

Education

Indian Institute of Science (IISc)
Bachelor of Science (Research) in Physics

Bengaluru, Karnataka
Aug. 2021 – Present

Current CGPA: 9.7/10 (Batch highest)

Ramsheth Thakur Public School
Higher Secondary Schooling
97.4% in 12th std. central examination

Navi Mumbai, Maharashtra
Aug. 2019 – Aug. 2021

Research Experience

Studying limitations on CPTP in non-Lindbladian Master equations
Prof. Manas Kulkarni (ICTS), Devashish Tupkary (University of Waterloo)

Jan 2024 – Present
IISc, Bengaluru

- My work involves identifying how quantum master equations for systems connected to multiple baths have limitations in the framework, such that any construction or approximations (like the Redfield equation) must be satisfied for the mapping to be CPTP. It involves coding an XXZ chain to test our results.

Adaptive measurements in IQP Circuits
Soumik Ghosh (University of Chicago)

Jan 2024 – Present
IISc, Bengaluru

- The present idea is to explore if adaptive measurements and gadgets therein can provide any classical sampling hardness like (or better) the current IQP circuit model can provide. Ideas like differences between GapP and P classes come into the picture.

The high density phase of oriented hard rectangles
Prof. Deepak Dhar (NIUS, IISER Pune)

May 2023 – September 2024
Pune, India

- I am studying entropy-driven phase transitions in systems of long hard rods initially, especially the second transition from nematic to high-density disordered (HDD) phase as a first-order transition, using theoretical arguments and Monte Carlo evidence. These ideas will be carried forward to study the systems of hard rectangles and the involved phase transitions.

Quantum synchronization with a composite two-qubit oscillator
Prof. Baladitya Suri, Athreya Shankar (IISc)

May 2023 – Dec 2023
IISc, Bengaluru

- I am studying the general open system of quantum Van der Pol oscillators coupled to each other and how phase locking occurs in such scenarios in both the individual and composite systems. Later on, I will explore one such system in more depth. I also study quantum phase transitions in such a system via analogies to a classical Markov chain.

Basics of Quantum Mechanics
Prof. Anshu Pandey (IISc)

July 2022 – September 2022
IISc, Bengaluru

- I studied the basics of quantum mechanics in more mathematical rigor from the books of Cohen, Laloe, and Tannoudji and an intuitive approach in the form of Leonard Susskind's "The theoretical minimum". Studied the theory and applications of Variational methods, Perturbation theory, Density matrix formalism, entanglement, and coherence of states. Finished off with providing solutions to a problem set for graduate-level students.

Bug-eecha: A gamified approach for better quality test cases
Prof. Viraj Kumar, Amrit M Joseph, Shelly Singh (IISc)

June 2022 – Present
IISc, Bengaluru

- We made a simple game running on Node.js and Mongo DB, which encourages students to give inputs and outputs to programming questions and eliminate buggy implementations of the solution from a given set. A successful paper presentation of the same was done in SIGCSE '23. Currently, we are working on Bug-eecha 2.0, which is about making the GUI much more friendly for students and teachers and improving the dataset of questions.

IGEM 2022: Halocleen

Group project by students of IISc

May 2022 – Oct. 2022

IISc, Bengaluru

- Keywords: Modelling and graphing, Web-development
- I was a core team member in the Dry Lab, part of the Igem team from IISc. I have worked on modeling various non-linear ODEs using MATLAB and the motivation part for the Igem project by collecting on-site data of plastic consumption in ground-level industries.
- Also modified and updated our IGEM wiki page to look smoother by using frontend JS and CSS.

Coursework

Introduction to Quantum Measurement and sensing

Prof. Baladitya Suri

Spring 2023

IAPT, IISc

Keywords: Standard Quantum Limits, QND Measurements, Open quantum systems, Decoherence

Quantum-safe cryptography

Prof. Sanjit Chatterjee

Spring 2023

CSA, IISc

Keywords: Post Quantum cryptography, hashing, lattice-based cryptography, Authentication protocols.

Introduction to Quantum Computation

Prof. Apoorva Patel

Fall 2023

IAPT, IISc

Keywords: Quantum states and theory, Entanglement, Universal quantum logic gates, Quantum algorithms

Design and Analysis of algorithms

Prof. Arindam Khan, Prof. Siddharth Barman

Fall 2023

CSA, IISc

Keywords: Greedy algorithms, Divide and conquer strategies, Dynamic programming, NP-Hardness, Approximation algorithms.

Advanced Quantum Computation and Information

Prof. Apoorva Patel

Spring 2024

IAPT, IISc

Keywords: Variational techniques, Machine learning, Quantum error correction, Quantum hardware platforms

Quantum Error-Correcting Codes

Prof. Naveen Kashyap

Spring 2024

ECE, IISc

Keywords: Quantum codes, constructions, bounds, Entanglement-assisted quantum error-correcting codes, Fault-tolerant quantum computation

Posters and Publications

Joseph, A.,..., Sarma, S. et al. Bug-eecha: A Gamified Approach to Programming Problem Comprehension and Testing, published at SIGCSE '23, <https://dl.acm.org/doi/10.1145/3545947.3573225>.

Joseph, A.,..., Sarma, S. et al. Bug-eecha 2.0: An Educational Game for CS1 Students and Instructors, published at COMPUTE '23, <https://dl.acm.org/doi/10.1145/3627217.3627236>.

(in preparation) Sarma, S. et al. Reduction-based problems in LLM models (a tentative title).

Research Interests and preparation

My current research interests lie in Quantum Information theory and Quantum many-body theory, especially **Quantum algorithms and Error-correcting codes** (on the QComputing side) and **Topological quantum computing** (on the more condensed matter side). I have been studying the field myself from references like **Nielsen and Chuang**, **Prof. Preskill's notes**, Ashcroft and Mermin, etc. I have and can code using Python, C, and C++ and utilize important packages like **QuTiP and Qiskit**. One of my research interests is newer error-correcting codes like **quantum LDPC codes** and their approach to Fault-tolerant quantum computation. Still, I am quite open to exploring other Quantum many-body systems and computing fields in my present stage to learn and experience them better. I am also parallelly pursuing summer programs and open-source courses from IBM on topics of my interest, like **Quantum Explorers 2023 and Quantum Global Summer School 2023**.

Technical skills

Programming Languages	Python, C++, HTML, CSS, JavaScript
Developer Tools	VS Code, Anaconda distribution
Technologies/Frameworks	GitHub, LaTeX, MATLAB
Packages	Numpy, Matplotlib, QuTiP, Qiskit

Educational Achievements and Awards/Fellowships

Won Physics Cup in 2022 and 2023 as a bronze medalist from India (for both years). Physics Cup is an internationally held online physics competition consisting of problems considered too difficult for IPhO, EuPhO, and such. Five such problems are coupled into a 6-month long contest.

Was selected for National Initiative on Undergraduate Science (NIUS). NIUS, hosted by TIFR, selects 50 top undergraduate students for research projects with professors around India. The offline camp includes lectures, experiments, and other such activities. A screening test selects them for further projects.

Was selected for STEMS Tessellate Round 2 (a nationwide contest organised by Chennai Mathematical Institute (CMI), Chennai, India) (top 30 students to be selected from a first round of selection tests). Couldn't attend due to end-semester exams.

Was team captain of NC India, selected for PLANCKS '23, Italy (PLANCKS is an annual physics competition organized by AIPS, a student body in Italy). We were a team of 4 selected to represent India in Milan, Italy. Unfortunately, VISA requirements couldn't be finished in time for us to attend the event.

Was selected (as a team of four, representing IISc) for Abhiprajna 2022 national annual science quiz conducted by Indian Institute of Science Education and Research (IISER), Tirupati, Chennai) (top teams from the top six performing institutions in the preliminary round were selected for finals). Couldn't attend due to unfortunate circumstances.

Qualified Joint Entrance Examinations (JEE), a national level two-stage examination system for undergraduate admissions to top tier institutions in India – **Qualified JEE Main 2021** with an **All India Rank of 720** (General Category), out of around 1.1 million candidates. **Qualified JEE Advanced 2021** with an **All India Rank of 627** (General Category) out of around 0.15 million candidates shortlisted from JEE Main.

Was top 1% in my state in National Standard Examination in Physics (NSEP) 2020 and qualified **Regional Mathematics Olympiad (RMO) 2019**, both state-level olympiad exams, from my state Maharashtra.

Qualified Kishore Vaigyanik Protsahan Yojana (KVPY) Examination 2019 7 (SA Stream – Class 11), the then national level selection examination for a scholarship programme funded by the Department of Science and Technology (DST), Government of India, for pursuing an undergraduate degree in basic science, with an **All India Rank of 136** (General Category) out of around 80 thousand candidates. Based on this rank, I got admission to IISc, Bengaluru.

Was honored to be a National Talent Search Examination (NTSE) 2018 Scholar (Nationwide scholarship examination out of which around 1000 students get a yearly scholarship from the Government of India)

Was a Technothon City winner for 2017, with an All India Rank of 79 (Technothon is the annual exam conducted by IIT Guwahati for their technical festival)

