


# Sasha Gaines

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## EDUCATION

**PhD - Astronomy (NSF & Gruber Fellow)**, 2019-2025.

Yale University, New Haven, CT.

Research in cosmology.

Advisor: Nikhil Padamanabhan.

**M.Sc. by Research - Physics (Fulbright Scholarship)**, 2018-2019.

Durham University, Durham, UK.

Thesis: *Rosella: A mock catalogue of galaxy luminosities, colours and positions for cosmology.*

Advisors: Dr. Peder Norberg and Prof. Shaun Cole.

**B.S. - Physics**, 2015-2017.

University of Arizona, Tucson, AZ. Magna Cum Laude.

**B.S. - Marketing & Comparative Literature**, 2009-2013.

New York University, New York, NY.

## TEACHING EXPERIENCE

**Yale Teaching Fellow**, August 2019 - present:

- CPSC 553 Unsupervised Machine Learning (Fall 2021)
- ASTR 255 Research Methods in Astrophysics (Fall 2020)
- ASTR 110 Planets and Stars (Summer 2020, Fall 2019)
- ASTR 120 Galaxies and the Universe (Spring 2020)

**Machine Learning Workshop TA**, January 2021:

- Machine Learning for Single Cell Analysis - Virtual machine learning coding labs

**University of Arizona Undergraduate Preceptor**, August-December 2017:

- PHYS 140 Calculus-based Introductory Mechanics (Fall 2017)

## SELECTED PUBLICATIONS

### First author

*Leveraging protohalos and scale-dependent bias to calibrate the BAO scale in real space.*

**Gaines, S.**, Nikakhtar, F., Padmanabhan, N., Sheth, R. K. 2024. *Submitted to Physical Review D.*

*Rosella: A mock catalogue from the P-Millennium simulation.*

**Gaines, S.**, Norberg, P., Cole, S. 2021. *MNRAS* 505. [arxiv:2009.00005](#)

### N<sup>th</sup> author

*Effective cosmic density field reconstruction with convolutional neural network.*

Chen, X.; Zhu, F.; **Gaines, S.**; Padmanabhan, N.. 2023. *MNRAS* 505. [arxiv:2306.10538](#)

*Clusters Have Edges: The Projected Phase Space Structure of SDSS redMaPPer Clusters.*

Tomooka, P., Rozo, E., et al (incl. **Gaines, S.**). 2020. *MNRAS* 499. [arxiv:2306.10538](#)

*Swimming bacteria power microspin cycles.*

Hamby A. E., Vig D. K., **Gaines S.**, Wolgemuth C.W. 2018. *Science Advances* 4, 12.

### Alphabetical author in a large collaboration

*DESI Bright Galaxy Survey: Final Target Selection, Design, and Validation.*

Hahn, C.; Wilson, M.; et al. (incl. **Gaines, S.**) 2023. *Astronomical Journal* 165, 6.

*Overview of the Instrumentation for the Dark Energy Spectroscopic Instrument.*

DESI Collaboration (incl. **Gaines, S.**) 2022. *Astronomical Journal* 164, 5.

*Overview of the DESI Legacy Imaging Surveys.*

Dey, A., Schlegel, D. J., et al. (incl. **Gaines, S.**) 2019. *Astronomical Journal* 157, 5.

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|------------------------|--|
| SEMINARS & COLLOQUIA   | <ul style="list-style-type: none"> <li>◇ <i>Studying cosmic history with machine learning.</i> Invited lecture for the Yale undergraduate physics course “Expanding Ideas of Time and Space” (Dec 2021)</li> <li>◇ <i>Six neural nets astronomers should be using more.</i> Yale Data Science x Astro Seminar (Sept 2021)</li> <li>◇ <i>Harnessing Large Scale Structure information using graphs.</i> Yale Astro Grad Seminar (Feb 2021)</li> <li>◇ <i>Populating dark matter with galaxies for a cosmological survey.</i> Yale Astro Grad Seminar (Feb 2020)</li> <li>◇ <i>Populating P-Millennium with galaxies.</i> Durham University Postgrad Seminar (Jun 2019)</li> </ul>   |
| PROFESSIONAL TALKS     | <ul style="list-style-type: none"> <li>◇ <i>Measuring the BAO scale and halo bias with protohalos.</i> Cole@60 (December 2023). Durham, UK.</li> <li>◇ <i>Rosella: A mock catalogue from the P-Millennium simulation.</i> DESI Forum (October 2020), Virtual</li> <li>◇ <i>Rosella: Reference mock catalogue for BGS.</i> DESI March Meeting (March 2020), Virtual</li> <li>◇ <i>Creating a mock galaxy catalogue for a cosmological survey.</i> UK Fulbright Forum (Jan 2019)</li> <li>◇ <i>Development of a mock galaxy catalogue for DESI.</i> Durham-Edinburgh eXtragalactic Workshop XV (January 2019). Edinburgh, UK.</li> <li>◇ <i>Donut analysis code for the Dark Energy Spectroscopic Instrument.</i> Steward Observatory Symposium (September 2017). University of Arizona, Tucson, AZ.</li> <li>◇ <i>Cosmic Donuts: Wavefront recovery code for the Dark Energy Spectroscopic Instrument.</i> Summer Research Symposium (August 2017). SLAC National Accelerator Laboratory, Menlo Park, CA.</li> <li>◇ <i>Development of a Smoothed Particle Hydrodynamics with Gravity code for astrophysics.</i> NASA Space Grant Symposium, (April 2017). Tempe, AZ.</li> <li>◇ <i>Algorithmic VLBI Baseline Selection.</i> REU Research Symposium, (August 2016). MIT Haystack Observatory, Westford, MA.</li> <li>◇ <i>Size Evolution in Early-Type Galaxies.</i> Undergraduate Research Symposium (May 2016). University of Arizona, Tucson, AZ.</li> <li>◇ <i>Relevance of Future DESI Outcomes to Cosmology.</i> Cosmology Journal Club (March 2016). University of Arizona Department of Physics, Tucson, AZ.</li> </ul> |
| PUBLIC TALKS           | <ul style="list-style-type: none"> <li>◇ <i>Our universe from its birth to its present.</i> Science in the News: Hidden Expansion Series. (3 virtual talks at schools and libraries in November 2020)</li> <li>◇ <i>Creating a mock galaxy catalogue for a cosmological survey.</i> The College of St. Hild and St. Bede Postgraduate Research Colloquium Series (January 2019). Durham, UK.</li> </ul>  |
| RESEARCH GRANTS        | <ul style="list-style-type: none"> <li>◇ Keck Observatory (November 2019). <i>Secrets of Digory Kirke’s ring: a quest for star formation in a quiescent galaxy’s remarkable ring of HI gas.</i></li> </ul>   |
| FELLOWSHIPS AND GRANTS | <ul style="list-style-type: none"> <li>◇ NSF Graduate Research Fellowship</li> <li>◇ Gruber Science Fellowship, Yale University, USA</li> <li>◇ Fulbright Scholar in Physics, Durham University, UK (2018-2019)</li> <li>◇ NASA Space Grant for Innovative Computing, University of Arizona (2016-2017).</li> </ul>  |
| LEADERSHIP AND SERVICE | <ul style="list-style-type: none"> <li>◇ PhD applicant interviewer (2022-24). <i>Yale University</i></li> <li>◇ Co-founder, Yale Cosmology Seminar (2022-23). <i>Yale University</i></li> <li>◇ Co-founder, Data Science x Astronomy Seminar (2021-23). <i>Yale University</i></li> <li>◇ Graduate student representative, Astronomy Student Council (2020-21). <i>Yale University</i></li> <li>◇ Advisor, Yale Undergraduate Review Journal (2020). <i>Yale University</i></li> <li>◇ Speaker, Yale Science In The News (2019-20). New Haven, CT</li> </ul>   |

- ◇ Designer of the Dark Matter and Jellyfish elementary school workshop (2019). *Durham University*
- ◇ Presenter of the Universe Creator cosmological arcade, Celebrate Science (2018). *Durham University*
- ◇ Postgraduate residential council (2018-19). *Durham University's College of St. Hild and St. Bede*
- ◇ Publicity Officer, Women in Physics (2015-17). *University of Arizona*

## SKILLS

### **Python programming (2015-present)**

- ◇ PyTorch
- ◇ scikit-learn & scikit-image
- ◇ matplotlib
- ◇ jupyter lab & notebook
- ◇ torchdiffeq [neural ODEs]
- ◇ h5py [for HDF5 files]
- ◇ seaborn
- ◇ numpy / scipy / pandas

### **More computational skills**

- ◇ Neural net design
- ◇ Linear algebra
- ◇ Slurm
- ◇ Familiar with C & C++
- ◇ Graph signal processing
- ◇ Statistics
- ◇ git & github
- ◇ Google Colab

### **Visual communication skills**

- ◇ Data visualization
- ◇ Graphic design
- ◇ Information Design
- ◇ Visual hierarchy
- ◇ Traditional and digital drawing
- ◇ Color theory
- ◇ Procreate
- ◇ Photoshop
- ◇ InDesign

### **Verbal communication skills**

- ◇ Explaining abstract concepts with everyday metaphors
- ◇ Writing stories
- ◇ Speaking to large audiences with clarity and confidence

### **Other things I can do**

- ◇ Draw a circle in perspective
- ◇ Make a wedding dress
- ◇ Cut onions without crying
- ◇ Read Tolstoy in the original