DAC Winter Astronomy School

Python for Astronomy Intensive Program

https://www.astrodingra.in/dac-school

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Program Overview

This 10-day intensive winter school provides a comprehensive introduction to computational astronomy. Participants will progress from Python basics to advanced topics such as spectral analysis, Active Galactic Nuclei (AGNs), and large-scale cosmological simulations.

A core focus of this session is the transition from observational data to theoretical modeling. We will explore the **IllustrisTNG** project, a suite of state-of-the-art magnetohydrodynamic simulations and learn to interface with this data.

Course Details

- **Duration:** 3rd – 13th (+2 days for project showcase) June 2026 (4:00 PM – 6:00 PM IST)
- **Mode:** Live Lectures + Hands-on Coding Labs
- **Prerequisites:** Basic understanding of physics and mathematics; no prior coding experience required.

Daily Schedule

Day	Theme	Topics Covered
1	**Python Bootcamp I**	Orientation; Python basics (variables, loops, functions); Introduction to NumPy and mathematics for astronomy.
2	**Python Bootcamp II**	Data handling with Pandas; Visualization with Matplotlib; Introduction to FITS image handling (opening and manipulating astronomical images).
3	**The Astropy Ecosystem**	Introduction to Astropy: Units, physical constants, celestial coordinates (RA/Dec), and time transformations.
4	**Spectral Analysis**	Basics of spectroscopy; Emission vs. Absorption lines; Gaussian fitting techniques; Estimating Redshift from spectral data.
5	**Statistics & Simulation**	Basic statistics (mean, median, std dev); Introduction to Monte Carlo simulations; Simulating star clusters.
6	**Simulations & GALAMO**	**IllustrisTNG Project**: Accessing TNG API and snapshots. **GALAMO**: Galaxy Analysis & Modelling techniques; Modeling galaxy parameters using Python.
7	**Data Mining the Cosmos**	Introduction to Bayesian statistics; **SQL with Astroquery**; Accessing real-world databases (SDSS) vs. simulated datasets.
8	**Active Galactic Nuclei**	Physics of AGNs and Accretion Disks; Feedback mechanisms in TNG simulations; Creating BPT diagrams for classification.
9	**Hands-on Hackathon**	Guided session: Comparing TNG simulated galaxies with real SDSS observations using the tools learned.
10–12	**Final Showcase**	Final project presentations; Mentorship Q&A; Roadmap for research in computational astrophysics.

Tools & Libraries

- **Core Stack:** Python, NumPy, SciPy, Pandas, Matplotlib
- **Astronomy Specific:** Astropy, Astroquery, DS9, **GALAMO**
- **Data Sources: IllustrisTNG (TNG100/300)**, Sloan Digital Sky Survey (SDSS), HST Archives

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