

JOSHUA S. SPEAGLE

Statistical Sciences, Astronomy & Astrophysics, Dunlap Institute

University of Toronto

joshspeagle.github.io | j.speagle@utoronto.ca

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](#)