Karthik Prabhu Palimar

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SUMMARY

PhD candidate in cosmology with a strong background in statistical inference, high-dimensional data modeling, and generative machine learning. Applied novel inference techniques to extract cosmological information from low-noise CMB maps and trained deep generative models (DDPMs) to simulate non-Gaussian astrophysical foregrounds. Experienced with Python, PyTorch, Bayesian inference, and high-performance computing. Looking to apply these skills in areas where statistical modeling, uncertainty quantification, and real-world impact intersect.

EDUCATION

University of California-Davis, Davis, CA. Expected: Dec 2025
Ph.D. Physics
Thesis: Beyond Gaussianity: Inference and Simulation Techniques for Next-Generation CMB Data
Advisor: Lloyd Knox

IISER Pune, Pune, India 2013-2018
B.S. - M.S. Physics
Thesis: Reconstruction of the primordial power spectrum from CMB using Richardson-Lucy deconvolution
Advisor: Tarun Souradeep

SKILLS

Technical skills	Statistical inference, Forecasting, Sampling, Bayesian analysis, Optimization
Machine learning	Generative modeling, Retrieval Augmented Generation
Scientific computing	High-performance computing, FFTs, Monte Carlo methods, NumPy, SciPy
Programming languages	Python, Julia, C++, MATLAB, Java, SQL
Soft skills	Research mentoring, Technical writing, Science communication, Collaboration

EXPERIENCE

Doctoral Researcher Department of Physics and Astronomy, UC Davis

- Led forecasting efforts for cosmological parameter constraints using the SPT-3G telescope, applying the MUSE framework to map-level CMB data and exploring multiple survey configurations.
- Developed end-to-end generative models with Denoising Diffusion Probabilistic Models (DDPMs) to simulate correlated non-Gaussian extragalactic foregrounds, reducing simulation runtime from hours (traditional N-body methods) to seconds, enabling rapid foreground characterization.
- Built scalable computational pipelines with GPU acceleration (CUDA), auto-differentiation, and parallelization for high-dimensional inference and simulation.
- Modeled polarized galactic foregrounds with spatially varying spectral parameters; applied the model to BICEP/Keck data and presented results at collaboration teleconferences.
- Contributed to the development of MUSE, a fully-Bayesian inference code for cosmological parameter estimation from high-resolution CMB maps.
- Presented research at international conferences (e.g. American Physical Society, Monterey Data Conference), and published in peer-reviewed journals.

Undergraduate Researcher IISER-Pune and IUCAA-Pune

- Reconstructed a phenomenological model of primordial density fluctuations by applying Richardson–Lucy deconvolution to Planck CMB data; results formed the basis of Master's thesis.

- Developed a Fortran code for Bayesian estimation of hemispherical power asymmetry from Cosmic Microwave Background temperature field.
- Served as the coordinator of the IISER-Pune science club, organised talks by eminent scientists, and arranged other popular science activities such as science demos and Nobel Laureates Lecture Series.

PROFESSIONAL SERVICE AND LEADERSHIP

- Graduate Student Representative, UC Davis Alumni Association — Organized professional development and networking workshops for graduate students.
- Graduate Student Representative, Junior Scientist Advancement Committee, CMB-S4 Collaboration — Co-organized community workshops on career paths, mentorship, and proposal writing for early-career researchers.
- Member, Diversity and Inclusion in Physics, UC Davis — Helped organize department-wide workshops and co-authored a letter of support advocating for increased hiring of Under Represented Minority faculty.
- Team Lead, Code Review Group, UC Davis — Designed and implemented a recommendation engine using neural network architectures.

PUBLICATIONS

K. Prabhu*, S. Raghunathan, M. Millea, G. P. Lynch, P. A. R. Ade, E. Anderes, et al.,
Testing the ΛCDM Cosmological Model with Forthcoming Measurements of the Cosmic Microwave Background with SPT-3G,
The Astrophysical Journal, 973(1), 4 (2024) Open access

K. Prabhu*, et al.,
Learning Correlated Astrophysical Foregrounds with Denoising Diffusion Probabilistic Models,
arXiv:2506.09036 [astro-ph.CO] (2025) Preprint

B. Thorne, L. Knox, K. Prabhu,
A Generative Model of Galactic Dust Emission Using Variational Autoencoders,
Monthly Notices of the Royal Astronomical Society, 504(2), 2603–2613 (2021) Open Access

M. Doohan, M. Millea, S. Raghunathan, F. Ge, L. Knox, K. Prabhu,
Quantifying Bias due to non-Gaussian Foregrounds in an Optimal Reconstruction of CMB Lensing and Temperature Power Spectra,
arXiv:2502.20801 [astro-ph.CO] (2025) Preprint

AWARDS AND ACHIEVEMENTS

Summer Research Fellow, Indian Academy of Sciences (IAS). 2015
Selected for VIJYOSHI Camp Organized by KVPY (Kishore Vaigyanik Protsahan Yojana). 2013
INSPIRE Fellow, MHRD, Govt of India. 2013
NTSE Scholar, NCERT, Govt of India. 2009

SELECTED TALKS

- **Testing ΛCDM with Forthcoming Results from SPT-3G**,
  American Physical Society Meeting, Sacramento, CA. 2024
- **Search for Primordial Gravitational Waves in a Foreground-Contaminated Sky**,
  Davis and Aachen Research in Cosmology (DARC) Mini Conference. 2023
- **A Polarized Perspective of Our Universe** (Public Talk), *Astronomy on Tap*, Davis, CA. 2023

TEACHING AND MENTORSHIP

Teaching Assistant, UC Davis *2018 – 2025*

- **Physics 158** : Advanced undergraduate course on galaxy formation (Lead TA)
- **AST 10G / 10C** : Introductory general education courses: Stars, Galaxies, and the Universe (Fall 2020); Introduction to Cosmology (Lead TA)
- **Physics 7A/B** : General physics with labs for life science majors (Discussion TA)
- **Physics 9A/B/C** : Calculus-based physics sequence with integrated labs for physical sciences and engineering majors (Discussion TA)
- Mentored two graduate students at UC Davis and one in the SPT-3G collaboration.

REFERENCES

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