# Catherine Zucker

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## EDUCATION

**Harvard University:** PhD in Astronomy & Astrophysics                                    2017 - 2020
    Dissertation: *Charting our Uncharted Milky Way*
    Advisors: Alyssa Goodman & Douglas Finkbeiner

**Harvard University**: M.A. in Astronomy and Astrophysics                                    2015 - 2017

**University of Virginia**: B.A. in Astronomy-Physics and B.A. in History                 2011 - 2015

## RESEARCH HIGHLIGHTS

My research focuses on developing novel techniques to tease out the true 3D structure of our Galaxy. I use a combination of observations, simulations, astrostatistics, and data visualization to gain new insight into the physical nature, structure, and kinematics of our Milky Way's interstellar medium. Some of my research highlights include:

- Using 3D dust mapping to produce a very large catalog of accurate distances to local star-forming regions

- The discovery of the *Radcliffe Wave*, a 2.7 kpc long sinuosoidal structure which redefines the shape of the Local Arm in our Galaxy. Press.

- Knitting together spectral-line observations of gas with 3D maps of dust to produce high-resolution 4D views of nearby molecular clouds

- Characterizing the physical properties of the largest-scale filaments in the interstellar medium of our Galaxy via observations and simulations

- *Big Data*, bayesian statistics, statistical computing, and interactive data visualization

## PUBLICATIONS

I have co-authored 19 publications (refereed or under review), including eight as (co-) first author, and two as second author. My second-author publications include one *Nature* publication, and one undergraduate student-led publication for which I served as the primary science advisor. A full listing of my publications can be found on ADS.

### First Author/co-PI

1. **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.

2. **Zucker, C**; Smith, R.; Goodman, A. 2019. *ApJ*, 887, 186. Synthetic Large-Scale Galactic Filaments — on their Formation, Physical Properties, and Resemblance to Observations.

3. **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

4. **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.

5. **Zucker, C** & Chen, H. H. 2018. *ApJ*, 864, 162. RadFil: A Python Package for Building and Fitting Radial Profiles for Interstellar Filaments.

6. **Zucker, C**; Battersby, C.; Goodman, A. 2018. *ApJ*, 864, 2. The Physical Properties of Large-scale Galactic Filaments.

7. **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.

8. **Zucker, C**; Battersby, C.; Goodman, A. 2015. *ApJ*, 815, 23. The Skeleton of the Milky Way.

## Second Author

1. Das, K., **Zucker, C.**, Speagle, J., Goodman, A., Green, G., and Alves, J. *MNRAS*. Submitted. Constraining the Distance to the North Polar Spur with Gaia DR2

2. 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

## Other Co-Authored Publications

1. Izquierdo, A., Smith, R., Glover, S., Klessen, R., Treß, R., Sormani, M., Clark, P., Duarte-Cabral, A., and **Zucker, C**. 2020. *MNRAS*. Submitted. The Cloud Factory II: Gravoturbulent Line-Widths of Resolved Molecular Clouds in a Galactic Potential

2. Green, G., Rix, H-W., Tschesche, L., Finkbeiner, D., **Zucker, C.**, Schlafly, E., Rybizki, J., and Speagle, J. 2020. *ApJ*. Submitted. Data-Driven Stellar Models

3. 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*. Accepted. Dense Gas in a Giant Molecular Filament

4. 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

5. 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

6. 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.

7. 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 $NH_3$

8. 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

9. 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

## Unrefereed

1. Invited *Perspective* article for the February 2020 issue of the Star Formation Newsletter (distributed to > 1000 star formation researchers in 34 countries). *Distances to Star-Forming Regions.*

## PRESENTATIONS

I have given (or will give post COVID-19) a total of 27 talks, including 11 invited talks

## Talks

1. **Invited Colloquium**, ITC Colloquium (Harvard CfA) — September 2020
2. **Invited Talk**, The small-scale physics of galaxy evolution (MPIA) — July 2020 (postponed to 2021)
3. **Invited Talk**, The Grand Cascade (Orsay, France) — July 2020 (postponed to 2021)
4. **Invited Talk**, AAS 236 Meeting-in-Meeting: *The ISM of Galaxies in the Era of Big Data* — June 2020
5. Lunch Seminar, Harvard Astrostatistics Group (Harvard University) — March 2020
6. Lunch Seminar, University of Washington (Seattle, Washington) — February 2020
7. Contributed Talk, NE Regional Star Formation Meeting (U. Conn.) — January 2020
8. **Invited Colloquium**, AMNH (New York, New York) — December 2019
9. Contributed Talk, Harvard-Heidelberg Meeting on Star Formation (Cambridge, MA) — November 2019
10. **Invited Talk**, The self-organized star formation process (Orsay, France) — October 2019
11. Contributed Talk, Crete III – Through dark lanes to new stars (Heraklion, Crete) — September 2019
12. **Invited Colloquium** (with J. Speagle), SAO REU Summer Colloquium (Harvard CfA) — June 2019
13. Contributed Talk, New England Regional SF Meeting (UMass) — Januay 2019
14. Contributed Talk, Harvard Heidelberg Meeting on Star Formation (MPIA) — December 2018
15. Invited Talk, ITC Luncheon (Harvard CfA) — November 2018
16. Contributed Talk, Interstellar Filament Paradigm (Nagoya, Japan) — November 2018
17. **Invited Talk**, The Milky Way in the Age of Gaia (Orsay, France) — October 2018
18. **Invited Talk**, MIT Haystack — August, 2018
19. Contributed Talk, the Olympian Symposium (Paralia, Greece) — May 2018
20. Contributed Talk, AAS Splinter Session (Washington, DC) — January 2018
21. Contributed Talk, Sun, Stars, and Galaxies (U. Manchester, UK) — October 2017
22. Contributed Talk, Harvard Astrostats Day (Harvard CfA) — September 2017
23. Contributed Talk, Galactic Star Formation with Survey (MPIA) — July 2017
24. **Invited Talk**, Dunlap Institute (Toronto, Canada) — May 2017
25. Contributed Talk, New England Region SF Meeting — January 2016
26. Contributed Talk, Filamentary Structure in Molecular Clouds (Charlottesville, VA) — October 2014
27. Talk, SAO Astronomy Intern Symposium (Harvard CfA) — August 2014

## SELECTED AWARDS

- [Fireman Fellow](#)        Spring 2020
  *Department's highest honor, awarded by the Harvard Astronomy Faculty*
  *to a single graduating PhD student on the basis of their doctoral work*
- [Harvard-Horizons 2020 Scholar](#)        Spring 2020
  *Top eight graduate students selected across Harvard to receive*
  *professional development training, culminating in public "TED-style" talk*
- Certificate of Distinction in Teaching, Harvard University        Fall 2019
- Harvard Astronomy Departmental Teaching Award        Spring 2018
- Certificate of Distinction in Teaching, Harvard University        Spring 2018
- La Serena School for Data Science Full Scholarship        Summer 2017
- NSF Graduate Research Fellowship Award        Fall 2016-Spring 2020
  *Supports outstanding graduate students in NSF-supported science disciplines*
- John P. and Carol J. Merrill Graduate Fellowship, Harvard University        Fall 2015-Spring 2017
- Peirce Fellowship, Harvard Astronomy        Fall 2015-Fall 2018
  *Internal fellowship for top three admitted Harvard Astronomy applicants*
- UVA Undergraduate Physics Research Symposium, 1st Place        Fall 2014
- Vyssotsky Prize, University of Virginia Astronomy        Spring 2014
  *Awarded to one outstanding third year astrophysics major at the University of Virginia*
- Double Hoo Research Award, University of Virginia        Spring 2014
- Intermediate Honors, University of Virginia        Fall 2013
- Virginia Space Grant Consortium Research Fellowship        Summer 2013–Spring 2014
- Kate Cabell Claiborne Cox Scholarship, University of Virginia History        Spring 2013
- Harrison Undergraduate Research Award, University of Virginia        Summer 2013–Spring 2014
- Echols Scholarship Fund Grant, University of Virginia        Summer 2012
- Small Research and Travel Grant, University of Virginia        Summer 2012
- Wolfe Undergraduate Docent Award, University of Virginia        Spring 2012
- Echols Scholar, University of Virginia        Fall 2011–Fall 2015

## TEACHING & MENTORING

### Teaching

I have served as a teaching fellow for both an undergraduate and graduate course. Both times, I received the Bok Center Certificate of Distinction in Teaching, based on high evaluations in student course feedback. I also received the Harvard Astronomy departmental award for teaching excellence in Spring 2018.

- Physics & Chemistry of the ISM (AY203). Harvard University.        Spring 2019
- Galactic and Extragalactic Astronomy (AY17). Harvard University.        Fall 2017

## Mentoring

I have served as the primary science advisor for three undergraduate students.

- Alan Tu (Harvard University). Undergraduate Research. Summer 2020 - Present
  *Characterizing the 3D Motion of Young Stars in the Radcliffe Wave*

- Kaustav Das (IIT Kanpur). Undergraduate Research. Summer 2019 - Present
  *Constraining the Distance to the North Polar Spur with Gaia DR2. MNRAS*, Submitted.

- Laura Chapman (Harvard University). Undergraduate Research. Summer 2018
  *A Statistics Plugin for the glue Visualization Environment.* See code on pypi.

## PROFESSIONAL ACTIVITIES

- Harvard Data Science Review, Student Editorial Board                    Spring 2020 - Present
- Scientific Organizing Committee, Harvard-Heidelberg Star Formation Meeting 2019    Fall 2019
- Referee for *ApJ*, *AJ*, *A&A*, and *MNRAS*                              Fall 2018 - Present
- Core member, `glue` visualization software team                         Spring 2017 - Present
- CfA Star Formation Journal Club Series Co-Organizer                      Spring 2018 - Present
- American Astronomical Society, Junior Member                            Fall 2015 - Present

## PRESS

For full overview of *Radcliffe Wave* press coverage, see our website. Total of 324 news stories, with selected highlights below.

- Appeared live on NPR's Science Friday (with A. Goodman) discussing the *Radcliffe Wave*    January 2020
- Harvard Gazette Interview on the discovery of the *Radcliffe Wave*       January 2020
- Interview with The Associated Press on the *Radcliffe Wave*             January 2020
- Interview with Sky & Telescope on the *Radcliffe Wave*
- Appeared on Dr. Becky podcast (with A. Goodman & J. Alves) on the *Radcliffe Wave*    January 2020
- Interview with Space.com on the Milky Way Skeleton                      January 2015

## OUTREACH

- Public Talk, Gloucester Area Astronomy Club                            Summer 2019
- Astronomy Rewind, Volunteer Lead                                       Fall 2018
- Public Talk, New Hampshire Astronomical Society                        Spring 2018
- Cambridge Explores the Universe Volunteer, Harvard University          Spring 2016, 2017, 2018, 2019
- Development of the MilkyWay3D.com Galactic Plane Mapper Tool           Fall 2016
- WorldWide Telescope Ambassador                                        Fall 2015 - Present
- *Dark Skies, Bright Kids Planetarium Lead*, University of Virginia     March 2012–May 2015
- Harrison Institute for American History Docent, University of Virginia September 2011–May 2015

## OBSERVING EXPERIENCE

Cerro Tololo Observatory, Chile (Blanco 4m) (2 half-nights)                    July 2019
Cerro Tololo Observatory, Chile (Blanco 4m) (2 nights)                          May 2019
Cerro Tololo Observatory, Chile (Blanco 4m) (2 half-nights)               January 2019
Cerro Tololo Observatory, Chile (Blanco 4m) (4 half-nights)               August 2018
Cerro Tololo Observatory, Chile (Blanco 4m) (3 nights)                   February 2018
MMT Observatory; Tucson, AZ (4 nights)                                       August 2014
Kitt Peak Observatory (Bok 90"); Tucson, AZ (5 nights)                  December 2012