Cathal Maguire - CV

Ph.D. Candidate in Astrophysics · Trinity College Dublin

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Education

Ph.D., Astrophysics — *Trinity College Dublin*, Dublin, Ireland

Expected Graduation: September 2024 — *2020 – Present*

B.A. (Mod), Physics & Astrophysics — *Trinity College Dublin*, Dublin, Ireland

Graduated with First Class Honours — *2016 – 2020*

Awarded a Gold Medal for "exceptional merit at degree examinations"

Research Experience

Postgraduate Researcher | Supervisor: Prof. Neale Gibson — *Trinity College Dublin*, Dublin, Ireland

- *High-resolution transmission spectroscopy observations of exoplanetary atmospheres with VLT/ESPRESSO* — *2020 – Present*
- *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

Teaching Assistant — *Trinity College Dublin*, Dublin, Ireland

- *Undergraduate teaching assistant for Junior Sophister astrophysical labs* — *2020 – Present*
- *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

6 **Maguire, Cathal** et al., 2024, *High-resolution atmospheric retrievals of WASP-76b transmission spectroscopy with ESPRESSO: Monitoring limb asymmetries across multiple transits,* ***A&A. (in press)***.

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. (in press)***.

4 Ramkumar, Swaetha *et al.* (4 co-authors, incl. **Maguire, Cathal**), 2023, *High-resolution emission spectroscopy retrievals of MASCARA-1b with CRIRES+: strong detections of CO, H2O, 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

7 **Cathal Maguire**, August 2023. "Optimising the removal of telluric contamination from high-resolution transmission spectra." *Irish National Astronomy Meeting (INAM)*, University College Cork, Ireland†

6 **Cathal Maguire**, July 2023. "Optimising the removal of telluric contamination from high-resolution transmission spectra." *Exoplanets by the Lake*, Starnberg, Germany†

5 **Cathal Maguire**, May 2023. "Optimising the removal of telluric contamination from high-resolution transmission spectra." *European Southern Observatory*, Santiago, Chile⋆

4 **Cathal Maguire**, April 2023. "Transmission Spectroscopy of WASP-121b with ESPRESSO." *Universidad Adolfo Ibáñez*, Santiago, Chile⋆

3 **Cathal Maguire**, December 2022. "Transmission Spectroscopy of WASP-121b with ESPRESSO." *DUblin STar formation, DeBris dIsks and plaNets (DUSTBIN) Meeting*, Maynooth University, Ireland⋆

2 **Cathal Maguire**, 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†

1 **Cathal Maguire**, 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†

(†Contributed, ⋆Seminar)

Current Research Interests (selected)

- Exoplanetary atmospheres (observations & modelling)
- High-resolution spectroscopy
- Bayesian inference methods
- High-performance computing
- Telluric correction of ground-based 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: 2024-05-28.

Miscellaneous

Sales Consultant *Next Retail Plc.*, Dublin, Ireland

2015 – 2020

Rides Operator *Canada's Wonderland*, Vaughan, Canada

Jun 2018 – Aug 2018

Interests & Hobbies

I am passionate about sports, having participated in teams across a variety of sports, including soccer and gaelic football.

I am also interested in science and advancing technologies, with my main interests coming in the physical and space sciences.