Robb Calder

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Education

PhD in Astrophysics **Cambridge, UK**
Institute of Astronomy, University of Cambridge *Sep 2023 – Present*

- Funded studentship from the Science and Technology Facilities Council, UKRI
- Project title: 'Atmospheric Processes on Hot Rocky Planets'
- Supervisors: Prof. Oliver Shorttle and Dr. Paul Rimmer

Integrated MPhys in Astrophysics **St Andrews, UK**
School of Physics and Astronomy, University of St Andrews *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*. In this project, I used a Parker Wind model to study the interaction between stellar winds and evaporating planetary atmospheres.
- Studied a wide range of courses including *Advanced Data Analysis*, *Magnetofluid Dynamics*, *Observational Astrophysics*, *Monte-Carlo Radiative Transfer Techniques* and *Observational Astrophysics*
- Awarded class medal in final year for being among the highest ranking astrophysics students.
- Deans Scholar for each consecutive year of undergraduate degree.

Research Experience

PhD - Atmospheric Processes on Hot Rocky Planets **Cambridge, UK**
Institute of Astronomy, University of Cambridge *Sep 2023 – Present*

- Ran retrievals on transmission spectra of K2-18b and WASP-17b using petitRADTRANS.
- Used 1D photochemical model (ARGO) to model the atmospheres of Venus and Venus-like exoplanets.
- Modified ARGO to include pseudo-chemical reactions that produce arbitrary amounts of gaseous species to simulate unknown chemical pathways.
- Used 1D photochemical models as input for synthetic spectra generation using petitRADTRANS.
- Used coupled climate-geohysical evoltion model (PROTEUS) to simulate the thermal evolution of planets in the sub-Neptune regime.

Masters' Project - Smothering Exoplanet Winds **St Andrews, UK**
School of Physics and Astronomy, University of St Andrews *Jan 2023 – May 2023*

- Used a 1D Parker Wind model to determine if a stellar wind acts to reduce the evaporation rate of a planetary atmosphere.
- Ran simulations to determine the region of the parameter space (stellar mass, planet mass, orbital separation) in which the stellar wind reduces the atmospheric evaporation rate.
- Used results of simulations to explore 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.

Summer Research Project - Cloud Formation on Hot Jupiter Exoplanets **St Andrews, UK**
School of Physics and Astronomy, University of St Andrews *Jun 2021 – Oct 2021*

- Received funding from the Laidlaw Leadership and Research Scholarship to undertake a research project under the supervision of Prof. Christiane Helling.

- Used a grid of Global Circulation Models as input for a 1D kinetic cloud formation code, in order to study cloud formation on Hot-Jupiter exoplanet atmospheres.
- Visualised the GCM data using Python to inform the cloud formation simulations
- Wrote bash script to automate the distribution of cloud formation simulations across a high performance computing cluster.
- Used Python to visualise the vast quantity of output data (60GB) in a concise and insightful format.

Technical Skills

Programming

- Python (including numpy, matplotlib, astropy and scipy), Mathematica, Fortran, Bash.
- LaTeX, HTML, CSS.

Coding Packages

- Use and modification of 1D photochemical-kinetics code (ARGO).
- Use of petitRADTRANS for atmospheric retrievals and synthetic spectra generation.
- Use of PROTEUS to simulate the thermal evoltion of planets in the sub-Neptune regime.

Conferences

IoA 50 - Frontiers Conference **Cambridge, UK**
Attended in Person *July 2024*

Origins Federation Conference **Cambridge, UK**
Attended in Person *Sep 2024*

Leverhume Centre for Life in the Universe Science Day, 2025 **Cambridge, UK**
Attended in Person, presented poster titled: 'Abiotic Ozone in the Observable Atmospheres of Venus and Venus-like Exoplanets' *February 2025*

UK Exoplanet Meeting 2025 **Leeds, UK**
Attended in Person, presented poster titled: 'Abiotic Ozone in the Observable Atmospheres of Venus and Venus-like Exoplanets' *March 2025*

Selected Publications

- Calder, R., Shorttle, O., Jordan, S., Rimmer, P., Constantinou, T. (2025). Abiotic ozone in the observable atmospheres of Venus and Venus-like exoplanets. Monthly Notices of the Royal Astronomical Society, 540(3), 2432-2450.
- Helling, C., Samra, D., Lewis, D., Calder, R., Hirst, G., Woitke, P., ... & Chubb, K. L. (2023). Exoplanet weather and climate regimes with clouds and thermal ionospheres-A model grid study in support of large-scale observational campaigns. Astronomy & Astrophysics, 671, A122.

Teaching Experience

Undergraduate Supervisor **Cambridge, UK**
University of Cambridge *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: Topics in Astrophysics (3rd Year Undergraduate Course): 9 students, 12 sessions
- 2nd Year: Topics in Astrophysics (3rd Year Undergraduate Course): 4 students, 8 sessions

Outreach

Public Lectures and Stargazing **Cambridge, UK**
University of Cambridge *Sep 2024 - May 2026*

Gave lectures to members of the public explaining current science and led supervised star-gazing sessions for

members of the public.

- 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 **Cambridge, UK**
University of Cambridge *Jan 2025 - Mar 2025*

Participated in the International Women's Day committee. This 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.
- Gave a lecture at the Institute of Astronomy Open Day about famous female astrophysicists in the field of exoplanets.