PRIYABRATA JENA

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

Email: physicspriyabrat@gmail.com | **Website:** sites.google.com/view/priyabratajena |

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

Higher Secondary Certificate (Class XII) *2021*

Higher Secondary School Anandapur, Odisha

Secondary School Certificate (Class X) *2019*

Nilok High School, Odisha

RESEARCH EXPERIENCE

Tolman–Oppenheimer–Volkoff (TOV) Equation *2024 – Present*

Independent Study

- Derived the TOV equation from the Einstein field equations for a spherically symmetric, static spacetime.
- Implemented numerical integration routines (Runge–Kutta) in Python to compute relativistic stellar structure and compact star configurations.
- Analyzed the mass–radius relationship for neutron stars under different Equations of State.

Lane–Emden Equation and Polytropic Stellar Models *2023 – 2024*

Independent Study

- Derived and numerically solved the Lane–Emden equation for polytropic indices $n = 0, 1, 1.5, 3, 5$.
- Analyzed mass–radius relations and structural properties of classical polytropic stellar models.

Frustrated Magnetism in Correlated Spin Systems *2023 – 2024*

Course Project | IIT Mandi

- Studied competing spin interactions and ground-state degeneracy in geometrically frustrated lattice systems.
- Investigated spin liquid phases and exotic magnetic ordering in strongly correlated systems.

Electronic Structure of $LaSrMnO_3$ and $SrCaRu_2O_6$ *2023*

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 *2023*

Theoretical Study | IIT Mandi

- Studied quantum dot systems as sources of polarization-entangled photon pairs for quantum information applications.
- Analyzed the role of fine-structure splitting in biexciton–exciton cascade emission.

Unitarity Fermi Gas *2022 – 2023*

Theoretical Study

- Investigated strongly interacting fermionic systems near the unitary limit where the scattering length diverges.
- Studied universal thermodynamic properties and the Bertsch parameter governing the universal equation of state.

Quantum Mechanics: Complex Potential Well *2022*

Analytical Study

- Analyzed quantum mechanical bound states and scattering resonances in non-Hermitian complex potentials.
- Studied the role of $\mathcal{PT}$-symmetry in systems with complex potentials.

TECHNICAL SKILLS

Programming Languages: Python, C++

Scientific Computing: Mathematica

Numerical Methods: ODE integration (RK4, shooting method), eigenvalue problems, finite difference methods

Computational Physics: Basic Density Functional Theory (DFT); exposure to first-principles methods (PGP/PGP-2)

Document Preparation: LaTeX (proficient)

Operating System: Linux (Ubuntu/Debian)

Version Control: Git (basic)

Web Technologies: HTML (basic structural understanding)

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.

REFERENCES

Available upon request. Letters of recommendation can be arranged from faculty supervisors at IIT Mandi.