CURRICULUM VITAE

Anushka Agarwal

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Education

Indian Institute of Technology(IIT) – Indore June 2023 – May 2025
M.Sc. Astronomy | CPI: 8.31/10 *Madhya Pradesh, India*

Binod Bihari Mahto Koyalanchal University – Dhanbad July 2019 – June 2022
B.Sc. (Hons.) Physics | CGPA: 7.59/10 *Jharkhand, India*

Research Projects

The temperature of the neutral hydrogen in the Galaxy June 2024 – May 2025
Master's Thesis | Supervisor: Dr. Narendranath Patra

- Conducted a high-velocity resolution HI 21-cm absorption study towards 12 compact background radio sources using the upgraded Giant Metrewave Radio Telescope (uGMRT) to investigate the temperature distribution of neutral gas in the interstellar medium of the Milky Way.
- Employed frequency-switching bandpass calibration to enhance sensitivity for detecting weak absorption lines; data reduction and analysis performed using the CASA-based GARUDA pipeline.
- Extracted key physical parameters including optical depth, line-of-sight HI column density, and spin temperature for all sightlines.
- Achieved an optical depth RMS noise of $\sim 10^{-6}$ per km s^{-1}, enabling the detection of broad, shallow absorption features indicative of the warm neutral medium (WNM).
- Detected spin temperatures $T_S > 10^3$ K, confirming the presence of the WNM phase of the interstellar medium.

Markov Chain Monte Carlo Simulation January 2024 – May 2024
Minor Project | Instructor: Dr. Suman Majumdar *GitHub*

- Estimated cosmological parameters from Type Ia supernova data using Markov Chain Monte Carlo (MCMC) methods—an iterative Bayesian sampling approach that generates samples from a target probability distribution.
- Implemented both Metropolis-Hastings and Hamiltonian Monte Carlo (HMC) methods within cosmological statistical models.

Time Series Analysis and Forecasting Project July 2023 – November 2023
Minor Project | Instructor: Dr. Amit Shukla *GitHub*

- Applied statistical methods such as curve fitting and chi-square hypothesis testing to validate data models.
- Used time series analysis techniques to transform non-stationary COVID-19 and MJD flux datasets into stationary series.
- Performed ARIMA modeling to forecast time series data.

Key Courses

M.Sc. Astronomy Program:
Astrostatistics (Bayesian Inference), Relativity and Cosmology, Astrophysical Fluids and Plasmas, Radio Astronomy, Galactic and Extragalactic Astronomy, Computational Methods in Astronomy and Space Sciences, Electrodynamics, Mathematical Physics, and Quantum Mechanics.

B.Sc. Physics Program:
Classical Mechanics, Electricity and Magnetism, Waves and Optics, Thermodynamics, Mathematical Physics, Modern Physics, Quantum Mechanics and Applications, Solid State Physics, Electromagnetic Theory, Statistical Mechanics, Classical Dynamics, Nuclear and Particle Physics.

Skills

Programming Languages: Python

Astronomical Software: CASA, WSClean

Data Reduction: GARUDA, SPAM

Libraries & Tools: NumPy, SciPy, Pandas, Matplotlib, Jupyter, Statsmodels (ARIMA)

Simulations: N-body, ReionYuga, FoF Halo Finder, Kelvin-Helmholtz instability

OS & Documentation: Windows, Linux, LaTeX, MS Office

Qualifications and Scholarships

Joint Admission Test for M.Sc (JAM)–Indian Institute of Technology
National Rank: 317 (out of approximately 13,000 candidates) March 2023

Joint Entrance Screening Test (JEST) for Int.-Ph.D./Ph.D. admissions in premier institutes
National Rank: 331 May 2023

Merit Cum Means (MCM) scholarship from IIT Indore, India October 2024

Workshops

Cosmology with SKA and beyond *at IIT Indore, India* April 2025

Special Topics in Astrophysical Fluid Dynamics *by Prof. Ilian Iliev* January 2025
Studied linear perturbation theory and the formation of structures, including nonlinear evolution and basic galaxy formation concepts. Also learned about the HII regions and various fluid instabilities, such as **Kelvin-Helmholtz instability** and **Rayleigh-Taylor instability**.

Cosmology in the Next Decade *by Dr.Dylan Nelson* November 2024
Learned about simulating galaxies with cosmological hydrodynamical simulations, followed by a hands-on session with **Illustris-TNG**.

Workshop on Numerical Radiative Transfer *by Prof. Ilian Iliev* January 2024
Studied theoretical and computational aspects of radiative transfer using **C2Ray** algorithm.

Outreach Activities

Research Symposium, Department of Astronomy, IIT Indore November 2024
Presented a talk on *"The temperature of neutral hydrogen in the Galaxy"*

National Space Day August 2024
Volunteered in a telescope-building workshop for school students, fostering a hands-on session.
Engaged in demonstrating scientific concepts to school students and presented a talk.

Active member of the **Astronomy Club** at IIT Indore, India. 2023-Present
Volunteered in multiple stargazing sessions organized for local school students.

Volunteered in a telescope-building workshop for first-year undergraduate students of IIT Indore, India. July 2024

Languages

Hindi Fluent *(native speaker)*

English Fluent

French Beginner

Other Interests and Activities

Learned swimming during MSc at IIT Indore.

Passionate about dancing with active participation in various programs.

I enjoy teaching children engaging topics that foster curiosity and learning.

Self-taught artist with interest in painting.

Date: August 8, 2025