

# Gerrit Farren

*Cosmologist & Research Engineer*

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## Profile

Cosmologist and research engineer with experience designing, building, evaluating and deploying end-to-end systems for scientific analysis and AI-supported research. Created CLArXivR, an LLM-based platform for scientific literature discovery and comprehension, while co-leading large-scale cosmological analyses within DESI.

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## Selected Technical Projects

CLArXivR **Creator & Lead Developer**, [clarxiv.org](https://clarxiv.org) / [How it works](#)

- Built and deployed CLArXivR to help researchers keep up with new literature; it ranks newly released arXiv papers against researchers' libraries and uses LLMs to explain relevant work in the context of their research.
- Designed its retrieval and paper analysis pipeline, combining embeddings, feedback-aware ranking, cross-encoder reranking, and contextual synthesis; now extending it with a tool-using research assistant.
- Built fixture-based evaluations for factual support, coverage, and cross-paper connection quality. Detected reduced coverage after a model update, traced it to stricter adherence to prompts tuned for the previous version, and guided prompt revisions to address the regression.
- Built a fault-tolerant Python backend that keeps analyses running through browser disconnects, retries transient model failures, and validates and repairs malformed output. Used concurrency controls and caching to prevent race conditions and redundant processing.

DESI × CMB Lensing **Analysis Co-Lead**, *Lawrence Berkeley National Laboratory*

- Led development of the measurement and analysis pipeline for DESI–CMB lensing cross-correlations, processing tens of millions of galaxies across six samples and coordinating integration across the collaboration.
- Designed a shared data framework that lets collaborators reuse computed results with automatic provenance tracking and validation. A common serial/MPI interface handles data partitioning, aggregation, and parallelizes computations across available resources.
- Developed modular inference software so researchers can swap theory and likelihood components; used JAX just-in-time compilation and analytic marginalization to reduce computational cost.
- Implemented validation and systematic-error control, enabling robust sub-percent constraints on cosmic structure growth and the universe's expansion history.

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## Technical Skills

Languages Python, SQL, Bash

LLM & retrieval Semantic retrieval, embeddings, reranking, source-grounded evaluation

Statistical inference Bayesian inference, Markov chain Monte Carlo (MCMC), likelihood modeling, covariance estimation, simulation-based validation

Signal analysis 3D Fourier- and spherical-harmonic methods, power- and cross-spectrum estimation

Scientific computing JAX, NumPy/SciPy, numerical integration, surrogate modeling

Parallel computing MPI, parallel HDF5, Slurm

Engineering FastAPI, package and API design, Git, CI/CD, pytest

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## Professional Experience

- Sep 2024–present **Owen Chamberlain Postdoctoral Fellow**, *Physics Division, Lawrence Berkeley National Laboratory*, Berkeley, CA
- Developed and led an independent research program focused on multi-tracer analyses and cosmic structure formation, including methods for systematic-error control that advance CMB lensing cross-correlations as precision cosmological probes.
  - Co-lead a key DESI DR2 analysis and the Simons Observatory cross-correlation working group; served on Simons Observatory Collaboration’s talks panel.
  - Mentored and co-supervised undergraduate, post-baccalaureate, and PhD students on projects resulting in publications.
- Oct 2020–Jul 2024 **PhD Researcher**, *Department of Applied Mathematics and Theoretical Physics, University of Cambridge*, Cambridge, United Kingdom
- Developed and validated methods for precision cosmology, including a way to measure cosmic expansion from galaxy-survey data without relying on the field’s standard calibration scale. Independent studies have since adopted and extended this method.
  - Led open-ended research to refine this calibration-independent approach, testing successive methods and diagnosing why they discarded useful information or retained unwanted calibration dependence. Developed and validated a revised model that removed the dependence while preserving useful information.
  - Taught undergraduate and master’s students in classes and tutorials, adapting explanations of complex scientific concepts to different levels of preparation.

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## Selected Publications

- Farren, G. S.**, Chiarenza, S., Baleato Lizancos, A., Krolewski, A., Maus, M., et al. *Measurement and Systematics Control for DESI DR2 CMB Lensing Cross-correlations*. Manuscript in preparation.
- Sailer, N., **Farren, G. S.**, Ferraro, S., and White, M. *Addressing Tensions in  $\Lambda$ CDM Cosmology by an Increase in the Optical Depth to Reionization*. *Phys. Rev. Lett.* 136(8), 081002 (2026). Joint first authors: N. Sailer and G. S. Farren.
- Farren, G. S.**, Krolewski, A., MacCrann, N., Ferraro, S., Abril-Cabezas, I., et al. *The Atacama Cosmology Telescope: Cosmology from Cross-correlations of unWISE Galaxies and ACT DR6 CMB Lensing*. *Astrophys. J.* 966(2), 157 (2024).
- Farren, G. S.**, Philcox, O. H. E., and Sherwin, B. D. *Determining the Hubble constant without the sound horizon: Perspectives with future galaxy surveys*. *Phys. Rev. D* 105(6), 063503 (2022).

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## Education

- 2024 **PhD, Applied Mathematics and Theoretical Physics**, *University of Cambridge*, Cambridge, United Kingdom
- 2020 **BSc, Physics**, *Haverford College*, Haverford, PA
- Self-directed study **Machine Learning for Physicists**, Florian Marquardt, FAU Erlangen-Nürnberg  
Neural-network training, convolutional and recurrent networks, representation learning, generative modeling, and reinforcement learning, with Python/JAX exercises.

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## Selected Fellowships & Awards

- 2024–present **Owen Chamberlain Postdoctoral Fellowship**, *Lawrence Berkeley National Laboratory*
- 2020–2024 **Isaac Newton Studentship**; **Helen Stone Scholarship**; and **Honorary Vice-Chancellor’s Award**, *University of Cambridge*