Swaetha Ramkumar

PhD Candidate in Astrophysics | Trinity College Dublin

ramkumas@tcd.ie 0000-0003-0815-8366 Swaetha Ramkumar swaetharamkumar.github.io

Education

2021 – Present **Ph.D. in Astrophysics,** *Trinity College Dublin*
Supervisor: *Prof. Neale Gibson*

2019 – 2020 **M.Sc. in Astrophysics,** *University College London (UCL)*
Thesis title: *Assessing the stability of nuclear disc orbits against migrating resonances.*
Supervisor: *Dr. Ralph Schoenrich*
Distinction

2016 – 2019 **B.Sc. in Physics,** *Amrita Vishwa Vidyapeetham*
Project title: *Basic properties of Solar and Interstellar Plasma.*
Supervisor: *Dr. Bharat Kishore Sharma*
First Class with Distinction (CGPA: 9.10 out of 10)

Research Experience

2021-Present **PhD Researcher**, *Trinity College Dublin*

- Atmospheric characterisation of exoplanets using high-resolution emission spectroscopy.
- Leveraged cross-correlation and Bayesian inference techniques to probe the physical and chemical properties of ultra-hot Jupiters.
- Analysed day-side atmospheres across different phase sequences with VLT/CRIRES+ to investigate variations in atmospheric properties as the planet rotates.

Mar 2020-Sep 2020 **Master's Research Project**, *University College London (UCL)*

- Studied the non-axisymmetric bar of the Milky Way and performed simulations using an orbit integrator (written in C++).
- Investigated the behaviour of x_2 orbits and their interactions with the bar.
- Explored the behaviour of orbital resonances and x_2 orbits when introducing a nuclear disk.

Feb 2019-May 2019 **Undergraduate Research Project**, *Amrita Vishwa Vidyapeetham*

- Investigated the basic properties of Solar and Interstellar Plasma.
- The simulation output was investigated in Python to determine the plasma parameters (such as Debye length and Debye number) as a function of temperature. These results were then compared with observed values in the Solar wind and Interstellar medium.

Research Publications

First-Authored

1. **S. Ramkumar**, Gibson, Neale P., Nugroho, Stevanus K., Fortune, Mark, and Maguire, Cathal, "New perspectives on mascara-1b: A combined analysis of pre- and post-eclipse emission data using crires+," *A&A*, vol. 695, A110, 2025. DOI: 10.1051/0004-6361/202453520.

2. **S. Ramkumar**, N. P. Gibson, S. K. Nugroho, C. Maguire, and M. Fortune, "High-resolution emission spectroscopy retrievals of MASCARA-1b with CRIRES+: strong detections of CO, H_2O, and Fe emission lines and a C/O consistent with solar," *MNRAS*, 2023. DOI: 10.1093/mnras/stad2476.

Co-Authored

1. M. Fortune, N. P. Gibson, D. Foreman-Mackey, T. M. Evans-Soma, C. Maguire, and **S. Ramkumar**, "How do wavelength correlations affect transmission spectra? Application of a new fast and flexible 2D Gaussian process framework to transiting exoplanet spectroscopy," *A&A*, 2024. DOI: 10.1051/0004-6361/202347613.

2. C. Maguire, N. P. Gibson, S. K. Nugroho, M. Fortune, **S. Ramkumar**, S. Gandhi, and E. de Mooij, "High resolution atmospheric retrievals of WASP-76b transmission spectroscopy with ESPRESSO: Monitoring limb asymmetries across multiple transits," *A&A*, 2024. DOI: 10.1051/0004-6361/202449449.

3. C. Maguire, N. P. Gibson, S. K. Nugroho, **S. Ramkumar**, M. Fortune, S. R. Merritt, and E. de Mooij, "High-resolution atmospheric retrievals of WASP-121b transmission spectroscopy with ESPRESSO: Consistent relative abundance constraints across multiple epochs and instruments," *MNRAS*, 2023. DOI: 10.1093/mnras/stac3388.

Talks and Presentations

2025

- **New perspectives on MASCARA-1b: Probing pre- and post-eclipse emission with CRIRES+**
  ExoClimes VII, July 7-11, 2025 (poster presentation)
- **The day-side atmosphere of MASCARA-1b through the eyes of CRIRES+**
  EAS Annual Meeting, June 23-27, 2025 (poster presentation)
- **Probing Ultra-Hot Jupiter Atmospheres with Phase-Resolved Emission Spectroscopy**
  Trinity College Dublin Postgraduate Seminar, May 2025 (seminar talk)
- **New perspectives on MASCARA-1b**
  Trinity College Dublin Astrophysics Seminar, May 2025 (seminar talk)
- **The Cosmic Blowtorch: Planets Under Extreme Heat**
  Three Minute Thesis (3MT), Trinity College Dublin – Heats (March 11, 2025) & Final (March 20, 2025).
- **"Ultra-hot" Jupiters: Where a Year Lasts a Day**
  IOP Ireland Spring Conference: Rosse Medal entrant, Feb 28-01 Mar 2025 (poster presentation).

2024

- **MASCARA: Does it help your eyelash?**
  Two HoRSEs, July 15-19, 2024 (poster presentation).
- **MASCARA: Does it help your eyelash?**
  Exoplanets 5, June 17-21, 2024 (poster presentation).
- **Atmospheres of Alien Worlds.**
  IOP Ireland Spring Conference: Rosse Medal entrant, Apr 06, 2024 (poster presentation).

2023

- **MASCARA: does it help your eyelash?**
  Irish National Astronomy Meeting (INAM) 2023, Aug 24-25, 2023 (contributed talk).
- **High-resolution emission spectroscopy retrievals of MASCARA-1b with CRIRES+**
  Exoplanets by the Lake Summer School, Jul 31-Aug 4, 2023 (contributed talk).
- **High-resolution emission spectroscopy retrievals of MASCARA-1b with CRIRES+**
  Trinity College Dublin Astrophysics Seminar (seminar talk).

Talks and Presentations (continued)

- **High-resolution emission spectroscopy retrievals of MASCARA-1b with CRIRES+**
  2023 Sagan Exoplanet Summer Hybrid Workshop, Jul 24-28, 2023 (poster presentation).
- **The atmosphere of MASCARA-1b through the eyes of CRIRES+**
  Theo Murphy meeting, the Royal Society: Spectroscopy of exoplanets at high resolution, Feb 6-7, 2023 (flash talk).

Observing Experience and Proposals

2024 **CRIRES+ at the Very Large Telescope (VLT)**
Phase Curve observations (K-band) during cycle P113, PI: Nugroho, ***CoI: S. Ramkumar****.*

2023 **CRIRES+ at the Very Large Telescope (VLT)**
Phase Curve observations (K-band) during cycle P112, PI: Gibson, ***dPI: S. Ramkumar****.*

Teaching and Outreach

June 2025 **Session Chair**
EAS Annual Meeting, Cork
Symposium 14: New Frontiers in Characterising Gas-Giant Exoplanets and Brown Dwarfs

Scientific Organiser
EAS Annual Meeting, Cork
Symposium 14: New Frontiers in Characterising Gas-Giant Exoplanets and Brown Dwarfs

2021 – 2025 **Teaching Assistant in PYU33AP4 - JS AP Astro Computational Lab**
Trinity College Dublin

Oct 2023 – Nov 2023 **Teaching Assistant in PYU33AP3 - JS Practical in Astrophysics**
Trinity College Dublin

Apr 2023 **Transition Year Physics Experience (TYPE) Mentor**
Trinity College Dublin

Nov 2022 – Mar 2023 **STEM@Universi-TY Educator**
Trinity Walton Club, Trinity College Dublin
https://www.tcd.ie/waltonclub/ty.php

Prizes, Awards & Grants

2021 – Present **Research Grant**, Provost's PhD Award
Trinity College Dublin
Recipient of a full scholarship to undertake doctoral-level research at Trinity for four years.

March 2025 **Three Minute Thesis (3MT) Finalist**
Trinity College Dublin
Finalist in the university-wide 3MT competition, presenting PhD research in three minutes using a single slide, to a non-specialist audience (3MT Slide & Heat Photos).

June 2024 **Science in Shorts 2024**
Nature Awards
Science in Shorts is one of Nature's Awards, where you present your research in a 1-minute video. My video was selected for inclusion in the Shortlist and is featured on their YouTube channel: Science in Shorts: Turn into a force ghost!

Prizes, Awards & Grants (continued)

Aug 2023 — **Peter Curran Award**
Astronomical Society of Ireland (ASI)
Best student talk at the Irish National Astronomy Meeting (INAM) for the year 2023.
https://astronomers.ie/peter-curran-award/

Technical Skills

Research Interests	Exoplanet atmospheres (observations and modelling), Low- and High-resolution spectroscopy, Cross-correlation analysis, Atmospheric retrievals, Planet formation.
Programming	Python, C/C++ (*intermediate*), SQL (*basic*)
Markup Languages	LaTeX, HTML/CSS
Design & Publishing	Affinity Designer, Affinity Publisher
Data Visualisation	Matplotlib, Gnuplot, Seaborn
Miscellaneous	Bayesian inference with MCMC, Cross-correlation analysis, Web development, Data Reduction pipelines

Languages

English	**Full professional proficiency**
Tamil	**Native or bilingual proficiency**
Hindi	**Limited working proficiency**
Telugu	**Elementary proficiency**