

# HILAY SHAH

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## EDUCATION

<b>Australian National University</b> Doctor of Philosophy, Research School of Astronomy and Astrophysics Supervisors: Naomi McClure-Griffiths, Mark Krumholz, Christoph Federrath, Amit Seta, Freeke van de Voort	Canberra, Australia April 2023 - Present
<b>Indian Institute of Technology Roorkee</b> Bachelor of Technology Engineering Physics, GPA: 8.241/10 (first class) Relevant courses: Mathematics-I (linear algebra, calculus, probability theory), Computer Programming, Optimization Techniques, Statistical and Mathematical Physics, Numerical Analysis and Computational Physics, Signals and Systems, Data Structures, Theoretical Mechanics	Roorkee, India July 2017 - July 2021

## EXPERIENCE

<b>Doctoral Researcher [1]</b> <i>Australian National University</i> - Created a realistic galaxy simulation (Python, C++) on NCI Gadi Supercomputer (high-performance computing and parallelisation) costing $\sim 5+$ million CPU-h generating $\sim 30+$ TB data. - Developed new electron density prediction models using physics-informed machine learning (symbolic regression) and probability theory (Markov chain Monte Carlo) on easily available indirect observables. - Currently applying the Cosmic Ray Interstellar Propagation Tool (Stochastic calculus tool based on Itô Calculus) on the galaxy simulation to predict gamma-ray and radio observations.	Canberra, Australia April 2023 - Present
<b>Outreach Assistant, Publication Collection Officer</b> <i>Australian National University</i> - Hosted hundreds of school visits, private stargazing sessions, and gave 3 public talks. - Maintained and verified $\sim 1000$ publications from researchers around the department using the ARIES portal.	Canberra, Australia September 2023 - Present
<b>Research Collaborator [2], [4]</b> <i>Cardiff University</i> - Used AURIGA cosmological simulations containing over 100 billion datapoints containing $\sim 100$ different physical properties (100+ TB data). - Identified the cause of gas mixing from all different gas properties influencing it with various statistical tests between physics-informed quantities using Cardiff superclusters.	Cardiff, Wales July 2021 - Present
<b>Research Intern [3], [6]</b> <i>The Australian National University</i> - Cross-matched and queried (SQL) large catalogues of radio and optical observations to identify galaxy hosts in multiple wavelengths. - Measured the statistically significant (using the KS-test and Chi-squared test) magnetic field strength in elliptical galaxies using two independent physical methods.	Canberra, Australia May 2020 - June 2021
<i>Indian Space Research Organization (Space Applications Center)</i> - Simulated and tested a polarimetric synthetic aperture radar system (using MATLAB, Simulink, and ANSYS STK) to image the surface of Venus by performing trade-off studies between different radar, antenna, and orbital configurations to optimise the system.	Ahmedabad, India (May 2019 - July 2019)

## TECHNICAL SKILLS

Programming Languages:	FORTRAN, Python, C++, SQL
Scientific Computing:	MATLAB, Jupyter/Anaconda environment, high-performance and parallel computing using SSH servers, GitHub, VS Code, Docker
Software:	ANSYS STK, COMSOL MULTIPHYSICS 5.5, Latex, FLASH, GIZMO
Libraries:	pandas, NumPy, Matplotlib, SciPy, AstroPy, scikit-learn, PhasedArrayToolbox

## PUBLICATIONS

<i>First-author publications</i>
[1] <b>Hilay Shah</b> , Mark Krumholz, and Naomi McClure-Griffiths (2025). <i>published</i> in Monthly Notices of Royal Astronomical Society at link.
[2] <b>Hilay Shah</b> , Freeke van de Voort, Amit Seta, and Christoph Federrath (2025). <i>published</i> in Monthly Notices of Royal Astronomical Society at link.
[3] <b>Hilay Shah</b> and Amit Seta (2021). <i>published</i> in Monthly Notices of Royal Astronomical Society at link.
<i>Co-author publications</i>
[4] Nugent et al. (2024): Author-N = 4. <i>published</i> in the Astrophysical Journal: at link.
[5] Jabłońska et al. (2025): Author-N = 4. <i>submitted</i> in Royal Astronomical Society Techniques at link.
[6] Seth et al. (2022): Author-N = 2. <i>published</i> in 44th COSPAR Scientific Assembly at link.

[7] Nguyen et al. (2025): Author-N = 20. *published* in Monthly Notices of Royal Astronomical Society at link.

TALKS

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- Contributed talks: COMRAD 2024 (Italy), EAS 2025 (Ireland), II7 2025 (France)
- Seminar talks: MSSS 2023 (Australia), University of Oxford 2025, Leiden University 2025, Cardiff University 2025
- Public talks: Siding Spring Observatory Open Day 2025, Mt Stromlo Public Night 2024, Mulligans Flat Public Night 2025

AWARDS AND ACHIEVEMENTS

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- Olin J. Eggen Research Award (Best International PhD Student) - A\$2500.
- ANU Vice-Chancellor’s travel grant and Cardiff University research visitor travel grant (A\$3000).
- Travel funding for the COMRAD’24 conference in Pisa, Italy, the EAS 2025 in Ireland, the 18th Thinkshop in Germany, and the Interstellar Institute 7 in France (A\$10000).
- Awarded RSAA PhD and supplementary scholarships (2 selections out of 100 applications).
- Secured an All India Rank in the top 0.2% out of 1.2 million candidates in the JEE examination.
- Secured an All India Rank of 43 out of 33,000 candidates in the 7<sup>th</sup> National Interactive Math Olympiad (NIMO).

EXTRACURRICULAR AND OUTREACH ACTIVITIES

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- Mt Stromlo Observatory, RSAA**

  - Publication Collection Officer.
  - Senior outreach leader leading private nights and school visits.
  - Seminar committee host.
  - PhD selection committee student representative.
  - Organiser of the postdoc-student writing retreat 2024 and student writing retreat 2025.
- Canberra, Australia