Karthik Prabhu Palimar

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Summary

PhD candidate in cosmology with a strong background in statistical inference, high-dimensional data analysis, and generative machine learning. Implemented Bayesian inference techniques to extract cosmological information from low-noise, high-resolution CMB maps as well as trained deep generative models to tackle complex astrophysical foregrounds. Experienced with HPC, PyTorch, CUDA and HF-Accelerate. Seeking opportunities to develop scalable simulation and inference frameworks for next-generation experiments.

Education

Ph.D. Physics Expected: Dec 2025

University of California-Davis, Davis, CA.

Thesis: Beyond Gaussianity: Inference and Simulation Techniques for Next-Generation CMB Data

Advisor: Prof. Lloyd Knox

B.S. - M.S. Physics 2013-2018

IISER-Pune, Pune, India

Thesis: Reconstruction of the primordial power spectrum from CMB using Richardson-Lucy deconvolution

Advisor: Prof. Tarun Souradeep

Research Experience

Doctoral Researcher Department of Physics and Astronomy, UC Davis

- Led forecasting efforts for cosmological parameter constraints using the SPT-3G telescope, applying a Bayesian 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 non-Gaussian extragalactic foregrounds, enabling rapid foreground characterization and uncertainty modeling.
- 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 with moment expansion formalism and applied the model to publicly available BICEP/Keck data.
- Contributed to the development of MUSE, a fully-Bayesian inference code for cosmological parameter estimation from high-resolution CMB maps.

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.
- Studied the effects of cosmological parameters on the phase of the harmonic nature of the CMB power spectrum

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, Volume 973, Issue 1, 2024 Open access

K. Prabhu, et al.,
Learning Correlated Astrophysical Foregrounds with Denoising Diffusion Probabilistic Models,
Journal of Cosmology and Astroparticle Physics, Volume 2025, Issue 09, 2025 Open access

B. Thorne, L. Knox, **K. Prabhu**,
A Generative Model of Galactic Dust Emission Using Variational Autoencoders,
Monthly Notices of the Royal Astronomical Society, Volume 504, Issue 2, 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,
Journal of Cosmology and Astroparticle Physics, Volume 2025, Issue 9, 2025 Open access

Selected Talks & Posters

Monterey Data Conference (Invited poster), Monterey, CA 2025
American Physical Society Meeting, Sacramento, CA. 2024
Davis and Aachen Research in Cosmology (DARC) Mini Conference, 2023
Astronomy on Tap (Public Talk), Davis, CA. 2023

Skills

Technical skills	Statistical inference, Forecasting, Sampling, Bayesian analysis, Optimization
Machine learning	Diffusion Models, Retrieval Augmented Generation, LLM
Scientific computing	MPI, PyTorch Distributed, FSDP, scripting, HF-Accelerate, CUDA
Programming languages	Python, Julia, MATLAB, SQL

Teaching & Mentorship

AST 10G – Stars, Galaxies, and the Universe Lead TA, 2020, 2025
AST 10C – Introduction to Cosmology Lead TA, 2023
Physics 158 – Galaxy Formation (upper-division) Lead TA, 2020
Physics 9A/B/C – Physics for majors Discussion TA, 2021
Physics 7A/B – Physics for non-majors Discussion TA, 2019–2020
Mentored three graduate students (two at UC Davis and one within the SPT-3G Collaboration).

Professional Service & Leadership

Physics and Astronomy Alumni Association Committee
– Graduate Student Representative, Organized professional development and networking workshops for graduate students.

Junior Scientist Advancement Committee
– Graduate Student Representative, Co-organized community workshops on career paths, mentorship, and proposal writing for early-career researchers.

Diversity and Inclusion in Physics
– Member, Helped organize department-wide workshops and co-authored a letter of support advocating for increased hiring of Under Represented Minority faculty.

Code Review Group

– Designed and implemented a recommendation engine using neural network architectures.

Coordinator of Science Club

– Organised talks by eminent scientists, and arranged other popular science activities such as science demos and Nobel Laureates Lecture Series.

Awards & 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

Outreach & Communication

GradOps Mentor 2022
Diversity in Physics Member 2022
Astronomy on Tap Speaker 2022
DISHA club for educating marginalized communities, Member 2016

References

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Ethan Anderes
Professor
Department of Statistics
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Email: ebanderes@ucdavis.edu

Srinivasan Raghunathan
Survey Science Fellow
Centre for Astro-Physical Surveys
University of Illinois,
Urbana-Champaign, USA
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