Oli Basquette Astronomy PhD Student

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Education

PhD in Astronomy, University of Cambridge — Cambridge, UK
High-redshift astronomy and radio cosmology — 2025 – present

MSci Natural Sciences, University of Cambridge — Cambridge, UK
Part III Astrophysics (Year 4 - Class I) — 2024 – 2025

- Ranked 4th in the cohort
- Won funding to continue working on my master's project over summer

BA Natural Sciences, University of Cambridge — Cambridge, UK
Part II Astrophysics (Year 3 – Class I) — 2023 – 2024

- Ranked 5th in the cohort
- Awarded Robinson College Prize and re-elected to Scholarship

Part IB (Year 2 – 76%) — 2022 – 2023

- Physics A, Physics B, Mathematics
- Awarded Robinson College Prize and Scholarship

Part IA (Year 1 – 71%) — 2021 – 2022

- Physics, Mathematics, Materials Science and Chemistry

A-Levels and GCSEs, Bishop Wordsworth's School — Salisbury, UK
4 A-Levels and 12 GCSEs — 2014 – 2021

Research Experience

Part III/MSci Research Project — October 2024 – present

- Used a binary population synthesis (BPS) code to produce a catalogue of Population II X-ray binaries
- Synthesised X-ray spectra for these XRBs using astrophysical disc models, accounting for Compton upscattering and local absorption
- These spectra were implemented in cosmological simulations, and the effect of the resultant heating and ionisation on the hydrogen 21-cm radio signal was analysed
- Ran code on the Cambridge HPC clusters
- Supervised by Professor Anastasia Fialkov, Dr Nina Sartorio and Dr Rob Izzard

Summer Internship, Queen Mary University of London — July – September 2024

- Used data from four spacecraft (STEREO, ACE, Wind) from CDAWEB to simulate forecasts of the solar wind, accounting for transients like coronal mass ejections
- Evaluated the forecast quality of statistical properties of solar wind plasma turbulence, at a range of scales and two-dimensional angular separations
- Studied forecasts from Lagrange point L5 in preparation for the ESA Vigil mission
- Proposed a novel method for calculating forecast lead time, accounting for differential solar rotation and giving slightly improved forecasts
- Attended the most recent London Space Plasma Meeting at UCL
- Wrote a first draft of a paper based on my work
- Supervised by Dr Chris Chen

Summer Internship, Cavendish Laboratory — August – October 2023

- Built 3D electromagnetic simulations of *Morpho* butterfly wing nanostructures and their interaction with light, using Python with C and Fortran libraries
- Predicted some observed reflectance properties not previously seen in simulations
- Used OpenMPI to parallelise and speed up simulations on a Linux server
- Rebuilt several libraries from source to further increase simulation speed
- My work formed the basis for a 2023 MSci project offered at the University of Cambridge, and features in a paper currently in preparation
- Supervised by Professor Crispin Barnes and Dr Peter Newton

Other Computing Experience

CATAM Computing Projects (Python) August – December 2023

- Matrices over Finite Fields – Reduced row echelon form, rank, rowspace, kernel and annihilators for Galois fields
- Ordinary Differential Equations – Euler, AB2 and RK4 methods, numerical stability and growth rates, WKB approximation of a nonuniform string
- Cosmological Distances – Distance and volume measures in FRW spacetime, lookback time, cosmological redshift, Friedmann equations
- Isolating Integrals for Geodesic Motion – Poincaré maps and particle trajectories in Kerr and Schwarzschild spacetimes

General Expertise

- 10 years of Python experience, including simulations, data analysis and object-oriented programming
- 5 years of experience with LaTeX
- Some experience with scientific computing in C, C++, Fortran and MATLAB
- Basic knowledge of web development languages (HTML, Javascript)
- Fully comfortable working in Linux and Windows, and some experience with macOS

Talks and Outreach

Academic Talks

- *The effect of Population II and III X-ray binaries on the 21-cm signal* – MSci viva presentation (May 2025)
- *A scale-dependent, multi-spacecraft study of solar wind forecasts at L5* – Astronomy Unit, Queen Mary University of London (September 2024)
- *Are Lithium-Rich Giants Binaries? A Radial Velocity Variability Analysis of 1400 Giants* – Undergraduate Journal Club, Institute of Astronomy (February 2024)
- *Simulations of structural colour in Morpho butterflies*, for visitors from Universidad Nacional de Cañete – Cavendish Laboratory (September 2023)
- *The Finite-Difference Time-Domain Method for Electromagnetic Simulations* – Group meeting, Cavendish Laboratory (August 2023)

Outreach & Science Communication

- *Aurorae, Space Weather and the Solar Wind* – IoA open evening talk (January 2025)
- *Life, Death and Milky Tea: An Introduction to Cosmology* – Talk at a secondary school in Wiltshire, as part of their British Association of Young Scientists scheme (September 2024)
- Cambridge Interview Workshops, Robinson College outreach team (January 2025 and September 2024)
- Helped run a scientific poster session at QMUL for local Sixth Formers to present their research on a topic of their choice (August 2024)
- Member of the Oxbridge Launchpad, a student-run organisation providing free Oxbridge mentoring and mock interviews to students from underrepresented backgrounds (January 2022 - Present)
- *How does the Pythagorean Theorem imply time dilation?* – Talk at my old Sixth Form (August 2021)
- Volunteer, Fordingbridge Astronomers (2019-2021)

Miscellaneous

- Intermediate knowledge of German
- Basic experience with electronics and hardware (e.g. Raspberry Pi, PC building)
- Interested in amateur astronomy and astrophotography
- Advocate for citizen science (particularly in astronomy!)
- Previously tutored GCSE and A-Level Maths and Sciences
- Enjoy long-distance running and rowing
- Coordinated various charity runs and sporting events in my college
- Treasurer of Robinson College Boat Club