

# Dr. Cathal Maguire

Postdoctoral Researcher · University of Bristol

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## EDUCATION

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### Ph.D., Astrophysics

Trinity College Dublin, Dublin, Ireland

2020 – 2024

### B.A. (Mod), Physics & Astrophysics

Trinity College Dublin, Dublin, Ireland

Graduated with First Class Honours

2016 – 2020

Awarded a Trinity Gold Medal for “exceptional merit at degree examinations”

## RESEARCH EXPERIENCE

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### Postdoctoral Researcher | PI: Prof. Hannah Wakeford

University of Bristol, Bristol, UK

- JWST transmission spectroscopy observations of exoplanetary atmospheres Jan 2025 – Present
- Applied advanced light curve modelling techniques to study multi-dimensionality of exoplanetary atmospheres

### PhD Researcher | Supervisor: Prof. Neale Gibson

Trinity College Dublin, Dublin, Ireland

- High-resolution transmission spectroscopy observations of exoplanetary atmospheres with VLT/ESPRESSO Sep 2020 – Sep 2024
- Applied advanced Bayesian inference techniques to large high-resolution data sets to constrain atmospheric composition, vertical T-P profiles, and dynamics of ultra-hot Jupiters
- Monitored ultra-hot Jupiter atmospheres over months/years via novel and archival observations
- Developed a novel rotational broadening kernel which allows distinct atmospheric limbs to be separated in velocity and modelled/retrieved separately

### SSDF Visitor | Supervisor: Dr. Elyar Sedaghati

European Southern Observatory, Santiago, Chile

- Compared efficacy of high-resolution telluric removal techniques from high-resolution observations Mar 2023 – May 2023
- Conducted multiple nights of observations at the Very Large Telescope (VLT), Paranal Observatory
- Utilised the ESPRESSO instrument for both scientific and calibration observations

### Research Assistant | Supervisor: Prof. Salvatore Orlando

PRACE, Cineca, Bologna, Italy

- Worked remotely as part of the PRACE Summer of High-Performance Computing (SoHPC) Jun 2020 – Aug 2020
- Simulated highly energetic supernovae and investigated the interaction of their ejecta with their surrounding environments
- Focused on efficient data management and remote high-performance computing with the GALILEO supercomputer

### Undergraduate Researcher | Supervisor: Prof. Aline Vidotto

Trinity College Dublin, Dublin, Ireland

- Modelled the 1D velocity and temperature profile of the stellar wind of the red supergiant Alpha Orionis Sep 2019 – Jan 2020
- Compared radiative transfer modelling of stellar wind with radio observations

## TEACHING & OUTREACH

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### Teaching Assistant

Trinity College Dublin, Dublin, Ireland

- Undergraduate teaching assistant for Junior Sophister astrophysical labs 2020 – 2024
- Facilitated laboratory exercises, providing hands-on support to students and ensuring a conducive learning environment
- Completed a postgraduate course focusing on pedagogical methods and best practices

### STEM Mentor

Innumeris Education, Dublin, Ireland

- Mentored final year secondary school students from underrepresented backgrounds 2020 – 2022
- Assisted with university admissions procedures, offering insights and support
- Delivered tailored tutoring sessions, addressing individual learning needs

## PUBLICATIONS

### PEER-REVIEWED PUBLICATIONS

- 7 Ramkumar, Swaetha; *et al.* (4 co-authors, incl. **Maguire, Cathal**), 2025, *New perspectives on MASCARA-1b: A combined analysis of pre- and post-eclipse emission data using CRIRES<sup>+</sup>*, [A&A, 695, A110](#).
- 7 **Maguire, Cathal** *et al.*, 2024b, *Assessing methods for telluric removal on atmospheric retrievals of high-resolution optical exoplanetary transmission spectra*, [A&A, 692, A8](#).
- 6 **Maguire, Cathal** *et al.*, 2024a, *High-resolution atmospheric retrievals of WASP-76b transmission spectroscopy with ESPRESSO: Monitoring limb asymmetries across multiple transits*, [A&A, 687, A49](#).
- 5 Fortune, Mark; *et al.* (5 co-authors, incl. **Maguire, Cathal**), 2024, *How do wavelength correlations affect your transmission spectrum? Application of a new fast and flexible 2D Gaussian process framework to transiting exoplanet spectroscopy*, [A&A, 686, A89](#).
- 4 Ramkumar, Swaetha *et al.* (4 co-authors, incl. **Maguire, Cathal**), 2023, *High-resolution emission spectroscopy retrievals of MASCARA-1b with CRIRES<sup>+</sup>: strong detections of CO, H<sub>2</sub>O, and Fe emission lines and a C/O consistent with solar*, [MNRAS, 525, 2985](#).
- 3 Gandhi, Siddharth *et al.* (11 co-authors, incl. **Maguire, Cathal**), 2023, *Retrieval Survey of Metals in Six Ultrahot Jupiters: Trends in Chemistry, Rain-out, Ionization, and Atmospheric Dynamics*, [AJ, 165, 242](#).
- 2 **Maguire, Cathal** *et al.*, 2023, *High-resolution atmospheric retrievals of WASP-121b transmission spectroscopy with ESPRESSO: Consistent relative abundance constraints across multiple epochs and instruments*, [MNRAS, 519, 1030](#).
- 1 Gibson, Neale P. *et al.* (4 co-authors, incl. **Maguire, Cathal**), 2022, *Relative abundance constraints from high-resolution optical transmission spectroscopy of WASP-121b, and a fast model-filtering technique for accelerating retrievals*, [MNRAS, 512, 4161](#).

### CONFERENCE & SEMINAR TALKS

- 9 **July 2025**, "Multi-dimensional insights from high- and low-resolution spectroscopy." *Exoclimes VII*, Université de Montréal, Montréal, Canada<sup>†</sup>
- 8 **November 2024**, "Probing the atmospheres of ultra-hot Jupiters at high-resolution." *Astrophysics Seminar*, University of Bristol, UK\*
- 7 **August 2023**, "Optimising the removal of telluric contamination from high-resolution transmission spectra." *Irish National Astronomy Meeting (INAM)*, University College Cork, Ireland<sup>†</sup>
- 6 **July 2023**, "Optimising the removal of telluric contamination from high-resolution transmission spectra." *Exoplanets by the Lake*, Starnberg, Germany<sup>†</sup>
- 5 **May 2023**, "Optimising the removal of telluric contamination from high-resolution transmission spectra." *European Southern Observatory*, Santiago, Chile\*
- 4 **April 2023**, "Transmission Spectroscopy of WASP-121b with ESPRESSO." *Universidad Adolfo Ibáñez*, Santiago, Chile\*
- 3 **December 2022**, "Transmission Spectroscopy of WASP-121b with ESPRESSO." *Dublin STar formation, DeBris dIsks and plaNets (DUSTBIN) Meeting*, Maynooth University, Ireland\*
- 2 **September 2022**, "Above the Clouds: Probing the atmosphere of the ultra-hot Jupiter WASP-121b with VLT/ESPRESSO." *AIP Thinkshop 2022: High-resolution spectroscopy for exoplanet atmospheres and biomarkers*, Leibniz Institute for Astrophysics, Potsdam, Germany<sup>†</sup>
- 1 **August 2022**, "Above the Clouds: Probing the atmosphere of the ultra-hot Jupiter WASP-121b with VLT/ESPRESSO." *Irish National Astronomy Meeting (INAM)*, Dunsink Observatory, Ireland<sup>†</sup>

(<sup>†</sup>Contributed, \*Seminar)

### CURRENT RESEARCH INTERESTS (SELECTED)

- Exoplanetary atmospheres (observations & modelling)
- Low- and High-resolution spectroscopy
- Bayesian inference methods
- High-performance computing
- Telluric correction of high-resolution spectra

### PROFESSIONAL SKILLS

- **Programming / Markup Languages:** Python, IDL, C/C++, JavaScript, HTML/CSS,  $\LaTeX$
- **Data Analysis Techniques:** Bayesian inference, Cross-correlation analysis, Astronomical image reduction, Radiative transfer, Open-source code management, Web development
- **Languages:** English (native), Irish (native), Spanish (intermediate)

*References are available upon request. Last updated: 2025-09-30.*