Michael M. Foley

Contact Information

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Appointments

AWS Climate Data Science Fellow 2024 - Present
Building the world's most comprehensive dataset of reported crop yield data at subnational scales.

Research Interests

Creating global datasets of crop yield information. Coupling remote sensing with ground-based observations of agriculture. Investigating how climate dynamics shape yield responses. Interactive data visualization and analysis across disciplines, particularly through contributions to the package glue.

Education

Harvard University - Ph.D. in Astrophysics 2024
Advisors: Lars Hernquist and Alyssa Goodman
Thesis: Shock-Turbulence Interactions in Star Formation

University of Notre Dame – B.S. in Mathematics and Honors Physics 2018
Minors: Astrophysics Concentration, Glynn Family Honors Program
Thesis: Physics of Near-Infrared Type Ia Supernova Light Curves

Published Research Highlights

- Helped discover that all local star formation occurs on the surface of the Local Bubble. Additionally, helped model how our Solar System passed through the surface of the Local Bubble 5 million years ago, which has been confirmed with geological records.
- Led the creation of the first high-resolution, interactive 3D map of the Orion star-forming complex.
- Produced and analyzed multi-terabyte simulations on the formation processes for star-forming gas.
- Collaborated with private industry in the production of the first augmented reality figure ever published in astronomy.
- Assisted in numerous discoveries regarding the Radcliffe Wave, now known to be the local arm of our Milky Way galaxy.
- Worked with an international team to place (at the time) the tightest constraints on the strength and nature of dark energy ever.
- Calculated (at the time) the tightest constraints on the production of the first elements (hydrogen, helium, and lithium) after the Big Bang.
- Designed the first system control interface for iLocater, a state-of-the-art instrument finding exoplanets on the Large Binocular Telescope.

Publication Summary

3 published first-author papers with 1 more submitted and 2 in preparation.
12 published contributing-author publications (2 published in Nature) with 2 preprints and 1 more submitted.**Over 4300 citations** and **h-index of 11**.

Honors and Awards

Certificate of Distinction in Teaching, Harvard University	2022
NSF Graduate Research Fellowship	2018 - 2021
Gates Cambridge Scholarship (declined)	2018
Dean's Research Award, University of Notre Dame College of Science	2018
Sigma Pi Sigma (Physics Honors Society)	2018
American Astronomical Society Chambliss Medal Recipient	2017
Barry M. Goldwater Scholar	2017
Phi Beta Kappa Early Inductee	2017
Notre Dame Glynn Family Honors Program Member	2014

Teaching Experience

Class: Climate, Crops, and Food Security — Fall 2025
Undergraduate Level, Harvard – Student Reviews: 5/5

Class: Interstellar Medium and Star Formation — Spring 2023
Graduate Level, Harvard – Student Reviews: 4.75/5

Class: The Unity of Science — Spring 2022
Undergraduate Level, Harvard – Student Reviews: 4.75/5
Awarded Certificate of Distinction in Undergraduate Teaching

Bok Center Teaching Practicums — 2021 - 2024
Took two month-long workshops, conducted formal teaching evaluation, and gave guest lectures to improve my teaching

Class: Astrophysical Fluids and Plasmas — Spring 2021
Graduate Level, Harvard – Student Reviews: 4.13/5

Class: Prediction: The Past and Present of the Future — Spring 2020
Undergraduate Level, Harvard – Student Reviews: N/A in 2020

Students Mentored

*Denotes students whose work has lead to an authored publication.

HarvestStat Student Team Members: 2025 - Present
Hong Chang (China Agricultural University),
Zhiqing Huang (University of Michigan),
Chaiti Bhagawat (University of Michigan),
Amelia Hawkins (Stanford University),
Vanessa Zhang (Harvard University),
Natalia de los Rios (Harvard University),
Hailey Akey (Harvard University),
Gabe DiAntonio (Harvard University),
Zoë Geller-Alford (UBC)

Sophia Millay — 2025 - Present
Harvard Master's student
Novel Approaches for Predicting Food Insecurity in East Africa

Anay Patel — 2025 - Present
Harvard Master's student
Validating Government Statistics with Remote Sensing in India

Wissam Alghabra — 2025 - Present
Harvard undergraduate
Building Crop Statistics Datasets in Syria and Bulgaria

Shreya Gandhi — 2025 - Present
Dartmouth undergraduate
Climate Impacts on Crop Production in Vietnam

Luke Tan — 2025 - Present
Harvard undergraduate
Effects of Severe Weather on Tree Crops in the Philippines

Mike (Guangming) Zhao — 2025 - Present
UBC undergraduate
Geographical Effects of Climate Change on Crop Production in Thailand

Aaron Angress* — 2023 - 2025
Northeastern undergraduate, now CUNY graduate student
Molecular Gas Production on the Edges of Simulated Superbubbles.
Deliverable: Conference Presentation and Publication.

Tovi Sonnenberg — 2023 - 2024
Harvard undergraduate
Association of Molecular Gas and Feedback Bubbles in M33.
Deliverable: Conference Presentation

Shreya Karri — 2019 - 2022
High school student, now consultant at BNY Mellon
A Modern Tour of Stellar Feedback.
Deliverable: Public Tour

Skills

Technical Proficiencies: Python | Fortran | Matlab | C++ | Linux | System Control | Data Visualization | High-performance computing

Languages: English | Spanish (full professional competency)

Observational Experience

Las Campanas Observatory, Swope 1m: 5 nights
Kitt Peak National Observatory, Mayall 4m (KOSMOS): 1 night **ATel #10620**
Lick Observatory, Shane 3m (KAST): 1 night **ATel #10654**
William M. Keck Observatory, Keck1 10m (LRIS): 1 night

Professional Service

American Astronomical Society Education Committee Member	2022 - 2025
CfA Star Formation Journal Club Co-Organizer	2019 - 2024
CfA Superlocal Group Meeting Co-Organizer	2019 - 2024
Harvard-Heidelberg Annual Star Formation Conference - SOC/LOC	2019 - 2024
Organizing Committee Member - 2018, 2019, 2021, 2022	
Organizing Committee Chair - 2023	
Astrobites: Author, Co-Chair of Education & Policy Committees	2018 - 2024
AAS 241 Education Workshop Lead	2023
Red Sox NASA STEM Day Volunteer	2022
Seeing the Future: Of the Universe, Data, Learning, & Digital Scholarship Conference - SOC/LOC	2022
Center for Astrophysics Director Executive Search Committee	2021
APS Ideas Sustainability Subcommittee Member	2019 - 2021
Harvard Writing Center NSF GRFP Panelist	2021
CfA Latino Initiative Program Volunteer - Resume and Python Support	2021
CfA Graduate Student Mentorship Panel Organizer	2020
Cambridge Explores the Universe Volunteer	2019

Other Service

Prison Tutor - Petey Greene Program	2018 - Present
Bilingual English and STEM Tutor (Over 1000 hours completed)	2017 - Present
Skype-a-Scientist Volunteer	2022 - 2024
Big Brothers Big Sisters Mentor	2021 - 2024
Dear Future Colleague Student Mentor	2020 - 2024
ComSciCon Expert Reviewer	2023
ComSciCon Local and Programming Organizing Committees	2022
St. Paul's Catholic Center ESL Tutor	2021 - 2022
The Bald and the Beautiful - Co-Chair of Sponsorships	2014 - 2018
Society of Physics Students - Vice President	2014 - 2018
Scientia Undergraduate Research Journal - Co-Editor of Physics	2015 - 2018

Grants Awarded

AAS 241 EPD Grant - $7,700	2023
Supporting Your Introductory Astronomy Courses: Integrating Astrobites, Sky & Telescope, and Other Digital and Hands-On Resources into Your Courses	
NSF Graduate Research Fellowship - $103,500	2018 - 2021

Schools/Reading Groups

Harvard Business School Mini-MBA Certificate	2021
GPAP Plasma Physics Summer School	2019
Vatican Observatory Summer School	2018
Purpose: *Stellar Variability in the Era of Large Surveys*	
Lie Groups, Lie Algebras, and Representation Theory Directed Readings	2017
Origin of Nuclei in the Universe, Joliot-Curie School	2016
Purpose: *Attended graduate lectures on nuclear physics and astrophysics and presented my research on primordial nucleosynthesis*	
Notre Dame Department of Mathematics Topology Reading Group	2015

Selected Press/Articles

Universe Today: *Recent Supernovae Produced Giant Cavities in the Orion Nebula* 2022
Sky & Telescope: *Supernovae Swept Out Barnard's Loop in Orion* 2022
CfA Press Release: *Did Supernovae Help Form Barnard's Loop?* 2022
Weekly Space Hangout: *The Sun's Local Bubble and Nearby Star Formation* 2022
Global News CHQR Radio Interview: *A Bubbly Origin for Stars Around the Sun with Mike Foley* 2022
Daily Galaxy: *Harvard Astronomers on the "Detective Story" of a 1,000-Light-Year-Wide Bubble Surrounding Earth* 2022

First Author Publications

4. *Topology of Shock-Turbulence Interactions* – **M. M. Foley**, L. Hernquist, P. Mocz, A. Goodman, T. J. O'Neill, B. Burkhart. Submitted to ApJ. 2026.
3. *Development of Turbulence in Postshock Regions* – **M. M. Foley**, P. Mocz, B. Burkhart, A. Goodman, L. Hernquist. (2025), ApJ 992 2.
2. *A 3D View of Orion: I. Barnard's Loop* – **M. M. Foley**, C. Zucker, A. Goodman, J. C. Forbes, J. Alves, S. Bialy, C. Swiggum, M. Grudić, J. Bally, J. Soler, M. Grudic, T. Ensslin, R. Leike (2023), ApJ 947 2. https://arxiv.org/abs/2212.01405. Interactive Authorea version.
1. *Revised Uncertainties in Big Bang Nucleosynthesis* – **M. M. Foley**, N. Sasankan, M. Kusakabe, G. J. Mathews. (2017), International Journal of Modern Physics E. 1741008. Vol 26 No. 8. https://arxiv.org/pdf/1706.02834.pdf

Contributing Author Publications

*Denotes student-led publication

15. *HarvestStat: a global effort towards open and standardized sub-national agricultural data* – K. F. Davis, W. Anderson, S. Ehrmann, R. Flach, C. Meyer, J. Proctor, D. Ray, L. You, **M. Foley**, et al. (2025), Environ. Res. Lett. 20 052001 https://iopscience.iop.org/article/10.1088/1748-9326/adcb54
14. *Tracing 3-D Magnetic Field Structure Using Dust Polarization and the Zeeman Effect* – B. Shane, B. Burkhart, P. Mocz, **M. Foley**, L. Hernquist, et al. https://arxiv.org/abs/2411.10286
13. **Superbubbles Properties in Simulated Dwarf Galaxies* – A. Angress, **M. Foley**, et al. Submitted to ApJ.
12. *The Radcliffe Wave is Oscillating* – R. Konietzka, A. A. Goodman, C. Zucker, A. Burkert, J. Alves, **M. M. Foley**, et al. (2024) Nature. 628 8006. https://www.nature.com/articles/s41586-024-07127-3.
11. *Improving Undergraduate Astronomy Students' Skills with Research Literature via Accessible Summaries: An Exploratory Case Study with Astrobites-based Reading Assignments* – B. L. Lewis, A. R. Waggoner, E. Clarke, A. L. Crisp, M. Dodici, G. M. Doskoch, **M. M. Foley**, et al. (2025), Physical Review Physics Education Research. 21 1. https://journals.aps.org/prper/pdf/10.1103/PhysRevPhysEducRes.21.010124
10. *Star Formation Near the Sun: A New Frontier* – C. Zucker, A. Goodman, J. Alves, S. Bialy, **M. Foley**, et al. (2022), Nature 601 7893. https://arxiv.org/abs/2201.05124
9. *Blowing Bubbles around Intermediate-Mass Stars: Feedback from Main-Sequence Winds is not Enough* – A. L. Rosen, S. S. R. Offner, **M. M. Foley**, L. Lopez. (2021), https://arxiv.org/abs/2107.12397
8. *On the Three-Dimensional Structure of Local Molecular Clouds* – C. Zucker, A. Goodman, J. Alves, S. Bialy, E. W. Koch, J. S. Speagle, **M. M. Foley**, et al. (2021), ApJ 919 1. https://arxiv.org/abs/2109.09765
7. *THE PER-TAU SHELL: A GIANT STAR-FORMING SPHERICAL SHELL REVEALED BY 3D DUST OBSERVATIONS* – S. Bialy, C. Zucker, A. Goodman, **M. Foley**, et al. (2021), ApJL 919 1. https://arxiv.org/abs/2109.09763
6. *Evidence for Radial Expansion at the Core of the Orion Complex with Gaia EDR3* – C. Swiggum, E. D'Onghia, J. Alves, J. Grosschedl, **M. M. Foley**, et al. (2021), ApJ 917 1. https://arxiv.org/abs/2101.10380
5. *The Foundation Supernova Survey: Measuring Cosmological Parameters with Supernovae from a Single Telescope* – D. O. Jones, D. M. Scolnic, R. J. Foley, A. Rest, R. Kessler, P. J. Challis, K. C. Chambers, D. A. Coulter, K. G. Dettman, **M. M. Foley**, et al. (2019), ApJ 881 19. https://arxiv.org/abs/1811.09286

4. *Should Type Ia Supernova Distances Be Corrected for Their Local Environments?* – D. O. Jones, A. G. Riess, D. M. Scolnic, Y.-C. Pan, E. Johnson, D. A. Coulter, K. G. Dettman, **M. M. Foley**, et al. (2018), ApJ 867 108. https://arxiv.org/abs/1805.05911
3. *The Complete Light-Curve Sample of Spectroscopically Confirmed Type Ia Supernova from Pan-STARRS1 and Cosmological Constraints from the Combined Pantheon Sample* – D. M. Scolnic, D. O. Jones, A. Rest, Y.C. Pan, R. Chornock, R. J. Foley, M. E. Huber, R. Kessler, G. Narayan, A. Riess, S. Rodney, E. Berger, P. J. Challis, M. Drout, D. Finkbeiner, R. Lunnan, R. Kirshner, N. Sanders, E. Schlafly, S. Smartt, C. W. Stubbs, J. Tonry, W. M. Wood-Vasey, **M. Foley**, et al. (2018), ApJ 859 2. https://arxiv.org/abs/1710.00845
2. *The Foundation Supernova Survey: Motivation, Design, Implementation, and First Data Release* – Ryan J. Foley, Daniel Scolnic, Armin Rest, S. W. Jha, Y.-C. Pan, A. G. Riess, P. Challis, K. C. Chambers, D. A. Coulter, K. G. Dettman, **M. M. Foley**, et al. (2017), MNRAS 475 1. https://arxiv.org/abs/1711.02474
1. *On-Sky Single-Mode Fiber Coupling Measurements at the Large Binocular Telescope* – A. Bechter, J. Crass, R. Ketterer, J. R. Crepp, R. O. Reynolds, E. Bechter, F. Pedichini, **M. Foley**, et al. (2016) SPIE Proceedings Vol. 9909. https://arxiv.org/pdf/1609.04410.pdf

White Papers

1. *Astro2020 Decadal Review: Astrobites as a Community-led Model for Education, Science Communication, and Accessibility in Astrophysics* – G. Khullar, S. Kohler, T. Konchady, **M. M. Foley**, et al. (2019), ApJ 881 (1), 19. https://arxiv.org/abs/1907.09496

Fun Papers

1. *First Detections of Exop(lan)ets: Observations and Follow-Ups of the Floofiest Transits on Zoom* – S. Sagynbayeva, B. Lewis, G. M. Doskoch, ... incl. **M. M. Foley**, et al. (2022), https://arxiv.org/abs/2203.17185

Invited Talks

11. *Tufts Nutrition Data Symposium* — *October 2025*
Tufts University – Cambridge, MA
10. *Satellite-Enabled Earth Observation & Digital Solutions for Agriculture (SEEDS) Conference* — October 2025
University of Maryland – Virtual
9. *Infrared Astronomy* - ***Co-Shapley Lecturship*** — April 2025
Elgin Community College – Elgin, IL
8. *Shock-Turbulence Interactions in Astrophysics* — October 2023
Harvard Astronomy Research Forum – Cambridge, MA
7. *Building a 3D Model of Our Local ISM* — April 2023
University of Maryland CTC Seminar – Baltimore, MD.
6. *Building a 3D Model of Our Local ISM* — February 2023
STScI Low Density Universe Seminar – Balitmore, MD.
5. *Building a 3D Model of Our Local ISM* — February 2023
Northwestern CIERA Observers Seminar – Virtual.
4. *In Dust We Trust: Mapping Our Galaxy in 3D* — Jul 2022
Harvard REU Program Colloquium – Cambridge, MA.
3. *Building a 3D View of the Orion Star-Forming Region* — Jun 2022
AAS 240 Press Conference – Pasadena, CA.
2. *Modern Supernova Cosmology* — November, 2017
"Talk Science" - University of Notre Dame College of Science.
1. *Advances in Supernova Cosmology* — October, 2017
University of Notre Dame Glynn Family Honors Program.

Contributed Talks

12. *Impacts of Climate Change on Agriculture in South-east Asia Measured by HarvestStat Asia, a New Dataset of Subnational Crop Data* — December 2025
AGU – New Orleans, LA.

11. *Harmonization of Subnational Crop Data* — May 2025
Harvard Kennedy School Food+ Conference – Cambridge, MA.

10. *Building a Subnational Crop Yield Database: HarvestStat Asia* — October 2024
IFPRI Global Sub-national Agricultural Data Workshop – Washington, D.C.

9. *Shock-Turbulence Interactions in Star Formation* — October 2023
Harvard-Heidelberg Star Formation Workshop – Cambridge, MA.

8. *Bubbles Are Cool...ed Efficiently* — July 2023
Center for Astrophysics Blackboard Talks – Cambridge, MA.

7. *Shock-Turbulence Interactions in Star Formation* — June 2023
New England Star Formation Workshop – Cambridge, MA.

6. *Building a 3D View of Orion* — July 2022
Harvard-Heidelberg Star Formation Workshop – Heidelberg, Germany.

5. *Building a 3D View of Orion* — July 2022
New England Star Formation Meeting – Middletown, CT.

4. *Building a 3D View of Orion* — June 2022
AAS 240 – Pasadena, CA.

3. *A New Look at Barnard's Loop* — May 2022
Seeing the Future – New Castle, NH.

2. *A New Look at Barnard's Loop* — March 2021
Harvard-Heidelberg Star Formation Workshop – Virtual.

1. *The Second Maximum in NIR Type Ia Supernova Light Curves* — January, 2018
231st Meeting of the American Astronomical Society – Washington, D.C.

Poster Presentations

9. *Development of Turbulence in Postshock Regions* — December, 2019
Universality: Turbulence Across Vast Scales – NYC. Poster Presentation.

8. *Adiabatic Expansion Matters for Stellar Wind Bubbles* — September, 2019
Crete 3 – Heraklion, Crete, Greece. Poster Presentation.

7. *Glue: A Linked-Data Visualization Tool* — September, 2019
SuperVOSS – Rome, Italy. Poster Presentation.

6. *Calibration and Simulation of the Foundation Supernova Survey* — January, 2017
229th Meeting of the American Astronomical Society – Dallas, TX. Poster.
Chambliss Medal Recipient

5. *Data Pipeline Development for the Foundation Supernova Survey* — October, 2016
University of Notre Dame Fall Undergraduate Research Fair. Poster.

4. *Revised Uncertainties in Big Bang Nucleosynthesis* — September, 2016
Joliot-Curie Summer School – Port Barcares, France. Poster.

3. *Revised Uncertainties in Big Bang Nucleosynthesis* — June, 2016
Great Lakes Cosmology Conference – Hamilton, Canada. Poster.

2. *Revised Nuclear Abundance Uncertainties in Big Bang Nucleosynthesis* — April, 2016
University of Notre Dame COS-JAM Research Fair. Poster.

1. *iLocater: A Diffraction-Limited, Radial Velocity Planet Finder* — October, 2015
University of Notre Dame Fall Undergraduate Research Fair. Poster.

Public Seminars

2. *In Dust We Trust: Mapping Out Our Galaxy in 3D* — April, 2022
Science in the News

1. *A View of Star Formation in the Milky Way: From the Largest to Smallest Scales (with Charles Law)* — March, 2021
Beacon Hill Seminar, MA

Astrobites Research

12. *Dust in Time – Supernovae May Not Destroy Dust As Quickly As We Think* March, 2021
11. *A Windy Day in the Milky Way* September, 2020
10. *Do Aluminum Abundances Foil Our Theory of Galaxy Evolution?* July, 2020
9. *Shaken, Not Stirred: Subgrid Metal Diffusion in Galaxy Simulations* May, 2020
8. *Enigmatic Explosions: How Different Supernova Models Yield Very Different Galaxies* April, 2020
7. *The "Shocking" Mystery about Filaments* December, 2019
6. *When Do Stars Form? Simulating Dynamic Star Formation Efficiencies in Giant Molecular Clouds* November, 2019
5. *Is the Milky Way Gaining or Losing Mass?* September, 2019
4. *Making it Rain in the Circumgalactic Medium* July, 2019
3. *Is That a Supernova? Classifying Transients in Real-Time with Machine Learning* June, 2019
2. *The "Turbulent" Relationship between Stellar Feedback and Magnetic Fields* March, 2019
1. *Type Ia Supernovae Could Use Some More Color* February, 2019

Astrobites Interviews

8. *Meet the AAS Keynote Speakers: Dr. William Donahue* June, 2022
7. *Meet the AAS Keynote Speakers: Adrian Price-Whelan* January, 2021
6. *Meet Kelsie Krafton* June, 2020
5. *Meet the AAS Keynote Speakers: Dr. Jackie Faherty* May, 2020
4. *Meet the AAS Keynote Speakers: Dr. Daniel Kasen* January, 2020
3. *Meet the AAS Keynote Speakers: Dr. Robert Kennicutt* January, 2020
2. *Meet the AAS Keynote Speakers: Professor Elisabeth Mills* June, 2019
1. *Meet the AAS Keynote Speakers: Professor Joshua Winn* June, 2019

Science Policy

2. *Grad Student Unions: Part 1 - History and the UC Santa Cruz Strike (contributor)*
   Astrobites May, 2020
1. *Breaking Down Brexit: Potential impacts on science in the UK*
   Science in the News September, 2019