Colin J. Burke, PhD

Personal

Citizenship:	United States and Canada (dual)
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Research Interests

Supermassive black hole formation, seeding, growth

Variability and scaling relations of active galactic nuclei

Education

Ph.D. Astronomy, University of Illinois Urbana-Champaign August 2023
Thesis: *Optical variability of intermediate-mass black holes as a probe of black hole accretion and growth*

B.S. Physics, Purdue University – West Lafayette May 2018
Minor in Astronomy
Certificate of learning beyond the classroom

Research & Professional Experience

NSF AAPF Postdoctoral Fellow August 2023 –
Department of Astronomy, Yale University

· Advisor: Priyamvada Natarajan

Graduate Research Assistant May 2018 – July 2023
Department of Astronomy, University of Illinois Urbana-Champaign

· Advisor: Xin Liu

R&D Intern, Space and Missile Systems June 2018 – August 2018
Engility Corporation (currently SAIC) June 2017 – August 2017

Undergraduate Research Assistant February 2014 – May 2018
Department of Physics and Astronomy, Purdue University

· Advisor: John R. Peterson

Grants & Awards

NSF Astronomy and Astrophysics Postdoctoral Fellowship & Simonyi-NSF Schoarship 2023 – 2026
National Science Foundation ($330,000)

Lewis E. Snyder Memorial Award Fall 2022
Department of Astronomy, University of Illinois Urbana-Champaign ($1,000)

Mr. and Mrs. Hsiang-pai and Wen-hua Chu Department of Astronomy Excellence in Research Graduate Student Award 2022
Department of Astronomy, University of Illinois Urbana-Champaign ($1,000)

Center for AstroPhysical Surveys (CAPS) Graduate Fellowship 2019 – 2022
National Center for Supercomputing Applications ($30,000 renewed x 3)

Teacher Ranked as Excellent Spring 2019
University of Illinois Urbana-Champaign

Richard W. King Award 2017
Department of Physics & Astronomy, Purdue University

Publications

First-Author Publications

- **Burke, C. J.**, Natarajan, P., Baldassare, V. F., & Geha, M. 2024, ApJ Accepted, arXiv:2410.11177, *Multi-wavelength constraints on the local black hole occupation fraction*
- **Burke, C. J.**, Liu, Y., Ward, C. A., et al. 2024, ApJ, 971, 140, *DAVOS: Dwarf Active Galactic Nuclei from Variability for the Origins of Seeds: Properties of Variability-selected Active Galactic Nuclei in the COSMOS Field and Expectations for the Rubin Observatory*
- **Burke, C. J.**, Liu, X., & Shen, Y. 2024, MNRAS, 527, 5356, *Gemini near-infrared spectroscopy of high-redshift Fermi blazars: jetted black holes in the early universe were overly massive*
- **Burke, C. J.** 2023, MNRAS, 523, 5535, *The variational slope of quasar light curves is not a distance indicator*
- **Burke, C. J.**, Liu, X., Shen, Y., et al. 2022, MNRAS, 516, 2736-2756, *Dwarf AGNs from Optical Variability for the Origins of Seeds (DAVOS): insights from the dark energy survey deep fields*
- **Burke, C. J.**, Shen, Y., Liu, X., et al. 2022, MNRAS, 518, 1880-1904, *Dwarf AGNs from Variability for the Origins of Seeds (DAVOS): Intermediate-mass black hole demographics from optical synoptic surveys*
- **Burke, C. J.**, Shen, Y., Blaes, O., et al. 2021, Science, 373, 789-792, *A characteristic optical variability time scale in astrophysical accretion disks*
- **Burke, C. J.**, Liu, X., Chen, Y.-C., Shen, Y., & Guo, H. 2021, MNRAS, 504, 543-550, *On the AGN nature of broad balmer emission in four low-redshift metal-poor galaxies*
- **Burke, C. J.**, Shen, Y., Chen, Y.-C., et al. 2020, ApJ, 899, 136, *Optical Variability of the Dwarf AGN NGC 4395 from the Transiting Exoplanet Survey Satellite*
- **Burke, C. J.**, Baldassare, V. F., Liu, X., et al. 2020, ApJ, 894, L5, *The Curious Case of PHL 293B: A Long-lived Transient in a Metal-poor Blue Compact Dwarf Galaxy*

- **Burke, C. J.**, Aleo, P. D., Chen, Y.-C., et al. 2019, MNRAS, 490, 3952-3965, *Deblending and classifying astronomical sources with Mask R-CNN deep learning*
- **Burke, C. J.**, Peterson, J. R., Egami, E., et al. 2019, Journal of Astronomical Telescopes, Instruments, and Systems, 5, 038002, *PhoSim-NIRCam: photon-by-photon image simulations of the James Webb Space Telescope's near-infrared camera*

Contributing-Author Publications

- Dattathri, S., Natarajan, P., Porras-Valverde, A. J., et al. 2024, arXiv e-prints, arXiv:2410.13958, *The redshift evolution of the $M_{\rm BH} - M_*$ scaling relation: new insights from cosmological simulations and semi-analytic models*
- Ren, W., Guo, H., Shen, Y., et al. 2024, ApJ, 974, 153, *Prior-informed Active Galactic Nucleus Host Spectral Decomposition Using PyQSOFit*
- Ward, C., Melchior, P., Sampson, M. L., et al. 2024, Astronomy & Computed submitted, *Disentangling transients and their host galaxies with Scarlet2: A framework to forward model multi-epoch imaging*
- Zhuang, M.-Y., Yang, Q., Shen, Y., et al. 2024, ApJS submitted, *High-quality Extragalactic Legacy-field Monitoring (HELM) with DECam*
- Sokolovsky, K. V., Aydi, E., Malanchev, K., et al. 2023, ApJ submitted, *TESS photometry of the nova eruption in V606 Vul: asymmetric photosphere and multiple ejections?*
- Merz, G., Liu, Y., **Burke, C. J.**, et al. 2023, MNRAS, 526, 1122, *Detection, instance segmentation, and classification for astronomical surveys with deep learning (DEEPDISC): DETECTRON2 implementation and demonstration with Hyper Suprime-Cam data*
- Wang, Z. F.[1], **Burke, C. J.**, Liu, X., & Shen, Y. 2023, MNRAS, 521, 99, *Dwarf AGNs from variability for the origins of seeds (DAVOS): optical variability of broad-line dwarf AGNs from the zwicky transient facility*
- Stone, Z., Shen, Y., **Burke, C. J.**, et al. 2022, MNRAS, 514, 164-184, *Optical variability of quasars with 20-yr photometric light curves*
- Bellm, E. C., **Burke, C. J.**, Coughlin, M. W., et al. 2022, ApJS, 258, 13, *Give Me a Few Hours: Exploring Short Timescales in Rubin Observatory Cadence Simulations*
- Shen, Y., & **Burke, C. J.** 2021, ApJ, 918, L19, *A Sample Bias in Quasar Variability Studies*
- Palmese, A., Fishbach, M., **Burke, C. J.**, Annis, J., & Liu, X. 2021, ApJ, 914, L34, *Do LIGO/Virgo Black Hole Mergers Produce AGN Flares? The Case of GW190521 and Prospects for Reaching a Confident Association*
- Guo, H., Peng, J., Zhang, K., et al. 2020, ApJ, 905, 52, *High-redshift Extreme Variability Quasars from Sloan Digital Sky Survey Multiepoch Spectroscopy*
- Sánchez, J., Walter, C. W., Awan, H., et al. 2020, MNRAS, 497, 210-228, *The LSST DESC data challenge 1: generation and analysis of synthetic images for next-generation surveys*
- Guo, H., **Burke, C. J.**, Liu, X., et al. 2020, MNRAS, 496, 3636-3647, *Dark Energy Survey identification of a low-mass active galactic nucleus at redshift 0.823 from optical variability*
- Peterson, J. R., Peng, E., **Burke, C. J.**, Sembroski, G., & Cheng, J. 2019, ApJ, 873, 98, *Deformation of Optics for Photon Monte Carlo Simulations*

Non-Refereed Publications & White Papers

[1] Student advised by Burke

- Breivik, K., Connolly, A. J., Ford, K. E. S., et al. 2022, arXiv e-prints, arXiv:2208.02781, *From Data to Software to Science with the Rubin Observatory LSST*
- Thomas, D., Kahn, S. M., Bianco, F. B., et al. 2018, arXiv e-prints, arXiv:1812.02932, *Unveiling the Rich and Diverse Universe of Subsecond Astrophysics through LSST Star Trails*

Approved Observing Programs

Gemini Observatory 8-meter Telescope

- $>$ 6 nights awarded as PI, 0.5 night DDT awarded as Co-I

Palomar 200-inch (5.1-meter) Hale Telescope

- 5 nights awarded as PI (Yale TAC)

Blanco 4-meter Telescope

- 0.5 nights awarded as Co-I, $>$ 5 nights observing experience for DECAT collaboration

WIYN 3.5-meter Telescope

- 6 nights awarded as Co-I (Purdue TAC)

Very Large Array

- $\sim$ 75 hours total awarded as PI

Talks

Invited Talks

- **Astronomy Seminar, Texas A&M University** (August 2024)
- Santa Cruz Galaxy Workshop (August 2024)
- Rubin Project and Community Workshop, Science Medley parallel session (August 2023)
- **KICP Seminar, University of Chicago (May 2023)**
- AAS#241, DES special session (January 2023)
- **BHI Colloquium, Harvard University (November 2022)**
- KIPAC Tea Talk, Stanford University (October 2022; remote)
- **MPE Seminar, Max Planck Institute for Extraterrestrial Physics (September 2022)**
- ESO AGN Coffee Series, European Southern Observatory, Garching (September 2022)
- Astronomy Tea Talk, Caltech (May 2022; remote)
- X-ray Binaries Group, University of Southampton (February 2022; remote)
- CosmoPalooza webinar (January 2022)
- LSST AGN Science Collaboration Meeting (July 2021; remote)
- MINERVA Seminar, Paris Observatory (May 2021; remote)
- DES Collaboration Meeting Plenary (May 2020; remote)
- LSST Science Collaboration Meeting: DESC deblending parallel session (May 2019; remote)

Contributed Talks

- AAS#243 (January 2024)

- Intermediate-mass black holes (December 2023)
- AAS#241, AGN VI session (January 2023)
- *Origin, growth and feedback of black holes in dwarf galaxies*, San Sebastián, Spain (September 2022)
- *Boom! A Workshop on Explosive Transients with LSST*, University of Illinois Urbana-Champaign (July 2022)
- *Intermediate-Mass Black Holes: New Science from Stellar Evolution to Cosmology* workshop, Northwestern University/COFI (May 2022)
- *Illinois Astrofest*, University of Illinois Urbana-Champaign (April 2022)
- AAS#239, AGN variability session (January 2022; canceled due to COVID pandemic)
- Astroinformatics 2021, Caltech (November 2021; remote)
- TESS Science Conference II, Massachusetts Institute of Technology (August 2021; remote)
- *New Faces of Black Holes* workshop, Joint Space-Science Institute (November 2019)

Professional Service

- Referee for major peer-reviewed journals in astronomy, e.g., *Astronomy & Astrophysics, The Astrophysical Journal, Monthly Notices of the Royal Astronomical Society, Astronomy & Computing.*
- Significant open source software contributions: *PhoSim*, *lightkurve*, *PyQSOFit*, *PyZOGY*.
- SOC, 2024 Tinsley Workshop - JWST results on galaxies and black holes in the early Universe
- Reviewer, FONDECYT-Chile Astronomy & Astrophysics grants
- Yale telescope TAC for Keck and Palomar (Fall 2023 -)
- Organizing committee of UIUC Astrofest (2021)
- Organizer of UIUC Journal Club seminar series (2021-2022)

Teaching & Outreach

Student Advising & Mentoring

- Astronomy Mentorship Program for Upcoming Postdocs (AMP-UP) mentor
- Diego Miura (Yale STARS undergraduate)
- Carmen Muscolina (Yale senior thesis)
- Yichen Liu (astronomy undergraduate → U. Arizona graduate student)
- Z. Franklin Wang (astronomy undergraduate → TAMU graduate student)
- Yufeng Liu (NCSA SPIN undergraduate)
- Anshul Shah (NCSA SPIN undergraduate → Finance internship at Citadel)
- Will Lande (high school student, Illinois State Science Fair project)

Teaching

- Guest lecturer: ASTR 170: Introduction to Cosmology (Fall 2024)
- Guest lecturer: ASTR 596: AI and Big Data in Astronomy (Fall 2021)
- Teaching Assistant: ASTR 122: Stars and Galaxies (Spring 2019; Ranked as excellent teacher)
- Teaching Assistant: ASTR 350: Big Bang, Black Holes, and the Universe (Fall 2018)

Broader Outreach

· Speaker for Yale Pathways to Science: Exploring Science and Science Cafe programs
· Secured thousands of dollars in grant money for purchase and distribution of 10,000 solar eclipse glasses to schools and libraries near Purdue's campus in 2017
· Co-taught middle school physics in joint Purdue–Jiangsu Second Normal University service learning trip to Nanjing, China (May 2017)

Media

· Work featured in popular media outlets such as *The London Times*, *space.com*, *Popular Science*, *Science News*.