Charlotte Ward

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Education

Ph.D., Astronomy, University of Maryland at College Park — 2022
Thesis: *Tracing the formation and merger-driven growth of massive black holes with the Zwicky Transient Facility*
Advisors: *Suvi Gezari & Peter Nugent*

M.Sc., Astronomy, University of Maryland at College Park — 2019

B.Sc. (Adv) (Hons), Physics & Mathematics, University of Sydney — 2016
Thesis: *Machine learning techniques for discovery of Fast Radio Bursts with the Parkes Radio Telescope*
Advisor: *Tara Murphy*

Professional Employment and Internships

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

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)

Mercedes Richards Career Development Professorship (Penn State, $60K awarded) — 2025
A Scarlet2 framework for characterizing transients and their host galaxies
(LSST Discovery Alliance LINCC Frameworks Incubator Program, $22.5K awarded) — 2025
Exploring the physical origin of compact millimeter emission in radio-quiet AGN with Swift X-ray monitoring (Swift, $8K awarded) — 2025
Unveiling disk formation and evolution in rebrightening tidal disruption events (WIYN) — 2025

Understanding variable radio emission in changing-look AGN (VLA) 2025

Joint modeling of imaging data from LSST and complementary surveys to maximize early transient science (LSST Discovery Alliance Small Grant Proposal, $8K awarded) 2024

Understanding young radio jets in changing-look AGN with ATCA (ATCA) 2024

Understanding episodic SMBH accretion triggering with changing-look AGN (Magellan) 2023

Investigating 10 Candidates for Gravitational Wave Recoil from an SMBH merger (Keck, NASA allocation, $15K awarded) 2023

Confirming the presence of AGN for the variability-selected IMBH candidates from ZTF and WISE (Magellan) 2023

CoI: Various HST, Chandra, VLA and ATCA proposals 2023 - 2025

Research Advising

Graduate students

Kendall Sippy (1st year): Multi-resolution analysis of Rubin/LS4, MBH population studies 2025 –

Miranda Zak (2nd year): Millimeter/X-ray studies of radio-quiet AGN, changing-look AGN 2024 –

Chloe Klare (4th year): Young radio jets in AGN, anomaly detection in time-domain surveys 2024 –

Undergraduate students

Sufia Birmingham (Princeton astro):

2 x Undergraduate Summer Research Program, Junior Thesis → AAS Chambliss award

1 submitted first-author publication, 3 co-authored publications 2022-2025

Hy Truong (Princeton astro → MSc student SDSU): Junior Thesis, Senior Thesis 2023-2025

Veena Krishnaraj (Princeton astro): Junior Thesis → publication in prep 2025 –

Anavi Uppal (Yale astro—> PhD student and NSF fellow at UCSC):

1 accepted first-author publication, AAS Chambliss award 2023

Sophie Chen (Princeton engineering): Senior Thesis 2023

Abigail García-Pérez (GRAD-MAP student → PhD student University of Turin):

Winter Workshop project → 1 co-authored publication 2019

Immaculate Oyoo (GRAD-MAP student):

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

Discussion Panelist, Hubble Space Telescope Cycle 32 Review & Cycle 33 Review 2024, 2025

Discussion Panelist, NSF Division of Astronomical Sciences 2025

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

Teaching: Classroom and Workshops

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

EDI and Public Outreach

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

Honors, Awards and Press Coverage

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

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

Selected Colloquia, Seminars and Conference Talks

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

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.†, 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.† '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', 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 Roestal, 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

Prof. Peter Melchior
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