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St Edmunds College, Cambridge
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Samuel AK Leeney

2nd year PhD in Physics candidate

github.com/samleeney
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My research focuses on developing machine learning tools and Bayesian methods for cosmological applications. I recently designed a machine learning-based radiometer calibration system for the REACH experiment, which aims to detect a faint, previously unseen signal from the early universe. In parallel, I am applying a Bayesian anomaly detection method—originally developed during my master's research—to refine supernova measurements and contribute to resolving the Hubble tension.

Publications

A differentiable Bayesian anomaly detection framework for robust SALT3 Parameter estimation and Supernova distance calibration using JAX **2025**
Journal TBC, Leeney et al *In prep*

Measuring the temperature of the early universe with machine learning based radiometer calibration **2025**
Nature Communications, Leeney et al *Under review*

Receiver design for the REACH global 21-cm signal experiment **2024**
Monthly Notices of the Royal Astronomical Society, ILV Roque et al *Published*

Enhanced Bayesian RFI mitigation and transient flagging using likelihood reweighting **2023**
Monthly Notices of the Royal Astronomical Society, Anstey and Leeney *Published*

A Bayesian approach to RFI mitigation **2023**
Physical Review D 108, 062006, Leeney et al *Published*

Intra-operative ex-vivo assessment of lymph node metastases by selective-sampling Raman micro-spectroscopy **2024**
Nature Scientific Reports, Barkhur et al *Published*

Academic Talks

Bayesian Anomaly Detection for RFI, Radio Transients and Supernovae **January 2025**
Handley Lab group meeting *Cambridge, United Kingdom*

New Data Analysis Methods for Radiometer Calibration **2024**
Global 21cm Conference, RRI *Bengaluru, India*

Machine learning for radiometer calibration in REACH **2024**
REACH annual meeting *Cambridge, United Kingdom*

Machine learning for radiometer calibration **2024**
European AI for Fundamental Physics Conference *Cambridge, United Kingdom*

Bayesian anomaly detection **November 2023**
Breakthrough Listen UK Technosignature Workshop *Jodrell Bank, United Kingdom*

A Bayesian approach to RFI mitigation **June 2023**
Kavli Astrostatistics and Machine Learning *Cambridge, United Kingdom*

A Bayesian approach to RFI mitigation **October 2022**
5th Global 21cm Conference, UC Berkeley *Berkeley, United States*

RFI Management in the REACH pipeline **April 2022**
Observational and Theoretical 21cm Cosmology, Kavli Institute for Cosmology *Cambridge, United Kingdom*

Research Experience

PhD student **October 2023 — Present**
Cavendish Astrophysics *Cambridge, United Kingdom*

- Fully funded by an ERC grant.
- Developing statistical methods for global 21cm Cosmology to be used in the REACH telescope.
- Extending Bayesian anomaly detection to time transient anomalies of interest such as fast radio bursts.

Research assistant / SKA data challenge **April 2023 — October 2023**
Cavendish Astrophysics *Cambridge, United Kingdom*

- Working on the Cambridge effort to separate a mock 21cm signal from simulated foregrounds in the SKA data challenge.

MPhil Project / Bayesian anomaly detection **Jan 2022 — Jan 2023**
Cavendish Astrophysics *Cambridge, United Kingdom*

- Using novel Bayesian inference techniques mitigate for radio frequency interference
- Initially designed for use in global 21cm Cosmology
- Now trialing as a general Bayesian anomaly detector for radio transients
- Published in APS Physical Review D

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Extended summer research project / image segmentation techniques for breast cancer diagnosis **June 2021 — Dec 2021**
Nottingham University *Nottingham, United Kingdom*

- My work on this project (continued from my undergraduate thesis) was to design an image segmentation algorithm to generate sampling points for raman spectra analysis, providing a highly sensitive diagnosis on malignant tissue in intra-operative timeframes.
- This was achieved using convolutional neural networks.
- These works are currently in preparation for publication. I will be named as the third co author.

Education

MPhil Physics **Lent 2022 — Lent 2023**
Cambridge University *Cambridge, United Kingdom*

- Developiong statistical tools for the REACH 21cm Cosmology experiment

First Class Degree in Physics **Sept 2018 — July 2021**
Nottingham University *Nottingham, Unted Kingdom*

- Notable Electives: Physics Research Project B (79); Introductory Experimental Physics (89); Intermediate Experimental Physics (82); The Quantum World (77).

A-Levels and GCSES **Sept 2000 — July 2013**
The King Alfred School *London, United Kingdom*

Teaching

Supervisions: Part IA Physics for Natural Sciences **Michaelmas 2023 - Present**
Supervisions: Part IA Scientific Computing **Lent 2023**
Demonstrating: Part IA Physics Labs **Lent 2023**

Computer Skills

Computing/Programming Unix, BASH, zsh, vim, git, Python, MATLAB, MPI, TensorFlow, PyTorch, JAX