42	Crystallisation Incubator	Tofayel Ahmed	322	W	3
43	PCR Machine (Hi Media)	Partha Saha	316	W	15
44	UV-Vis Spectrophotometer	Tofayel Ahmed	325	W	10
45	UV-visible Spectrophotometer	Sampa Biswas	308	W	10
46	Biophotometer	Sampa Biswas	308	W	7
47	Refrigerated water bath circulator -1	Sampa Biswas	308	W	7
48	Peristaltic pump x 2	Sampa Biswas	308	W	4
49	Mobile Workstation	Subhendu Roy	3312	W	2
50	Rotospin-T.T Rotator	H Raghuraman	301	W	5
51	Homozenizer Microfluidizer	H Raghuraman	322	W	4
52	Tabletop Refrigerated Centrifuge	H Raghuraman	301	W	5
53	Vibration free Crystallization Incubator	Udayaditya Sen	306	W	3
54	Refrigerated BOD Incubator	Partha Saha	315	W	4
55	Refrigerated BOD Incubator	Partha Saha	321	W	4
56	Ultra Centrifuge	H Raghuraman	322	W	10
57	Modular Spectrophotometer	H Raghuraman	303	W	12
58	Microvolume Spectrophotometer	H Raghuraman	303	W	20
59	ICP OES	Dulal Senapati	223	W	> 10
60	Microwave digester	Dulal Senapati	119	W	> 10
61	HPGe (80%) detector with lead shielding (1000 kg).		120	W	
62	Liquid Scintillation Counter		120	W	
63	Well type HPGe detector		120	W	
64	5”x5” NaI(Tl) detector		120	W	
65	HPGe(25%) detector		120	W	
66	LaBr (Ce) Detector		120	W	
67	CD (Photophysics)	Padmaja Prasad Mishra	230	W	
68	JASCO V-650	Dulal Senapati	230	W	> 30
69	Evolve EMCCD	Padmaja Prasad Mishra	227	W	> 10
70	Andor EMCCD	Padmaja Prasad Mishra	227	W	> 10
71	Andor EMCCD	Padmaja Prasad Mishra	227	W	> 10
72	Horiba QM-400	Dulal Senapati	234	W	> 40
73	Horiba Jobin Yvon Fluoromax-3 Fluorescence Spectrometer	Dulal Senapati, Padmaja Prasad Mishra	234	W	> 20
74	Zetasizer	Dulal Senapati	3406	W	> 20
75	Bruker AFM	Dulal Senapati	319	W	> 30
76	Jasco V-770	Dulal Senapati	3406	W	> 20
77	Olympus Microscope	Dulal Senapati	3406	W	> 10
78	Orbital Shaker	Chandrima Das	Ph - IV	W	
79	ABI Step One TM		3101	NW	
80	Confocal microscope 710 with FCS attachment	Debashis Mukhopadhyay, Oishee Chakrabarti	Ph. IV	NW	

Sl No	Instrument name	Responsible faculty	Location	Working/ Nonworking	No of User
81	FACS Caliber		3101	NW	
82	GALAXY 170 R CO2 Incubator	Sangram Bagh	3122	NW	
83	Laser Capture Microdissection System	Debashis Mukhopadhyay	3110	NW	
84	MALDI TOF/TOF	Debashis Mukhopadhyay, Soumen Kanti Manna	3103	NW	
85	MicroCal ITC-200	Subhabrata Majumder	3108	NW	
86	Motorized Inverted Microscope Axio Observer Z.1		3110	NW	
87	Ultra Centrifuge	Kaushik Sengupta, Chandrima Das	3118	NW	
88	VP ITC	Subhabrata Majumder	3108	NW	
89	Waters Acquity UPLC & Lock Spray source with ESI probe	Soumen Kanti Manna	3103	NW	
90	Waters Xevo G2 Electro Spray Ionization	Soumen Kanti Manna	3103	NW	
91	ICP MS	Dulal Senapati	223	NW	> 10
92	HPGe Compton Suppressor with lead shielding (1300 kg)		120	NW	
93	LEPS with lead shielding		120	NW	
94	XRF	Dulal Senapati	120	NW	
95	FALCON		120	NW	
96	IR (Perkin Elmer)	Padmaja Prasad Mishra	230	NW	
97	Horiba JobinYvon Lifetime system	Padmaja Prasad Mishra	227	NW	
98	Femtosecond Upconvertion System (CDP 2015 + FOG100 + CDP2022D)		232	NW	
99	Nanosecond laser photolysis spectrometer		232	NW	
100	Monochromator Pulser unit, Pulsed Xenon lamp		232	NW	
101	Nd:YAG Laser pumped Dye laser system		232	NW	
102	Microfluidic Cell on a Chip MED64	Sangram Bagh	3122	Just arrived, Due for installation	

Full list of students in the Group since 2017

Sl. No.	Student Name	Supervisor	Ph.D. date/Status
1	Soumita Mukherjee	Partha Saha	May 2017
2	Priyanka Majumder	Oishee Chakrabarti	May 2017
3	Manindra Bera	Kaushik Sengupta	Nov 2017
4	Supratim Ghatak	Sanghamitra Raha	Jan 2018
5	Rukmini Mukherjee	Oishee Chakrabarti	Apr 2018
6	Zenia Kaul	Oishee Chakrabarti	Aug 2018
7	Sourav Ghoshal	Montu K. Hazra	Aug 2018
8	Tapas Paul	Padmaja P. Mishra	Aug 2018
9	Sudha Bucha Sancheti	Nitaipada Bhattacharya & DebashisMukhopadhyay	Sep 2018
10	Subhas Ch Bera	Padmaja P. Mishra	Oct 2018
11	Sanghati Roychowdhury	Udayaditya Sen	Nov 2018
12	Maireyee Bhattacharya	Dulal Senapati	Nov 2018
13	Sudeshna Das Chakraborty	Dulal Senapati	Feb 2019
14	Piyali Majumder	Debashis Mukhopadhyay	May 2019
15	Sabyasachi Sen	Chandrima Das	Jun 2019
16	Dipayan Bose	Abhijit Chakrabarti	Nov 2019
17	Shramana Chatterjee	Udayaditya Sen	Jan 2020
18	Isha Sengupta	Chandrima Das	Feb 2020
19	Saran Chattopadhyaya	Subrata Banerjee	Feb 2020
20	Sandip Kumar De	Dulal Senapati	Dec 2020
21	Kamalendu Pal	Udayaditya Sen	Jan 2021
22	Shweta Singh	Subrata Banerjee	Feb 2021
23	Satyabrata Maiti	D Bhattacharyya (Guide) Montu K. Hazra (Co-Guide)	Mar 2021
24	Malti Yadav	Udayaditya Sen	Mar 2021
25	Kaushik Chanda	Debashis Mukhopadhyay	Jun 2021
26	Satyaki Chatterjee	H Raghuraman	Jun 2021
27	Sayak Mukhopadhyay	Sangram Bagh	Sep 2021
28	Benazir Alam	Sampa Biswas	Feb 2022
29	Anindita Das	H Raghuraman	Feb 2022
30	Tulika Chakraborty	Udayaditya Sen	Apr 2022
31	Debdatto Mookherjee	Oishee Chakrabarti	May 2022
32	Kathakali Sarkar	Sangram Bagh	May 2022
33	Payel Mondal	Chandrima Das	May 2022
34	Gargi Biswas	Rahul Banerjee	May 2022
35	Suparna Saha	Debashis Mukhopadhyay	May 2022
36	Rajdeep Das	Oishee Chakrabarti	Aug 2022
37	Debolina Bandyopadhyay	Padmaja P Mishra	Dec 2022
38	Rajkamal Srivastava	Sangram Bagh	Apr 2023
39	Debayan Purkait	Padmaja P Mishra	May 2023
40	Subhoja Chakraborty	Sampa Biswas	Jul 2023
41	Duhita Sengupta	Kausik Sengupta	Jul 2023
42	Chandrayee Mukherjee	Kausik Sengupta	Aug 2023
43	Anuradha Roy	Dulal Senapati	Synopsis over
44	Deepro Bonnerjee	Sangram Bagh	Synopsis Over
45	Priyadarshini Suchismita Sethy	Partha Saha	Continuing
46	SK RAMIZ ISLAM	Soumen K Manna	Continuing
47	Indranil Modak	Partha Saha	Continuing
48	Aditya Sinha Roy	Partha Saha	Continuing
49	Sebabrata Maity	Oishee Chakrabarti	Continuing
50	Palamou Das	Oishee Chakrabarti	Continuing
51	Vipin K Singh	Chandrima Das	Continuing
52	Rupashree Brahma	H. Raghuraman	Continuing
53	Arpita Nandy	Dulal Senapati	Continuing
54	Priyanka Sengupta	Denashis Mukhopadhyay	Continuing
55	Swagata Adhikari	Chandrima Das	Continuing

Sl. No.	Student Name	Supervisor	Ph.D. date/Status
56	Saikat Sadhukhan	Montu K. Hazra	Continuing
57	Soumen Mondal	Montu K. Hazra	Continuing
58	Farhana Islam	Padmaja Mishra	Continuing
59	Somenath Sen	Debashis Mukhopadhyay	Continuing
60	Rachayita Nag	Subhabrata Majumder	Continuing
61	Russa Das	Debashis Mukhopadhyay	Continuing
62	Debasish Prusty	Soumen K Manna	Continuing
63	Manali Basu	Padmaja Mishra	Continuing
64	Sourav Mondal	Dulal Senapati	Continuing
65	Pallavi Chatterjee	D. Mukhopadhyay	Continuing
66	Manorama Ghosal	Dulal Senapati	Continuing
67	Nialanjan Das	Oishee Chakrabarti	Continuing
68	Saswata Chakraborty	Sangram Bagh	Continuing
69	Subhradip Nath	Kaushik Sengupta	Continuing
70	Arpan Bysack	H Raghuraman	Continuing
71	Atanu Mondal	Chandrima Das	Continuing
72	Shreyasi Dey Sarkar	Kaushik Sengupta	Continuing
73	Madhumanti Halder	Oishee Chakrabarti	Continuing
74	Prem Das	Oishee Chakrabarti	Continuing
75	Ankita Karmakar	Debashis Mukhopadhyay	Continuing
76	Sneha Dutta	Debashis Mukhopadhyay	Continuing
77	Sandhik Nandi	Chandrima Das	Continuing
78	Amrita Goswami	Soumen K Manna	Continuing
79	Abhishek Paul	Sangram Bagh	Continuing
80	Aindrila Kabiraj	Chandrima Das	Continuing
81	Arnab Bhattacharya	Subhabrata Majumder	Continuing
82	Biyas Mukherjee	Sangram Bagh	Continuing
83	Shakya Sinha	Subhabrata Majumder	Continuing
84	Shubhashri Parua	H Raghuraman	Continuing
85	Sudarshana Chakraborty	Oishee Chakrabarti	Continuing
86	Tarit Sarkar	H Raghuraman	Continuing
87	Ritwika Basu	Sangram Bagh	Continuing
88	Antara Saha	Tofayel Ahmed	Continuing
89	Ritesh Sonar	Padmaja P Mishra	Continuing

Year-wise distribution of students

Joined before, but continued in 2017 or afterward — Total 40

Soumita Mukherjee, Manindra Bera, Supratim Ghatak, Sourav Ghoshal, Tapas Paul, Sudha Bucha Sancheti, Subhas Ch Bera, Sanghati Roychowdhury, Piyali Majumder, Sabyasachi Sen, Isha Sengupta, Priyanka Majumder, Rukmini Mukherjee, Zenia Kaul, Kamalendu Pal, Malti Yadav, Debdatto Mookherjee, Shramana Chatterjee, Benazir Alam, Dipayan Bose, Saran Chattopadhyaya, Maireyee Bhattacharya, Sudeshna Das Chakraborty, Sandip Kumar De, Shweta Singh, Satyabrata Maiti, Kaushik Chanda, Sayak Mukhopadhyay, Tulika Chakraborty, Kathakali Sarkar, Payel Mondal, Suparna Saha, Rajdeep Das, Satyaki Chatterjee, Anindita Das, Gargi Biswas, Rajkamal Srivastava, Subhoja Chakraborty, Deepro Bonnerjee, Priyadarshini Suchismita Sethy

Joined in 2017 — Total 07

SK RAMIZ ISLAM, Debolina Bandyopadhyay, Debayan Purkait, Duhita Sengupta, Chandrayee Mukherjee, Indranil Modak, Aditya Sinha Roy

Joined in 2018 — Total 08

Sebabrata Maity, Anuradha Roy, Palamou Das, Vipin K Singh, Rupashree Brahma, Arpita Nandy, Priyanka Sengupta, Swagata Adhikari

Joined in 2019 — Total 12

Saikat Sadhukhan, Soumen Mondal, Farhana Islam, Somenath Sen, Rachayita Nag, Russa Das, Debasish Prusty, Manali Basu, Sourav Mondal, Pallavi Chatterjee, Manorama Ghosal, Nialanjan Das

No Student admission in 2020 due to the pandemic situation

Joined in 2021 — Total 04

Saswata Chakraborty, Subhradip Nath, Arpan Bysack, Shreyasi Dey Sarkar

Joined in 2022 — Total 15 (Jan plus Aug batch)

Atanu Mondal, MADHUMANTI HALDER, PREM DAS, ANKITA KARMAKAR, SNEHA DUTTA, SANDHIK NANDI, AMRITA GOSWAMI, Abhishek Paul, Aindrila Kabiraj, Biyas Mukherjee, Sudarshana Chakraborty, Arnab Bhattacharya, Shakya Sinha, Shubhashri Parua, Tarit Sarkar

Joined in 2023 — Total 03 (Jan batch)

Ritwika Basu, Antara Saha, Ritesh Sonar

In addition, seven (07) students have joined in August 2023, who are doing course work.

Faculty-wise distribution of students

Name of faculty member	No. of students from 2017 onward
Nitaipada Bhattacharya & Debashis Mukhopadhyay	01
Subrata Banerjee	02
Abhijit Chakrabarti	01
Dhanajay Bhattacharyya & Montu Hazra	01
Partha Saha	04
Rahul Banerjee	01
Sampa Biswas	02
Udayaditya Sen	05
Debashis Mukhopadhyay	09
Oishee Chakrabarti	11
Chandrima Das	08
Kaushik Sengupta	05
Sangram Bagh	08
H Raghuraman	06
Dulal Senapati	07
Padmaja Prasad Mishra	07
Montu K Hazra	03
Soumen Kanti Manna	03
Subhabrata Majumder	03
Subhendu Roy	00
Tofayel Ahmed	01

Placement of student (2017 onward)

Sl. No.	Student Name	Supervisor	Ph.D. date	Present Affiliation / Job Status
1	Soumita Mukherjee	Partha Saha	May 2017	Research Associate, Bose Inst., Kolkata
2	Priyanka Majumder	Oishee Chakrabarti	May 2017	Program Associate-BIG SINE, IIT Bombay
3	Manindra Bera	Kaushik Sengupta	Nov 2017	Post doc, Yale University, USA
4	Supratim Ghatak	Sanghamitra Raha	Jan 2018	Manager (Medical Content Lead) at BioQuest Solutions
5	Rukmini Mukherjee	Oishee Chakrabarti	Apr 2018	Research Scientist, Altos Labs Inc., USA
6	Zenia Kaul	Oishee Chakrabarti	Aug 2018	Post Doc, NIH, USA
7	Sourav Ghoshal	Montu K. Hazra	Aug 2018	NPDF at Visva-Bharati University, India
8	Tapas Paul	Padmaja P. Mishra	Aug 2018	Post-Doc, John-Hopkins University
9	Sudha Bucha Sancheti	Nitaipada Bhattacharya & DebashisMukhopadhyay	Sep 2018	NPDF, CSIR-IICB, Kolkata, India
10	Subhas Ch Bera	Padmaja P. Mishra	Oct 2018	Post Doc, IZNF Germany
11	Sanghati Roychowdhury	Udayaditya Sen	Nov 2018	PDF, AIIMS, New Delhi, India
12	Maireyee Bhattacharya	Dulal Senapati	Nov 2018	Working as a Scientist in Inpria Inpriya.com
13	Sudeshna Das Chakraborty	Dulal Senapati	Feb 2019	RA at NML @ Jamshedpur
14	Piyali Majumder	Debashis Mukhopadhyay	May 2019	Chief Scientific Officer, UrjanovaC Pvt Ltd, Mumbai, India
15	Sabyasachi Sen	Chandrima Das	Jun 2019	Postdoctoral Fellow, Perelman School of Medicine at the University of Pennsylvania
16	Dipayan Bose	Abhijit Chakrabarti	Nov 2019	PDF at Yale University
17	Shramana Chatterjee	Udayaditya Sen	Jan 2020	PDF-Michigan State University
18	Isha Sengupta	Chandrima Das	Feb 2020	Erstwhile Post-doc at A*STAR, Singapore; NPDF at IIT-Kharagpore
19	Saran Chattopadhyaya	Subrata Banerjee	Feb 2020	PDF at UC Santa Cruz, USA
20	Sandip Kumar De	Dulal Senapati	Dec 2020	Assistant Professor @UPL University of Sustainable Technology
21	Kamalendu Pal	Udayaditya Sen	Jan 2021	PDF, University of Iowa, USA
22	Shweta Singh	Subrata Banerjee	Feb 2021	Assistant professor at School of Allied Healthcare & Sciences, Bangalore
23	Satyabrata Maiti	D Bhattacharyya (Guide) Montu K. Hazra (Co-Guide)	Mar 2021	PDF at International Institute of Molecular and Cell Biology in Warsaw, Poland

Sl. No.	Student Name	Supervisor	Ph.D. date	Present Affiliation / Job Status
24	Kaushik Chanda	Debashis Mukhopadhyay	Jun 2021	Post-doctoral Research Associate, Department of Neurosciences, The Scripps Research Institute, Florida, USA
25	Satyaki Chatterjee	H Raghuraman	Jun 2021	Postdoctoral researcher at Oregon Health Science University (OHSU), Portland, Oregon, USA
26	Sayak Mukhopadhyay	Sangram Bagh	Sep 2021	Postdoctoral Research Associate, Department of Chemical Engineering, Texus A&M University, USA
27	Benazir Alam	Sampa Biswas	Feb 2022	Senior Scientist, EVOTEC (UK) LIMITEDOxfordshire,UK
28	Anindita Das	H Raghuraman	Feb 2022	Postdoctoral researcher at UTHealth Houston, Texas, USA
29	Tulika Chakraborty	Udayaditya Sen	Apr 2022	PDF, Ludwig-Maximilians-University, Germany
30	Debdatto Mookherjee	Oishee Chakrabarti	May 2022	Post Doc, Biozentrum, Switzerland
31	Kathakali Sarkar	Sangram Bagh	May 2022	Postdoctoral Researcher : Imperial College London
32	Payel Mondal	Chandrima Das	May 2022	Postdoctoral Researcher, National Cancer Institute, National Institute of Health, USA
33	Gargi Biswas	Rahul Banerjee	May 2022	Post Doc., Weizmann Inst. of Science, Israel
34	Suparna Saha	Debashis Mukhopadhyay	May 2022	PDF, NINDS, National Institute of Health, Maryland, USA
35	Rajdeep Das	Oishee Chakrabarti	Aug 2022	Post Doc, The Francis Crick Institute, UK
36	Debolina Bandyopadhyay	Padmaja P Mishra	Dec 2022	Post Doc, Texas A& M University, USA
37	Rajkamal Srivastava	Sangram Bagh	Apr 2023	Postdoctoral Research Associate, Harvard Medical School, Harvard University, Boston, USA
38	Debayan Purkait	Padmaja P Mishra	May 2023	Post Doc Pennsylvania State University
39	Subhoja Chakraborty	Sampa Biswas	Jul 2023	Post Doc, Central University of Florida, US
40	Duhita Sengupta	Kausik Sengupta	Jul 2023	To join EMBL, Heidelberg, Germany in Oct, 2023
41	Chandrayee Mukherjee	Kausik Sengupta	Aug 2023	To join Yale University, USA in Oct, 2023

Research Associates in the Group working from 2017

Name of RA	Join date	End date	Mentor	SINP/Extramural
Moitri Basu	Mar 2015	Feb 2017	Chandrima Das	DBT-RA
Tania Majumdar	May 2015	Nov 2015	Dulal Senapati	SERB young Scientist
Sumana Roy	2015	2018	Sampa Biswas	DST-WOS
Munmun Bardhan	Dec 2015	Dec 2018	Dulal Senapati	SERB young Scientist
Siddhi Chaudhuri	2016	2018	Debashis Mukhopadhyay	SERB - NPDF
Chandrima Jash	Aug 2016	Aug 2018	H. Raghuraman	SERB - NPDF
Sanjima Pal	Oct 2016	Sep 2017	Patha Saha	SINP
Uttam Pal	Nov 2016	Jun 2018	Dulal Senapati	SINP
Biswadeep Chaudhuri	2017	2018	Kaushik Sengupta	SINP
Subrata Mondal	Aug 2017	Aug 2019	Dulal Senapati	NPDF
Sarmistha Ray	May 2018	Sep 2019	Dulal Senapati	LSRB-DRDO
Debmita Chatterjee	Jul 2018	Apr 2022	Oishee Chakrabarti	SERB - NPDF
Shravanti Mukherkee	Aug 2018	Aug 2020	Chandrima Das	SERB - NPDF
Karthik Menon	Feb 2019	Feb 2021	H. Raghuraman	SINP
Srabani Karmakar	Mar 2019	Mar 2023	Padmaja Prasad Mishra	TARE
Soma Monda;	Jul 2019	Jul 2022	Padmaja Prasad Mishra	DBT RA
Amrita Sengupta	Oct 2019	Oct 2022	Chandrima Das	DBT-RA
Nabanita Naskar	Oct 2019	Oct 2022	Dulal Senapati	SINP
Deblina Guha	Dec 2020	Dec 2022	Chandrima Das	DBT-RA
Subhadip Maiti	Nov 2021	Continuing	Soumen Kanti Manna	SINP
Apoorva Bhattacharya	Jan 2022	Dec 2022	Chandrima Das	SERB - NPDF
Uttam Jana	Apr 2022	Apr 2023	Partha Saha	SINP
Srestha Ghosh	Apr 2022	Continuing	Udayaditya Sen	SINP
Shouvik Mohanti	Nov, 2022	Continuing	Sampa Biswas	SINP
Anagh Mukherjee	Nov 2022	Continuing	Subhendu Roy	SINP
Tamalika Paul	Aug 2023	Aug 2024	Chandrima Das	DST-SERB

Research Profile

Broad research area	Faculty members	Students
Disease Biology	Debashis Mukhopadhyay	Piyali Majumder, Sudha Bucha Sancheti, Kaushik Chanda, Suparna Saha, Priyanka Sengupta, Somenath Sen, Pallavi Chatterjee, Russa Das, Ankita Karmakar, Sneha Dutta
	Oishee Chakrabarti	Priyanka Majumder, Rukmini Mukherjee, Zenia Kaul, Debdatto Mookherjee, Rajdeep Das, Sebabrata Maity, Palamou Das, Nilanjan Das, Madhumanti Halder, Prem Das, Sudarshana Chakraborty
	Kaushik Sengupta	Manindra Bera, Chandreyee Mukherjee, Duhita Sengupta, Subhradip Nath, Shreyasi Dey Sarkar
	Chandrima Das	Sabyasachi Sen, Isha Sengupta, Payel Mondal, Vipin K Singh, Swagat Adhikari, Atanu Mondal, Sandhik Nandi, Aindrila Kabiraj
	Soumen Kanti Manna	Sk Ramiz Islam, Debasish Prusty, Amrita Goswami,
	Partha Saha	Soumita Mukherjee, Indranil Modak, Aditya Sinha Roy, Priyadarshini Suchismita Sethy,
Structure and function of biological macromolecules	Rahul Banerjee	Gargi Biswas
	Sampa Biswas	Benazir Alam, Subhoja Chakraborty
	Udayaditya Sen	Kamalendu Pal, Malti Yadav, Sanghati Roychowdhury, Shramana Chatterjee, Tulika Chakraborty
	H. Raghuraman	Satyaki Chatterjee, Anindita Das, Rupashree Brahma, Arpan Bysack, Shubhashri Parua, Tarit Sarkar
	Subhabrata Majumder	Rachayita Nag , Arnab Bhattacharya, Shakya Sinha,
	Tofayel Ahmed	Antara Saha
Synthetic Biology	Sangram Bagh	Kathakali Sarkar, Sayak Mukhopadhyay, Deepro Bonnerjee, Rajkamal Srivastava, Saswata Chakraborty, Abhishek Paul, Biyas Mukherjee, Ritwika Basu,
Computational Biology	Subhendu Roy	
Chemical Science and Nanotechnology	Padmaja Prasad Mishra	Tapas Paul, Subhas Chandra Bera, Debolina Bandyopadhyay, Debayan Purkait, Farhana Islam, Manali Basu, Ritesh Sonar,
	Dulal Senapati	Maireyee Bhattacharya, Sudeshna Das Chakraborty, Sandip Kumar De, Anuradha Roy, Arpita Nandy, Sourav Mondal, Manorama Ghosal,
	Montu K Hazra	Sourav Ghoshal, Satyabrata Maiti, Saikat Sadhukhan, Soumen Mondal,

Other Points

- **Key areas in which the Group can make impact and is planning to expand in the coming 3 to 5 years**

  With our present knowledge and skill, the Biophysical Sciences Group envisages a few areas in which it intends to make an impact on science – in India as well as globally. So far, we have expertise and facilities to address problems in cell biology, epigenetics, structural biology, synthetic biology, mass-spectrometry, spectroscopy, nanotechnology and propose *in silico* models for difficult to address yet important questions about key biological phenomena. We plan to take this further in a few focused ways.

  Firstly, we like to establish a comprehensive 3D organoid/tissue culture facility for complex 3D tissue structure generation and measure changes in tumour microenvironment, brain microcircuit, and propose wetware computation models in more physiologically relevant conditions. Here, we will generate 3D cultures from cell lines as well as various types of patient tissue samples. Alteration in the tumour microenvironment is what regulates outcome of the disease, with respect to pathogenesis, prognosis and recurrence. Not just the tumour microenvironment, an artificial organ architecture will be simulated by 3D-bioprinting of cells. The tumour and organ-like microenvironments will be characterized – through super resolution imaging, epigenetically, RNA sequencing (mRNAs, miRNAs, lncRNAs), proteomic and metabolomics analyses. Multidisciplinary approaches including mechanobiology will be employed to understand the nuclear response to mechanical forces concomitantly with chromosome repositioning events and gene expression. Dried blood and urine spot-based methodology will be developed for remote sampling and monitoring of wellness and disease markers. Comprehensive analyses through cross-platform approaches are needed to address not just the conundrum of cancer, but also neurodegeneration and metabolic disorders.

  Secondly, stem/pluripotent cells will be manipulated by synthetic biological approaches to force them into specific lineage (like neuronal) and establish 3D cultures in small and large scale. So far, we have successfully altered bacterial gene circuitry to develop a framework for future biocomputing. The next step will be to synthetically manipulate mammalian cells, characterize their properties and develop 3D organ-like architectures from them.

  Thirdly, we will take our expertise in structural biology and biophysical analyses of membrane and soluble proteins further by setting up two facilities – one for pulsed electron paramagnetic resonance (EPR) and another for 800 MHz nuclear magnetic resonance (NMR). Facilities as envisaged are lacking in this entire Eastern zone of the country, hence will be National facilities. The pulsed EPR will help advance our understanding of membrane protein structure-function correlation, dynamics and conformational transitions under physiological conditions. The state-of-art High Field NMR National facility will cater to internal and external users across the country. Further, electron-microscopic analyses will be undertaken to characterize biochemical and structural properties of membrane proteins to shed light on its mechanism of action and drug binding sites.

  Fourthly, we aim to extend our understanding of enzymatic activities and also membrane proteins. While on one hand these enzymes have been identified, isolated and characterized for their kinetics for the past few decades, the mode of their activity still remains an enigma. The membrane proteins remain a challenge worldwide. Our present understanding brings forth the essentiality of performing large-scale QM, MD and QM/MM MD, and Coarse-Grained (CG) simulations of several mutant protein structures in order to formulate a rational enzyme design method and also to develop a multi-scale model for membrane proteins having a strongly electron-correlated active site to understand their mechanism of function.

  Fifth, we will extend our present expertise on single molecule spectroscopy to understand the activity of DNA repair proteins during double strand DNA breaks to image biological phenomena at the molecular scale. Triplex DNA structures will be characterized for their activity in gene silencing and potential role in therapeutics. Our

skills and knowledge in biophysics will be utilized to develop an optical tweezer platform for detection of early drug resistance in difficult to treat cancers.

Last but not the least, we propose to diversify our skills in nanotechnology to plasmonic nanomaterials and explore their potential in anti-cancer nano-therapeutics. On one hand, Raman spectroscopy and imaging will characterize the mechanism of drug delivery to cancer cells, on the other, identification and quantification of specific trace-level of toxins in biological systems (solid as well as liquid) will be executed using Surface Enhanced Raman Scattering (SERS) technique. We have so far designed a single fuel cell with a power output of only 15W. We plan to modify and extend our present set up to establish fuel cells with power outputs of ~100W – a step towards the generation of "green" fuel cells.

Over the next 3-5 years we foresee making significant contributions to not only basic understanding of biological phenomena, we will also try to make advances in biocomputation, onco-diagnostics and "green" fuel cells.

- **Faculty members (with their research areas) retired since 2017**

Name of Faculty	**Date of Retirement**	**Broad Research Area**
Amitabha De	Oct 2017	Conducting polymers
Samita Basu	Jan 2019	Spectroscopy & dynamics of Biomolecules
Subrata Banerjee	Aug 2019	Cell Biology
Dhananjay Bhattacharyya	Jul 2020	Computational Biology
Munna Sarkar	Sep 2020	Biomolecular Spectroscopy
Susanta Lahiri	Jul 2021	Nuclear Chemistry, Radiochemistry
Abhijit Chakrabarti	Apr 2022	Biochemistry, Biophysics

- **Faculty members (with their research areas) recruited since 2017**

Name of Faculty	**Joining Date**	**Broad Research Area**
Subhendu Roy	Aug 2019	Computational Biophysics & Biochemistry
Subhabrata Majumder	Dec 2019	Structure & function of macromolecules (NMR)
Tofayel Ahmed	Sep 2022	Macromolecular Structure (Cryo-EM)

- **Number of seminars organized since 2017 : 56**
- **Number of conferences/workshops/schools organized since 2017 : 08**
- **Number of summer trainee (SINP / Academies) since 2017 : 101**
- **Number of undergraduate trainee (SINP / Academies) since 2017 : 09**
- **Number of outreach programs since 2017 : 57**
- **Number of invited talks given by Group members since 2017 : 218**

- **Instruments/facilities which the Group is planning to install/develop in next 3 to 5 years**

1. 800 MHz NMR spectrometer with TCI probe
2. Pulsed EPR Spectroscopy
3. Cryo-TEM with a 4k x 4k CMOS camera with Additional DED camera
4. LC-ESI-Orbitrap along with requisite softwares and accessories
5. 3D neural network stimulating and measuring in-vitro large scale electrical properties (3D NN SMiLE).
6. HD/HT MEA based electro-optical system
7. Bioreactors for stem cell culture3D bioprinting facilities.
8. FACS with imaging
9. Temperature and oxygen-controlled cell culture system
10. Digital droplet PCR system
11. Single Cell RNA Sequencer for patient sample analysis
12. DCS, MLAS, ITC
13. High-end High-Performance Computing (HPC) CPU+GPU cluster
14. Fast Protein Liquid Chromatography (FPLC)
15. SKY MIcroscope
16. Micromode Plate Reader
17. Epifluorescence Microscope
18. Microscale thermophoresis
19. Polarized Optical Tweezer
20. Fluorescence Cross-Correlation
21. Single Molecule Localization Microscope (SMLM)
22. Raman Imaging Instrument
23. Online GC-MS

- **Number of courses offered by the Group in teaching since 2017**

Basic courses

- Principles of Biochemistry
- Principles of Physical Chemistry
- Structural and Computational Biology
- Advanced Laboratory Practices

Advanced courses

- Macromolecular crystallography
- Chromatography and Mass spectrometry
- Spectroscopic techniques
- Imaging techniques
- Cell cycle regulation

- Mechanobiology
- Chromatin and epigenetics
- Intracellular trafficking
- Neuroscience
- Membrane biophysics and structural dynamics of membrane proteins
- Introduction to synthetic biology
- Drug discovery: modern day approach
- Nanomaterials

- **List of institutions collaborating with the Group**

IISER KOLKATA	CDFD Hyderabad
IIT BOMBAY	RRCAT indore
IIT KHARAGPUR	St Xaviers college, Kolkata
IPGMER SSKM Hospital, Kolkata	Ramakrishna Mission Vivekananda Educational and Research Institute
ISI, Kolkata	Karolinska Institute, Sweden
College of Medicine and Sagore Dutta Hospital, Kolkata	IISc Bangalore
BARC, Mumbai	IIT-IISM Dhanbad
TMH-ACTREC, Mumbai	NIT Rourkela
Gandhi Medical College, Secunderabad	CV Raman Institute, Odisha
IMS-BHU, Varanasi	National Agricultural and Biotechnology Institute, Chandigarh
Presidency University, Kolkata	IACS
ICMR-RMRCNE, Dibrugarh	IIT Kanpur
NRSMC&H	MISiS, Moscow, Russia
Institute of Neuroscience, Kolkata	Moscow State University
CSIR-IICB, Kolkata	IISER-TVM
Manipur University & RIMS, Imphal	IIT-Indore
Safdarjung Hospital, New Delhi	NISER, Bhubaneswar
Instituto Gulbenkian De Ciência, Portugal	SNBNCBS
King Abdullah University of Science and Technology, Saudi Arabia	Shiv Nadar University
Institute of Biochemistry II, Goethe University, Germany	Translational Health Science and Technology Institute
Assam University, Silchar	Bose Institute
The University of Texas MD Anderson Cancer Center, Houston	IISER-Pune
Texas Tech University Health Sciences Center El Paso, El Paso, Texas	NCBS, Bangalore
Texas A&M College of Medicine, Houston	R.G. Kar Medical College and Hospital
UNSW, Australia	ICMR-NICED
Dept. of Biochemistry, Calcutta University	

- **Main difficulties faced by the Group since 2017**

  - Procedural procrastination impacting procurement and maintenance
  - Space constraints – minimum per capita space allocated
  - Inadequate human resources – the group needs more scholars (RF/PDF) and technical support
  - Handling of extramural projects – requires more support staff for professional efficiency

- **List of extramural projects with PI's names since 2017 (Total 28)**

Faculty Name	Project Title	Funding Agency	Duration	Fund Rs, lakh	Manpower	Remarks
Oishee Chakrabarti	Understanding ERAD tuning and its regulation of ER-mitochondria interactions	SERB	Mar 2017-Mar 2020	45.35	NIL	PI
Oishee Chakrabarti	Molecular characterization of the mitochondria-associated membrane hubs and their role in neurodegeneration.	DBT	Mar 2019-Mar 2024	25.00	NIL	PI
Oishee Chakrabarti	Unravel the ER-mitochondria axis: crosstalk between UPRER and UPRmt.	SERB	Feb 2022-Feb 2025	47.08	NIL	PI
Kaushik Sengupta	Myopathic mutations in lamin A leads to altered transcriptome and epigenetic landscape	SERB	Jun 2016-Jun 2019	30.08	1	
Chandrima Das	Sensitizing the drug resistant triple negative breast cancer through Extracellular Matrix Remodelling by the epigenetic regulators	SERB	Jun 2023-Jun 2026	46.50	NIL	PI
Chandrima Das	Reprogramming of Host Epigenomic landscape during viral infection	SwarnaJayanti Fellowship, DST	Jun 2021-Jun 2024	225.39	Research Associate	PI
Chandrima Das	Prolyl isomerization as a novel mode to regulate chromatin function	Ramalingaswami Fellowship, DBT	Apr 2012-Jun 2017	32.50	Project Assistant	PI
Chandrima Das	A putative chromatin reader ZMYND8 and its role in neuronal differentiation	SERB	Jun 2015-Jun 2018	44.22	NIL	PI
Chandrima Das	Investigating the role of epigenetic reader TCF19 as a cellular glucose sensor in conjunction with p53	SERB	Apr 2019-Apr 2022	34.56	NIL	PI
Chandrima Das	Zinc Finger Transcription Factors as regulators of neuronal differentiation programs through epigenetic reprogramming	DBT	Apr 2019-Apr 2022	57.38	Research Associate	PI

Faculty Name	Project Title	Funding Agency	Duration	Fund Rs, lakh	Manpower	Remarks
Chandrima Das	Investigating the functional interplay between key transcription factor TCF7l2 and epigenetic regulator TCF19 to modulate metabolic gene expression programs during Endoplasmic Reticulum stress	S. Ramachandran - National Bioscience Award for Career Development, DBT	Mar 2020-Mar 2023	17.00	NIL	PI
Debashis Mukhopadhyay	Activity of keratinolytic bacteria from selected biotopes of Manipur on beta amyloid plaques	DBT-Twinning Project	2015-2019	19.63	NIL	Co-PI
Debashis Mukhopadhyay	Role of Oncogenic IncRNAs in Regulating Neurodegeneration and Possible link with X-chromosome	SERB	Feb 2022-Feb 2025	29.40	NIL	
Soumen Kanti Manna	Role of methylation in stress response	SERB	Apr 2016-Mar 2021	38.00	NIL	
Soumen Kanti Manna	Identification of non-invasive signatures for differential diagnosis of biopsy-proven diabetic nephropathy and non-diabetic kidney disease by metabolomics and peptidomics approach	Research Society for the Study of Diabetes in India	Apr 2018-Mar 2020	29.90	NIL	Co-PI
Soumen Kanti Manna	Evaluation of Lipidomic Signature in Prediction of Onset of Polycystic Ovarian Syndrome	WB-DST	2022-2025	24.30	NIL	Co-PI
Sangram Bagh	Multi-input and modular synthetic genetic classifier circuits in E.coli to classify multiple chemical signals and its potential application in programmed delivery of shRNAinto cancer cells based on cancer mimetic multi-parametric chemical signature"	SERB	Mar 2019-Mar 2022	45.83	NIL	PI
Sangram Bagh	CRISPY Brick for yeast synthetic metabolic engineering: A novel CRISPR/Cas9 based biobrick type system for systematic library construction of genetic parts, bidirectional assembly, integration of multiple heterologous genetic cassettes in yeast genome and easy optimization of heterologous gene expression	BIRAC	2020-2021	24.44	NIL	PI

Faculty Name	Project Title	Funding Agency	Duration	Fund Rs, lakh	Manpower	Remarks
Sangram Bagh	Genetic Logic Gate	DST- Ramanujan	2015-2020	35.00	NIL	PI
Subhabrata Majumder	Use of in-cell NMR as a viable technology for development of novel therapuetics	DBT/Wellcome Trust Early Career Fellowship	2020-2025	167.00	NIL	PI
Subhabrata Majumder	Scope and validity of high resolution NMR methods in assessing higher order structure of biotherapeutics	SRG-SERB	2021-2023	26.00	NIL	PI
Dulal Senapati	Research and Development of Stabilized Colloidal Metal Nanoparticle-Based Label-Free Nanoplasmon Biochip for Cost-Effective, Rapid, and Early Bioanalytical Detection	DBT	2014-17	70.00	2 PostDoc	PI
Dulal Senapati	Development of aptamer based selective localization of gold nanoparticles for early stage detection and future applications in therapeutic prevention of dengue infection	LSRB	2018-20	40.00	1 PostDoc	PI
Udayaditya Sen	“Structural and biological studies to understand the role of the second messenger c-di-GMP in regulating the transcription factors implicated in motility and biofilm formation in Vibrio cholerae”	SERB	2016-2020	50.00		Co-PI
Subhendu Roy	Multiscale Modeling of Complex Chemical and Biological Systems	DBT-Ramalingaswami	2019-2024	40.00	NIL	PI
H. Raghuraman	Structural dynamics of the voltage sensor during lipid-dependent gating in potassium channels	DST-SERB	2017-2019	31.51	NIL	PI
H. Raghuraman	Structural dynamics associated with magnesium transport across membranes	India Alliance DBT-Wellcome Intermediate Fellowship	2018-2023	359.48	1 Project Assistant	PI
Padmaja Prasad Mishra	A Single Molecule Approach to Explore the Mechanisms of Dealing with Replication Problems Induced by DNA Damage	SERB	2020-2023	85.66		PI

- **List of patents since 2017**

Prof. Kaushik Sengupta

A System for Carrying out Active Microrheology to Probe Viscoelasticity of Protein (Indian App. No. 202231030594)

System for Executing Nuclear Morphology based Analytics for Accurate Diagnosis / Prognosis of Cancer including Ovarian Cancer (Indian App. No. 202231061023)

Prof. Dulal Senapati (with Prof. Biswajit Karmakar of Group D)

A Highly Sensitive H_2 Sensor based on CVD Graphene (Indian App. No. 202331040958 dated June, 2023)

Prof. Oishee Chakrabarti (with Dr. Devashish Sengupta, Department of Chemistry, Assam University)

Amphiphilic cancer cell differentiation promoting Quinazolinone-C_{70} and apoptosis promoting Quinazolinone-C_{60} nanohybrids as new generation antineoplastic agents under photoactivated conditions" (Indian App. No. 202331048869, dated July 2023).