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*

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*

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	2015, 2016
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-wavelength analysis of astrophysical transients; dwarf galaxy AGN; changing-state AGN; tidal disruption events; strongly lensed QSOs and SNe; SMBH binaries; pulsar optical variability; multi-resolution image modeling techniques for joint-survey analysis; large-scale pipelines for wide-field time-domain surveys.

Grants and Observing Proposals

PI: *Exploring the physical origin of compact millimeter AGN in radio-quiet AGN with Swift X-ray monitoring* (Swift, $8K awarded)	2025
PI: *Unveiling disk formation and evolution in rebrightening tidal disruption events* (WIYN)	2025
PI: *Understanding variable radio emission in changing-look AGN (VLA)*	2025
PI: *Joint modeling of imaging data from LSST and complementary surveys to maximize early transient science* (LSST Discovery Alliance Small Grant Proposal, $8K awarded)	2024
PI: *Understanding young radio jets in changing-look AGN with ATCA* (ATCA)	2024
PI: *Understanding episodic SMBH accretion triggering with changing-look AGN*	

(Magellan) 2023

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

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

Honors, Awards and Press Coverage

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 article 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, Transients in Space, STScI 2025

Contributed Talk, Aspen Winter Conference: The Era of Binary SMBHs 2025

Contributed Talk, AAS Winter Meeting 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

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

EDI and Public Outreach

Peyton Observatory Public Observing: volunteer/ lead observer/co-coordinator , Princeton U. 2022 - 2024
EDI seminar series coordinator, Princeton University 2023 - 2024
Astronomy on Tap Trenton Chapter: co-coordinator/speaker, Princeton University 2023 - 2024
Postdoc - Grad Student Mentoring Program mentor, Princeton University 2023 - 2024
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, University of Maryland. Selected events:
- GRAD-MAP Open House (speaker, coordinator) 2019-2021
- GRAD-MAP visits to Prince George's Community College, Howard University, Montgomery CC and Howard CC (speaker, coordinator) 2019-2021
- Anne Arundel County Public Library's STEM day (volunteer) 2019
- UMD observatory Open House (volunteer) 2018

Pulse@Parkes High School Outreach Program volunteer, CSIRO 2014-2015

Professional Service and Leadership

Discussion Panelist, Hubble Space Telescope Cycle 32 Review 2024
Invited Speaker, VLASS Epoch 4 Review Panel 2024
Astrocoffee (arXiv journal club) host, Princeton University 2023 - ongoing
Referee for MNRAS, ApJ 2022 - ongoing
VLASS Survey Science working group 2024 - ongoing
CanTAC Gemini external proposal referee 2022
Co-coordinator of the Department of Astronomy Journal Club, University of Maryland 2019-2021

Teaching and Research Mentoring

Undergraduate Summer Research Program Advisor, Princeton University 2023, 2024
Undergraduate Junior Thesis Advisor, Princeton University 2023, 2024
Undergraduate Senior Thesis Advisor, Princeton University 2024
Masters Thesis Co-advisor (engineering), Princeton University 2023
Undergraduate Summer Research Program Co-Advisor, Space Telescope Science Institute 2023
GROWTH time-domain astronomy school tutor, San Diego State University 2020
Research advisor, GRAD-MAP Winter Workshop, University of Maryland 2019

Teaching Assistant, 'Special Problems in Astronomy: Big Data', University of Maryland	2018
Research Co-advisor, GRAD-MAP Winter Workshop, University of Maryland	2018
GRAD-MAP Python Bootcamp developer, University of Maryland	2018
3rd year computational physics lab tutor, University of Sydney	2017
2nd year experimental physics lab tutor, University of Sydney	2017
Grok Learning interactive programming course developer, University of Sydney	2017

Selected Peer-Reviewed and Submitted Publications

36 total, 22 with significant contributions, h-index=21, 3097 total citations.

*****: graduate student †: undergraduate student

Ward, C., Melchior, P., Sampson, M.* et al. 'Disentangling transients and their host galaxies with Scarlet2: A framework to forward model multi-epoch imaging', in press Astronomy and Computing, 2025, arXiv: 2409.15427.

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.

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', in press ApJ, **2024,** arXiv: 2405.11026.

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.

Onoue, M. et al., (author 7 of 35), 'A Post-Starburst Pathway to Forming Massive Galaxies and Their Black Holes at z>6', submitted to Nature Astronomy, **2024**, arXiv: 2409.07113.

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

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.

Papers in preparation

Ward, C., Sampson, M.*, et al. 'Strongly lensed supernovae in focus: deblending marginally resolved lenses via joint modeling of ground and space-based imaging'

Ward, C., Kerr, M., et al. 'Optical detections and upper limits for radio pulsars in the PanSTARRS, HSC-wide and Legacy Surveys', in prep.

Ward, C., et al. 'Double-peaked emitters in hard X-ray-selected AGN populations', in prep.

Birmingham, S.[†], **Ward, C.** et al. 'The onset of optical variability and launching of young radio jets in changing-state AGN', in prep.

Skills

Software: Key astronomy and computing software such as jax, Github, Docker, Swarp, Scamp, Sextractor, Psfex, Aplpy, astropy, ds9, Hotpants, iraf, LaTeX, scikit-learn.
Observing and data reduction: Obtaining and reducing optical imaging, spectrograph and IFU observations.
Time-domain astronomy tools: Source investigation and follow-up with the Transient Name Server, Vizier, NED, the HEASARC Data Archive, the GROWTH Marshal, SkyPortal and alert brokers such as AMPEL.
Transient alert filtering: Developing filters for transient alerts from large optical surveys and implementing machine learning classifiers for transient discovery.
Optical image modeling: Forward modeling optical images for source characterization and photometry.

High performance computing: Developing software for computationally intensive analysis and processing of large data sets on supercomputing clusters, including on GPUs. Use of cluster resource management and checkpointing software. Use of HPSS archives for data storage.

Database management: SQL query construction. Use of postgreSQL for database management.

References

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