Bose Institute
Kolkata

(An autonomous research institute of Dept. of Science & Technology, Govt. of India)

Advertisement No. : BI/NET-JRF/01/2022-23

Admission for PhD Programme
Spring 2022

Acharya J.C. Bose, the founder of modern science in the Indian subcontinent, established Bose Institute in 1917. The Institute was set up as Asia's first interdisciplinary research centre and bears a century-old tradition of excellence in research.

The Institute desires to admit students for its Ph.D. programme twice a year, for sessions beginning tentatively in January and July. Interviews for this session will be held tentatively during the middle May, 2022, in the offline mode.

Areas of research: Atmospheric Sciences, Chemical Sciences, Life Sciences, Physical Sciences and Applied Biosciences.

- Candidates can apply simultaneously to a maximum of two positions as mentioned in **Annexure - I**.
- Candidates are required to provide a **Statement of Purpose** (SOP), in prescribed format, for **each of the positions** she/he applies for.

Fellowship: Admissible as per Govt. of India rules.

Reservation: Reservation quota as per the Government of India rules.

Eligibility for PhD Interview:

(1) Candidates should have an award of JRF (CSIR-UGC JRF/ DBT-JRF/ ICMR-JRF/ DST- INSPIRE/ DBT-BINC or equivalent), whose last date of validity should not be earlier than **30th September, 2022**. If candidates, who are in the final year of their Master's degree programme **and** are in possession of an award of a JRF, are selected, they will have to submit their final degree certificate at the time of joining.

(2) Master's degree or equivalent in any of the following fields: Engineering/ Science/ Technology with at least 55 % of marks for general candidates, while 50% marks is necessary for SC/ST/OBC (non-creamy layer)/ differently-abled and other categories of candidates, as per UGC norms.

(3) Age limit: Below 28 years as on 30th September 2022 (relaxation of age is applicable as per Government of India rules).

(4) DST-INSPIRE candidates can only be admitted provisionally. Confirmation of their admission to the PhD programme of Bose Institute is subject to the final award of INSPIRE fellowship by DST. If the candidate is not finally awarded the INSPIRE fellowship by DST, his/her provisional admission is liable to be cancelled by the Institute.

(5) Candidates who have qualified in GATE/ JEST/ JGEEBILS/ NET (LS) etc. but who do not have a valid award of JRF mentioned in (1) above or equivalent are **ineligible to apply**.

Application Process:

Interested candidates fulfilling required eligibility should apply online at the URL – http://www.jcbose.ac.in/applications/PHD-ADMISSION/

Deadline for online application: 6 PM of April 20th, 2022

An acknowledgement receipt will be generated following successful submission of the online application form. Candidates should retain this receipt for future reference. Candidates **must** produce this acknowledgement receipt if called for the interview. No candidate will be allowed to appear for the interview without this receipt.

For any difficulties pertaining to online application, please send email to:
bosephdadmission@gmail.com

Selection Process:

- Past academic record will be the basis for shortlisting of candidates for interview
- Names of the shortlisted candidates, along with the date and time of interview will be displayed on the Institute website
- It should be noted that mere appearance on the shortlist does not imply admission
- The interview will be conducted in offline mode. Barring pandemic-related exigencies, candidates will have to appear for the interview in person
- No TA/DA will be allowed for appearing for the interview
- Specific instructions regarding the interview will be communicated to the shortlisted candidates
- The medium of the interaction for the interviews is English
- Candidates qualifying in the interview will be called for counselling
- Following counselling, the final list of selected candidates will be displayed on the Institute website
- The Institute Authority reserves the right to reject any or all applications without assigning any reason thereof.

Important Dates:

- Last Date for online application: 18:00 hrs. April 20th, 2022
- Date for display of short-listed candidates and instructions on the Institute website: April 29th, 2022
- Tentative period of interview: Middle of May, 2022

Annexure – I

Areas of Research: Atmospheric Sciences

Project Code	Name of Faculty	Research Project	Desired Master's Background
AS01	Abhijit Chatterjee	**Title:** Air Quality and Land-Use Land-Cover Changes: Long-term Study over Himalaya **Description:** The major focus of the project is to address the connection between long-term changes of land-use land-cover over high altitude Himalayan regions and its effect on the anthropogenic emissions. The changes in anthropogenic emissions over the years could severely affect the air quality especially the chemical features of the lower atmosphere. The long-term changes in the air quality, in turn, affect the regional climate that bears immense importance for such ecologically fragile and climatically important parts of the world.	Atmospheric Science/ Environmental Science/ Geography (specialized on Geomorphology)
AS02	Sanat Kumar Das	**Title:** Study on Fog-induced changes of Aerosol properties and its impact on Fog Forecasting **Description:** This research work is a part of the project funded by CSIR, Govt. of India. The work is on improvement of fog forecast system, which is important for navigation, agriculture, human health etc., and thereby plays a significant role in national economy. Forecast of fog is a big challenge for atmospheric scientists as it is very difficult to reduce the uncertainty present in the output of forecast models. The uncertainty comes from lack of on-field observational data of alteration of hygroscopic properties of aerosols during foggy period. This research work includes not only challenging field experiments to obtain time-series of aerosol optical and physical properties, but also run the atmospheric models. Therefore, the work is very	Atmospheric Science/ Environmental Science

		demanding and includes fieldwork. The student should have a good understanding of basic physics and knowledge of basic programing languages. The selected student will participate in on-field group work to collect atmospheric observational data from in-situ experiments using monochromatic lasers, carry out lab-based measurements using modern sophisticated instruments and perform data analysis and simulation work for pursuing PhD.	

Areas of Research: Chemical Sciences

Project Code	Name of Faculty	Research Project	Desired Master's Background
CS01	Achintya Singha	**Title:** Surface-Enhanced Raman Scattering (SERS) based biosensor **Description:** Surface-Enhanced Raman Scattering (SERS) combines molecular fingerprint specificity with singlemolecule detection, which is the ultimate sensitivity required in chemical analysis, trace detection and bio -sensing. The present work aims to develop TMDc-plasmon hybrid structures to detect and study single molecule using the SERS technique.	Chemistry
CS02	Ajit Bikram Datta	**Title:** Understanding the molecular basis for the E2 specificity of the non-canonical ubiquitin E1, Uba6 **Description:** All higher vertebrates, unlike lower organisms such as yeast, code for two ubiquitin activating enzymes, referred as Uba1 and Uba6. Out of these two, Uba6 was discovered and characterized about a decade ago and is referred as the non-canonical E1. Uba6 is also unique amongst all UbL activating E1 enzymes due to the fact that it can activate two UbLs,	Chemistry

		Ubiquitin and FAT10. This non-canonical E1 transfers the activated ubiquitin to only a subset of E2s, some of which, but not all, are also capable of accepting ubiquitn from Uba1. Interestingly, though the C-terminal Ufd domain of E1s is thought to impart their E2 specificity, swapping of the Ufd domain of Uba1 with that of Uba6 does not make Uba1 to transfer ubiquitin to Ube2Z, an Uba6 specific E2. This observation emphasized that other E1 domains apart from the Ufd also takes part in E2 recognition. To understand the basis of this, we aim to determine the atomic resolution structure of Uba6 employing either crystallography or single-particle cryo-EM. This structural studies shall be extended further with biochemical assays, biophysical experiments and protein chemistry, We further aim to understand the biological implications of the mutations in cultured cell lines.	
CS03	Ajit Bikram Datta	**Title:** Understanding the residues that regulate the activity of Ubiquitin conjugating E2 enzymes upon "back-binding" of the allosteric ubiquitin **Description:** Ubiquitin conjugating E2s share a common UBC fold domain that harbors the catalytic cysteine residue. Many of the E2s also harbor a second ubiquitin binding site distal to the active site that is referred as the "back-binding site". It has been demonstrated that for a subset of E2s binding of this second ubiquitin molecule distal to the catalytic cysteine significantly enhances their catalytic efficiency though the precise molecular events behind this phenomenon is yet to be understood. We have serendipitously stumbled upon a few E2 residues that play an important role in determining the catalytic activity of an E2, most likely via the back-binding though many of these residues are away from either the catalytic or the or the backbinding site. This project shall involve biochemical studies on pinpointing the exact roles of these residues.	Chemistry

CS04	Shubhra Ghosh Dastidar	**Title:** Obtaining mechanistic insights into the allosteric regulations in Kinases and making therapeutic applications **Description:** Kinases are often activated allosterically by the induction of other. Our recent investigations have observed that such mechanism allostery is highly customized for a specific kinase domain, in spite of their structural homology across kinase families. It is hypothesized that the natural design in the primary sequence level possibly codes this mutual compatibility of the kinase domain and activator to participate in a particular mechanism of activation, which needs to be investigated further and proven. This could also be exploited to design kinase-specific allosteric inhibitor(s) that would have only minimal side effects as therapeutic drugs. The project would explore these possibilities using computational methods.	Chemistry
CS05	Shubhra Ghosh Dastidar	**Title:** Understanding the mechanism of Tubulin-microtubule allosteric inter-conversion for therapeutic applications **Description:** The α,β-tubulin dimers are in dynamic equilibrium with their superstructures, called microtubules, which grow further to form spindles at the time of mitotic cell divisions. Some ligands are capable to induce a subtle change in the global conformation of the dimer which leads to population shift in the desired direction, either to favor the spindle's stability or to disfavor it, both of which would slow down the normal cell cycle. Taking this advantage, many diseases could be treated, as some molecules as drugs are already in practice or in trial. But such applications are yet to be based on the actual understanding of the molecular mechanism of the allosteric regulation by the ligands that could have predicted that how exactly it could be tuned further by modifying the ligands suitably. The project would explore this area for fundamental	Chemistry

		understanding and also to pave the way for more accurate therapeutic applications.	
CS06	Suman Kumar Banik	**Title:** Information transmission in biochemical network **Description:** In the course of its lifetime a living system experiences several extra- and intra-cellular signals. One of the important functions of the living system is to process these signals. Our group focuses on the development of mathematical and computational methods of signal transduction in model gene regulatory networks within the purview of classical information theory. We employ both chemical kinetic approaches and nonequilibrium statistical methodologies to quantitate different statistical measures, e.g., transfer entropy, mutual information, signal-to-noise ratio, etc.	Chemistry

Areas of Research: Life Sciences

Project Code	Name of Faculty	Research Project	Desired Master's Background
LS01	Ajit Bikram Datta	**Title:** Understanding the molecular basis for the E2 specificity of the non-canonical ubiquitin E1, Uba6 **Description:** All higher vertebrates, unlike lower organisms such as yeast, code for two ubiquitin activating enzymes, referred as Uba1 and Uba6. Out of these two, Uba6 was discovered and characterized about a decade ago and is referred as the non-canonical E1. Uba6 is also unique amongst all UbL activating E1 enzymes due to the fact that it can activate two UbLs, Ubiquitin and FAT10. This non-canonical E1 transfers the activated ubiquitin to only a subset of E2s, some of which, but not all, are also capable of accepting ubiquitn from Uba1. Interestingly, though the C-terminal Ufd domain of E1s is thought to impart their E2 specificity,	Microbiology

		swapping of the Ufd domain of Uba1 with that of Uba6 does not make Uba1 to transfer ubiquitin to Ube2Z, an Uba6 specific E2. This observation emphasized that other E1 domains apart from the Ufd also takes part in E2 recognition. To understand the basis of this, we aim to determine the atomic resolution structure of Uba6 employing either crystallography or single-particle cryo-EM. This structural studies shall be extended further with biochemical assays, biophysical experiments and protein chemistry, We further aim to understand the biological implications of the mutations in cultured cell lines.	
LS02	Ajit Bikram Datta	**Title:** Understanding the residues that regulate the activity of Ubiquitin conjugating E2 enzymes upon "back-binding" of the allosteric ubiquitin **Description:** Ubiquitin conjugating E2s share a common UBC fold domain that harbors the catalytic cysteine residue. Many of the E2s also harbor a second ubiquitin binding site distal to the active site that is referred as the "back-binding site". It has been demonstrated that for a subset of E2s binding of this second ubiquitin molecule distal to the catalytic cysteine significantly enhances their catalytic efficiency though the precise molecular events behind this phenomenon is yet to be understood. We have serendipitously stumbled upon a few E2 residues that play an important role in determining the catalytic activity of an E2, most likely via the back-binding though many of these residues are away from either the catalytic or the or the backbinding site. This project shall involve biochemical studies on pinpointing the exact roles of these residues.	Microbiology
LS03	Sanat Kumar Das	**Title:** Investigation of Atmospheric microbial loading over Indian Subcontinent **Description:** This research work is a part of the project approved by SERB, Govt. of India that comprises of several campaigns over Indian Subcontinent, and	Microbiology/ Zoology

		oceanic regions. There are varieties of continental air-borne microbiomes transported from the mainland of India to its surrounding oceanic regions. This project is to identify the different types of air-borne microbiomes and the reason behind their presence and survival in the marine environment using different types of on-board in-situ experiments. The objective is to find their role in cloud formation processes. The student should have a basic understanding of microbiology. Additional knowledge in basic meteorology is preferable. The selected student should be able to work in a group for on-board ship experiments, carry out lab-based measurements using modern sophisticated instruments and perform data analysis and simulation work for pursuing PhD.	
LS04	Soumen Roy	**Title:** Microbial Systems Biology **Description:** Recently published and ongoing projects from our lab are in the areas of: (1) phage-bacteria interaction and dynamics, and, (2) antimicrobial resistance. Our research here is strongly guided by theoretical (rigorous mathematical and computational) investigations which can be validated by experimental studies conducted in our own lab and/or that of collaborators. Theoretical approaches include but are not limited to network science, game theory, nonlinear dynamics, statistical physics, and information theory. If they wish, selected candidates are welcome to pursue this project in conjunction with other lab project/s of their choice.	Microbiology/ Zoology/ Botany
LS05	Soumen Roy	**Title:** Systems Biology of Macromolecular Interactions **Description:** Macromolecular interactions define molecular recognition and cell signaling. Recently published and ongoing projects from our lab are in the areas of amino acid residue interaction networks, protein-protein interaction networks, protein-nucleic acid complexes as well as protein-small molecule	Microbiology/ Zoology/ Botany

		interactions. We strongly focus on the theoretical (rigorous mathematical methods and computational) aspects of intra-macromolecular and inter-macromolecular interactions. Validation of our theoretical predictions can be carried out through our experimental collaborators as well as our in-house setup. If they wish, selected candidates are welcome to pursue this project in conjunction with other lab project/s of their choice.	

Areas of Research: Applied Biosciences

Project Code	Name of Faculty	Research Project	Desired Master's Background
AB01	Ajit Bikram Datta	**Title:** Understanding the molecular basis for the E2 specificity of the non-canonical ubiquitin E1, Uba6 **Description:** All higher vertebrates, unlike lower organisms such as yeast, code for two ubiquitin activating enzymes, referred as Uba1 and Uba6. Out of these two, Uba6 was discovered and characterized about a decade ago and is referred as the non-canonical E1. Uba6 is also unique amongst all UbL activating E1 enzymes due to the fact that it can activate two UbLs, Ubiquitin and FAT10. This non-canonical E1 transfers the activated ubiquitin to only a subset of E2s, some of which, but not all, are also capable of accepting ubiquitn from Uba1. Interestingly, though the C-terminal Ufd domain of E1s is thought to impart their E2 specificity, swapping of the Ufd domain of Uba1 with that of Uba6 does not make Uba1 to transfer ubiquitin to Ube2Z, an Uba6 specific E2. This observation emphasized that other E1 domains apart from the Ufd also takes part in E2 recognition. To understand the basis of this, we aim to determine the atomic resolution structure of Uba6 employing either crystallography or single-particle cryo-EM. This structural studies shall be extended further with biochemical assays, biophysical experiments and protein chemistry, We further	Biotechnology/ Biochemistry/ Biophysics

		aim to understand the biological implications of the mutations in cultured cell lines.	
AB02	Ajit Bikram Datta	**Title:** Understanding the residues that regulate the activity of Ubiquitin conjugating E2 enzymes upon "back-binding" of the allosteric ubiquitin **Description:** Ubiquitin conjugating E2s share a common UBC fold domain that harbors the catalytic cysteine residue. Many of the E2s also harbor a second ubiquitin binding site distal to the active site that is referred as the "back-binding site". It has been demonstrated that for a subset of E2s binding of this second ubiquitin molecule distal to the catalytic cysteine significantly enhances their catalytic efficiency though the precise molecular events behind this phenomenon is yet to be understood. We have serendipitously stumbled upon a few E2 residues that play an important role in determining the catalytic activity of an E2, most likely via the back-binding though many of these residues are away from either the catalytic or the or the backbinding site. This project shall involve biochemical studies on pinpointing the exact roles of these residues.	Biotechnology/ Biochemistry/ Biophysics
AB03	Shubhra Ghosh Dastidar	**Title:** Obtaining mechanistic insights into the allosteric regulations in Kinases and making therapeutic applications **Description:** Kinases are often activated allosterically by the induction of other. Our recent investigations have observed that such mechanism allostery is highly customized for a specific kinase domain, in spite of their structural homology across kinase families. It is hypothesized that the natural design in the primary sequence level possibly codes this mutual compatibility of the kinase domain and activator to participate in a particular mechanism of activation, which needs to be investigated further and proven. This could also be exploited to design kinase-specific allosteric inhibitor(s)	Biotechnology/ Biochemistry/ Biophysics

		that would have only minimal side effects as therapeutic drugs. The project would explore these possibilities using computational methods.	
AB04	Shubhra Ghosh Dastidar	**Title:** Understanding the mechanism of Tubulin-microtubule allosteric inter-conversion for therapeutic applications **Description:** The α,β-tubulin dimers are in dynamic equilibrium with their superstructures, called microtubules, which grow further to form spindles at the time of mitotic cell divisions. Some ligands are capable to induce a subtle change in the global conformation of the dimer which leads to population shift in the desired direction, either to favor the spindle's stability or to disfavor it, both of which would slow down the normal cell cycle. Taking this advantage, many diseases could be treated, as some molecules as drugs are already in practice or in trial. But such applications are yet to be based on the actual understanding of the molecular mechanism of the allosteric regulation by the ligands that could have predicted that how exactly it could be tuned further by modifying the ligands suitably. The project would explore this area for fundamental understanding and also to pave the way for more accurate therapeutic applications.	Biotechnology/ Biochemistry/ Biophysics
AB05	Soumen Roy	**Title:** Microbial Systems Biology **Description:** Recently published and ongoing projects from our lab are in the areas of: (1) phage-bacteria interaction and dynamics, and, (2) antimicrobial resistance. Our research here is strongly guided by theoretical (rigorous mathematical and computational) investigations which can be validated by experimental studies conducted in our own lab and/or that of collaborators. Theoretical approaches include but are not limited to network science, game theory, nonlinear dynamics, statistical physics, and information theory. If they wish, selected candidates are welcome to pursue	Biotechnology/ Biochemistry/ Biophysics

		this project in conjunction with other lab project/s of their choice.	
AB06	Soumen Roy	**Title:** Systems Biology of Macromolecular Interactions **Description:** Macromolecular interactions define molecular recognition and cell signaling. Recently published and ongoing projects from our lab are in the areas of amino acid residue interaction networks, protein-protein interaction networks, protein-nucleic acid complexes as well as protein-small molecule interactions. We strongly focus on the theoretical (rigorous mathematical methods and computational) aspects of intra-macromolecular and inter-macromolecular interactions. Validation of our theoretical predictions can be carried out through our experimental collaborators as well as our in-house setup. If they wish, selected candidates are welcome to pursue this project in conjunction with other lab project/s of their choice.	Biotechnology/ Biochemistry/ Biophysics
AB07	Suman Kumar Banik	**Title:** Information transmission in biochemical network **Description:** In the course of its lifetime a living system experiences several extra- and intra-cellular signals. One of the important functions of the living system is to process these signals. Our group focuses on the development of mathematical and computational methods of signal transduction in model gene regulatory networks within the purview of classical information theory. We employ both chemical kinetic approaches and nonequilibrium statistical methodologies to quantitate different statistical measures, e.g., transfer entropy, mutual information, signal-to-noise ratio, etc.	Biophysics
AB08	Zhumur Ghosh	**Title:** Understanding the role of noncoding RNAs in axonal degeneration **Description: Axonal degeneration** is the destruction of axons which can occur as an effect of **sudden** Traumatic	Bioinformatics/ Computer Science/ Information Technology/

		Brain injury (TBI) as in the case of Diffuse axonal injury (DAI) or can occur **gradually** at the early stages of neurodegenerative conditions like Alzheimer's disease(AD), Amyotrophic lateral sclerosis(ALS), and Parkinson's disease(PD). Despite differences in the rate of degeneration, axon loss in neurodegenerative diseases like AD or ALS share many morphological features with those in acute injuries like DAI. Long noncoding RNAs (lncRNAs) are a group of novel noncoding RNAs which has a profound role in neuronal development and disorders. In this problem, we shall specifically focus on the cases of DAI for sudden axonal degeneration and AD and ALS for gradual axonal degeneration and shall probe into the role of microglia shared common gene regulatory circuits orchestrated by lncRNAs in both the cases of sudden and gradual axonal degeneration. We shall employ computational integrated with machine learning approach to solve the problem.	Related Disciplines

Areas of Research: Physical Sciences

Project Code	Name of Faculty	Research Project	Desired Master's Background
PS01	Achintya Singha	**Title:** Raman and photoluminescence spectroscopy of 2D semiconductor nanostructures at extreme conditions **Description:** Understanding structural, vibrational and electronic properties of 2D semiconductor nanostructures using high pressure, low temperature Raman and optical spectroscopy	Physics
PS02	Achintya Singha	**Title:** Surface-Enhanced Raman Scattering (SERS) based biosensor	Physics

		Description: Surface-Enhanced Raman Scattering (SERS) combines molecular fingerprint specificity with singlemolecule detection, which is the ultimate sensitivity required in chemical analysis, trace detection and bio -sensing. The present work aims to develop TMDc-plasmon hybrid structures to detect and study single molecule using the SERS technique.	
PS03	Dhruba Gupta	**Title:** Breakup of the ^{7}Be nucleus in the context of nuclear astrophysics **Description:** Breakup reactions involving loosely bound nuclei are extensively used to study nuclear reactions and astrophysics. While stable nuclei having prominent cluster structures have been studied a lot, breakup studies of the radioactive nuclei have been very difficult due to the low beam intensities. The breakup nuclear reaction leads to a minimum three body final state with a broad continuum in the energy spectra. The reaction may occur as a direct breakup, or a sequential breakup through resonance states in the breakup continuum of the nuclei. Both Coulomb and nuclear forces can contribute to the breakup processes. Coulomb breakup reactions with a heavy target like ^{208}Pb, are often used to derive information on the time reversed, astrophysically relevant, radiative capture reactions, whose direct measurements are almost impossible due to extremely low yield. We plan to study both the direct and sequential breakup of ^{7}Be with ^{208}Pb, over a wide angular range. The relative contribution of the direct and sequential breakup would throw light on the reaction dynamics as we move from stable to unstable nuclei. The breakup fragments detected at very forward angles would help in deriving astrophysical information in the context of the radiative capture reaction ^{3}He + ^{4}He → ^{7}Be + γ. Monte Carlo simulations of proposed experiments would be carried out using the NPTool package, based on CERN Root and Geant4 framework.	Physics

		The successful candidate will be involved in all aspects of experiments namely, simulations, experimental design and setup, data analysis, and publication of scientific results. The candidate will also participate in other research endeavors of the group. We offer the opportunity to work in a stimulating environment on cutting edge research. The PhD work may involve experimental activity in leading international research facilities like HIE-ISOLDE at CERN.	
PS04	Dhruba Gupta	**Title:** Breakup of the ^{9}Li nucleus in the context of nuclear astrophysics **Description:** Considerable attention has been paid to the possibility that the early universe might have been rather inhomogeneous, consisting of high density proton rich regions along with low-density regions, which were comparatively neutron-rich. This was the natural consequence of neutron's longer mean free path, for which it could diffuse out of the high-density zones. Although D, ^{3}He and ^{4}He are produced in the observed relative abundances, there may also be non-negligible production of A >12 isotopes. It is difficult to evaluate the merits of inhomogeneous nucleosynthesis versus standard big-bang nucleosynthesis, because the rates of several important reactions are either not measured or not well established. For example, only few reactions involving ^{8}Li have been measured and thus any conclusions regarding A>6 nucleosynthesis must be regarded as tentative. Previous attempts to study the neutron capture ^{8}Li(n, γ)^{9}Li reaction were mostly through (d,p) reaction with only a couple of experiments where direct (n, γ) was studied through Coulomb breakup. The main constraint in the previous measurements was low beam intensity and the difficulty to separate Coulomb and nuclear breakup contributions. In the proposed experiment we plan to separate these two contributions using low beam energy of 7 MeV/A and take advantage of higher ^{9}Li beam intensity offered by HIE-ISOLDE at CERN. We plan to use the scattering	Physics

		chamber and SAND array at the third beamline of HIE-ISOLDE. The successful candidate will be involved in all aspects of experiments namely, simulations, experimental design and setup, data analysis, and publication of scientific results. The candidate will also participate in other research endeavors of the group. We offer the opportunity to work in a stimulating environment on cutting edge research. The PhD work may involve experimental activity in leading international research facilities like HIE-ISOLDE at CERN.	
PS05	Saikat Biswas	**Title:** Research and development of Gas Electron Multiplier detector for the high-rate heavy ion experiment **Description:** Micro Pattern Gaseous Detector (MPGD) is one of the best choices for the ongoing and upcoming high rate heavy-ion experiments because of its good rate handling capability and spatial resolution. The Gas Electron Multiplier (GEM) detector is one of the most advanced members of the MPGD group. The proposed project aims at the detailed investigation of the GEM detector which will include the understanding of the behaviour of the chamber under high irradiation (~ 10 MHz/cm2), the effect of the geometry of the chamber on its erformance under high irradiation and also Monte Carlo based simulation studies to give an insight on the possible modification in the detector technology to improve its performance for the high rate heavy-ion experiments (e.g. FAIR in Germany). The work will consist of hardware activities and the development of a simulation framework for the GEM detector. As a part of a large collaboration, the student needs to collaborate in several experiments in India as well as abroad.	Physics/ Electronics
PS06	Saikat Biswas	**Title:** Research and development of Resistive Plate Chamber for the high-rate heavy ion experiment	Physics/ Electronics

		Description: The Resistive Plate Chambers (RPC) are widely used in High Energy Physics (HEP) Experiments for timing and tracking purposes. With the ever-increasing requirement of high luminosity in heavy-ion experiments (e.g. FAIR in Germany, CERN at Switzerland), detectors with good rate handling capability are needed. The goal of the proposed project is to address the issues like limited rate handling (~ 10 kHz/cm2) capability of the RPC detector, effect of electrode materials on the rate handling capability of the detector, effect of gas mixtures and treatment of the electrodes (e.g. oil coating) on the performance of the chamber at higher rates. The work will consist of hardware and imulation of the RPC detector. As a part of a large collaboration, the student needs to participate actively in several experiments in India as well as abroad.	
PS07	Saikat Biswas	**Title:** Research on gaseous detectors for imaging **Description:** Several R&D on the societal application of the gas-filled detectors, developed for the High Energy Physics (HEP) experiments are ongoing across the globe. The proposed work is aimed to understand the possibility and applicability of gas-filled detectors such as Resistive Plate Chamber (RPC), Gas Electron Multiplier (GEM) etc as an imaging device. The work will require a dedicated involvement for the hardware activities and in the development of the software framework. The R&D on the proposed project can be carried out at the operational detector laboratory at Bose Institute. The selected student will work mostly in the laboratory.	Physics/ Electronics
PS08	Sanat Kumar Das	**Title:** Carbonaceous aerosols and their radiative warming effect on Himalayan glacier melting **Description:** Our nation is going to face severe drinking water crisis in future due to day-by-day reduction in	Physics

		input water of glacier-fed rivers. However, at present there is no known solution for this problem. This project is for a student who is ready to accept this challenge to find out a plausible solution. My earlier research work discovered various types of carbonaceous aerosols present in the atmosphere. This research project is to quantify these various types of carbonaceous aerosols and simulate their radiative effect that warms up the atmosphere over the Himalayas. However, the most challenging part of this work is to identify the dominating type of carbonaceous aerosols responsible for the Himalayan glacier melting and find out the possible solution to remove them from the atmosphere. The selected student should have an understanding of basic physics and knowledge of basic programing languages. The student should be able to work in-group to take atmospheric observations using modern sophisticated instruments over the Himalayas and perform data analysis and simulation works for pursuing PhD.	
PS09	Shubhra Ghosh Dastidar	**Title:** Obtaining mechanistic insights into the allosteric regulations in Kinases and making therapeutic applications **Description:** Kinases are often activated allosterically by the induction of other. Our recent investigations have observed that such mechanism allostery is highly customized for a specific kinase domain, in spite of their structural homology across kinase families. It is hypothesized that the natural design in the primary sequence level possibly codes this mutual compatibility of the kinase domain and activator to participate in a particular mechanism of activation, which needs to be investigated further and proven. This could also be exploited to design kinase-specific allosteric inhibitor(s) that would have only minimal side effects as therapeutic drugs. The project would explore these possibilities using computational methods.	Physics/ Computer Science/ Computer Application

PS10	Shubhra Ghosh Dastidar	**Title:** Understanding the mechanism of Tubulin-microtubule allosteric inter-conversion for therapeutic applications **Description:** The α,β-tubulin dimers are in dynamic equilibrium with their superstructures, called microtubules, which grow further to form spindles at the time of mitotic cell divisions. Some ligands are capable to induce a subtle change in the global conformation of the dimer which leads to population shift in the desired direction, either to favor the spindle's stability or to disfavor it, both of which would slow down the normal cell cycle. Taking this advantage, many diseases could be treated, as some molecules as drugs are already in practice or in trial. But such applications are yet to be based on the actual understanding of the molecular mechanism of the allosteric regulation by the ligands that could have predicted that how exactly it could be tuned further by modifying the ligands suitably. The project would explore this area for fundamental understanding and also to pave the way for more accurate therapeutic applications.	Physics/ Computer Science/ Computer Application
PS11	Sidharth Kumar Prasad	**Title:** Understanding the dynamics of small collision systems **Description:** One of the main goals of the relativistic nucleus-nucleus (A-A) collisions is to produce and characterize a system of strongly interacting deconfined quarks and gluons known as Quark Gluon Plasma (QGP). Proton-proton (p-p) and proton-nucleus (p-A) collisions at same centre of mass energies are performed to provide a baseline measurements for making final conclusions about the QGP formation in A-A collisions. Conventionally formation of QGP is not expected in p-p and p-A collisions due to small achieved energy densities in these collisions. However, in recent experimental measurements, some of the observables in high multiplicity events for these collision systems are found to resemble features similar to that in A-A	Physics

		collisions hinting towards the possible formation of medium in these collisions. Some of the other observables related to the phenomena of jet quenching (one of the most important signatures of QGP) in contrary, do not show the effect of presence of medium in these collisions. Whether the QGP like effect seen in small collision systems is really a final state effect due to QGP formation or it is a manifestation of some initial state effects or both is not yet conclusive. As a part of this research project we plan to investigate and study the particle production mechanism in small collision systems (p- p and p-A) at LHC energies by the measurements of hard probes and distributions of multiplicity, transverse momentum and energy of the produced particles in these collisions.	
PS12	Sidharth Kumar Prasad	**Title:** Study of relativistic nuclear collisions using photons **Description:** At the Large Hadron Collider (LHC) at CERN two beams of heavy ions are made to collide at relativistic energies. A new form of matter of free quarks and gluons known as Quark-Gluon-Plasma (QGP) is produced in these collisions. One of the main goals of experiments at LHC is to study and characterize the properties of the produced matter. Both in theoretical and experimental fronts there are various observables that are defined using the properties of the produced particles in these collisions and used to characterize the QGP. As a part of this research project we plan to explore and study the QGP properties using produced photons at high transverse momentum.	Physics
PS13	Sidharth Kumar Prasad	**Title:** Study of relativistic nuclear collisions using hard probes **Description:** At the Large Hadron Collider (LHC) at CERN two beams of heavy ions are made to collide at relativistic energies. A new form of matter of free quarks and gluons known as Quark-Gluon-Plasma	Physics

		(QGP) is produced in these collisions. One of the main goals of experiments at LHC is to study and characterize the properties of the produced matter. Both in theoretical and experimental fronts there are various observables that are defined using the properties of the produced particles in these collisions and used to characterize the QGP. As a part of this research project we plan to explore and study the QGP properties using particles that are produced in the initial stage of collisions with large transvers momentum (hard probes/jets).	
PS14	Soumen Roy	**Title:** Quantum Entanglement and Quantum Information **Description:** Quantum entanglement reexamines the concept of locality and reality in quantum mechanics. It allows non-local connections between two or more distant objects. This enables us to explore several useful information processing protocols such as quantum teleportation, quantum cryptography, quantum dense coding, etc. On the other hand, quantum information helps us in exploiting the principles of quantum mechanics in information processing. The study of quantum information is necessary for quantum computation and also in quantum communication. Though quantum entanglement can be implemented in various quantum algorithms, the effect of quantum entanglement in quantum information needs further scrutiny. We intend to study various problems in both quantum entanglement and quantum information separately and possibly in conjunction. Another aim is to study how entanglement influences the flow of information between quantum states towards the secure establishment of long-range quantum communication. If they wish, selected candidates are welcome to pursue this project in conjunction with any other lab project/s of their choice.	Physics/ Electronics/ Computer science/ Mathematics/ Engineering
PS15	Soumen Roy	**Title:** Interdisciplinary Statistical Physics: Games, Networks, Economies, and, Living Systems	Physics/

		Description: The interdisciplinary potential of statistical physics was foreseen over a century ago by Ludwig Boltzmann. Today, statistical physics is widely regarded as one of the most interdisciplinary areas in modern science. The following is a brief summary of recently published and ongoing projects in our lab. We remain perennially interested in finding new measures to investigate the structure, function, and dynamics of complex networks as well as their diverse innovative applications, e.g. information retrieval and image processing, noninvasive diagnostics, evolutionary landscapes, optogenetics, mutagenesis, and, phage resistance. Of late, we have scrutinised the effect of topology in various game theory problems on networks. A range of phenomena in life sciences ranging from the level of individual proteins to microbial organisms are studied in the lab – both theoretical and/or experimentally. More recent interests include the physics of wealth distributions. If they wish, selected candidates are welcome to pursue this project in conjunction with other lab project/s of their choice.	Mathematics/ Statics/ Engineering/ Computer science
PS16	Soumen Roy	**Title:** Microbial Systems Biology **Description:** Recently published and ongoing projects from our lab are in the areas of: (1) phage-bacteria interaction and dynamics, and, (2) antimicrobial resistance. Our research here is strongly guided by theoretical (rigorous mathematical and computational) investigations which can be validated by experimental studies conducted in our own lab and/or that of collaborators. Theoretical approaches include but are not limited to network science, game theory, nonlinear dynamics, statistical physics, and information theory. If they wish, selected candidates are welcome to pursue this project in conjunction with other lab project/s of their choice.	Physics/ Mathematics/ Statistics/ Engineering
PS17	Soumen Roy	**Title:** Systems Biology of Macromolecular Interactions	Physics/ Mathematics/

		Description: Macromolecular interactions define molecular recognition and cell signaling. Recently published and ongoing projects from our lab are in the areas of amino acid residue interaction networks, protein-protein interaction networks, protein-nucleic acid complexes as well as protein-small molecule interactions. We strongly focus on the theoretical (rigorous mathematical methods and computational) aspects of intra-macromolecular and inter-macromolecular interactions. Validation of our theoretical predictions can be carried out through our experimental collaborators as well as our in-house setup. If they wish, selected candidates are welcome to pursue this project in conjunction with other lab project/s of their choice.	Statistics/ Engineering
PS18	Suman Kumar Banik	**Title:** Information transmission in biochemical network **Description:** In the course of its lifetime a living system experiences several extra- and intra-cellular signals. One of the important functions of the living system is to process these signals. Our group focuses on the development of mathematical and computational methods of signal transduction in model gene regulatory networks within the purview of classical information theory. We employ both chemical kinetic approaches and nonequilibrium statistical methodologies to quantitate different statistical measures, e.g., transfer entropy, mutual information, signal-to-noise ratio, etc.	Physics