

Charlotte Ward

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Education

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

Professional Employment and Internships

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

Research interests

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)

<i>Institute for Computational and Data Sciences Rising Researcher Collaborations Seed Grant</i> (Penn State, \$18K awarded)	2025
<i>Mercedes Richards Career Development Professorship</i> (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 X-ray monitoring</i> (Swift, \$8K awarded)	2025
<i>Unveiling disk formation and evolution in rebrightening tidal disruption events</i> (WIYN)	2025
<i>Understanding variable radio emission in changing-look AGN</i> (VLA)	2025
<i>Joint modeling of imaging data from LSST and complementary surveys to maximize early transient science</i> (LSST Discovery Alliance Small Grants, \$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
CoI: Various HST, Chandra, VLA and ATCA proposals	2023 - 2025

Research Advising

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 (5th year):</i> Young radio jets in AGN, anomaly detection in time-domain surveys	2024 –

Undergraduate students

<i>Grace Davis (Penn state astro):</i> Sophomore research project	2025
<i>Naren Arun (Penn state astro):</i> Junior research project	2025
<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, Senior 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 –
Mary Ogborn (Penn State): Accretion disk simulations for reverberation mapping	2025 –

Professional Service and Leadership

<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>LSST Builder Status</i> , For 2 years FTE of direct observatory efforts	2025
<i>External proposal referee</i> , Hubble Space Telescope DDT proposal	2025
<i>Referee for MNRAS, ApJ, Nature Astronomy</i>	2022 - ongoing
<i>Invited Speaker</i> , VLASS Epoch 4 Review Panel	2024
<i>Member</i> , LS4 Black Holes WG	2025 - ongoing
<i>Member</i> , Rubin/Euclid Derived Data Products WG	2024 - ongoing
<i>Member</i> , BASS survey collaboration	2024 - ongoing
<i>Member</i> , VLASS Survey Science WG	2024 - ongoing
<i>Member</i> , LSST AGN Science WG	2024 - ongoing
<i>Astrocoffee (arXiv journal club) host</i> , Princeton University	2023 - 2025
<i>Member</i> , ZTF Black Holes WG	2017 - 2022
<i>External proposal referee</i> , CanTAC Gemini	2022
<i>Co-coordinator of the Department of Astronomy Journal Club</i> , University of Maryland	2019-2021

Teaching: Classroom and Workshops

<i>ASTRO 589 Graduate Seminar: Survey Science</i> , Penn State	2025
<i>Lecturer</i> , Undergraduate Summer Research Program seminars, Princeton University	2024, 2025
<i>Instructor</i> , GROWTH time-domain astronomy school, San Diego State University	2020
<i>Teaching Assistant</i> , ‘Special Problems in Astronomy: Big Data’, University of Maryland	2018
<i>GRAD-MAP Python Bootcamp developer</i> , University of Maryland	2018
<i>Instructor</i> , 3rd year computational physics lab, University of Sydney	2017
<i>Instructor</i> , 2nd year experimental physics lab, University of Sydney	2017
<i>Grok Learning interactive programming course developer</i> , University of Sydney	2017

EDI and Public Outreach

<i>Astronomy on Tap State College: speaker</i> , Penn State	2025
<i>Peyton Observatory Public Observing: volunteer/lead observer/co-coordinator</i> , Princeton U.	2022 - 2025
<i>EDI seminar series coordinator</i> , Princeton University	2023 - 2025
<i>Astronomy on Tap Trenton: co-coordinator/speaker</i> , Princeton University	2023 - 2024
<i>Postdoc - Grad Student Mentoring Program mentor</i> , Princeton University	2023 - 2025
<i>Solar Eclipse Festival: co-coordinator</i> , Princeton University	2024
<i>‘Science Under the Stars’ speaker</i> , New Jersey State Museum & Planetarium	2024
<i>Co-lead of GRAD-MAP (Graduate Resources Advancing Diversity in Maryland Astronomy and Physics) program</i> , University of Maryland	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

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

Selected Colloquia, Seminars and Conference Talks

<i>Invited Talk, Accretion History of AGN, Miami</i>	2025
<i>Invited Seminar, University of Kentucky</i>	2025
<i>Invited Talk, LINCC Tech Talks, LSST Discovery Alliance</i>	2025
<i>Contributed Talk, Strongly Lensed Transients from Rubin: Readiness Workshop</i>	2025
<i>Invited Seminar, Berkeley Theoretical Astrophysics Center</i>	2025
<i>Contributed Talk, Data-Driven Discovery in the Rubin Era, SLAC</i>	2025
<i>Contributed Talk, Transients in Space, STScI</i>	2025
<i>Contributed Talk, Aspen Winter Conference: The Era of Binary SMBHs</i>	2025
<i>Contributed Talk, AAS Winter Meeting</i>	2025
<i>Internal Talk, Bahcall Lunch, Princeton U./IAS</i>	2025
<i>Invited Talk, HEACOSS-2024 conference</i>	2024
<i>Invited Talk, SIFA Morning Tea, University of Sydney School of Physics</i>	2024
<i>Invited Seminar, Naval Research Laboratory Remote Sensing Division</i>	2024
<i>Contributed Talk, Rubin Community Workshop</i>	2024
<i>Contributed Talk, Tidal Disruption Events and Nuclear Transients conference</i>	2024
<i>Contributed Talk, BASS2024 Team Meeting</i>	2024
<i>Internal Talk, Thursday Lunch Talks, Princeton U.</i>	2024
<i>Invited Colloquium, The Pennsylvania State University, Department of Astronomy</i>	2023
<i>Contributed Talk, IMBHs: The Dawn of a Revolutionary Era conference</i>	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, 4873 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.[†], **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**, Nature Astronomy, doi:10.1038/s41550-025-02628-1.

Gulanti, A.* et al (author 5 of 27), ‘ASKAP J0055–2558: A Luminous, Long-Lived Radio Transient at $z = 0.1$ – an Orphan Afterglow or a Jetted TDE from an IMBH?’, **2025**, submitted to ApJ.

Liu, Y.[†], 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.

Miller et al., (including Ward, C.), ‘The La Silla Schmidt Southern Survey’, **2025**, in press PASP, arXiv: 2503.14579.

Sampson, M.*, Melchior, P., **Ward, C.**, Birmingham, S.[†] ‘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.[†], **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.[†], **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’, **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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