Chandra Prakash

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Research Interests

Early Universe Cosmology · Dark Matter · Quantum Field Theory in Curved Spacetime · General Relativity as an Effective Field Theory · Primordial Black Holes · Ideas in Holography

Education

Indian Institute of Technology Guwahati (IITG) *M.Sc. Physics, GPA: 8.65/10*
July 2023 – June 2025
Top performer in **Quantum Field Theory (PH543)** and **General Relativity (PH706)**.
Thesis: *From Quantum Fields to Cosmic Structures: Tracing the Early Universe through Correlation Functions* (Supervisor: **Dr. Debaprasad Maity**).
Focus on particle production during inflation, correlation functions, and cosmological observables.

Savitribai Phule Pune University *B.Sc. Physics, GPA: 9.38/10*
June 2020 – June 2023
Graduated among top 5% of class. Completed independent projects on black hole thermodynamics and entanglement entropy.

Publications & Preprints

- *Cosmological correlator and CMB physics* — in preparation (with D. Maity, IITG).
- *Statistical Origin of Black Hole Entropy*, *arXiv:2010.10868* (2020).
- *Black Hole Shadow in the presence of Lorentz violating background field* — in preparation (with A. Chatterjee, Haridwar University)

Prior Research Experience

Cosmological Collider Physics IIT Guwahati (2024–2025)
Supervisor: **Dr. Debaprasad Maity**

- Explored how cosmological correlators can serve as sensitive probes of gravitational and decay-induced particle production processes during the early universe.
- Analyzed gravitational particle production and computed number density spectra in expanding universe.
- Explored how modified Power Spectrum influences CMB observables through CMB-based numerical implementations.

Bootstrap and Heavy Fields in de Sitter Space IIT Mandi (Summer 2025)
Supervisor: **Dr. Nirmalaya Kajuri**

- Explored the constraints imposed over heavy field from cosmological collider physics.
- Used stereographic projection to derive Newton–Hooke limit in dS backgrounds.
- Investigating non-relativistic constraints on heavy field interactions.

CMB Parameter Estimation using ACT Data IIT Guwahati (2025)

- Performed full-likelihood cosmological parameter estimation using ACT data.
- Implemented MCMC pipelines in Python and validated results with CAMB.
- Repository: github.com/PhysicsiPhile/Cosmology.

Personal Research Projects (B.Sc.) Pune University (2021–2023)

- **Statistical Origin of Black Hole Entropy** — arXiv:2010.10868.
  Derived generalized Helmholtz free energy for Kerr-like metrics; studied AdS and Lorentz-violating spacetimes.
- **Entanglement Entropy via Heat Kernel and Replica Trick** — Explored field-theoretic origin of black hole entanglement entropy.
- **Shadow of Rotating Black Holes** — Applied Newman–Janis algorithm in Lorentz-violating gravity models and studied BH shadow to probe observable impact of Lorentz violation.

Technical Skills

Theory

- QFT, EFT, GR, CFT
- QFT in curved spacetime

Computational

- Software: CAMB, Mathematica
- Programming: Python, C++, Fortran, Bash, LaTeX
- Methods: MCMC, symbolic algebra

Selected Schools & Workshops

- **Loop the Loop Workshop (Nov 2024):** Self-force and loop corrections in GR.
- **GIAN Course on Standard Model EFT (Dec 2024):** EFT methods in particle physics.
- **IUCSS Summer School (May 2021):** Lorentz and CPT-violating SM extensions.
- **String 2021 Conference (June 2021):** Talks on holography and string theory.

Additional Information

- Maintains detailed notes on Conformal Field Theory and Early Universe Cosmology at physicsiphile.github.io.
- Secured first prize in the poster presentation competition held on Science Day at Pune University.
- Selected to present research on Black Hole Entropy at the "Zonal Level Aavishkar" event during undergraduate studies.

Referees

- **Dr. Nirmalya Kajuri**
  Assistant Professor, School of Physical Sciences
  Indian Institute of Technology Mandi
  Email: nirmalya@iitmandi.ac.in
  Website: https://sites.google.com/view/nirmalya-kajuri/home

- **Dr. Debaprasad Maity**
  Professor, Department of Physics
  Indian Institute of Technology Guwahati
  Email: debu@iitg.ac.in
  Website: https://iitg.irins.org/profile/128459

- **Prof. Lalita Rane (Retired)**
  Former Professor, HoD of Department of Physics
  Prof. Ramakrishna More College, Pune
  Email: lalitarane@pdearmacs.edu.in