

# JOSHUA S. SPEAGLE (沈佳士)

Statistical Sciences | Astronomy &amp; Astrophysics

University of Toronto

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## RESEARCH INTERESTS

I develop methods and analyze large datasets to understand how **galaxies** like our own **Milky Way** form, behave, and evolve. This work lies in the interdisciplinary fields of **astrostatistics** and **data science** at the intersections of statistics, astronomy, and computer science.

## POSITIONS

<b>Assistant Professor of Astrostatistics:</b> University of Toronto	2022-Present
<b>Dunlap Postdoctoral Fellow:</b> University of Toronto	2020-2022
<b>Banting Postdoctoral Fellow:</b> University of Toronto	2020-2022
Supervisor: Gwen Eadie	
<b>Project Academic Support Staff:</b> Kavli IPMU, University of Tokyo	2015-2016
Supervisors: Naoki Yoshida, Alexie Leauthaud, & Kevin Bundy	

## EDUCATION

<b>Harvard University:</b> PhD in Astronomy	2016-2020
Advisers: Doug Finkbeiner, Charlie Conroy, Daniel Eisenstein, & Alyssa Goodman	
<b>Harvard University:</b> MA in Astronomy	2016-2020
Advisers: Daniel Eisenstein & Alexie Leauthaud	
<b>Harvard University:</b> BA in Astrophysics and Physics	2011-2015

## SELECTED AWARDS & HONORS

John Charles Polanyi Prize in Physics (Council of Ontario Universities)	2022
Best Astrostatistics Student Paper Award (ASA/AIG)	2020
Eric R. Keto Prize for Best Thesis in Theoretical Astrophysics (Harvard)	2020
Department of Astronomy Teaching Award (Harvard)	Spring 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, applied statistics, and data science. See my [teaching statement](#) for additional details.

## EQUITY, DIVERSITY, & INCLUSION

I am committed to improving equity, diversity, and inclusion (EDI) in the classroom, in my work, and in the wider academic community. See my [EDI statement](#) for additional details.

## SUPERVISION & MENTORSHIP

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I am currently (co-)supervising/mentoring a total of **19 individuals**. This includes:

- 3 postdoctoral researchers
- 6 doctoral students
- 10 undergraduate students

See my [List of Mentees](#) for a full record of the **48 individuals** I have (co-)supervised/mentored.

## SELECTED PROFESSIONAL ACTIVITIES & SERVICE

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### American Astronomical Society (AAS)

Steering Committee: Working Group on Astroinformatics & Astrostatistics 2020-Present

### American Statistical Association (ASA)

Web Director: Astrostatistics Interest Group 2020-Present

### Canadian Astronomical Society (CASCA)

Postdoc Committee 2020-2023

### University of Toronto (UofT) Astronomy

Training & Mentoring Committee 2021-Present

Summer Undergraduate Research Program (SURP) Committee 2021-Present

Graduate Admissions Committee Winter 2021

### Center for Astrophysics | Harvard & Smithsonian (CfA)

Founder: CfA Machine Learning Journal Club 2017-2020

### Workshops & Conferences

Joint Statistical Meetings (JSM) 2021 August 2021

Topic-Contributed Panel: Understanding a Data-Rich Universe with Data-Driven Approaches

Co-organizer: Annual UofT Stellar Stats Workshop 2021-Present

### Manuscript Referee

Annals of Applied Statistics 2022-Present

Statistical Science 2022-Present

RAS Techniques and Instruments (RASTI) 2022-Present

Bayesian Analysis 2021-Present

Journal of Open Source Software (JOSS) 2020-Present

Astronomy & Astrophysics (A&A) 2017-Present

Monthly Notices of the Royal Astronomical Society (MNRAS) 2016-Present

American Astronomical Society (AAS) Journals (AJ, ApJ, ApJL, ApJS) 2014-Present

## SELECTED PRESENTATIONS & APPEARANCES

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I have given numerous presentations on the work being done by me and my collaborators to the scientific community and the public along with providing lectures and tutorials and participating in panel discussions. Recent appearances are provided below. See my [List of Talks](#) for a full record.

### Invited Talks

NSF IAIFI Summer Workshop August 2023

Uncertainty and Interpretability in Machine Learning Models	
MaxEnt 2023 Workshop	July 2023
Frontiers of Nested Sampling Meeting-within-a-Meeting	
Musings on Nested Sampling from Interactions with Everyday Users	
Statistical Challenges in Modern Astronomy VIII	June 2023
Extending Bayesian Modeling Approaches to ML Applications	
IAU General Assembly 2022	August 2022
Machine Learning in Astronomy: Possibilities and Pitfall	
Incorporating Errors into Machine Learning Methods	

## Colloquia & Seminars

Carnegie Mellon University	September 2023
STAMPS Seminar	
Nested Sampling: Past, Present, and Future	
University of Pittsburgh	September 2023
Astronomy Seminar	
From Panchromatic Images to Stellar Ages and Beyond	
Center for Astrophysics   Harvard & Smithsonian	August 2023
AstroAI Seminar	
Extending Statistical Thinking to ML Applications	
McMaster University	April 2023
Astronomy Lunch Seminar	
From Panchromatic Images to Stellar Ages and Beyond	
University of Waterloo	February 2023
Astroseminar	
From Panchromatic Images to Stellar Ages and Beyond	
NRC Herzberg Astronomy and Astrophysics Research Centre	November 2022
Colloquium	
Galaxy Evolution through the Eyes of the Milky Way	
Queen's University	November 2022
Astronomy Seminar	
Galaxy Evolution through the Eyes of the Milky Way	
Institute for Advanced Study	August 2022
Astrophysics Seminar	
From Panchromatic Images to Stellar Ages and Beyond	
Saint Mary's University	August 2022
Department of Astronomy and Physics Colloquium	
More Data + More Parameters = More Fun with Galaxy Evolution	

## Contributed Talks

University of Michigan	August 2023
2023 Clusters & Streams Workshop	

Rapid Stellar Parameter Inference with Probabilistic Machine Learning	
JSM 2023	August 2023
True North Strong and... Amazing at Astrostatistics! (Invited Paper Session)	
Connecting Galaxy Evolution between Observation, Simulation, and Theory	
Surveys to Discovery (S2D) Conference	May 2023
Photometric Biases in Modern Surveys	
2023 Spring Research Conference (SRC)	May 2023
From Light to Mass and Back Again: Exploring Galaxy Evolution with “New” Methods and “Old” Outcomes	
McMaster University	August 2022
2022 Clusters Workshop	
Panchromatic Modelling of Co-Eval Stellar Populations	
JSM 2022	August 2022
Advances in Astrostatistics in the Great White North (Invited Paper Session)	
Mapping the Milky Way in 5-D with Big Data	

## Lectures & Tutorials

2023 ESO Conference	September 2023
Two in a million – The interplay between binaries and star clusters	
Machine Learning for Star Cluster Science	
University of Michigan	August 2023
2023 Clusters & Streams Workshop	
Dimensionality Reduction: Applications to Star Cluster Science	
NSF IAIFI Summer School	August 2023
Uncertainty and Interpretability in Machine Learning Models (with Alex Gagliano)	
Statistical Challenges in Modern Astronomy VIII	June 2023
A Tutorial of (Dynamic) Nested Sampling	

## Panels

NSF IAIFI Summer School	August 2023
Career Panel	
Dunlap Institute for Astronomy & Astrophysics	June 2023
15 <sup>th</sup> Anniversary Homecoming Celebration	
From Dunlap to Diverse Careers: A Panel Discussion on Opportunities and Challenges for Astrophysics Graduates (Moderator)	

## Posters

2023 ESO Conference	September 2023
Two in a million – The interplay between binaries and star clusters	
A machine-learning led search for extra-tidal stars of globular clusters	

## Public Talks & Events

## PUBLICATIONS

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I am an author on **90+ papers** that have **7900+** citations ([h-index=34](#)). This includes:

10+ papers as (co-)lead author with 2300+ citations ([h-index=10](#))

25+ papers with significant contributions with 2200+ citations ([h-index=16](#))

5+ papers led by students with 45+ citations ([h-index=3](#))

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

See my full [Publications List](#) for additional details.

### Top 5 Most Cited Publications as (Co-)Lead Author

- 1121 cites: **Speagle, J. S.**; Steinhardt, C. L.; Capak, P. L.; & Silverman, J. D., 2014, The Astrophysical Journal Supplement Series, Vol. 214, Iss. 2, id. 15  
A Highly Consistent Framework for the Evolution of the Star-Forming ‘Main Sequence’ from  $z \sim 0-6$   
arxiv: [1405.2041](#)
- 955 cites: **Speagle, J. S.**, 2020, Monthly Notices of the Royal Astronomical Society, Vol. 493, Iss. 3, p. 3132-3158  
*dynesty*: A Dynamic Nested Sampling Package for Estimating Bayesian Posteriors and Evidences  
arxiv: [1904.02180](#)
- 181 cites: **Zucker, C. & Speagle, J. S.**; Schlafly, E. F.; Green, G. M.; Finkbeiner, D. P.; Goodman, A. A.; & Alves, J., 2019, The Astrophysical Journal, Vol. 879, Iss. 2, id. 125  
A Large Catalog of Accurate Distances to Local Molecular Clouds: The Gaia DR2 Edition  
arxiv: [1902.01425](#)
- 25 cites: **Speagle, J. S.**, arxiv e-print  
A Conceptual Introduction to Markov Chain Monte Carlo Methods  
arxiv: [1909.12313](#)
- 23 cites: **Speagle, J. S.** et al. [11 additional co-authors], 2019, Monthly Notices of the Royal Astronomical Society, Vol. 490, Iss. 4, p. 5658-5677  
Galaxy-Galaxy Lensing in HSC: Validation Tests and the Impact of Heterogeneous Spectroscopic Training Sets  
arxiv: [1906.05876](#)

### Top 5 Most Cited Publications with Significant Contributions

- 681 cites: Green, G. M.; Schlafly, E. F.; Zucker, C.; **Speagle, J. S.**; & Finkbeiner, D. P., 2019, The Astrophysical Journal, Vol. 887, Iss. 1, id. 93  
A 3D Dust Map Based on Gaia, Pan-STARRS 1 and 2MASS  
arxiv: [1905.02734](#)
- 264 cites: Johnson, B. D.; Leja, J.; Conroy, C.; & **Speagle, J. S.**, 2021, The Astrophysical Journal Supplement Series, Vol. 254, Iss. 2, id. 22

Stellar Population Inference with Prospector

arxiv: [2012.01426](#)

256 cites: Leja, J.; Carnall, A. C.; Johnson, B. D.; Conroy, C.; & **Speagle, J. S.**, 2019, The Astrophysical Journal, Vol. 876, Iss. 1, id. 3

How to Measure Galaxy Star Formation Histories II: Nonparametric Models

arxiv: [1811.03637](#)

225 cites: Tanaka, M.; Coupon, J.; Hsieh, B.-C.; Mineo, S.; Nishizawa, A. J.; **Speagle, J.**; Furusawa, H.; Miyazaki, S.; & Murayama, H., 2018, Publications of the Astronomical Society of Japan, Vol. 70, Iss. SP1, id. S9

Photometric Redshifts for the Hyper Suprime-Cam Subaru Strategic Program Data Release 1

arxiv: [1704.05988](#)

157 cites: Steinhardt, C. L.; **Speagle, J. S.** et al. [22 additional co-authors], 2014, The Astrophysical Journal Letters, Vol. 791, Iss. 2, id. L25

Star Formation at  $4 < z < 6$  from the Spitzer Large Area Survey with Hyper-Suprime-Cam (SPLASH)

arxiv: [1407.7030](#)

Media: [JPL](#)

### Top 5 Most Cited Publications as a Contributing Author

754 cites: Aihara, H. et al. [142 additional co-authors including **Speagle, J. S.**], 2018, Publications of the Astronomical Society of Japan, Vol. 70, Iss. SP1, id. S4

The Hyper Suprime-Cam SSP Survey: Overview and Survey Design

arxiv: [1704.05858](#)

484 cites: Aihara, H. et al. [108 additional co-authors including **Speagle, J. S.**], 2018, Publications of the Astronomical Society of Japan, Vol. 70, Iss. SP1, id. S8

First Data Release of the Hyper Suprime-Cam Subaru Strategic Program

arxiv: [1702.08449](#)

466 cites: Hikage, C. et al. [35 additional co-authors including **Speagle, J. S.**], 2019, Publications of the Astronomical Society of Japan, Vol. 71, Iss. 2, id. 43

Cosmology from cosmic shear power spectra with Subaru Hyper Suprime-Cam first-year data

arxiv: [1809.09148](#)

Media: [PASJ Excellent Paper Award \(English\)](#)

200 cites: Mandelbaum, R. et al. [30 additional co-authors including **Speagle, J. S.**], 2018, Publications of the Astronomical Society of Japan, Vol. 70, Iss. Sp1, id. S25

The first-year shear catalog of the Subaru Hyper Suprime-Cam SSP Survey

arxiv: [1706.06745](#)

151 cites: 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., 2019, The Astrophysical Journal, Vol. 877, Iss. 2, id. 140

An Older, More Quiescent Universe from Panchromatic SED Fitting of the 3D-HST Survey

arxiv: [1812.05608](#)