

Lyra Cao

VIDA Postdoctoral Fellow
Stellar Magnetic Fields and Star Spots
Stellar Evolution and Gyrochronology
Near-Infrared Survey Spectroscopy

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EDUCATION **The Ohio State University** Advisor: Marc Pinsonneault
Doctor of Philosophy, Astronomy, Summer 2023
Master of Science, Astronomy, May 2021

California Institute of Technology Advisor: Lynne Hillenbrand
Bachelor of Science, Astrophysics, June 2017
Thesis: The Effects of Accretion on the Age Spreads of Young Stars

AWARDS SDSS-V Early Career Scientist Travel Fund Award, \$500
SDSS-IV Early Career Scientist Travel Fund Award, \$2000
Ohio State University Distinguished University Fellowship Award (2017–2018)

PUBLICATIONS **First Author Publications**

1. **Cao, L.** et al. The LEOPARD Starspot Catalog - I. Starspot Measurements on Solar-like Stars. *ApJS*, in prep.
2. **Cao, L.**, Pinsonneault, M. H., & Sharifi, K. Star spots and the Pleiades lithium spread. *ApJL*, in prep.
3. **Cao, L.**, Pinsonneault, M. H., & van Saders, J. L. Core-envelope decoupling drives radial shear dynamos in cool stars. *ApJL*, **951**, L49 (2023).
4. **Cao, L.** & Pinsonneault, M. H. Star-spots and magnetism: testing the activity paradigm in the Pleiades and M67. *MNRAS*, **517**, 2165–2189 (2022).
5. **Cao, L.**, Pinsonneault, M. H., Hillenbrand, L. A., Kuhn, M. A. Age Spreads and Systematics in λ Orionis with Gaia DR2 and the SPOTS Tracks. *ApJ*, **924**, 84 (2022).

Contributing Author Publications

6. Plummer, M. K., Wang, J., **Cao, L.**, and 3 coauthors. Extensive Polar Spots on a Weak-Line T Tauri Star. *ApJ*, submitted.
7. Ong, J. M. J., and 21 coauthors incl. **Cao, L.**. The Gasing Pangkah Collaboration: I. Asteroseismic Identification and Characterisation of a Rapidly-Rotating Engulfment Candidate. *ApJ*, accepted. arXiv:2402.16971.
8. Claytor, Z. R., van Saders, J. L., **Cao, L.** and 3 coauthors. TESS Stellar Rotation up to 80 days in the Southern Continuous Viewing Zone. *ApJ*, **962**, 47 (2024).

9. Patton, R., Pinsonneault, M. H., **Cao, L.** and 4 coauthors. Spectroscopic identification of rapidly rotating red giant stars in APOKASC-3 and APOGEE DR16. *MNRAS*, **528**, 3232 (2024).
10. Serna, J. and 19 coauthors incl. **Cao, L.** Rotational Evolution of Classical T Tauri Stars: Models and Observations. *ApJ*, accepted. arxiv:2403.07505.
11. Phillips, A., Kochanek, C. S., Jayasinghe, T., **Cao, L.** and 3 coauthors. Seven Classes of Rotational Variables From a Study of 50,000 Spotted Stars with ASAS-SN, Gaia, and APOGEE. *MNRAS*, **527**, 5588 (2024).
12. Beck, P. G. and 25 coauthors incl. **Cao, L.** Constraining stellar and orbital co-evolution through ensemble seismology of solar-like oscillators in binary systems. *A&A*, **682**, A7 (2024).
13. Wanderley, F., Cunha, K., Souto, D., Smith, V. S., **Cao, L.**, and 21 coauthors. Stellar characterization and radius inflation of Hyades M dwarf stars from the APOGEE survey. *ApJ*, **951**, 90 (2023).
14. Kounkel, M. and 17 coauthors incl. **Cao, L.** ABYSS I: Targeting strategy for APOGEE & BOSS young star survey in SDSS-V. *ApJS*, **266**, 10 (2023).
15. Alzate, J. A., and 6 coauthors incl. **Cao, L.** Constraints on star formation in Orion A from Gaia. *MNRAS*, **523**, 4821 (2023).
16. Smith, A., and 8 coauthors incl. **Cao, L.** pynucastro: A Python Library for Nuclear Astrophysics. *ApJ*, **947**, 65 (2023).
17. Binks, A. S., Jeffries, R. D., Sacco, G. G., Jackson, R. J., **Cao, L.**, and 11 coauthors. The Gaia-ESO survey: constraining evolutionary models and ages for young low mass stars with measurements of lithium depletion and rotation. *MNRAS*, **513**, 5727–5751 (2022).
18. Somers, G., **Cao, L.**, & Pinsonneault, M. H. The SPOTS Models: A Grid of Theoretical Stellar Evolution Tracks and Isochrones for Testing the Effects of Starspots on Structure and Colors. *ApJ*, **891**, 29 (2020).

PROPOSALS

1. NASA ADAP. PI: Pinsonneault, M. H., Co-I: 2 incl. **Cao, L.** “An Activity Treasury: Rotation, Star Spots, and Dynamos”, selected, \$663,000.
2. TESS Guest Investigator Cycle 6, PI: Ong, J. M. J., Co-I: 7 incl. **Cao, L.** “Magnetic Activity on Rapidly-Rotating Red Giants with 200-second TESS FFIs”, \$70,000.
3. CFHT University of Hawaii (IfA). PI: van Saders, J. L., Co-I: 2 incl. **Cao, L.** “Probing Surface Activity During the Epoch of Core-Envelope Recoupling”, awarded.
4. TESS Guest Investigator Cycle 5, PI: Pinsonneault, M. H., Co-I: 4 incl. **Cao, L.** “Rotation, Star Spots And Activity In Tess Cycle 5”, \$70,000.

CONFERENCE
TALKS

Invited Conference Talks

- δ Cool Stars 22 — (June 2024). “Li Depletion in Pre-main Sequence stars”. Review Talk, Lithium Splinter Session.
- δ CASCA-TO 2024 — (June 2024). “Starspots and radius inflation: the evolution of stellar activity and its impact on derived stellar parameters”.
- δ Fifty Years of the Skumanich Relations (March 2022). “Detecting Starspots in APOGEE Spectra”.

Contributed Talks & Posters

- δ TESS Science Conference III (July 2024). “TESS Light Curve Amplitudes, Rotation Periods, and Starspots in Lower Main Sequence Stars”. Contributed talk.
- δ Stellar Magnetic Fields from Protostars to Supernovae (October 2023). Workshop at MIAPbP. Contributed talks.
- δ SDSS-V Collaboration Meeting (July 2023). “Starspots, magnetism, and Milky Way Mapper: the LEOPARD spot catalog”. Contributed talk.
- δ TASC7/KASC14 (July 2023). “LEOPARD Starspots Catalog: Impact of Stellar Magnetism on Dwarfs and Giants”. Contributed talk.
- δ AAS 241, Seattle (January 2023). “Starspots and Magnetism: Testing the Activity Paradigm in the Pleiades and M67”. Dissertation talk.
- δ AAS 241, Seattle (January 2023). Press conference: “Starspots and Magnetism: Testing the Activity Paradigm in the Pleiades and Messier 67 Star Clusters”.
- δ Cool Stars 21, Toulouse (July 2022). “Spectroscopic Starspot Filling Factor Measurements with APOGEE”. Poster.
- δ SDSS Collaboration Meeting, Johns Hopkins University (August 2021). “Spots and Pre-MS Stellar Characterization from APOGEE DR17 Spectra”. Talk.
- δ Cool Stars 20.5, Virtual (March 2021). “Age Spreads and Systematics in λ Orionis with Gaia DR2 and the SPOTS tracks”. Poster.
- δ SciPy 2020 (July 2020). “pynucastro: A Python Library for Exploring Nuclear Reaction Rates”. Poster.
- δ AAS DPS 48 (October 2016). “A Study of Saturn’s Normal Mode Oscillations and Their Forcing of Density Waves in the Rings”. Poster.

Department Talks, Seminars & Colloquia

- δ Carnegie Observatories, Pasadena (December 2022). “Magnetochronology: The Stellar Dynamo Revealed”. Department talk.
- δ Keele University, Keele (December 2022). “Magnetochronology: The Stellar Dynamo Revealed”. Invited seminar.

δ Department of Physics, Boise State University (March 2022). “Starspot Detections and the Evolution of the Stellar Dynamo”. Invited seminar.

MENTORING

- ★ *Kayvon Sharifi*, Ohio State University, former undergraduate. Supervising on two papers in preparation.
- ★ *Alyssa Whalen*, Ohio State University, undergraduate. Co-supervised with Pinsonneault, M. H. as part of the Summer Undergraduate Research Program.
- ★ *Erin Duell*, Ohio State University, undergraduate. Supervised as part of the Polaris mentorship program.

TEACHING

Graduate Teaching Assistant, Ohio State University

- *Stellar Evolution* (Spring 2022). Senior-level major course in theoretical stellar astrophysics.
- *Methods of Astronomical Observation & Data Analysis* (Fall 2021). Junior-level major course in computational astrophysics.
- *Basic Astrophysics & Planetary Astronomy* (Fall 2021). Sophomore-level major course in the principles of astrophysics.
- *Life in the Universe* (Fall 2018, Spring 2022). Non-major course in astronomy.
- *Planets and the Solar System* (Spring 2019). Non-major course in astronomy.
- *From Planets to the Cosmos* (Fall 2018, Spring 2019). Non-major laboratory course in astronomy.

Undergraduate Teaching Assistant, Caltech

- *The Evolving Universe* (Spring 2016). Non-major course in astronomy.
- *Analog Electronics for Physicists* (Fall 2015, Fall 2015). Sophomore-level major laboratory course in analog electronics.

OUTREACH

- ⊕ *Starts With a Bang!* Guest in the public podcast of the Starts With a Bang! Podcast by theoretical astrophysicist and science communicator Ethan Siegel.
- ⊕ *Polaris Mentorship Program*. Mentored traditionally underrepresented undergraduate students at the Ohio State University to prepare them for research opportunities in astronomy.
- ⊕ *Friends of Ohio State Astronomy and Astrophysics*. Volunteered and met with interested members of the public about my research.
- ⊕ *Arne Slettebak Planetarium*. Presented planetarium programs at the Arne Sletteback Planetarium.

⊕ *Science Olympiad*. Ran events and regularly supervised *Astronomy C* and *Solar System B* events in the Los Angeles Regionals and Southern California States competitions from 2014–2017; assisted in the Columbus Regionals competition (2019).

SERVICE	Peer Reviewer — The Astrophysical Journal Peer Reviewer — Monthly Notices of the Royal Astronomical Society Peer Reviewer — Astronomy & Astrophysics 2023 NASA Astrophysics Theory Program Panelist	
OBSERVING	Palomar Observatory 200" Hale, Large Format Camera	1 night