

JOSHUA S. SPEAGLE

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RESEARCH INTERESTS

My research interests lie in the interdisciplinary fields of **astrostatistics** and **data science** at the intersections of astronomy, statistics, and computer science. My research focuses on using large datasets to better understand how galaxies like our own **Milky Way** form, behave, and evolve.

POSITIONS

Banting/Dunlap Postdoctoral Fellow: University of Toronto	2020-present
Project Academic Support Staff: Kavli IPMU, University of Tokyo	2015-2016

EDUCATION

Harvard University: PhD in Astronomy	2016-2020
<i>Advisers: Doug Finkbeiner & Charlie Conroy (with Daniel Eisenstein & Alyssa Goodman)</i>	
Harvard University: AM in Astronomy	2016-2020
<i>Advisers: Daniel Eisenstein (with Alexie Leauthaud; UCSC)</i>	
Harvard University: BA in Astrophysics and Physics	2011-2015

AWARDS & HONORS

Best Astrostatistics Student Paper Award (ASA/AIG)	2020
Eric R. Keto Prize for Best Thesis in Theoretical Astrophysics (Harvard)	2020
Banting Postdoctoral Fellowship (Canada)	2020
Department of Astronomy Teaching Award (Harvard)	Spring 2018
Bok Center Certificate of Distinction in Teaching (Harvard)	Spring 2017, 18; Fall 2018
NSF Graduate Research Fellowship (USA)	2016

TEACHING

I have a strong interest in education and pedagogy, with a focus on skills such as **programming**, **statistics**, **machine learning**, and **data science** that are invaluable across a wide range of disciplines but too often not taught as part of a typical science curriculum.

See my [teaching statement](#) for additional details and past experience.

PROFESSIONAL ACTIVITIES

Founder and Organizer: CfA Machine Learning Journal Club	2017-2020
Manuscript Referee: ApJ, ApJL, AJ, A&A, MNRAS, JOSS	2014-present

RECENT PRESENTATIONS

- Villanova:** Colloquium October 2019
Exploring the Galaxy Near and Far in the Age of Gaia
- Harvard:** Summer Colloquium (joint with Catherine Zucker) June 2019
Charting Nearby Molecular Clouds with Gaia: A New Map of Our Local Interstellar Medium
- GitHub Satellite 2019:** Keynote Address Participant May 2019
Invited for open source code contributions (dynesty) in the analysis of the supermassive black hole in M87 by the Even Horizon Telescope collaboration
- Cambridge:** Data Intensive Science Seminar April 2019
Mapping the 3-D Distribution of Dust in the Milky Way with Stellar Photometry
- Harvard:** CMSA Big Data Conference August 2018
Revealing the Milky Way's Dust-iny
- Bayes Comp 2018:** Poster March 2018
Dynamic Nested Sampling with dynesty
- UMass Amherst:** Data Science Tea October 2017
Big Data Inference: Combining Hierarchical Bayes and Machine Learning to Improve Photometric Redshifts

PUBLICATIONS

I am an author of **39 papers** that have over **2200 citations** ([h-index=17](#)). This includes:

10 papers as (co-)first author (in **red**) with over **800 citations** ([h-index=7](#))

15 papers with substantial contributions (in **blue**) with over **400 citations** ([h-index=9](#))

Most of my papers can be found online on [arxiv](#) and [ADS](#). My ORCID is [0000-0003-2573-9832](#).

In Preparation

- 41. Speagle, J. S.;** Zucker, C.; Cargile, P. A.; Bonaca, A.; Johnson, B. D.; Beane, A.; Kamdar, H.; Dotter, A.; Naidu, R.; Han, J.; Conroy, C.; Green, G. M.; Schlafly, E. F.; Finkbeiner, D. P.; Rix, H.-W.; Ting, Y.-S.; Goodman, A.; & Eisenstein, D. J.
Mapping the Milky Way in 5-D with 170 Million Stars at High Galactic Latitudes
- 40. Speagle, J. S.;** Zucker, C.; Cargile, P. A.; Johnson, B. D.; Beane, G.; Green, G. M.; Schlafly, E. F.; Finkbeiner, D. P.; Dotter, A.; Bonaca, A.; Naidu, R.; Han, J.; Conroy, C.; Rix, H.-W.; Ting, Y.-S.; Goodman, A. A.; & Eisenstein, D. J.
Deriving Stellar Properties, Distances, and Reddenings from Photometry and Astrometry with brutus

Under Review

- 39.** Das, K. K.; Zucker, C.; **Speagle, J. S.;** Goodman, A.; Schlafly, E. F.; Green, G. M.; Finkbeiner, D. P.; & Alves, J., submitted to **MNRAS**
Constraining the Distance to the North Polar Spur with Gaia DR2
- 38.** Green, G. M.; Tschesche, L.; Rix, H.-W.; Finkbeiner, D. P.; Zucker, C.; Schlafly, E. F.; Rybizki, J.; & **Speagle, J. S.,** submitted to **ApJ**
Data-Driven Stellar Models

2020

37. Johnson, B. D.; Conroy, C.; Naidu, R. P.; Bonaca, A.; Zaritsky, D.; Ting, Y.-S.; Cargile, P. A.; Han, J. J.; & **Speagle, J. S.**, **ApJ**
A Diffuse Metal-Poor Component of the Sagittarius Stream Revealed by the H3 Survey
arxiv: [2007.14408](#)
36. Cargile, P. A.; Conroy, C.; Johnson, B. D.; Ting, Y.-S.; Bonaca, A.; Dotter, A.; & **Speagle, J. S.**, **ApJ**
MINEsweeper: Spectrophotometric Modeling of Stars in the Gaia Era
arxiv: [1907.07690](#)
35. Cabrera-Ziri, I.; **Speagle, J. S.**; Dalessandro, E.; Usher, C.; Bastian, N. J.; Salaris, M.; Martocchia, S.; Kozhurina-Platais, V.; Niederhofer, F.; Lardo, C.; & Larsen, S. S., **MNRAS**
Searching for Globular Cluster Chemical Anomalies on the Main Sequence of a Young Massive Cluster
arxiv: [2004.09636](#)
34. Bonaca, A.; Conroy, C.; Hogg, D. W.; Cargile, P. A.; Caldwell, N.; Naidu, R. P.; Price-Whelan, A. M.; **Speagle, J. S.**; & Johnson, B. D., **ApJL**
High-Resolution Spectroscopy of the GD-1 Stellar Stream Localizes the Perturber Near the Orbital Plane of Sagittarius
arxiv: [2001.07215](#)
33. Leja, J.; **Speagle, J. S.**; Johnson, B. D.; Conroy, C.; van Dokkum, P.; & Franx, M., **ApJ**
A New Census of the $0.2 < z < 3.0$ Universe, Part I: The Stellar Mass Function
arxiv: [1910.04168](#)
32. **Portillo, S. K. N. & Speagle, J. S.**; & Finkbeiner, D. P., **AJ**
Photometric Biases in Modern Surveys
arxiv: [1902.02374](#)
Press: [AAS](#)
31. **Speagle, J. S.**, **MNRAS**
dynesty: A Dynamic Nested Sampling Package for Estimating Bayesian Posteriors and Evidences
arxiv: [1904.02180](#)
30. Alves, J.; Zucker, C.; Goodman, A. A.; **Speagle, J. S.**; Meingast, S.; Robitaille, T.; Finkbeiner, D. P.; Schlafly, E. F.; & Green, G. M., **Nature**
Discovery of a Galactic-scale gas wave in the Solar Neighborhood
arxiv: [2001.08748](#)
Press: [Official Website](#)
29. 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
arxiv: [2001.00591](#)

2019

28. **Speagle, J. S.**, [arxiv](#)
A Conceptual Introduction to Markov Chain Monte Carlo Methods
arxiv: [1909.12313](#)
27. Green, G. M.; Schlafly, E. F.; Zucker, C.; **Speagle, J. S.**; & Finkbeiner, D. P., **ApJ**
A 3D Dust Map Based on Gaia, Pan-STARRS 1 and 2MASS
arxiv: [1905.02734](#)
26. Huang, S.; Leauthaud, A.; Hearin, A.; Behroozi, P.; Bradshaw, C.; Ardila, F.; **Speagle, J.**; Tenenti, A.; Bundy, K.; Greene, J.; Sifón, C.; & Bahcall, N., **MNRAS**
Weak Lensing Reveals a Tight Connection Between Dark Matter Halo Mass and the Distribution of Stellar Mass in Massive Galaxies
arxiv: [1811.01139](#)
Press: [CfA Science Update](#)
25. **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., **MNRAS**
Galaxy-Galaxy Lensing in HSC: Validation Tests and the Impact of Heterogeneous Spectroscopic Training Sets
arxiv: [1906.05876](#)
24. Namikawa, T. **et al.** [73 additional co-authors], **ApJ**
Evidence for the Cross-correlation between Cosmic Microwave Background Polarization Lensing from POLARBEAR and the Cosmic Shear from Subaru Hyper Suprime-Cam
arxiv: [1904.02116](#)
23. Forbes, J. C.; Krumholz, M. R.; & **Speagle, J. S.**, **MNRAS**
Towards a Radially-Resolved Semi-Analytic Model for the Evolution of Disc Galaxies Tuned with Machine Learning
arxiv: [1810.12919](#)
22. Cook, B. A.; Conroy, C.; van Dokkum, P.; & **Speagle, J. S.**, **ApJ**
Measuring Star-Formation Histories, Distances, and Metallicities with Pixel Color-Magnitude Diagrams I: Model Definition and Mock Tests
arxiv: [1904.00011](#)
21. Safarzadeh, M.; Berger, E.; Leja, J.; & **Speagle, J. S.**, **ApJL**
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
arxiv: [1905.04310](#)
Press: [AAS NOVA](#)
20. Hikage, C. **et al.** [35 additional co-authors], **PASJ**
Cosmology from cosmic shear power spectra with Subaru Hyper Suprime-Cam first-year data
arxiv: [1809.09148](#)
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**
An Older, More Quiescent Universe from Panchromatic SED Fitting of the 3D-HST Survey
arxiv: [1812.05608](#)

18. **Zucker, C. & Speagle, J. S.**; Schlafly, E. F.; Green, G. M.; Finkbeiner, D. P.; Goodman, A. A.; & Alves, J., **ApJ**
A Large Catalog of Accurate Distances to Local Molecular Clouds: The Gaia DR2 Edition
arxiv: [1902.01425](#)
17. Leja, J.; Carnall, A. C.; Johnson, B. D.; Conroy, C.; & **Speagle, J. S.**, **ApJ**
How to Measure Galaxy Star Formation Histories II: Nonparametric Models
arxiv: [1811.03637](#)

2018

16. Zucker, C.; Schlafly E. F.; **Speagle, J. S.**; Green, G. M.; Portillo, S. K. N.; Finkbeiner, D. P.; & Goodman, A. A., **ApJ**
Mapping Distances Across the Perseus Molecular Cloud Using CO Observations, Stellar Photometry, and Gaia DR2 Parallax Measurements
arxiv: [1803.08931](#)
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**
Source Selection for Cluster Weak Lensing Measurements in the Hyper Suprime-Cam Survey
arxiv: [1706.00427](#)
14. Mandelbaum, R. **et al.** [30 additional co-authors], **PASJ**
The first-year shear catalog of the Subaru Hyper Suprime-Cam SSP Survey
arxiv: [1706.06745](#)
13. Tanaka, M.; Coupon, J.; Hsieh, B.-C.; Mineo, S.; Nishizawa, A. J.; **Speagle, J.**; Furusawa, H.; Miyazaki, S.; & Murayama, H., **PASJ**
Photometric Redshifts for the Hyper Suprime-Cam Subaru Strategic Program Data Release 1
arxiv: [1704.05988](#)
12. Aihara, H. **et al.** [108 additional co-authors], **PASJ**
First Data Release of the Hyper Suprime-Cam Subaru Strategic Program
arxiv: [1702.08449](#)
11. Aihara, H. **et al.** [142 additional co-authors], **PASJ**
The Hyper Suprime-Cam SSP Survey: Overview and Survey Design
arxiv: [1704.05858](#)
10. Oguri, M. **et al.** [24 additional co-authors], **PASJ**
An optically-selected cluster catalog at redshift $0.1 < z < 1.1$ from Hyper Suprime-Cam Subaru Strategic Program S16A data
arxiv: [1701.00818](#)

2017

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

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

2016

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

2015

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

2014

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

2011

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