EMIKO C. GARDINER

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EDUCATION

Ph.D. in Astrophysics, University of California at Berkeley, Berkeley, CA (expected) May 2028

M.A. in Astrophysics, University of California at Berkeley, Berkeley, CA May 2024

B.S. in Physics and Engineering Science, University of Virginia, Charlottesville, VA May 2022
Rodman Scholar, Dean's List, Highest Distinction, Cumulative GPA: 3.83/4, Physics GPA: 3.92/4

RESEARCH

University of California, Berkeley / NANOGrav Jan 2023–present
Graduate Student Researcher, NANOGrav Associate Member, Advisor: Luke Z. Kelley *Berkeley, CA*
- Predicting GW anisotropy and continuous waves (CWs) from supermassive black hole binaries by with semi-analytic simulations of massive black hole binary populations.
- Placing constraints on astrophysical models for galaxy populations and binary evolution based on current nondetection of CWs and upper limits on anisotropy.

Virginia/Chalmers Initiative on Cosmic Origins May 2021–Aug 2022
Undergraduate Research Fellow, Advisors: Jonathan Tan, Jan Staff, Jon Ramsey *Gothenburg, Sweden*
- Modeled shocks, photoionization, and free-free emission in a 3D magnetohydrodynamic simulation of massive protostellar disk-wind driven outflow.
- Predicted observables including ionization fraction, emissions intensity, spectra, and flux variability using Python. Compared these predicted observables to both observations and theory.

National Radio Astronomy Observatory May 2020–May 2021
Summer Student Researcher (NSF REU), Advisors: Ilsang Yoon, Bjorn Emonts *Charlottesville, VA*
- Identified 39 strong X-shaped Radio Galaxy (XRG) candidates by their radio morphology and imaged them with SA0Imageds9
- Conducted spectral decomposition on 63 strong XRG candidates for [OIII] emission line analysis from a pool of all 236 then-known XRGs and classified them as single or doubled-peaked Gaussians by comparing their reduced χ^2 values, BIC, and AIC
- Correlated spectral classifications to physical scenarios, finding support for the relic emissions model in which relic jets are left after a change in spin due to coalescing binary SMBHs

Duke Free Electron Laser Lab: High Intensity Gamma-ray Source Feb 2019–May 2020
Student Research Assistant, JLB Physics Lab, Blaine Norum *Charlottesville, VA*
- Conducted a research project minimizing the error in polarization observables for low-energy deuteron photodisintegration scattering experiments studying the strong interaction
- Developed procedures for building and testing liquid scintillator detectors

Fermilab: Mu2e Cosmic Ray Veto Detector Jan 2019–Aug 2019
Student Lab Technician, High Energy Physics Lab, Craig Group *Charlottesville, VA*
- Worked on all aspects of assembly and quality testing of the Cosmic Ray Veto for Fermilab's Mu2e experiment
- Developed and wrote the procedure for silicon photomultiplier (SiPM) manifold assembly

FIRST AUTHOR PUBLICATIONS

Gardiner, E. C., Bécse, B., Kelley, L. Z., Cornish, N. (*submitted to ApJ*), "Characterizing Continuous Gravitational Waves from Supermassive Black Hole Binaries in Realistic Pulsar Timing Array Data", arXiv:2502.16016

Gardiner, E. C., Kelley, L. Z., Lemke, A., Mitridate, A. (2024), "Beyond the Background: Gravitational Wave Anisotropy and Continuous Waves from Supermassive Black Hole Binaries", ApJ, 965, 164

Gardiner, E. C., Tan, J. C., Staff, J. E., Ramsey, J. P., Zhang, Y., Tanaka, K. E. (2024), "Shock-Ionized Jets from Massive Protostars", ApJ, 967, 145

NTH AUTHOR PUBLICATIONS

Agazie et al. (2023), "The NANOGrav 15-year Data Set: Constraints on Supermassive Black Hole Binaries from the Gravitational Wave Background", ApJL, 951, L8

Agazie et al. (2023), "The NANOGrav 15-year Data Set: The NANOGrav 15-year Data Set: Search for Anisotropy in the Gravitational-Wave Background", ApJL, 956, L3

Agazie et al. (2025), "The NANOGrav 15 yr Data Set: Running of the Spectral Index", ApJL, 978, L29

Agazie et al. (2025), "The NANOGrav 15 Yr Data Set: Removing Pulsars One by One from the Pulsar Timing Array", ApJ, 978, 168

Burnette et al. (*submitted to ApJL*), "The NANOGrav 15-year Data Set: Search for Gravitational Wave Memory", arXiv:2502.18599

Agazie et al. (*submitted to ApJ*), "The NANOGrav 15 yr Data Set: Harmonic Analysis of the Pulsar Angular Correlations", arXiv:2411.13472

Laal, N. et al. (*submitted to PRD*), "Deep Neural Emulation of the Supermassive Black-hole Binary Population", arXiv:2411.10519

Chen, Y. et al. (*submitted to Science*), "Galaxy Tomography with the Gravitational Wave Background from Supermassive Black Hole Binaries", arXiv:2411.05906

Agazie et al. (*submitted to PRD*), "The NANOGrav 15 yr data set: Posterior predictive checks for gravitational-wave detection with pulsar timing arrays", arXiv:2407.20510

PRESENTATIONS, CONFERENCES, & WORKSHOPS

The Origin and Evolution of Supermassive Black Holes, Sexten, Italy (Jul 2024). Gardiner, E. C., Kelley, L. Z., Bécsy, B., Lemke, A., Mitridate, A. *Continuous Wave Predictions and Constraints*.

International Pulsar Timing Array 2024 Meeting, Sexten, Italy, (Jun 24). Gardiner, E. C., Kelley, L. Z., Bécsy, B., Lemke, A., Mitridate, A. *Continuous Wave Predictions and Constraints*.

NANOGrav Fall 2024 Collaboration Meeting, Ann Arbor, MI, (Oct 2024). Gardiner, E. C., Bécsy B., Kelley L. Z. *Continuous Wave Constraints and Forecasts*.

Hernquist Group, Harvard-Smithsonian Center for Astrophysics, Boston, MA, (Feb 2024). Gardiner, E. C., Kelley, L. Z. *The Gravitational Wave Background and Beyond*.

ITC Luncheon, Harvard-Smithsonian Center for Astrophysics, Boston, MA, (Feb 2024). Gardiner, E. C., Kelley, L. Z., Lemke, A., Mitridate, A. *Beyond the Background: Gravitational Wave Anisotropy and Continuous Waves from Supermassive Black Hole Binaries*.

VICO/CICO Fall Workshop, Hybrid (Dec 2023). Gardiner, E. C., Kelley, L. Z., Lemke, A., Mitridate, A. *Beyond the Background: Gravitational Wave Anisotropy and Continuous Waves from Supermassive Black Hole Binaries*.

NANOGrav Fall 2023 Collaboration Meeting and Student Workshop, Vancouver, Canada (Oct 2023). Gardiner, E. C., Kelley, L. Z., Lemke, A., Mitridate, A. *Beyond the Background: Gravitational Wave Anisotropy and Continuous Waves from Supermassive Black Hole Binaries*.

International Pulsar Timing Array Gravitational Wave Analysis Telecon, Virtual, (Oct 2023). Gardiner, E. C., Kelley, L. Z., Lemke, A., Mitridate, A. *Beyond the Background: Gravitational Wave Anisotropy and Continuous Waves from Supermassive Black Hole Binaries*.

Berkeley Astronomy Department Short Talks, Berkeley, CA, (Sep 2023), Gardiner, E. C., Kelley, L. Z., Lemke, A., Mitridate, A. *Beyond the Background: Gravitational Wave Anisotropy and Continuous Waves from Supermassive Black Hole Binaries*.

Short Talk, Berkeley Astronomy Department, Berkeley, CA, (Jan 2023), Gardiner, E. C., Tan, J., Staff, J., Ramsey, J. *Shock and Photo Ionization from Massive Protostars*.

The 241st Meeting of the American Astronomical Society, Seattle, WA, (Jan 2023). Gardiner, E., Tan, J., Staff, J., Ramsey, J. *Ionization from Massive Protostars*.

CASSUM-VICO 2022 Summer Student Symposium, Gothenburg, Sweden, (Jul 2022). Gardiner, E. C., Advised by Staff, J., Tan, J. *Ionization from Massive Protostars*.

From Stars to Galaxies II, Chalmers University of Technology, Gothenburg, Sweden (Jun 2022). Gardiner, E., Tan, J., Staff, J., Ramsey, J. *Shock-Ionized Jets from Massive Protostars* [Poster and Prize Talk].

CASSUM-VICO 2021 Summer Student Symposium, Virtual, (Jul 2021). Gardiner, E., Advised by Staff, J., Ramsey, J., Tan, J. *Shock-Ionized Jets from Massive Protostars* [Virtual Presentation].

The 237th Meeting of the American Astronomical Society, Virtual, (Jan 2021). Gardiner, E., Yoon, I., Emonts, B. *Searching for X-Shaped Radio Galaxies Hosting Binary Supermassive Blackholes* [iPoster].

Undergraduate Research Network, University of Virginia, Virtual, (Sep 2020). Gardiner, E., Yoon, I., Emonts, B. *Searching for X-Shaped Radio Galaxies Hosting Binary Supermassive Blackholes*.

National Radio Astronomy Observatory Summer Student Symposium, Virtual, (Aug 2020). Gardiner, E., Advised by Yoon, I., Emonts, B., *Searching for X-Shaped Radio Galaxies Hosting Binary Supermassive Black Holes* [Virtual Presentation].

CONFERENCES & WORKSHOPS

Society for Women in Physical Sciences Symposium, U.C. Berkeley, Berkeley, CA, (Apr 2024). Gardiner, E. C., Willis, S. *Multi-messenger Signatures of Binary Black Holes Symposium* [Oral Presentation, Facilitator].

Establishing Multimessenger astronomy Inclusive Training Summer Program, Nashville, TN, (Jul 2023).

Code/Astro Software Engineering Workshop, Evanston, IL, (Jul 2023), [Developed and Presented `LTEpy`].

NANOGrav Spring 2023 Collaboration Meeting and Student Workshop, Corvallis, OR (Mar 2023).

Origins Workshop - ISM, Star and Cluster Formation, Salt Lake City, UT, (Jan 2022). Gardiner, E., Tan, J., Staff, J., Ramsey, J. *Shock-Ionized Jets from Massive Protostars* [Oral Presentation].

Engineering Research and Design Symposium, University of Virginia, Charlottesville, VA, (Apr 2022). [Head Coordinator]

The Sigma Pi Sigma Research Symposium, University of Virginia, Charlottesville, VA, (Nov 2021). Gardiner, E. *Shock-Ionized Jets from Massive Protostars* [Oral Presentation, Coordinator].

FUTURE of Physics 2021, California Institute of Technology, Pasadena, Ca, (Sep 2021).

Conference for Undergraduate Women in Physics, Virtual, (Jan 2021).

AWARDS

Honorable Mention, National Science Foundation Graduate Research Fellowship Program — Apr 2024
1st Place Popular Poster, From Stars to Galaxies II, Chalmers University of Technology — Jun 2022
Outstanding Engineering Science Student, University of Virginia — May 2022
Rodman Scholar, University of Virginia — Aug 2018–May 2022

TELESCOPE TIME ALLOCATIONS

VLA/21A-263: "Characterizing Radio Spectral Shape of 'Winged' Radio Galaxies", Approved Nov 9, 2020, Co-I (PI: Ilsang Yoon)

VLBA/21A-104: "Supermassive Black Hole in the Center of X-shape Radio Galaxy", Approved Nov 9, 2020, Co-I (PI: Ilsang Yoon)

VLA/20A-459: "Revealing Spectral Curvature of X-Shaped Radio Galaxies by 10GHz Observation" Approved May 7, 2020, Co-I (PI: Ilsang Yoon)

TEACHING, SERVICE, & OUTREACH

Teaching

- *Intro to Astronomy for Non-Science Majors*, Graduate Student Instructor — Aug 2022–Dec 2022
- *Intro to Astrophysics B (Galaxies and Cosmology)*, Graduate Student Instructor — Jan 2023–May 2023
- *Classical Mechanics*, Grader — Jan 2021–May 2021

Mentoring

- *POWER–Bay Area:* Mentoring for community college students of marginalized genders. — Sep 2023–present
- *The Compass Project*: Mentoring for UC Berkeley math/physical sciences undergrads. — Sep 2022–Jan 2023
- *Rodman Mentor-Mentee Program*: — May 2019–May 2022
  Coordinator (2019) and mentor (2019–2022) for first-year Rodmans at UVA.

Department Service & Leadership

- *Astronomy Dept Small Council (UC Berkeley),* Graduate Student Representative — Sep 2023–present
- *Society for Women in Physical Sciences (UC Berkeley)*: Graduate Event Coordinator — Sep 2023–present
- *SWPS Symposium on Multi-messenger Signatures of Binary Black Holes*, Co-Coordinator — Apr 2024
- *Astronomy Organizing Committee (UC Berkeley)*, GSI Representative — Sep 2022–Sep 2023
- *UVA Undergraduate Engineering Research and Design Symposium*, Head Coordinator — Apr 2022
- *UVA* $\Sigma\Pi\Sigma$ *Physics Research Symposium*, Head Coordinator — Nov 2021
- *Rodman Scholars Council (UVA)*: — Sep 2018–May 2022
  Research Chair (2021–2022), Co-President (2020–2021), Advising Co-Chair (2019–2020), Class Representative (2018–2020)
- $\Sigma\Pi\Sigma$ *(Physics Honor Society at UVA)*, President — May 2021–May 2022

Outreach

- *CRS "Be A Scientist" Program:* — Jan 2023–Mar 2023
  Guide 7th-graders in designing and conducting independent scientific investigations.