

# Cail M. Daley

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Département d’Astrophysique  
CEA Paris-Saclay  
Orme des Merisiers, Building 709  
F-91191 Gif-sur-Yvette, France

Email: [cail.daley@cea.fr](mailto:cail.daley@cea.fr)  
Phone: +33 07 75 72 18 07  
GitHub: <https://github.com/cailmdaley>

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## RESEARCH INTERESTS

- Gravitational lensing
- Large-scale structure
- Cosmic shear
- Cross-correlations
- CMB data analysis
- Radio astronomy & interferometry
- Millimeter-wavelength transients
- Circumstellar disks

## 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](https://arxiv.org/abs/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](https://arxiv.org/abs/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](https://arxiv.org/abs/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](https://arxiv.org/abs/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](https://arxiv.org/abs/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](https://arxiv.org/abs/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](https://arxiv.org/abs/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](https://arxiv.org/abs/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](https://arxiv.org/abs/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](https://arxiv.org/abs/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](https://arxiv.org/abs/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](https://arxiv.org/abs/2103.16017)
- Balkenhol, L., Dutcher, D., Ade, P. A. R., et al. 2021, *Constraints on  $\Lambda$  CDM extensions from the SPT-3G 2018 EE and TE power spectra*, Phys. Rev. D, 104, 083509, [arXiv:2103.13618](https://arxiv.org/abs/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](https://arxiv.org/abs/2101.01684)

Gif-sur-Yvette, France, November 12, 2024