

# CATHERINE ZUCKER

Astrophysicist, Smithsonian Astrophysical Observatory

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## RESEARCH INTERESTS

Galactic structure/dynamics, star formation, interstellar medium, stellar populations, big data, data visualization

## RESEARCH POSITIONS

|   |                         |
|---|-------------------------|
| Astrophysicist, Smithsonian Astrophysical Observatory                     | Summer 2023–Present     |
| Lecturer, Harvard University  |                         |
| Senior Member, Institute for Theory and Computation at Harvard University |                         |
| Hubble Fellow, Space Telescope Science Institute                          | Fall 2021–Summer 2023   |
| Postdoctoral Fellow, Center for Astrophysics   Harvard & Smithsonian      | Summer 2020–Summer 2021 |

## EDUCATION

|   |           |
|---|-----------|
| Harvard University: PhD in Astronomy                      | 2017–2020 |
| Advisors: Alyssa Goodman & Douglas Finkbeiner             |           |
| Dissertation: <i>Charting our Uncharted Milky Way</i>     |           |
| Harvard University: MA in Astronomy                       | 2015–2017 |
| University of Virginia: BA in Astronomy–Physics & History | 2011–2015 |

## SELECTED AWARDS & HONORS

|  |                        |
|--|------------------------|
| Bart J. Bok Prize Lectureship  | Spring 2024            |
| Awarded to a recent Harvard PhD recipient for observational research of the Milky Way  |                        |
| <a href="#">Astronomy Magazine Top 25 Rising Star</a>  | Fall 2022              |
| NASA Hubble Fellowship Program Hubble Fellowship   | Fall 2021              |
| Protostars & Planets VII (PPVII) Chapter Lead  | Fall 2020              |
| Competitively selected to lead review chapter for PPVII meeting  |                        |
| Fireman Fellow, Harvard Astronomy  | Spring 2020            |
| Department's highest honor, awarded to a single graduating PhD student for their doctoral work   |                        |
| Harvard–Horizons Scholar   | Spring 2020            |
| Top eight graduate students selected across Harvard to receive professional development training, culminating in public “TED–style” talk |                        |
| Department of Astronomy Teaching Award (Harvard)   | Spring 2018            |
| Bok Center Certificate of Distinction in Teaching (Harvard)  | Fall 2017, Spring 2019 |
| La Serena School for Data Science Full Scholarship   | Summer 2017            |
| NSF Graduate Research Fellowship   | Fall 2016              |
| Pierce Fellowship (Harvard Astronomy)  | Fall 2015              |
| Fellowship for top three admitted Harvard Astronomy applicants   |                        |
| Merrill Graduate Fellowship (Harvard)  | Fall 2015              |

## PUBLICATIONS

I have co–authored 48 publications with > 1900 citations. See [ADS](#) for a full list. Highlights include:

12 papers as first author/co–PI (> 700 citations), including 1 *Nature* publication and 1 review paper

18 papers as second or third author with significant contributions, including 2 *Nature* publications

5 papers led by students, for which I served as a primary science advisor or joint co–advisor (denoted by \*)

1<sup>st</sup> author/co–PI:

1. Zucker, C., Alves, J., Goodman, A., Meingast, S., and Galli, P. 2023. *Protostars and Planets VII*, ASP Conference Series, Vol. 534, [The Solar Neighborhood in the Age of Gaia](#).
2. Zucker, C., Peek, J., and Loebman, S., 2022. *ApJ*, 936, 160. [Disconnecting the Dots: Re-examining the Nature of Stellar “Strings” in the Milky Way](#).
3. Zucker, C., Goodman, A., Alves, J., Bialy, S., Foley, M., Speagle, J., Grossschedl, J., Finkbeiner, D., Burkert, A., Khimey, D., Swiggum, C. 2022. *Nature*. [Star Formation Near the Sun is Driven by Expansion of the Local Bubble](#).
4. Zucker, C., Goodman, A., Alves, J., Bialy, S., Koch, E., Speagle, J., Foley, M., Finkbeiner, D., Leike, R., Ensslin, T., Peek, J., and Edenhofer, G. 2021. *ApJ*, 919, 35. [On the Three-Dimensional Structure of Local Molecular Clouds](#).
5. Zucker, C., Speagle, J., Schlafly, E., Green, G., Finkbeiner, D., Goodman, A., Alves, J. 2020. *A&A*. 633, A51. [A Compendium of Distances to Molecular Clouds in the Star Formation Handbook](#).
6. Zucker, C., Smith, R., Goodman, A. 2019. *ApJ*, 887, 186. [Synthetic Large-Scale Galactic Filaments — on their Formation, Physical Properties, and Resemblance to Observations](#).
7. Zucker, C. & Speagle, J., Schlafly, E., Green, G., Finkbeiner, D., Goodman, A., Alves, J. 2019. *ApJ*, 879, 125. [A Large Catalog of Accurate Distances to Local Molecular Clouds: The Gaia DR2 Edition](#).
8. Zucker, C., Schlafly, E., Green, G., Speagle, J., Portillo, S., Finkbeiner, D., Goodman, A. 2018. *ApJ*, 869, 83. [Mapping Distances across the Perseus Molecular Cloud Using CO Observations, Stellar Photometry, and Gaia DR2 Parallax Measurements](#).
9. Zucker, C. & Chen, H. H. 2018. *ApJ*, 864, 162. [RadFil: A Python Package for Building and Fitting Radial Profiles for Interstellar Filaments](#).
10. Zucker, C., Battersby, C., Goodman, A. 2018. *ApJ*, 864, 2. [The Physical Properties of Large-scale Galactic Filaments](#).
11. Zucker, C., Walker, L.M., Johnson, K., Gallagher, S., Alatalo, K., Tzanavaris, P. 2016. *ApJ*, 821, 113. [Hierarchical Formation in Action: Characterizing Accelerated Galaxy Evolution in Compact Groups using Whole-Sky WISE Data](#).
12. Zucker, C., Battersby, C., Goodman, A. 2015. *ApJ*, 815, 23. [The Skeleton of the Milky Way](#).

## Second or Third Author:

13. Speagle, J., Zucker, C. [17 authors]. 2024. *ApJ*, Accepted. [Mapping the Milky Way in 5-D with 170 Million Stars at High Galactic Latitudes](#).
14. Speagle, J., Zucker, C. [17 authors]. 2024, *ApJ*, Submitted. [Deriving Stellar Properties, Distances, and Reddenings from Photometry and Astrometry with brutus](#).
15. \*Mullens, E., Zucker, C., Murray, C., and Smith, R. 2024. *ApJ*, Submitted. [Characterizing the 3D Structure of Molecular Cloud Envelopes in the Cloud Factory Simulations](#).
16. \*Cahlon, S., Zucker, C., Goodman, A., Lada, C., Alves, J. 2024. *ApJ*, 961, 153. [A Parsec-Scale Catalog of Molecular Clouds in the Solar Neighborhood Based on 3D Dust Mapping: Implications for the Mass-Size Relation](#).
17. Edenhofer, G., Zucker, C., Frank, P., Saydjari, A., Speagle, J., Finkbeiner, D., and Ensslin, T. 2024. *A&A*, Accepted. [A Parsec-Scale Galactic 3D Dust Map out to 1.25 kpc from the Sun](#).
18. \*Konietzka, R., Goodman, A., Zucker, C., Burkert, A., Alves, J., Foley, M., and Swiggum, C. 2024, *Nature*, Accepted. [Phase Space Analysis of the Local Interstellar Medium](#).
19. Opher, M., Loeb, A., Zucker, C., [9 co-authors]. 2024, *ApJ*, Submitted. [The Passage of the Solar System through the Local Bubble](#).
20. Soler, J., Zucker, C., Peek, J. [14 co-authors]. 2023, *A&A*, 675, A206. [A panoptic view of the Taurus molecular cloud](#).
21. Saydjari, A., Uszoy, A.S., Zucker, C., Peek, J., Finkbeiner, D. 2023, *ApJ*, 954, 141. [Measuring the 8623Å Diffuse Interstellar Band in Gaia DR3 RVS Spectra: Obtaining a Clean Catalog by Marginalizing over Stellar Types](#).
22. Foley, M., Goodman, A., Zucker, C. [11 co-authors]. 2022. *ApJ*, 947, 66. [A 3D View of Orion: I. Barnard’s Loop](#).
23. \*Tu, A., Zucker, C., Speagle, J., Beane, A., Goodman, A., Alves, J., Faherty, J., and Burkert, A. 2022, *ApJ*, 936, 57. [Characterizing the 3D Kinematics of Young Stars in the Radcliffe Wave](#).
24. Stephens, I., Myers, P., Zucker, C. [21 co-authors]. 2022. *ApJL*, 96, 6. [The Magnetic Field in the Milky Way Filamentary Bone G47](#).
25. Bialy, S., Zucker, C., Goodman, A., Foley, M., Alves, J., Semenov, V., Leike, R., Ensslin, T. 2021. *ApJL*, 919, L5. [The Per-Tau Shell: A Giant Star-forming Spherical Shell Revealed by 3D Dust Observations](#).
26. Kuhn, M., Benjamin, R., Zucker, C., Krone-Martins, A., de Souza, R., Castro-Ginard, A., Ishida, E., Povich, M., Hillenbrand, L. 2021, *A&A*, 651, L10. [A High Pitch Angle Structure in the Sagittarius Arm](#).
27. \*Das, K., Zucker, C., Speagle, J., Goodman, A., Green, G., and Alves, J. 2020. *MNRAS*. 498, 4. [Constraining the Distance to the North Polar Spur with Gaia DR2](#).
28. Alves, J., Zucker, C., Goodman, A., Speagle, J., Meingast, S., Robitaille, T., Finkbeiner, D., Schlafly, E., Green, G. 2020. *Nature*, 578, 237. [A Galactic-scale gas wave in the Solar Neighborhood](#).

29. Green, G., Schlafly, E., Zucker, C., Speagle, J., Finkbeiner, D. 2019. *MNRAS*, 887, 93. [A 3D Dust Map Based on Gaia, Pan-STARRS 1 and 2MASS.](#)
30. Lisenfeld, U., Alatalo, K., Zucker, C., Appleton, P. N., Gallagher, S., Guillard, P., Johnson, K. 2017. *A&A*, 607, A110. [The Role of Molecular Gas in Galaxy Transition in Compact Groups.](#)

### Other Co-Authored Publications:

31. Swiggum, C. and 11 co-authors, including Zucker, C. *Nature*, Submitted. The Origin of Young Local Star Clusters.
32. Posch, L. and 7 co-authors, including Zucker, C. *A&A*, Accepted. [The Corona Australis star formation complex is accelerating away from the Galactic plane.](#)
33. Ratzenbock, S. and 15 co-authors, including Zucker, C. *A&A*, 678, A71. [The star formation history of the Sco-Cen association. Coherent star formation patterns in space and time.](#)
34. Meingast, S. & 37 co-authors, including Zucker, C. *A&A*, 673, A58. [VISIONS: The VISTA Star Formation Atlas I: Survey Overview.](#)
35. Saydjari, A. & 12 co-authors, including Zucker, C. *ApJS*, 264, 28. [The Dark Energy Camera Plane Survey 2 \(DECaPS2\): More Sky, Less Bias, and Better Uncertainties.](#)
36. Kuhn, M. & 10 co-authors, including Zucker, C. 2022. *AJ*, 165, 3. [Spectroscopic Confirmation of a Population of Isolated, Intermediate-Mass YSOs.](#)
37. Swiggum, C., Alves, J., D’Onghia, E., Benjamin, R., Thulasidharan, L., Zucker, C., Poggio, E., Drimmel, R., Gallagher, J., and Goodman, A. 2022, *A&A*, 664, 13. [The Radcliffe Wave as the Gas Spine of the Orion Arm.](#)
38. Anderson, L., Benjamin, R., Hurley-Walker, N., McClure-Griffiths, N., Luisi, M., Liu, B., Linville, D., Zucker, C., and Kuhn, M. 2021. *ApJ*, Submitted. The Galactic Center Lobe is a Foreground HII Region.
39. Grasser, N., Ratzenbock, S., Alves, J., Grossschedl, J., Meingast, S., Zucker, C., Hacar, A., Lada, C., Goodman, A., Lombardi, M., Forbes, J., Bomze, I., and Moller, T., 2021. *A&A*, 652, A2. [The  \$\rho\$  Oph region revisited with Gaia EDR3: Two young populations, new members, and old impostors.](#)
40. Swiggum, C., D’Onghia, E., Alves, J., Grossschedl, J., Foley, M., Zucker, C., Meingast, S., Chen, B., Goodman, A. 2021. *ApJ*, 917, 21. [Evidence for Radial Expansion at the Core of the Orion Complex with Gaia EDR3.](#)
41. Kong, S., Arce, H., Carpenter, J., [9 authors], Zucker, C., [5 authors]. 2021. *AJ*, 161, 229. [High-resolution CARMA Observations of Molecular Gas in the North America and Pelican Nebulae.](#)
42. Green, G., Rix, H-W., Tschesche, L., Finkbeiner, D., Zucker, C., Schlafly, E., Rybizki, J., and Speagle, J. 2021. *ApJ*, 907, 57. [Data-Driven Stellar Models.](#)
43. Izquierdo, A., Smith, R., Glover, S., Klessen, R., Treß, R., Sormani, M., Clark, P., Duarte-Cabral, A., and Zucker, C. 2021. *MNRAS*, 500, 5286. [The Cloud Factory II: Gravoturbulent Line-Widths of Resolved Molecular Clouds in a Galactic Potential.](#)
44. Wang, Y., Beuther, H., Schneider, N., Meidt, S., Linz, H., Ragan, S., Zucker, C., Battersby, C., Soler, J., Schinnerer, E., Bigiel, F., Colombo, D. and Henning T. 2020. *A&A*, 641, A53. [Dense Gas in a Giant Molecular Filament.](#)
45. Smith, R. J., Tress, R., Sormani, C., Clover, S. Klessen, R., Clark, P., Izquierdo, A., Duarte-Cabral, A., Zucker, C. 2019. *MNRAS*, 492, 1594. [The Cloud Factory I: Generating resolved filamentary molecular clouds from galactic-scale forces.](#)
46. Fissel, L. & 39 co-authors, including Zucker, C. 2019. *ApJ*, 878, 110. [Relative Alignment between the Magnetic Field and Molecular Gas Structure in the Vela C Giant Molecular Cloud Using Low- and High- density Tracers.](#)
47. Monsch, K., Pineda, J., Liu, H.B., Zucker, C., H., Chen, H., Pattle, K., Offner, S., Di Francesco, J., Ginsburg, A., Ercolano, B., Arce, H., Friesen, R., Kirk, H., Caselli, P., Goodman, A. 2018. *ApJ*, 861, 77. [Dense Gas Kinematics and a Narrow Filament in the Orion A OMC1 Region using NH<sub>3</sub>.](#)
48. Walker, L.M., Butterfield, N., Johnson, K., Zucker, C., Gallagher, S., Konstantopoulos, I., Hornschemeier, A., Tzanavaris, P., Charlton, J. 2013. *ApJ*, 775, 129. [The Optical Green Valley vs Mid-IR Canyon in Compact Groups.](#)

## ADVISING

I have served as a (co-)advisor for twelve students, resulting in five student-led refereed publications:

### Graduate students:

|  |                   |
|--|-------------------|
| Ralf Konietzka (Harvard)               | Fall 2023–Present |
| Theo O’Neill (Harvard)                 | Fall 2023–Present |
| Annie Gao (JHU/SAO Predoctoral Fellow) | Fall 2022–Present |

**Undergraduate students:**

|   |                         |
|---|-------------------------|
| Stephanie Yoshida (Harvard)               | Fall 2023–Present       |
| Elijah Mullens (University of Florida)    | Spring 2022–Present     |
| Shlomo Cahlon (Harvard)                   | Fall 2020–Fall 2023     |
| Sara Starecheski (Sarah Lawrence College) | Summer 2022–Summer 2023 |
| Victoria Ono (Harvard)                    | Fall 2022–Winter 2022   |
| Diana Khimey (Harvard)                    | Winter 2020–Summer 2021 |
| Alan Tu (Harvard)                         | Summer 2020–Spring 2022 |
| Kaustav Das (IIT Kanpur)                  | Summer 2019–Fall 2020   |
| Laura Chapman (Harvard)                   | Summer 2018             |

**PRESENTATIONS**

I have given **66 talks**, including **45 invited** colloquia, seminars, and conference talks. Highlights include:

**Colloquia (Selected):**

|   |                |
|---|----------------|
| NRAO Socorro                            | December 2023  |
| UCLA                                    | October 2023   |
| Australian National University          | May 2023       |
| EPFL/University of Geneva               | December 2022  |
| NASA Goddard Spaceflight Center         | October 2022   |
| Max Planck Institute for Radioastronomy | September 2022 |
| Durham University                       | May 2022       |
| University of Vienna                    | April 2022     |
| Carnegie Observatories                  | March 2022     |

**Recent Invited Seminars (Selected):**

|                            |               |
|----------------------------|---------------|
| Boston University          | December 2023 |
| University of Utah         | October 2023  |
| University of Pennsylvania | February 2023 |

**Recent Invited Conference Talks (Selected):**

|  |                |
|--|----------------|
| Salpeter Workshop on the Diffuse Interstellar Medium (Cornell) | December 2023  |
| Surveying the Milky Way (IPAC)                                 | October 2023   |
| Self–Organization Across Scales (MIAPbP)                       | September 2022 |

**SELECTED PROFESSIONAL ACTIVITIES****Conference and Seminar Organization:**

|  |                                 |
|--|---------------------------------|
| SOC, Galactic Science with the Nancy Grace Roman Telescope, Yerkes Observatory                   | Spring 2024                     |
| Chair, AAS 243 Special Session: The Future of Galactic Plane Science with <i>Roman</i>           | Winter 2024                     |
| SOC, New Computational Methods in Milky Way Structure and Dynamics                               | Winter 2024                     |
| SOC, Early Phases of Star Formation (EPoS) 2024 Meeting  | Fall 2023                       |
| SOC, Mapping the Milky Way at the Lorentz Center   | Winter 2023                     |
| Organizer, Low Density Universe Meetings at STScI/JHU  | Fall 2022 – Spring 2023         |
| SOC Chair, <i>Seeing the Future</i> Conference   | Spring 2022                     |
| Interdisciplinary conference at the intersection of astronomy/data/education/digital scholarship |                                 |
| Harvard Star Formation Journal Club Series Co–Organizer  | Spring 2018–Spring 2020         |
| SOC, Harvard–Heidelberg Meeting on Star Formation  | Fall 2017, Fall 2019, Fall 2023 |

**Reviewing:**

|   |                     |
|---|---------------------|
| LMT External Proposal Reviewer  | Fall 2023           |
| Guest Editor, Annual Review of Astronomy & Astrophysics (ARAA, Volume 63) | Spring 2023         |
| NASA Astrophysics Data Analysis Program (ADAP) Panel Reviewer             | Summer 2022         |
| NSF Astronomy & Astrophysics Research Grants (AAG) Panel Reviewer         | Spring 2021         |
| Referee for ApJ, A&A, AJ, & MNRAS   | Fall 2018 – Present |

**Committees, Collaborations, & Leadership:**

|  |                         |
|--|-------------------------|
| CfA/Clay Fellowship Selection Committee              | Fall 2023               |
| CfA Decadal Survey Editorial Board                   | Fall 2023–Present       |
| SDSS–V Dust Program Working Group Co–Chair           | Summer 2022–Present     |
| AAS WorldWide Telescope Software Steering Committee  | Fall 2021 – Winter 2023 |
| Harvard Data Science Review, Emerging Scholars Board | Spring 2020–Fall 2022   |
| Core member, glue visualization software team        | Spring 2017–Present     |

**SELECTED OUTREACH & MENTORING**


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|--|-------------------------------------|
| Mentor, CfA Constellations Mentoring Program                                       | Spring 2024                         |
| <i>Astronomy Live</i> Show at AMNH Hayden Planetarium, Mapping the Milky Way in 3D | December 2023                       |
| Sky & Telescope guest writer   | Summer 2023                         |
| Article on <i>Mapping our Galactic Backyard</i>                                    |                                     |
| Mentor, Astronomy Mentorship Program for Upcoming Postdocs (AMP–UP)                | Spring 2022–Present                 |
| Subject Matter Expert, NASA Cosmic Data Stories                                    | Fall 2020 – Present                 |
| Public understanding of data science via interactive research stories              |                                     |
| WorldWide Telescope Ambassador   | Fall 2015 – Present                 |
| Cambridge Explores the Universe Volunteer  | Spring 2016, 2017, 2018, 2019, 2023 |
| Public Talks throughout New England  | Spring 2018–Present                 |
| Astronomy Rewind, Volunteer Lead   | Fall 2018                           |

**TEACHING**


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I have served as a teaching fellow for an undergraduate and graduate course. Both times, I received the Harvard Bok Center Certificate of Distinction in Teaching, based on high student course evaluations. I also received the Harvard Astronomy departmental award for teaching excellence.

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|---|-------------|
| Physics & Chemistry of the Interstellar Medium (Harvard University) | Spring 2019 |
| Galactic & Extragalactic Astronomy (Harvard University)             | Fall 2017   |

**SELECTED PRESS**


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My research has been featured in over one hundred news outlets worldwide including The Associated Press, The Wall Street Journal, The New York Times, CNN, BBC News and The Guardian. Highlights include:

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|---|--------------|
| <a href="#">New York Times</a> , <i>Where our Bubble Ends, Our Understanding Begins</i>                 | January 2022 |
| <a href="#">NBC News</a> , <i>Booms and a Bubble: How Supernovae Shaped our Galactic Neighborhood</i>   | January 2022 |
| <a href="#">CBC Radio Interview</a> , Quirks and Quarks   | January 2022 |
| <a href="#">NPR Radio Interview</a> , Science Friday  | January 2020 |
| <a href="#">The Associated Press</a> , <i>Titanic Wave of Star-forming Gases Found in the Milky Way</i> | January 2020 |