Saqlain Afroz

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Education

Indian Institute of Science Education and Research Kolkata *December 2020 – May 2025*
BS-MS Dual Degree in Physical Sciences (Ongoing)

- GPA: 8.0/10.0
- **Coursework:** Classical Mechanics, Quantum Mechanics, Statistical Mechanics, Astrophysics, General Theory of Relativity and Cosmology, Fluid and Magnetohydrodynamics, Condensed Matter Physics, Waves and Optics, Electromagnetism, Computational Physics, Quantum Field Theory, Non-Linear Dynamics, Thermal Physics, Mathematical Methods for Physicists, Real Analysis, Statistics and Probability, Topology, Linear Algebra

Inter-University Center for Astronomy and Astrophysics, Pune *August 2024 – April 2025*
Master's Thesis (Ongoing)

- **Supervisor:** Dr. Apratim Ganguly
- Deep Learning Based Search and Parameter Estimation of Gravitationally Lensed Gravitational Waves
  We used the Normalizing Flows model to make a neural network that estimates the parameters of gravitationally lensed gravitational waves. We are also exploring the same task with the Bayesian Neural Network. We are also working with Physics Informed Neural Network to model various lensing scenarios. I have attached my presentation below.
- Presentation: Report:

Skills

Programming Languages: Python, CUDA, Julia, Matlab, Arduino, C++, C, Linux, LaTeX, JavaScript, NextJS

High Performance Computing: HTCondor, SLURM, PBS, OpenMP, MPI

Deep Learning & Machine Learning: PyTorch, Tensorflow, CNNs, RNNs, LSTMs, SVMs, Transformers, Autoencoders, Physics Informed Neural Network, Decision Trees, K-means, k-NN, Random Forests

Statistical Techniques: Bayesian Inference, Maximum Likelihood Estimation, Hypothesis Testing, Markov Chain Monte Carlo (MCMC), Regression Analysis, Time Series Analysis

Software Tools & Frameworks: Git, Matlab, Colab, Bilby, Dingo, Qiskit, NumPy, SciPy etc

Spoken Languages: English, Hindi, Assamese

Research Experiences

Calculating Quasi Normal Modes of Black Holes Using Physics Innformed Neural Networks

February 2025 - Ongoing

Guide: Prof. Ajit Kembhavi, Dr. Ninan Sajeeth Philip, Dr. Dawood Kothawala

- I am developing a code that will help us calculate Quasi Normal Modes of Black Holes Using Physics-Informed Neural Networks, in alternate theories of gravity.
- Tools used: Pytorch

Gravitational Waves Data Analysis

December 2021 - March 2022

Guide: Dr. Rajesh Kumble Nayak

- Learned how to access LIGO data, generate waveforms in the time domain and frequency domain, perform Q-transform, and the physics of coalescence of BBH or BNS.
- Tools Used: Python, GWpy, PyCBC, Astropy, GWOSC.

Numerical Relativity

August 2024 - December 2024

Guide: Prof. Rajesh Kumble Nayak

- Studying 3 + 1 decomposition of Einstein's Field Equations.

Quantum Computation

December 2022 - August 2023

Guide: Prof. Prasanta K. Panigrahi

- Quantum Simulation of Hawking Radiation Using VQE Algorithm on IBM Quantum Computer.
- Tools Used: Qiskit, Python, Colab

Klein's paradox in Graphene P-N Junction

January 2023 - April 2023

Guide: Prof. Sourin Das

- This was my term paper project for my Advanced Quantum Mechanics course.

Developed Cubed-Sphere Grid to study Black-Hole Accretion Disks using Fortran (3 weeks short project)

August 2023 - September 2023

Guide: Prof. Sudip Kumar Garain

- Developed a program to generate a cubed sphere which will be used to solve MHD equations of accretion disk.
- Tools Used: Fortran, Julia

Natural Language Processing Project

August 2022 - January 2023

Guide: Prof. Kripabandhu Ghosh

- Developed a machine learning model which can do segmentation on clauses from Law contracts and then do clause classification.
- Tools used: Natural Language Processing

Workshops, Seminars and Conferences

National Science Day Seminar, 2025 *Cert.*

I delivered a public talk at IUCAA on National Science Day, where I introduced the audience to the beauty of the Universe and the fascinating concepts of General Relativity and Quantum Mechanics. I discussed how our everyday perceptions of reality differ from the deeper, more intricate physics that governs the cosmos.

AI / ML Workshop at IUCAA, 2025 *Cert.*

I attended the workshop organized by IUCAA and the University of Victoria presenting works of AI/ ML in astronomy and astrophysics.

LIGO Workshop, BITS Pilani and IUCAA, 2024 *Cert.*

This workshop included lectures and practical sessions on core principles of gravitational wave physics, including general relativity, source modeling, GW searches and parameter estimation.

NVIDIA AI Summit, Mumbai, 2024 *Cert.*

The sessions covered a range of topics, from deep learning frameworks to AI applications.

Classical and Quantum Gravity Conference, Cochin University, 2024 *Cert.*

This seminar covered a range of advanced topics including energy extraction from black holes, neutron star modeling, braneworld scenarios, and quantum cosmology. Key sessions explore gravitational radiation, ultra-compact objects, and implications of modified gravity theories on cosmic structures and the Hubble tension.

GWOSC Workshop 5, 2022 *Cert.*

A workshop organized by Gravitational Wave Open Science Center which taught concepts related to data analysis, noise characterisation, working of LIGO detectors, etc.

Quantum Information and Quantum Technology *Cert.*

An International Conference, hosted by IISER Kolkata in 2023.

Qiskit Global Summer School 2022 *Cert.*

A workshop organized by Qiskit for Introduction to Quantum Computation.

Awards

UP Science Talent Search Examination Scholarship *Cert.*

A scholarship awarded by the State government for students highly talented in Basic Sciences.

NCC Special Trophy *Cert.*

I was awarded a special trophy from National Cadet Corps, which is the youth wing of the Indian Armed Forces, for my excellent academic performance.

Robotics

I built a semi-autonomous robot using Arduino that can detect obstacles in its path and safely tackle them while walking on a specified track, using infrared sensors and ultrasonic sensors.

Research Interests

General Relativity and Cosmology
Gravitational Wave Astrophysics
Quantum Computation
Machine Learning
Multi-Messenger Astronomy
High-Energy Astrophysics

Test Scores

Duolingo English Result *Cert.*

Got an overall score of 150/160.

MOOCs

Machine Learning
By Andreww Ng
Coursera

Particle Physics: An Introduction
University of Geneva
Coursera

Introduction To Astrophysical Fluids
By Prof. Supratik Banerjee
IIT Kanpur, NPTEL

From Big Bang to Dark Energy
The University of Tokyo
Coursera

Extra-Curricular Activities

- **Painting:** Participated in a painting workshop, with artworks selected for exhibition.
- **Chess:** Secured a top-10 position in chess tournaments at IISER Kolkata and IUCAA.
- **Athletics:** Achieved 2nd place in the 100m district-level athletics event; represented IISER Kolkata in the Inter-IISER Sports Meet.
- **Web Development:** Designed and developed a personal website using Next.js.
- **Leadership & Management:**
  - Served as **Secretary of IISER Kolkata Student's Mess** for two consecutive years.
  - Held the position of **Office Bearer of the Institute's Gym**.
  - **Literary Captain** at UP Sainik School.
  - Managing the **official webpage of the Department of Physics, IISER Kolkata**.
- **Literature:**
  - Awarded **1st and 2nd place** in English and Hindi story writing competitions at UP Sainik School, recognized by a Lieutenant General.
- **Teaching:** Mentored and tutored students from high school to the undergraduate level in Mathematics, Physics, Chemistry, and Computer Science, providing guidance to those in need and helping them strengthen their conceptual understanding.
- **Hobbies & Interests:** Guitar, Photography, Cooking, Travelling, Speed-Cubing, and Stargazing.