

# Charlotte Ward

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## Education

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Ph.D., Astronomy, University of Maryland at College Park	2022
Thesis: <i>Tracing the formation and merger-driven growth of massive black holes with the Zwicky Transient Facility</i>	
M.Sc., Astronomy, University of Maryland at College Park	2019
B.Sc. (Adv) (Hons), Physics & Mathematics, University of Sydney	2016
Thesis: <i>Machine learning techniques for discovery of Fast Radio Bursts with the Parkes Radio Telescope</i>	

## Professional Employment and Internships

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Assistant Professor, The Pennsylvania State University	Starting 2025
Postdoctoral Research Associate, Princeton University	2022 – 2025
HEP Center for Computational Excellence Graduate Summer Internship, Lawrence Berkeley National Laboratory	2019
School of Physics Laboratory Tutor, University of Sydney	2017
Summer Scholar, Centre for Astronomy and Space Science, CSIRO	2014, 2015
Nanjing Research Exchange Visiting Scholar, Nanjing University	2015
Faculty of Science Information Officer, University of Sydney	2014 – 2015
Undergraduate research student, Quantum Control Laboratory, University of Sydney	2015
Undergraduate research student, Institute of Medical Physics, University of Sydney	2014

## Research interests

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Multi-resolution image modeling techniques for joint analysis of ground and space-based surveys; multi-wavelength analysis of astrophysical transients; dwarf galaxy AGN; changing-look AGN; tidal disruption events; strongly lensed QSOs and SNe; SMBH binaries; machine learning for transient classification and light curve prediction; large-scale pipelines for wide-field time-domain surveys.

## Grants and Observing Proposals (Principal Investigator)

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ICDS Rising Researcher Collaborations Seed Grant (Penn State, \$15K awarded)	2025
Mercedes Richards Career Development Professorship (Penn State, \$60K awarded)	2025
<i>A Scarlet2 framework for characterizing transients and their host galaxies</i>	
(LSST Discovery Alliance LINCC Frameworks Incubator Program, \$22.5K awarded)	2025
<i>Exploring the physical origin of compact millimeter emission in radio-quiet AGN with Swift</i>	
X-ray monitoring (Swift, \$8K awarded)	2025
<i>Unveiling disk formation and evolution in rebrightening tidal disruption events (WIYN)</i>	2025
<i>Understanding variable radio emission in changing-look AGN (VLA)</i>	2025

<i>Joint modeling of imaging data from LSST and complementary surveys to maximize early transient science</i> (LSST Discovery Alliance Small Grant Proposal, \$8K awarded)	2024
<i>Understanding young radio jets in changing-look AGN with ATCA</i> (ATCA)	2024
<i>Understanding episodic SMBH accretion triggering with changing-look AGN</i> (Magellan)	2023
<i>Investigating 10 Candidates for Gravitational Wave Recoil from an SMBH merger</i> (Keck, NASA allocation, \$15K awarded)	2023
<i>Confirming the presence of AGN for the variability-selected IMBH candidates from ZTF and WISE</i> (Magellan)	2023
<b>CoI:</b> Various HST, Chandra, VLA and ATCA proposals	2023 - 2025

## Research Advising

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### Graduate students

<i>Kendall Sippy (1st year):</i> Multi-resolution analysis of Rubin/LS4, MBH population studies	2025 –
<i>Miranda Zak (2nd year):</i> Millimeter/X-ray studies of radio-quiet AGN, changing-look AGN	2024 –
<i>Chloe Klare (4th year):</i> Young radio jets in AGN, anomaly detection in time-domain surveys	2024 –

### Undergraduate students

<i>Sufia Birmingham (Princeton astro):</i>	
2 x Undergraduate Summer Research Program, Junior Thesis → AAS Chambliss award	
1 submitted first-author publication, 3 co-authored publications	2022-2025
<i>Hy Truong (Princeton astro → MSc student SDSU):</i> Junior Thesis, Senior Thesis	2023-2025
<i>Veena Krishnaraj (Princeton astro):</i> Junior Thesis → publication in prep	2025 –
<i>Anavi Uppal (Yale astro → PhD student and NSF fellow at UCSC):</i>	
1 accepted first-author publication, AAS Chambliss award	2023
<i>Sophie Chen (Princeton engineering):</i> Senior Thesis	2023
<i>Abigail García-Pérez (GRAD-MAP student → PhD student University of Turin):</i>	
Winter Workshop project → 1 co-authored publication	2019
<i>Immaculate Oyoo (GRAD-MAP student):</i>	
Winter Workshop project → 1 co-authored publication	2019

### PhD thesis committee membership

Kyle Neumann (Penn State): ML techniques for X-ray/gamma-ray source classification	2025 –
Matt Sampson (Princeton): Latent ODEs for transient light curve prediction	2025 –

## Professional Service and Leadership

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<i>Discussion Panelist</i> , Hubble Space Telescope Cycle 32 Review & Cycle 33 Review	2024, 2025
<i>Discussion Panelist</i> , NSF Division of Astronomical Sciences	2025

<i>External proposal referee, Hubble Space Telescope DDT proposal</i>	2025
<i>LSST Builder Status, for 2 years FTE of direct observatory efforts</i>	2025
<i>Referee for MNRAS, ApJ, Nature Astronomy</i>	2022 - ongoing
<i>Invited Speaker, VLASS Epoch 4 Review Panel</i>	2024
<i>Member, Rubin/Euclid Derived Data Products WG</i>	2024 - 2025
<i>Member, VLASS Survey Science WG</i>	2024 - 2025
<i>Astrocoffee (arXiv journal club) host, Princeton University</i>	2023 - 2025
<i>Member, ZTF Black Holes WG</i>	2017 - 2022
<i>External proposal referee, CanTAC Gemini</i>	2022
<i>Co-coordinator of the Department of Astronomy Journal Club, University of Maryland</i>	2019-2021

## **Teaching: Classroom and Workshops**

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<i>Lecturer, Undergraduate Summer Research Program, Princeton University</i>	2024, 2025
<i>Instructor, GROWTH time-domain astronomy school, San Diego State University</i>	2020
<i>Teaching Assistant, 'Special Problems in Astronomy: Big Data', University of Maryland</i>	2018
<i>GRAD-MAP Python Bootcamp developer, University of Maryland</i>	2018
<i>Instructor, 3rd year computational physics lab, University of Sydney</i>	2017
<i>Instructor, 2nd year experimental physics lab, University of Sydney</i>	2017
<i>Grok Learning interactive programming course developer, University of Sydney</i>	2017

## **EDI and Public Outreach**

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<i>Peyton Observatory Public Observing: volunteer/ lead observer/co-coordinator , Princeton U.</i>	2022 - 2025
<i>EDI seminar series coordinator, Princeton University</i>	2023 - 2025
<i>Astronomy on Tap Trenton Chapter: co-coordinator/speaker, Princeton University</i>	2023 - 2024
<i>Postdoc - Grad Student Mentoring Program mentor, Princeton University</i>	2023 - 2025
<i>Solar Eclipse Festival: co-coordinator, Princeton University</i>	2024
<i>'Science Under the Stars' speaker, New Jersey State Museum &amp; Planetarium</i>	2024
<i>Co-lead of GRAD-MAP (Graduate Resources Advancing Diversity in Maryland Astronomy and Physics) program, University of Maryland</i>	2020-2021
<i>Astronomy outreach volunteer for UMD observatory, UMD Open House, Public Library STEM events, and Community College visits, University of Maryland</i>	2018-2021
<i>Pulse@Parkes High School Outreach Program volunteer, CSIRO</i>	2014-2015

## **Honors, Awards and Press Coverage**

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<i>Mercedes Richards Career Development Professorship, The Pennsylvania State U.</i>	2025
<i>Equity Prize for Outreach, Department of Astrophysical Sciences, Princeton U.</i>	2024
<i>Martin and Beate Block Winter Award, Aspen Center for Physics</i>	2023
<i>ZTF IMBH paper featured in Astrobites</i>	2023
<i>ZTF Recoiling AGN paper featured in New Scientist</i>	2021

<i>Graduate Student Summer Research Fellowship</i> , University of Maryland at College Park	2020
<i>Graduate School Dean's Fellowship for Astronomy</i> , University of Maryland at College Park	2017
<i>Physics Foundation Scholarship No III</i> , University of Sydney	2016
<i>School of Physics Honours Scholarship</i> , University of Sydney	2016
<i>Faculty of Science Merit Scholarship</i> , University of Sydney	2013-2015
<i>School of Physics Smith Prize in Experimental Physics</i> , University of Sydney	2013

## Selected Colloquia, Seminars and Conference Talks

<i>Invited Seminar</i> , Berkeley Theoretical Astrophysics Center	2025
<i>Contributed Talk</i> , Data-Driven Discovery in the Rubin Era, SLAC	2025
<i>Contributed Talk</i> , Transients in Space, STScI	2025
<i>Contributed Talk</i> , Aspen Winter Conference: The Era of Binary SMBHs	2025
<i>Contributed Talk</i> , AAS Winter Meeting	2025
<i>Internal Talk</i> , Bahcall Lunch, Princeton U./IAS	2025
<i>Invited Talk</i> , HEACOSS-2024 conference	2024
<i>Invited Talk</i> , SIFA Morning Tea, University of Sydney School of Physics	2024
<i>Invited Seminar</i> , Naval Research Laboratory Remote Sensing Division	2024
<i>Contributed Talk</i> , Rubin Community Workshop	2024
<i>Contributed Talk</i> , Tidal Disruption Events and Nuclear Transients conference	2024
<i>Contributed Talk</i> , BASS2024 Team Meeting	2024
<i>Internal Talk</i> , Thursday Lunch Talks, Princeton U.	2024
<i>Invited Colloquium</i> , The Pennsylvania State University, Department of Astronomy	2023
<i>Contributed Talk</i> , IMBHs: The Dawn of a Revolutionary Era conference	2023
<i>Invited Seminar</i> , ASKAP Variable And Slow Transients (VAST) team meeting	2023
<i>Contributed Talk</i> , Aspen Winter Conference: eXtreme Black Holes	2023
<i>Invited Colloquium</i> , Lawrence Berkeley National Laboratory, Computer Sciences Division	2022
<i>Invited Seminar</i> , Stanford KIPAC Tea Talk	2022
<i>Invited Colloquium</i> , Lawrence Berkeley National Laboratory, Physics Division	2022
<i>Invited Colloquium</i> , Australia Telescope National Facility, CSIRO	2022
<i>Invited Seminar</i> , Nanograv Meeting	2022
<i>Contributed Talk</i> , IMBHS: New Science from Stellar Evolution to Cosmology conference	2022
<i>Contributed Talk</i> , Aspen Winter Conference: Dynamical Formation of GW Sources	2022
<i>Invited Seminar</i> , Johns Hopkins University AGN Journal Club	2021
<i>Invited Seminar</i> , NASA Goddard AGN Seminar Series	2021
<i>Contributed Talks</i> , ZTF Team Meetings in Stockholm, Tel Aviv, and Pasadena	2018-2019

## Selected Peer-Reviewed and Submitted Publications

**39 total, 25 with significant contributions**, h-index=23, 4703 total citations.

\*: graduate student †: undergraduate student

**Ward, C.**, Koss, M. et al. ‘BASS LII: Clues from Twin Peaks — Investigating AGN accretion disks at low Eddington ratios using hard X-ray selected double-peaked emitters’, in press ApJ, arXiv: 2507.05380.

**Ward, C.**, Melchior, P., Sampson, M.\* et al. ‘Disentangling transients and their host galaxies with Scarlet2: A framework to forward model multi-epoch imaging’, **2025**, Astronomy and Computing, 51, 100930.

**Ward, C.**, Gezari, S., Nugent, P et al. ‘Panic at the ISCO: time-varying double-peaked broad lines from evolving accretion disks are common amongst optically variable AGN’, **2024**, The Astrophysical Journal, 961, 172.

**Ward, C.**, Gezari, S., Nugent, P et al. ‘Variability-selected intermediate mass black hole candidates in dwarf galaxies from ZTF and WISE’, **2022**, The Astrophysical Journal, 936, 104.

**Ward, C.**, Gezari, S., Frederick, S. et al. ‘AGNs on the Move: A Search for Off-nuclear AGNs from Recoiling Supermassive Black Holes and Ongoing Galaxy Mergers with the Zwicky Transient Facility’, **2021**, The Astrophysical Journal, 913, 102.

Birmingham, S.<sup>†</sup>, **Ward, C.** et al. ‘The birth of young radio jets in changing-look AGN: a population study’, submitted to ApJ, arXiv: 2507.01355.

Melchior P., **Ward, C.** et al. ‘scarlet2: Astronomical scene modeling in jax’, submitted to JOSS.

Yao, Y., Chornock, R., **Ward, C.** et al. ‘A Massive Black Hole 0.8 kpc from the Host Nucleus Revealed by the Offset Tidal Disruption Event AT2024tvd’, **2025**, ApJL, 985, L48.

Onoue, M. et al., (author 7 of 35), ‘A Post-Starburst Pathway to Forming Massive Galaxies and Their Black Holes at  $z > 6$ ’, **2025**, in press Nature Astronomy, arXiv: 2409.07113.

Liu, Y.<sup>†</sup>, Burke, C. et al. (author 7 of 7), ‘Dwarf Active Galactic Nuclei from Variability for the Origins of Seeds (DAVOS): Properties of Variability-Selected AGNs in the Dark Energy Survey Deep Fields’, **2025**, submitted to ApJ, arXiv: 2503.06372.

Sampson, M.\*, Melchior, P., **Ward, C.**, Birmingham, S.<sup>†</sup> ‘Score matching diffusion models as data-driven priors for improved multi-band source separation’, **2024**, Astronomy and Computing, Volume 49, id.100875, doi:10.1016/j.ascom.2024.100875.

Uppal, A.<sup>†</sup>, **Ward C.**, et al. ‘Astrometric Jitter as a Detection Diagnostic for Recoiling and Slingshot Supermassive Black Hole Candidates’, **2024**, ApJ, 975, 286.

Ridley, E.\* , Nicholl, M., **Ward, C.** et al. ‘AT2017bcc: time-varying double-peaked emission lines following the sudden ignition of a dormant galactic nucleus’, **2024**, MNRAS, 531, 1905.

Burke, C., Liu, Y.<sup>†</sup>, **Ward, C.** et al. ‘Dwarf AGNs from Variability for the Origins of Seeds (DAVOS): Properties of Variability-Selected AGNs in the COSMOS Field and Expectations for Rubin Observatory’, **2024**, ApJ, 971, 140.

Liang, Y.\* , Melchior, P., et al. (author 7 of 7) ‘Outlier Detection in the DESI Bright Galaxy Survey’, **2023**, ApJL, 956, L6.

- Liang, Y.\*, Melchior, P. et al. (author 5 of 5), ‘Autoencoding Galaxy Spectra II: Redshift Invariance and Outlier Detection’, **2023**, ApJ, 166, 75.
- Hammerstein, E.\*, Gezari, S. et al. (author 7 of 9), ‘Integral Field Spectroscopy of 13 Tidal Disruption Event Hosts from the ZTF Survey’, **2023**, ApJ, 957, 86.
- Arcodia, R. et al (author 17 of 19), ‘O Corona, where art thou? eROSITA’s view of UV-optical-IR variability-selected massive black holes in low-mass galaxies’, **2023**, A&A, 681, A97.
- Brightman, M., **Ward, C.** et al. ‘A Luminous X-Ray Transient in SDSS J143359.16+400636.0: A Likely Tidal Disruption Event’, **2021**, The Astrophysical Journal, 909, 102.
- Hammerstein, E.\*, Gezari, S., van Velzen, S. et al. (author of 6 of 20) ‘Tidal Disruption Event Hosts Are Green and Centrally Concentrated: Signatures of a Post-merger System’, Erica Hammerstein et al. **2021**, ApJL, 908, L20.
- van Velzen, S., Hammerstein, E.\*, Gezari, S., et al. (author 6 of 44) ‘Seventeen Tidal Disruption Events from the First Half of ZTF Survey Observations: Entering a New Era of Population Studies’, **2021**, ApJ, 908, 4.
- Frederick, S. et al. (author 8 of 20), ‘A Family Tree of Optical Transients from Narrow-Line Seyfert 1 Galaxies’, **2021**, ApJ, 920, 56.
- Stein, R. et al. (including Ward, C.), ‘A tidal disruption event coincident with a high-energy neutrino’, **2021**, Nature Astronomy, 5, 510.
- Coppejans, D. L. et al. (author 22 of 38), ‘A Mildly Relativistic Outflow from the Energetic, Fast-rising Blue Optical Transient CSS161010 in a Dwarf Galaxy’, **2020**, ApJL 895, L23.
- Andreoni, I. et al. (author 16 of 52), ‘GROWTH on S190814bv: Deep Synoptic Limits on the Optical/Near-infrared Counterpart to a Neutron Star-Black Hole Merger’, **2020**, ApJ, 890, 131.
- van Velzen, S. et al. (author 15 of 41), ‘The First Tidal Disruption Flare in ZTF: From Photometric Selection to Multi-wavelength Characterization’, **2019**, ApJ, 172, 198.
- Mahabal, A. et al. (author 15 of 50), ‘Machine Learning for the Zwicky Transient Facility’, **2019**, PASP, 131, 997.
- Frederick, S. J. et al. (author 15 of 20), ‘A New Class of Changing-look LINERs’, **2019**, The Astrophysical Journal, 883, 31.
- Hung, T. et al. (author 15 of 28), ‘Discovery of Highly Blueshifted Broad Balmer and Metastable Helium Absorption Lines in a Tidal Disruption Event’, ApJ, **2019**, 879, 119.
- Duev, D. et al. (author 11 of 11), ‘Real-bogus classification for the Zwicky Transient Facility using deep learning’, **2019**, MNRAS, 489, 3582.
- van Roestel, J. et al. (author 10 of 12), ‘Simultaneous Observations of the Northern TESS Sectors by the Zwicky Transient Facility’, **2019**, RNAAS, 3, 9, 136.

Perley, D. et al. (author 63 of 65), ‘The fast, luminous ultraviolet transient AT2018cow: extreme supernova, or disruption of a star by an intermediate-mass black hole?’, **2019**, The Monthly Notices of the Royal Astronomical Society, 484, 1.

Dobie, D. . et al. (author 28 of 30), ‘An ASKAP Search for a Radio Counterpart to the First High-significance Neutron Star—Black Hole Merger LIGO/Virgo S190814bv’, **2019**, The Astrophysical Journal, 887, 13.

Nordin, J. et al. (including Ward, C.), ‘Transient processing and analysis using AMPEL: alert management, photometry, and evaluation of light curves’, **2019**, A&A, 631, 147.

Kerr, M. et al. (author 3 of 6), ‘Extreme Scattering Events Towards Two Young Pulsars’, **2018**, MNRAS, 474, 4.

Hobbs, G. et al. (author 9 of 78), ‘A pilot ASKAP survey of radio transient events in the region around the intermittent pulsar PSR J1107- 5907’, **2016**, MNRAS, 456, 4.

Lynch, C. et al. (author 6 of 6), ‘Radio detections of southern ultracool dwarfs’, **2016**, The Monthly Notices of the Royal Astronomical Society, 457, 2.

## White Papers:

**Ward, C.**, Nugent P. & Strauss M., ‘After SDSS-V Blue Skies Ideas: Unveiling transients and their host galaxies in the era of time-domain surveys’, internal white paper, **2024**.

Nyland, K. et al. (including **Ward, C.**) ‘VLASS Epoch 4 Science Case’ white paper, **2024**, <https://science.nrao.edu/vlass/library/white-papers>.

## References

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