

# Soham Sahasrabuddhe

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## Education

Indian Institute of Technology, Bombay

B.Tech(Honors) in Engineering Physics with a minor in Mathematics

2023 – 2027

CPI: 9.64/10

## Research Experience

Phase Integral Methods and its Applications

Prof. Ameeya Bhagwat, CEBS Mumbai

December'24

Ongoing Research Project

- Explored the implications of differential equations, local analysis, and asymptotic approximations in modeling real-world systems such as plasma dynamics.
- Gained expertise in solving basic ordinary differential equations, advancing to asymptotic analysis techniques and the WKB approximation.

National Initiative for Undergraduate Sciences

Tata Institute of Fundamental Research (TIFR), Mumbai

June'24

Research Exposure Camp

- Selected among **72** students nationwide for a fortnight-long research exposure camp at the Homi Bhabha Centre for Science Education (HBCSE), attending seminars led by distinguished professors from institutions across the country.
- Gained a strong foundation in **theoretical**, **experimental**, and **computational** physics during the camp.
- Chosen for a year-long project on “**Phase Integral Method and its Applications**” under the guidance of **Professor Ameeya Bhagwat** (CEBS Mumbai) due to outstanding performance in theoretical selection tests.

## Scholastic Achievements

- Currently holding a **Department Rank 2** among over **60** students of the Engineering Physics'27
- Received the **Institute Award** given to **Top 50** among **1400+** students for stellar academic performance
- Achieved a Semester Performance Index (**SPI**) of **10/10** in Autumn semester of **1<sup>st</sup>** year of undergraduate
- Secured an **All India Rank** of **487** in IIT-JEE Advanced examination among over **0.2 million** candidates
- Among **Top 48** nationwide in Indian National Mathematics Olympiad (**INMO**) and attended **IMOTC**
- Among **Top 35** nationwide in the Indian National Chemistry Olympiad (**INChO**) and attended **OCSC**
- Attained **Advanced Performer** (AP) grade in Entrepreneurship course awarded to top **2%** of the batch
- Secured an **All India Rank** of **436** in JEE Main examination among over **1.2+ million** candidates
- Among Top 1% students nationwide in National Standard Examination in Physics and selected for **INPhO**
- State Topper in National Standard Examination in Astronomy and selected for the **INAO**
- Recipient of the **KVPY** fellowship with an All India Rank **154**, offered admission to **IISc Bangalore**
- Awarded the **NTSE Scholarship** by NCERT, selected among **2000** students nationwide

## Key Projects

Pinpricks on the Vortex - Star Cluster Analysis in Nearby Galaxies

Krittika, The Astronomy Club, IIT Bombay

May '24

Summer Project

- Analyzed the types and ages of the **star clusters** in the spiral galaxies using images from the **Hubble Telescope**
- Developed python scripts to perform **aperture photometry** and extract **cluster fluxes** in different wavelengths
- Correlated the flux differences to the physical properties of the star clusters such as **age and ellipticity**

Introduction to Quantum Machine Learning - Computational Physics Projects

Maths and Physics Club, IIT Bombay

Dec '24

Winter Project

- Gained foundational knowledge of **quantum computing**, quantum circuits, and simulation using **Qiskit** library
- Implemented **Variational Quantum Algorithm** to calculate minimum energy and ground state of the system
- Solved non-linear differential equations by designing **Differential Quantum Circuits** using the **Qadence** library

## Summer of Science - Elementary Particle Physics

May '24

Maths and Physics Club, IIT Bombay

Summer Project

- Explored **symmetry** properties, **Feynman diagrams**, and the basics of quantum field theory and their applications
- Conducted an in-depth study on the **Standard Model** and the associated **fundamental particle interactions**
- Explored foundational concepts in classical and quantum mechanics to enhance understanding of particle physics

## Junior Design Engineer, Propulsion Subsystem, IIT Bombay Rocket Team

February '24

IN-SPACe recognized technical team developing high-power rockets

Ongoing Technical Work

- Designed **10+ solid-propellant rocket motors** in SolidWorks, optimizing propellants and motor performance
- Fabricated propellants with various compositions and conducted **Crawford Bomb Tests** to assess their properties
- Performed static fire tests on multiple manufactured rocket motors, achieving a impulse exceeding 1000 N · s
- Performed literature review on **hybrid motors**, ideating and researching on suitable fuels and methods

## Turbulence: From Flowing Water to Molecular Clouds

September '24

Prof. Punit Parmananda, IIT Bombay

Course Project

- Investigated **non-linearity** in the **Navier-Stokes** equation, examining **turbulence** and chaotic behaviour of fluids
- Analyzed **vortex formation** in high Reynolds number flows, linking these dynamics to real-world phenomena
- Explored the impact of turbulence on various natural phenomena ranging from **atmospheric patterns to stars**

## NetWeaver: Creating a Neural Network from Scratch

Dec '23

Analytics Club, IIT Bombay

Winter Project

- Developed **neural networks** from scratch to classify handwritten digits **(0-9)** with **94.96%** accuracy using MNIST
- Reviewed probability, statistics, and linear regression models to deepen understanding of neural network functions
- Applied **ReLU** activation and used **backpropagation** in a three-layer neural network for training and prediction

## Other Projects

### Introduction to Astronomy and Astrophysics

July '24

Krittika, The Astronomy Club, IIT Bombay

Learner's Space

- Gained an understanding of key astrophysics topics to enhance knowledge of stellar and galactic phenomena
- Started with fundamental concepts, including **coordinate systems and time**, celestial mechanics, and **telescopes**
- Advanced to specialized topics such as solar physics, **multi-messenger astronomy**, and stellar evolution

### Universal Testing Machine

Nov '23

Prof. Joseph John, Prof. Krishna Jonnalagadda, IIT Bombay

Course Project

- Successfully designed and built a prototype of a **Universal Testing Machine** (UTM) for testing mechanical strength
- Utilized **AutoCAD** to ideate and create designs for the machine structure, gearbox, and specimen holder
- Developed an electric circuit using **Arduino** electronics for efficient data collection and automated gear operation

### XLR8, Bot Making Competition

Aug '23

Electronics and Robotics Club, IIT Bombay

Self Project

- Developed a **hand-controlled robot** with a differential mechanism, enabling navigation over complex obstacles
- Utilized **ESP-32** microcontroller and transmitter, along with **L298 motor driver** and IMU, to achieve precise control
- Designed a robust and light robot chassis using AutoCAD, fabricating the chassis from acrylic sheets

## Technical Skills

### Programming Languages

C++, C, Python, MATLAB, Fortran, HTML, Markdown

### Libraries

Astropy, NumPy, Scipy, Matplotlib, Pandas, Qiskit, QuTiP

### ML and Data Science

Pytorch, Scikit-Learn, TensorFlow, Keras

### Softwares

L<sup>A</sup>T<sub>E</sub>X, Git, LTSpice, Arduino, AutoCAD, OpenMotor, Ansys, ImageJ

## Key Courses Undertaken

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- Classical Mechanics
- Quantum Mechanics\*
- Electromagnetism\*
- General Relativity\*
- Nonlinear Dynamics
- Thermal Physics
- AI and Data Science
- Abstract Algebra
- Calculus
- Differential Equations
- Fourier Analysis\*
- Oscillations and Waves
- Complex Analysis
- Statistical Mechanics\*
- Analog Electronics
- Digital Electronics\*
- Computer Programming

\*To be completed by April '25

## Volunteer Work

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### Volunteer and Core Team Member

*Maths and Physics Club, IIT Bombay*

**Apr '24**

*Ongoing Responsibility*

- Collaborating in a **15-member** team to organize and manage logistics for club events, including field trips, guest lectures, and group discussions, while playing a pivotal role in **creating problem statements and quiz questions**
- Created content and managed social media accounts of Facebook (**9K+ followers**) and Instagram (**2K+ followers**)

### Mentor, Computational Astronomy Project

*Krittika, IIT Bombay*

**Dec '24**

*Winter Project*

- Mentored a group of 10 students in analyzing star clusters, focusing on characteristics such as age, location, and galaxy gas content
- Utilized Python to process and analyze data sourced from the PHANGS collaboration and the Hubble Space Telescope
- Conducted weekly online meetings to maintain project documentation, explain weekly objectives, and address both theoretical and computational questions

### Teaching Assistant, Classical and Quantum Physics

*Department of Physics*

**Jan '25**

*Ongoing Responsibility*

- Tutored **30+** undergraduate students in notions of introductory classical mechanics and quantum physics
- Conducted **weekly tutorial sessions** and periodic help sessions to clear conceptual doubts over the semester
- Corrected the answer sheets of the students over the semester

## Extracurricular activities

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- **First Runner Up** of India Quiz at Inter IIT Culturals 7.0 hosted among 20+ IITs and 120+ teams
- **Winner** of Astromania 2024, the Astronomy Quizzing Competition organised by Krittika at IITB
- Achieved **2<sup>nd</sup> runner-up** in the **Convexing Complexity Challenge** organized by Enpower IIT Bombay
- Participated in **CricMania**, institute IPL-based cricket league organized by the Cricket Club at IITB
- Secured **first runner-up** at **Inquizitive: The Gen Quiz** during Avenues, organized by **SJMSOM, IITB**

## Languages

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- English: Full Professional Proficiency
- Hindi: Limited Working Proficiency
- Marathi: Mother Tongue
- Sanskrit: Elementary Proficiency