

Joshua S. Speagle

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RESEARCH INTERESTS

My research interests lie in the interdisciplinary field of **astrostatistics** at the intersections of astronomy, statistics, and computer science. I focus on developing new statistical techniques to integrate and analyze large datasets in order to model stars, galaxies, and other astronomical phenomena.

EDUCATION

Harvard University: MA/PhD 2016-2020 (expected)
Advisers: [Daniel Eisenstein](#), [Charlie Conroy](#), [Doug Finkbeiner](#)
Harvard University: BA with Honors in Astrophysics and Physics 2011-2015
Adviser: [Daniel Eisenstein](#)

POSITIONS

Project Academic Support Staff: Kavli IPMU (WPI), UTIAS, The University of Tokyo 2015-2016
Worked with [A. Leauthaud](#) on weak lensing with Hyper Suprime-Cam data. **Led to papers [12], [30].**
Visiting Researcher: Infrared Processing and Analysis Center (IPAC), Caltech Summer 2014
Worked with [P. Capak](#) on improving photometric redshift estimation. **Led to paper [7].**
Visiting Researcher: Kavli IPMU (WPI), UTIAS, The University of Tokyo Summer 2013
Worked with [C. Steinhardt](#) on evolution of star-forming galaxies. **Led to papers [2], [3], [4].**
REU Student: Cornell University Summer 2012
Worked with [S. Parshley](#) and [G. Stacey](#) on submillimeter instrumentation.
Research Aide: University of Wisconsin-Milwaukee (UWM) Summer 2011
Worked with [D. Kaplan](#) on x-ray observations of a high-B pulsar. **Led to paper [1].**

TEACHING

I have a strong interest in **undergraduate education** and **pedagogy**, with a focus on practical skills such as **programming and statistics** that are invaluable but not often taught as part of a typical science curriculum.

Teaching Fellow: Harvard

I have taught four courses and every academic year since beginning my PhD program in 2016, substantially above the two courses required.

| | |
|---|-------------|
| ASTRON 191: Astrophysics Laboratory | Spring 2019 |
| ASTRON 17: Galactic and Extragalactic Astronomy | Fall 2018 |
| ASTRON 130: Cosmology | Spring 2018 |
| ASTRON 16: Stellar and Planetary Astronomy | Spring 2017 |

Course Instructor: Banneker Institute (Harvard)

The Banneker Institute prepares students of color for graduate programs in astronomy through research, coursework, and social science education.

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|--------|-------------------------|
| Python | Summer 2017, 2018, 2019 |
|--------|-------------------------|

AWARDS & HONORS

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|---|------------------------------|
| Department of Astronomy Teaching Award, Harvard | Spring 2018 |
| Certificate of Distinction in Teaching, Harvard | Spring 2017, 2018; Fall 2018 |
| National Science Foundation Graduate Research Fellowship | 2016 |
| AAS Chambliss Astronomy Achievement Student Award | Winter 2011 |

PUBLICATIONS

| Key: | (Co-)First Author | Substantial Contribution | Other |
|------|-------------------|--------------------------|-------|
|------|-------------------|--------------------------|-------|

I am an author of **33** papers, including **10 as (co-)first author** (highlighted in **red**) and **12 where I have made substantial contributions** (highlighted in **blue**). These papers have a total of **over 1400 citations**, including over **500 citations** for papers where I am (co-)first author.

In Preparation:

Speagle, J. S.; Zucker, C.; Bonaca, A.; Johnson, B. D.; Cargile, P. A.; Conroy, C.; Dotter, A.; Finkbeiner, D. P.; Green, G. M.; Schlafly, E. F.; Goodman, A. A.; & Alves, J.: “Photometric Properties of 170 Million Stars at High Galactic Latitudes”

Submitted:

- 33.** Leja, J.; **Speagle, J. S.**; Johnson, B. D.; Conroy, C.; van Dokkum, P.; & Franx, M., **submitted to ApJ**: “A New Census of the $0.2 < z < 3.0$ Universe, Part I: The Stellar Mass Function”
- 32.** **Speagle, J. S.**, **submitted to the Journal of Statistics Education (JSE)** ([1909.12313](#)): “A Conceptual Introduction to Markov Chain Monte Carlo Methods”
- 31.** Alves, J.; Zucker, C.; Goodman, A. A.; **Speagle, J. S.**; Meingast, S.; Robitaille, T.; Finkbeiner, D. P.; Schlafly, E. F.; & Green, G. M., **submitted to Nature**: “Discovery of a Galactic-scale gas wave in the Solar Neighborhood”
- 30.** **Speagle, J. S.**; Leauthaud, A.; Huang, S.; Bradshaw, C. P.; Ardila, F.; Capak, P. L.; Eisenstein, D. J.; Masters, D. C.; Mandelbaum, R.; More, S.; Simet, M.; & Sifón, C., **submitted to MNRAS** ([1906.05876](#)): “Galaxy-Galaxy Lensing in HSC: Validation Tests and the Impact of Heterogeneous Spectroscopic Training Sets”
- 29.** Green, G. M.; Schlafly, E. F.; Zucker, C.; **Speagle, J. S.**; & Finkbeiner, D. P., **submitted to ApJ** ([1905.02734](#)): “A 3D Dust Map Based on Gaia, Pan-STARRS 1 and 2MASS”
- 28.** **Speagle, J. S.**, **submitted to MNRAS** ([1904.02180](#)): “*dynesty*: A Dynamic Nested Sampling Package for Estimating Bayesian Posteriors and Evidences”
- 27.** Namikawa, T. **et al.** [73 additional co-authors], **submitted** ([1904.02116](#)): “Evidence for the Cross-correlation between Cosmic Microwave Background Polarization Lensing from POLARBEAR and the Cosmic Shear from Subaru Hyper Suprime-Cam”
- 26.** **Portillo, S. K. N. & Speagle, J. S.**; & Finkbeiner, D. P., **submitted to AJ** ([1902.02374](#)): “Photometric Biases in Modern Surveys”
- 25.** Huang, S.; Leauthaud, A.; Hearin, A.; Behroozi, P.; Bradshaw, C.; Ardila, F.; **Speagle, J.**; Tenenti, A.; Bundy, K.; Greene, J.; Sifón, C.; & Bahcall, N., **submitted to MNRAS** ([1811.01139](#)): “Weak Lensing Reveals a Tight Connection Between Dark Matter Halo Mass and the Distribution of Stellar Mass in Massive Galaxies”

2019:

- 24.** Zucker, C.; **Speagle, J. S.**; Schlafly, E. F.; Green, G. M.; Finkbeiner, D. P.; Goodman, A.; & Alves, J., **A&A**: “A Compendium of Distances to Molecular Clouds in the *Star Formation Handbook*”
- 23.** Forbes, J. C.; Krumholz, M. R.; & **Speagle, J. S.**, **MNRAS** ([1810.12919](#)): “Towards a Radially-Resolved Semi-Analytic Model for the Evolution of Disc Galaxies Tuned with Machine Learning”
- 22.** Cook, B. A.; Conroy, C.; van Dokkum, P.; & **Speagle, J. S.**, **ApJ** ([1904.00011](#)): “Measuring Star-Formation Histories, Distances, and Metallicities with Pixel Color-Magnitude Diagrams I: Model Definition and Mock Tests”
- 21.** Safarzadeh, M.; Berger, E.; Leja, J.; & **Speagle, J. S.**, **ApJL** ([1905.04310](#)): “Measuring the Delay Time Distribution of Binary Neutron Stars III. Using the Individual Star Formation Histories of Gravitational Wave Event Host Galaxies in the Local Universe”

20. Hikage, C. **et al.** [35 additional co-authors], **PASJ** ([1809.09148](#)): “Cosmology from cosmic shear power spectra with Subaru Hyper Suprime-Cam first-year data”
19. Leja, J.; Johnson, B. D.; Conroy, C.; van Dokkum, P.; **Speagle, J. S.**; Brammer, G.; Momcheva, I.; Skelton, R.; Whitaker, K. E.; Franx, M.; & Nelson, E. J., **ApJ** ([1812.05608](#)): “An Older, More Quiescent Universe from Panchromatic SED Fitting of the 3D-HST Survey”
18. **Zucker, C. & Speagle, J. S.**; Schlafly, E. F.; Green, G. M., Finkbeiner, D. P.; Goodman, A. A.; & Alves, J., **ApJ** ([1902.01425](#)): “A Large Catalog of Accurate Distances to Local Molecular Clouds: The Gaia DR2 Edition”
17. Leja, J.; Carnall, A. C.; Johnson, B. D.; Conroy, C.; & **Speagle, J. S.**, **ApJ** ([1811.03637](#)): “How to Measure Galaxy Star Formation Histories II: Nonparametric Models”

2018:

16. Zucker, C.; Schlafly E. F.; **Speagle, J. S.**; Green, G. M.; Portillo, S. K. N.; Finkbeiner, D. P.; & Goodman, A. A., **ApJ** ([1803.08931](#)): “A New Technique for Mapping Distances Across the Perseus Molecular Cloud Using CO Observations and Stellar Photometry”
15. Medezinski, E.; Oguri, M.; Nishizawa, A.; **Speagle, J. S.**; Miyatake, H.; Umetsu, K.; Leauthaud, A.; Murata, R.; Mandelbaum, R.; Sifón, C.; Strauss, M. A.; Huang, S.; Simet, M.; Okabe, N.; Tanaka, M.; & Yutaka, K., **PASJ** ([1706.00427](#)): “Source Selection for Cluster Weak Lensing Measurements in the Hyper Sprime-Cam Survey”
14. Oguri, M. **et al.** [24 additional co-authors], **PASJ** ([1701.00818](#)): “An optically-selected cluster catalog at redshift $0.1 < z < 1.1$ from Hyper Suprime-Cam Subaru Strategic Program S16A data”
13. Mandelbaum, R. **et al.** [30 additional co-authors], **PASJ** ([1705.06745](#)): “The first-year shear catalog of the Subaru Hyper Suprime-Cam SSP Survey”
12. Tanaka, M.; Coupon, J.; Hsieh, B.-C.; Mineo, S., Nishizawa, A. J.; **Speagle, J.**; Furusawa, H.; Miyazaki, S.; & Murayama, H., **PASJ** ([1704.05988](#)): “Photometric Redshifts for the Hyper Suprime-Cam Subaru Strategic Program Data Release 1”
11. Aihara, H. **et al.** [108 additional co-authors], **PASJ** ([1702.08449](#)): “First Data Release of the Hyper Suprime-Cam Subaru Strategic Program”
10. Aihara, H. **et al.** [142 additional co-authors], **PASJ** ([1704.05858](#)): “The Hyper Suprime-Cam SSP Survey: Overview and Survey Design”

2017:

9. **Speagle, J. S.** & Eisenstein, D. J., **MNRAS** ([1510.08080](#)): “Deriving Photometric Redshifts with Fuzzy Archetypes and Self-Organizing Maps II. Implementation”
8. **Speagle, J. S.** & Eisenstein, D. J., **MNRAS** ([1510.08073](#)): “Deriving Photometric Redshifts with Fuzzy Archetypes and Self-Organizing Maps I. Methodology”

2016:

7. **Speagle, J. S.**; Capak, P. L.; Eisenstein, D. J.; Masters, D. C.; Steinhardt, C. L., **MNRAS** ([1508.02484](#)): “Exploring Photometric Redshifts as an Optimization Problem: An Ensemble MCMC and Simulated Annealing-Driven Template-fitting Approach”
6. Steinhardt, C. L.; Capak, P. L.; Masters, D. C.; & **Speagle, J. S.**, **ApJ** ([1506.01377](#)): “The Impossibly Early Galaxy Problem”

2015:

5. Masters, D. C. **et al.** [19 additional co-authors], **ApJ** ([1509.03318](#)): “Mapping the Galaxy Color-Redshift Relation: Optimal Photometric Redshift Calibration Strategies for Cosmology Surveys”

2014:

4. Steinhardt, C. L. & **Speagle, J. S.**, **ApJ** ([1409.2883](#)): “A Uniform History for Galaxy Evolution”
3. Steinhardt, C. L.; **Speagle, J. S.** et al. [22 additional co-authors], **ApJL** ([1407.7030](#)): “Star Formation at $4 < z < 6$ from the Spitzer Large Area Survey with Hyper-Suprime-Cam (SPLASH)” [**~90 citations**] [**Press Release: [JPL](#)**]
2. **Speagle, J. S.**; Steinhardt, C. L.; Capak, P. L.; & Silverman, J. D., **ApJS** ([1405.2041](#)): “A Highly Consistent Framework for the Evolution of the Star-Forming ‘Main Sequence’ from $z \sim 0-6$ ” [**~450 citations**]

2011:

1. **Speagle, J. S.**; Kaplan, D. L.; & van Kerkwijk, M. H., **ApJ** ([1111.2877](#)): “The X-ray Counterpart of the High-*B* Pulsar J0726-2612”

SELECTED PRESENTATIONS

| Key: | Invited | Talk | Other |
|------------|-----------------------|--|-------|
| Oct. 2019: | Villanova | Colloquium: “Photometric Distances Near and Far in the Age of Gaia” | |
| Jun. 2019: | Harvard | Summer Colloquium: “Charting Nearby Molecular Clouds with Gaia: A New Map of Our Local Interstellar Medium” (joint talk with Catherine Zucker) | |
| May 2019: | GitHub Satellite 2019 | (invited participant for open source code contributions to EHT) | |
| Apr. 2019: | Cambridge | Data Intensive Science Seminar: “Mapping the 3-D Distribution of Dust in the Milky Way with Stellar Photometry” | |
| Aug. 2018: | Harvard | CMSA Big Data Conference: “Revealing the Milky Way’s Dust-iny” [Video] | |
| Mar. 2018: | Bayes Comp 2018: | “Dynamic Nested Sampling with <i>dynesty</i> ” | |
| Oct. 2017: | U. of Mass. Amherst | Data Science Tea: “Big Data Inference: Combining Hierarchical Bayes and Machine Learning to Improve Photometric Redshifts” | |
| May 2016: | COSMO21: | “Improving Photometric Redshifts for Hyper Suprime-Cam” | |
| Aug. 2013: | U. of Tsukuba: | “The Evolution of Star-Forming Galaxies Over Cosmic Time” | |
| Jan. 2012: | AAS 219: | “The X-ray Counterpart of the High- <i>B</i> Pulsar J0726-2612” (AAS Chambliss Award) | |