

PRIYABRATA JENA

M.Sc. in Physics · IIT Mandi · Aspiring Researcher in Astrophysics

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RESEARCH INTERESTS

Compact objects (neutron stars, white dwarfs) · Relativistic stellar structure · Equation of State of dense nuclear matter · General Relativity & gravitational physics · Computational Astrophysics

EDUCATION

M.Sc. in Physics

2024 – 2026

Indian Institute of Technology (IIT) Mandi, Himachal Pradesh, India

Relevant Coursework: General Relativity, Theoretical Particle Physics, Classical Mechanics, Electromagnetic Theory, Quantum Mechanics, Statistical Mechanics, Mathematical Physics, Computational Methods.

B.Sc. in Physics (Honours)

2021 – 2024

Bhadrak Autonomous College, Bhadrak, Odisha

RESEARCH EXPERIENCE

Tolman–Oppenheimer–Volkoff (TOV) Equation

2026 – Present

Independent Study

- Derived the TOV equation from Einstein field equations and numerically solve using python and compute neutron star mass-radius relation.

Lane–Emden Equation and Polytropic Stellar Models

2025

Independent Study

- Derived and analytically , numerically solved the Lane–Emden equation for polytropic indices $n = 0, 1, 1.5, 3, 5$. Then analyzed mass–radius relations.

Electronic Structure of LaSrMnO₃ and SrCaRu₂O₆

2025–2026

First-Principles Computational Study / IIT Mandi

- Performed electronic structure calculations using the PGP and PGP-2 computational frameworks.
- Analyzed electronic band structures, density of states, and magnetic properties of perovskite oxides.

Entangled Photon Generation from Quantum Dots

2025

Theoretical Study / IIT Mandi

- Studied quantum dot systems as sources of polarization-entangled photon pairs from biexciton cascade process.

Unitarity Fermi Gas

2025

Theoretical Study

- Investigated strongly interacting fermionic systems near the unitary limit where the scattering

length diverges and Studied universal thermodynamic properties and the Bertsch parameter governing the universal equation of state.

A study of Complex Potential Well

2024

Theoretical and Numerical Study

- Analyzed quantum mechanical bound states and scattering resonances in non-Hermitian complex potentials.

Frustrated Magnetism in Correlated Spin Systems

2024

Course Project / IIT Mandi

- Studied competing spin interactions and geometrically frustrated lattice systems. Refinement of LiCoVO₃ and SmAlGe using XRD data.

TECHNICAL SKILLS

Programming Languages: Python, C++

Scientific Computing: Mathematica

Numerical Methods: Numerical Integration, Numerical Differentiation, Linear Algebra, finite difference methods

Computational Physics: Basic Density Functional Theory (DFT); experience with HPC cluster environments

Document Preparation: L^AT_EX (proficient)

Operating System: Linux (Ubuntu/Mint)

Version Control: Git (basic)

Web Technologies: HTML (basic)

STANDARDIZED TESTS & QUALIFICATIONS

Joint Admission Test for M.Sc. (JAM) — Physics

2024

Qualified and secured admission to the M.Sc. Physics program at IIT Mandi through a competitive national examination.

ACADEMIC ACTIVITIES

- Regular participant in departmental seminars and colloquia at IIT Mandi covering high-energy astrophysics and condensed matter physics.
- Pursuing self-directed advanced study in relativistic astrophysics, compact object physics, and neutron star theory beyond the formal curriculum.
- Actively engaging with current literature on neutron star equations of state and gravitational wave astrophysics in preparation for doctoral research.

LANGUAGES

Spoken Languages: Odia (native), Hindi (fluent), English (professional proficiency)