# Catherine Zucker

# $Center\ for\ Astrophysics \mid Harvard\ \ \ \ Smithsonian$ catherine.zucker@cfa.harvard.edu

Last Updated: April 2020

#### **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 INTERESTS

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 nature and structure of our Milky Way's interstellar medium. Some of my research highlights include:

- Producing the largest and most accurate map of stellar nurseries in our solar neighborhood
- 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 gas and dust observations 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
- Biq Data, bayesian statistics, statistical computing, and interactive data visualization

#### **PUBLICATIONS**

I have co-authored 16 publications, including eight as (co-) first author. 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. 2018c. *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. 2018b. *ApJ*, 864, 162. RadFil: A Python Package for Building and Fitting Radial Profiles for Interstellar Filaments.
- 6. **Zucker, C**; Battersby, C.; Goodman, A. 2018a. *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.

# Contributing Author

- 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. Submitted. Dense Gas in a Giant Molecular Filament
- 2. Alves, J., **Zucker**, C., Goodman, A., Speagle, J., Meingast, S., Robitaille, T., Finkbeiner, D., Schlafly, E., Green, G. 2020. *Nature*. A Galactic-scale gas wave in the Solar Neighborhood.
- 3. Smith, R. J., Tress, R., Sormani, C., Clover, S. Klessen, R., Clark, P., Izquierdo, A., Duarte-Cabral, A., **Zucker, C.**. 2019. *MNRAS*. Accepted. The Cloud Factory I: Generating resolved filamentary molecular clouds from galactic-scale forces
- 4. 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.
- 5. 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.
- 6. 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>.
- 7. 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
- 8. 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 a total of 23 talks, including 7 invited talks.

## **Talks**

1. Lunch Seminar, Harvard Astrostatistics Group (Harvard University)	March 2020
2. Lunch Seminar, University of Washington (Seattle, Washington)	February 2020
3. Contributed Talk, NE Regional Star Formation Meeting (U. Conn.)	January 2020
4. Invited Colloquium, AMNH (New York, New York)	December 2019
5. Contributed Talk, Harvard-Heidelberg Meeting on Star Formation (Cambridge, MA)	November 2019
6. Invited Talk, The self-organized star formation process (Orsay, France)	October 2019

8. Invited Colloquium, SAO REU Summer Colloquium Series (Harvard CfA) 9. Contributed Talk, New England Regional SF Meeting (UMass) 10. Contributed Talk, Harvard Heidelberg Meeting on Star Formation (MPIA) 11. Invited Talk, Interstellar Filament Paradigm (Nagoya, Japan) 12. Contributed Talk, Interstellar Filament Paradigm (Nagoya, Japan) 13. Invited Talk, The Milky Way in the Age of Gaia (Orsay, France) 14. Invited Talk, The Milky Way in the Age of Gaia (Orsay, France) 15. Contributed Talk, the Olympian Symposium (Paralia, Greece) 16. Contributed Talk, MIT Haystack 16. Contributed Talk, Say, Splinter Session (Washington, DC) 17. Contributed Talk, Say, Stars, and Galaxies (U. Manchester, UK) 18. Contributed Talk, Harvard Astrostats Day (Harvard CfA) 19. Contributed Talk, Galactic Star Formation with Survey (MPIA) 20. Invited Talk, Dunlap Institute (Toronto, Canada) 21. Contributed Talk, New England Region SF Meeting 22. Contributed Talk, Filamentary Structure in Molecular Clouds (Charlottesville, VA) 23. Talk, SAO Astronomy Intern Symposium (Harvard CfA) 24. ELECTED AWARDS  25. Harvard-Horizons 2020 Scholar 26. Top cight graduate students selected across Harvard to receive professional development training, culminating in public "TED-style" talk 26. Certificate of Distinction in Teaching, Harvard University 27. Agental Astronomy Departmental Teaching Award 38. Pain 201 39. NSF Graduate Research Fellowship Award 40. Certificate of Distinction in Teaching, Harvard University 41. As Spring 201 42. NSF Graduate Research Fellowship Award 43. Spring 201 44. Pelice Fellowship, Harvard Astronomy applicants 45. John P. and Carol J. Merrill Graduate Fellowship, Harvard University 45. Pail 2015-Spring 201 46. Pail 2016-Spring 202 47. Syssotsky Prize, University of Virginia Astronomy Awarded to one outstanding third year astrophysics major at the University of Virginia 48. Pail 201 49. Vyssotsky Prize, University of Virginia Astronomy 40. Virginia Space Grant Consortium Research Fellowship 50. Star Cabell Claiborne Cox Schol	7. Contributed Talk, Crete III – Through dark lanes to new stars (Heraklion, C	Crete) September 2019
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Harvard-Horizons 2020 Scholar 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 Harvard Astronomy Departmental Teaching Award Certificate of Distinction in Teaching, Harvard University Spring 201  Certificate of Distinction in Teaching, Harvard University Spring 201  La Serena School for Data Science Full Scholarship Summer 201  NSF Graduate Research Fellowship Award Supports outstanding graduate students in NSF-supported science disciplines  John P. and Carol J. Merrill Graduate Fellowship, Harvard University Peirce Fellowship, Harvard Astronomy Internal fellowship for top three admitted Harvard Astronomy applicants  UVA Undergraduate Physics Research Symposium, 1st Place Vyssotsky Prize, University of Virginia Astronomy Awarded to one outstanding third year astrophysics major at the University of Virginia  Double Hoo Research Award, University of Virginia Intermediate Honors, University of Virginia Virginia Space Grant Consortium Research Fellowship Kate Cabell Claiborne Cox Scholarship, University of Virginia History Harrison Undergraduate Research Award, University of Virginia Summer 2013–Spring 201  Harrison Undergraduate Research Award, University of Virginia	NOT DOTTED AWA DOG	
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<ul> <li>Peirce Fellowship, Harvard Astronomy         Internal fellowship for top three admitted Harvard Astronomy applicants</li> <li>UVA Undergraduate Physics Research Symposium, 1st Place</li> <li>Vyssotsky Prize, University of Virginia Astronomy         Awarded to one outstanding third year astrophysics major at the University of Virginia</li> <li>Double Hoo Research Award, University of Virginia</li> <li>Intermediate Honors, University of Virginia</li> <li>Virginia Space Grant Consortium Research Fellowship</li> <li>Kate Cabell Claiborne Cox Scholarship, University of Virginia History</li> <li>Harrison Undergraduate Research Award, University of Virginia</li> <li>Summer 2013-Spring 201</li> <li>Harrison Undergraduate Research Award, University of Virginia</li> </ul>	$Supports\ outstanding\ graduate\ students\ in\ NSF-supported\ science\ disciplines$	
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<ul> <li>Intermediate Honors, University of Virginia</li> <li>Virginia Space Grant Consortium Research Fellowship</li> <li>Kate Cabell Claiborne Cox Scholarship, University of Virginia History</li> <li>Harrison Undergraduate Research Award, University of Virginia</li> <li>Summer 2013–Spring 201</li> <li>Summer 2013–Spring 201</li> </ul>	Awarded to one outstanding third year astrophysics major at the University of	Virginia
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• Harrison Undergraduate Research Award, University of Virginia Summer 2013–Spring 201	• Virginia Space Grant Consortium Research Fellowship	Summer 2013–Spring 201
· · · · · · · · · · · · · · · · · · ·	• Kate Cabell Claiborne Cox Scholarship, University of Virginia History	Spring 201
• Echols Scholarship Fund Grant, University of Virginia Summer 201	• Harrison Undergraduate Research Award, University of Virginia	Summer 2013–Spring 201
	• Echols Scholarship Fund Grant, University of Virginia	Summer 201

• Small Research and Travel Grant, University of Virginia

Summer 2012 Spring 2012

- Wolfe Undergraduate Docent Award, University of Virginia
- 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

• Kaustav Das (IIT Kanpur). Undergraduate Research.

Constraining the Distance to the North Polar Spur with Gaia DR2

Summer 2019 - Present

• Laura Chapman (Harvard University). Undergraduate Research.

A statistics plugin for the glue visualization environment

Summer 2018

#### PROFESSIONAL ACTIVITIES

• Harvard Data Science Review, Student Editorial Board	Spring 2020 - Present
$\bullet$ Scientific Organizing Committee, Harvard-Heidelberg Star Formation Meeting 2019	Fall 2019
• Referee for $A \mathcal{C}A$ , $AJ$ , 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

ullet 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 Science News on the Milky Way Skeleton December 2015

• 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
• Harvard College Undergraduate Research Association Conference Invited Sp	peaker Fall 2016
• 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