Cail M. Daley

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Research Interests

- CMB lensing
- Cosmic shear
- Large-scale structure
- Kinematic lensing
- CMB × galaxy cross-correlations
- Weak lensing systematics
- AI & scientific epistemology

Current Position

2024–Present **Postdoctoral Researcher** | TOSCA Project
CEA Paris-Saclay, CosmoStat Laboratory

Education

2018–2024 **Ph.D.** | Astronomy
University of Illinois Urbana-Champaign (UIUC)
Thesis: *CMB Lensing Measurements with Two Years of Data from the SPT-3G Survey*

2014–2018 **B.A.** | Astronomy & Physics (Dual Major)
Wesleyan University, Middletown, CT
Honors Thesis: *Using Vertical Structure to Infer the Dynamical Mass Hidden in the AU Mic Debris Disk*

Research Experience

2024–Present **CEA Paris-Saclay** | advised by Martin Kilbinger
· Working on the TOSCA project exploring weak lensing synergies between optical and radio datasets, particularly Euclid, UNIONS, and SKAO.

2019–2024 **University of Illinois Urbana-Champaign** | advised by Gil Holder
· Member of the South Pole Telescope project, studied gravitational lensing of the CMB and mm-wavelength transients. Lead one of three pipelines in the SPT-3G 2019+2020 CMB lensing analysis, producing the deepest CMB lensing maps to date.

2014–2018 **Wesleyan University** | advised by A. Meredith Hughes
· Studied debris disks at sub-mm wavelengths, led reduction and analysis of observations of the debris disk around AU Mic to measure its vertical structure at mm wavelengths for the first time.

2016–2017 **Leiden University** | advised by Catherine Walsh
· Modeled the kinematic structure of the circumstellar disk HD 100546. Selected for Leiden's LEAPS program from a pool of 450 applicants.

Outreach

2020-2023 **SPT First Discoveries:** Participated in SPT's premier outreach program that brings together pre-K and elementary students with scientists in classrooms to encourage participation in science from a young age. Planned and remotely led ∼5 lessons at the predominantly-Black Fiske Elementary in Chicago.

2020-2022 **UIUC Astronomy on Tap:** Organized monthly all-ages outreach events featuring conversations between astronomers and the public in informal settings. Involved in all aspects of program–giving talks, finding speakers, venue booking, etc. Livestreamed on YouTube during the pandemic, and held in-person at several establishments in the Urbana-Champaign area.

2019 **UIUC Education Justice Project:** Worked with the university's college-in-prison program and led a workshop on programming and astronomy data analysis at the Danville Correctional Center.

Mentorship

2022-2023 **Research Mentor:** Zimo Qu (undergraduate, transferred to UC Berkeley). Supported student in a search for stellar flares observed simultaneously by the SPT and TESS telescopes. Zimo presented a poster at the 2023 Illinois Astrofest.

2022-2023 **Undergraduate Tutor:** Participated in the department tutoring program and worked with three students on math, physics, and programming coursework.

2020-2021 **Undergraduate Mentor:** Participated in the Society for Equity in Astronomy mentorship program, with monthly meetings to discuss research, graduate school, and other topics. Mentored three students.

Teaching & Service

2021-2022 **UIUC Astronomy Journal Club:** Organized a weekly journal club with graduate students giving talks on their work and recent papers in the field.

2019 **Teaching Assistant,** ASTR 122: Stars and Galaxies

2018 **Teaching Assistant,** ASTR 404: Stellar Astrophysics

Schools & Workshops

2020 Michigan Cosmology School *(virtual)*

2019 La Serena School for Data Science, La Serena, Chile

2019 Open Science Grid School, Madison, WI

Awards

2023 **APS DAP Student/Early Career Meeting Award** ($600)
· Travel to APS April Meeting 2023, Minneapolis, MN

2021 **Chambliss Astronomy Achievement Student Award**
· AAS 238th Meeting (*virtual*)

2019-2020 **Center for Astrophysical Surveys Graduate Fellowship** ($30,000)
· University of Illinois Urbana-Champaign

2018 **Thesis High Honors**
· Wesleyan University

2017 **Student Travel Grant** ($1000)
· NASA Connecticut Space Grant Consortium
· Travel to AAS

2017 **3rd Prize, Visualizing Knowledge Exhibition**
· Wesleyan University
· Title: *Orbital Motion of Gas in Planetary System HD 100546*

2017 **Siver Scholarship**
· Wesleyan University
· awarded to undergraduate students majoring in or demonstrating strong academic interest in physics

2015 **Undergraduate Research Fellowship** ($5000)
· NASA Connecticut Space Grant Consortium
· Title: *Searching for Non-Axisymmetry in the Unusual Gas Disk Around a Main Sequence Star*

2015 **Research in Sciences Fellowship** ($4000)
· Wesleyan University
· Title: *Searching for Non-Axisymmetry in the Unusual Gas Disk Around a Main Sequence Star*

Skills

Programming languages: Python (advanced), unix (advanced), Julia (intermediate), HTML/CSS (intermediate) C/C++ (basic), Mathematica (basic), SQL (basic).

Software: CAMB, HEALPix, NaMaster, lenspyx, emcee, git, pandas, scikit-learn.

General: Signal processing, machine learning, statistical estimators, high-performance and high-throughput (Open Science Grid) computing.

Talks & Posters

01/2024 **American Astronomical Society 243th Meeting** (*dissertation talk*)
· New Orleans, LA
· *CMB Lensing Measurements with Two Years of Data from the SPT-3G Survey*

04/2023 **American Physical Society April Meeting 2023**
· Minneapolis, MN
· *CMB Lensing Measurements with Two Years of Data from the SPT-3G Survey*

05/2022 **Kavli Institute for Particle Physics and Cosmology Tea Talk**
· SLAC National Accelerator Laboratory, Menlo Park, CA
· *Lensing Maps and Transient Science with the South Pole Telescope*

06/2021 **American Astronomical Society 238th Meeting** (*poster, virtual*)
· *Detection of Stellar Flares at Millimeter Wavelengths with SPT-3G*

04/2021 **DES Milky Way Working Group Call** (*invited, virtual*)
· *Time-Domain Astronomy with the South Pole Telescope*

04/2021 **Illinois Astrofest** (*virtual*)
· University of Illinois Urbana-Champaign
· *Time-Domain Astronomy with the South Pole Telescope*

10/2019 **Center for Astrophysical Surveys Seminar**
· University of Illinois Urbana-Champaign
· *Gravitational Lensing of the CMB: Synergy with Optical Surveys*

01/2018 **American Astronomical Society 231st Meeting**
· National Harbor, MD
· *Using Vertical Structure to Infer the Total Mass Hidden in a Debris Disk*

7/2017 **Research in Sciences Poster Session**
· Wesleyan University
· Presented poster on AU Mic research.

10/2016 **Keck Northeast Astronomy Consortium**
· Wesleyan University
· Gave talk on HD 100546 research; published paper in conference proceedings.

08/2016 **LEAPS Symposium**
· Leiden University
· Gave talk on HD 100546 research to international audience.

10/2015 **Keck Northeast Astronomy Consortium**
· Williams College
· Gave talk on 49 Ceti research; published paper in conference proceedings.

07/2015 **Research in Sciences Poster Session**
· Wesleyan University
· Presented poster on 49 Ceti research.

Publications

Lead-Author or Substantial Contribution

Daley, C., & the SPT-3G Collaboration. 2023, *CMB Lensing Measurements with Two Years of Data from the SPT-3G Survey*, in prep.

Millea, M., **Daley, C.**, Chou, T. L., et al. 2021, *Optimal Cosmic Microwave Background Lensing Reconstruction and Parameter Estimation with SPTpol Data*, ApJ, 922, 259, arXiv:2012.01709

Guns, S., Foster, A., **Daley, C.**, et al. 2021, *Detection of Galactic and Extragalactic Millimeter-wavelength Transient Sources with SPT-3G*, ApJ, 916, 98, arXiv:2103.06166

Daley, C., Hughes, A. M., Carter, E. S., et al. 2019, *The Mass of Stirring Bodies in the AU Mic Debris Disk Inferred from Resolved Vertical Structure*, ApJ, 875, 87, arXiv:1904.00027

Walsh, C., **Daley, C.**, Facchini, S., & Juhász, A. 2017, *CO emission tracing a warp or radial flow within $\lesssim$100 au in the HD 100546 protoplanetary disk*, A&A, 607, A114, arXiv:1710.00703

Hughes, A. M., Lieman-Sifry, J., Flaherty, K. M., et al. 2017, *Radial Surface Density Profiles of Gas and Dust in the Debris Disk around 49 Ceti*, ApJ, 839, 86, arXiv:1704.01972

Collaboration Papers

Pan, Z., Bianchini, F., Wu, W. L. K., et al. 2023, *A Measurement of Gravitational Lensing of the Cosmic Microwave Background Using SPT-3G 2018 Data*, arXiv e-prints, arXiv:2308.11608, arXiv:2308.11608

Balkenhol, L., Dutcher, D., Spurio Mancini, A., et al. 2023, *Measurement of the CMB temperature power spectrum and constraints on cosmology from the SPT-3G 2018 TT, TE, and EE dataset*, Phys. Rev. D, 108, 023510, arXiv:2212.05642

Schiappucci, E., Bianchini, F., Aguena, M., et al. 2023, *Measurement of the mean central optical depth of galaxy clusters via the pairwise kinematic Sunyaev-Zel'dovich effect with SPT-3G and DES*, Phys. Rev. D, 107, 042004, arXiv:2207.11937

Chichura, P. M., Foster, A., Patel, C., et al. 2022, *Asteroid Measurements at Millimeter Wavelengths with the South Pole Telescope*, ApJ, 936, 173, arXiv:2202.01406

Ferguson, K. R., Anderson, A. J., Whitehorn, N., et al. 2022, *Searching for axionlike time-dependent cosmic birefringence with data from SPT-3G*, Phys. Rev. D, 106, 042011, arXiv:2203.16567

Sobrin, J. A., Anderson, A. J., Bender, A. N., et al. 2022, *The Design and Integrated Performance of SPT-3G*, ApJS, 258, 42, arXiv:2106.11202

Montgomery, J., Ade, P. A. R., Ahmed, Z., et al. 2022, *Performance and characterization of the SPT-3G digital frequency-domain multiplexed readout system using an improved noise and crosstalk model*, Journal of Astronomical Telescopes, Instruments, and Systems, 8, 014001, arXiv:2103.16017

Balkenhol, L., Dutcher, D., Ade, P. A. R., et al. 2021, *Constraints on Λ CDM extensions from the SPT-3G 2018 EE and TE power spectra*, Phys. Rev. D, 104, 083509, arXiv:2103.13618

Dutcher, D., Balkenhol, L., Ade, P. A. R., et al. 2021, *Measurements of the E-mode polarization and temperature-E-mode correlation of the CMB from SPT-3G 2018 data*, Phys. Rev. D, 104, 022003, arXiv:2101.01684

Gif-sur-Yvette, France, December 5, 2025