

Robb Calder

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Education

PhD in Astrophysics

Institute of Astronomy, University of Cambridge

Cambridge, UK

Sep 2023 – Present

- Project title: ‘The Atmospheres and Interiors of Hot Rocky Planets’.
- Supervised by Professor Oliver Shorttle and Dr. Paul Rimmer.
- Funded studentship from the Science and Technology Facilities Council, UKRI.

MPhys in Astrophysics

School of Physics and Astronomy, University of St Andrews

St Andrews, UK

Sep 2018 – Jun 2023

- Graduated First Class Honors with Distinction; 83/100.
- Carried out a research project under the supervision of Professor Moira Jardine titled *Smothering Exoplanet Winds*.
- Studied a wide range of courses including *Advanced Data Analysis*, *Magnetofluid Dynamics*, *Monte-Carlo Radiative Transfer Techniques* and *Observational Astrophysics*.
- Awarded class medal in final year for being among the highest ranking astrophysics students.
- Deans’ List for each consecutive year of undergraduate degree.

Research Experience

PhD - The Atmospheres and Interiors of Hot Rocky Planets

Institute of Astronomy, University of Cambridge

Cambridge, UK

Sep 2023 – Present

- Simulated the thermal evolution of planets in the sub-Neptune regime across a broad parameter space using a coupled atmosphere-interior evolution model (PROTEUS).
- Tested the magma ocean hypothesis for K2-18b by comparing PROTEUS simulations of this planet to observed transmission spectra.
- Incorporated petitRADTRANS into the PROTEUS framework, allowing the code to produce synthetic observations based on model results.
- Added a mantle evolution sub-module within PROTEUS with parameterised convection, to be used in planet mass regimes unsuitable for the more complex 1D mantle evolution sub-module.
- Contributed to the collaboration responsible for developing PROTEUS by attending regular meetings and sharing changes made to the model to the collaboration’s github repository.
- Modeled the atmospheres of Venus and Venus-like exoplanets with a 1D photochemical code (ARGO) to discover possible abiotic ozone production pathways.
- Modified ARGO to include pseudo-chemical reactions that produce arbitrary amounts of specific gaseous species to simulate unknown chemical pathways.
- Performed retrievals on transmission spectra of K2-18b and WASP-17b using the radiative transfer retrieval packages petitRADTRANS and PLATON.

Masters’ Project - Smothering Exoplanet Winds

School of Physics and Astronomy, University of St Andrews

St Andrews, UK

Jan 2023 – May 2023

- Used a 1D Parker Wind model to determine if stellar winds act to reduce the photo-evaporation rate of a planetary atmosphere.
- Determined the region of the parameter space; defined by stellar mass, planet mass and orbital separation; in which the stellar wind reduces the atmospheric evaporation rate.
- Explored the effect of stellar flares and stellar evolution on the ability of stellar winds to reduce atmospheric evaporation rates.
- Identified that the planet HD 97658b is expected to have a reduced atmospheric evaporation rate owing to the stellar wind, which may explain the lack of an observed evaporating atmosphere.

- Received funding from the Laidlaw Leadership and Research Scholarship to undertake a research project under the supervision of Professor Christiane Helling.
- Studied cloud formation on Hot-Jupiter exoplanet atmospheres using a grid of Global Circulation Models (GCMs) as input for a 1D kinetic cloud formation code.
- Visualised the GCM data using Python to inform the cloud formation simulations and identify pressure-temperature regimes that might have proven unsuitable for the model.
- Created a bash script to automate the distribution of cloud formation simulations across a high performance computing cluster.
- Designed a strategy for visualising the vast quantity of high-dimensional output data in a concise and insightful format.

Publication List

- Calder R., Shorttle O., Nicholls H., Lichtenberg T., Guimond C. M., 2026, **Most rocky sub-Neptunes are molten: Mapping the Solidification Shoreline for Gas Dwarf Exoplanets**. MNRAS, 549, stag1007 (DOI: [10.1093/mnras/stag1007](https://doi.org/10.1093/mnras/stag1007) [↗](#)).
- Calder R., Shorttle O., Jordan S., Rimmer P., Constantinou T., 2025, **Abiotic ozone in the observable atmospheres of Venus and Venus-like exoplanets**. MNRAS, 540, 2432–2450 (DOI: [10.1093/mnras/staf851](https://doi.org/10.1093/mnras/staf851) [↗](#)).
- Nicholls H., Lichtenberg T., Riegler B., Calder R., Fortuin V., 2026, **Constraining the Lives and Times of Exoplanets through Evolutionary Bayesian Retrievals**. Submitted to ApJ (arXiv: [2607.25845](https://arxiv.org/abs/2607.25845) [↗](#)).
- Helling C., Samra D., Lewis D., Calder R., Hirst G., Woitke P., et al., 2023, **Exoplanet weather and climate regimes with clouds and thermal ionospheres – A model grid study in support of large-scale observational campaigns**. A&A, 671, A122 (DOI: [10.1051/0004-6361/202243956](https://doi.org/10.1051/0004-6361/202243956) [↗](#)).
- Lewis D., Helling C., Calder R., Hirst G., Samra D., Woitke P., et al., 2022, **The supplementary catalogue: Exoplanet weather and climate regimes with clouds and thermal ionospheres** (DOI: [10.3217/p00p-et94](https://doi.org/10.3217/p00p-et94) [↗](#)).

Technical Skills

Programming

- Agent AI tools for code development, simulation management and document formatting.
- Python (including numpy, matplotlib, astropy and scipy), Mathematica, Fortran, Bash.
- Design of unit and integration tests consistent with modern programming standards.
- Proficiency in L^AT_EX, HTML, CSS.

Software Packages

- Use and modification of 1D photochemical-kinetics code (ARGO) to simulate chemistry in the upper-atmospheres of Venus-like planets.
- Use of radiative transfer retrieval packages (petitRADTRANS and PLATON) for atmospheric retrievals and synthetic spectra generation.
- Use and modification of coupled atmosphere-interior evolution model PROTEUS to simulate the thermal evolution of planets in the sub-Neptune regime.

Conferences and Invited Presentations

- **Edinburgh, UK, July 2026** — Invited talk at University of Edinburgh.
- **St Andrews, UK, July 2026** — Invited talk at University of St Andrews.
- **Porto, Portugal, June 2026** — Poster presentation at Exoplanets 6.
- **Madison, USA, May 2026** — Invited presentation at Astrobiology Science Conference 2026.
- **Boston, USA, May 2026** — Invited talk at Harvard Planetary Sciences Department, Harvard University.
- **Boston, USA, May 2026** — Invited talk at Earth and Planetary Sciences Department, MIT.
- **Bristol, UK, March 2026** — Talk at UK Exoplanet Meeting.

- **Cambridge, UK, February 2026** — Talk at Leverhulme Centre for Life in the Universe Science Day.
- **Groningen, Netherlands, January 2026** — Talk at Rocky Worlds Conference.
- **Cambridge, UK, December 2025** — Talk at Exoplanets Seminar.
- **Reykjavik, Iceland, June 2025** — Poster presentation at Biennial European Astrobiology Conference 2025.
- **Leeds, UK, March 2025** — Poster presentation at UK Exoplanet Meeting 2025.
- **Cambridge, UK, February 2025** — Poster presentation at Leverhulme Centre for Life in the Universe Science Day 2025.
- **Cambridge, UK, September 2024** — Attended Origins Federation Conference.
- **Cambridge, UK, July 2024** — Attended IoA 50 – Frontiers Conference.

Teaching Experience

Undergraduate Supervisor

University of Cambridge

Cambridge, UK

Feb 2024 - May 2026

Directed sessions involving 2-3 students to help them consolidate material covered in lectures. Marked submitted worksheets and past paper questions.

- 1st Year of PhD: Topics in Astrophysics (3rd Year Undergraduate Course): 9 students, 12 sessions
- 2nd Year of PhD: Topics in Astrophysics (3rd Year Undergraduate Course): 4 students, 8 sessions

Outreach

Public Lectures and Stargazing

University of Cambridge

Cambridge, UK

Sep 2024 - May 2026

Delivered lectures to members of the public explaining current findings in the field of exoplanet science and led supervised star-gazing sessions.

- 21/10/2024: Barrington Scout Group
- 22/11/2024: 6th/17th Cambridge Scouts
- 17/02/2025: 50th Cambridge Cub Scouts
- 18/02/2025: Team Consulting

International Women's Day Committee

University of Cambridge

Cambridge, UK

Jan 2025 - Mar 2025

Participated in the International Women's Day committee. The committee organised various department activities with the aim of celebrating female astronomers and promoting gender diversity in the field of astronomy.

- Lead and organised a workshop for local secondary school children to teach them about exoplanet transits and famous female astrophysicists in the field of exoplanets.
- Helped run the International Women's Day stall at the Institute of Astronomy Open Day, which presented examples of female astronomers throughout history.
- Presented a lecture at the Institute of Astronomy Open Day about famous female astrophysicists in the field of exoplanet science.