

# Sheridan B. Green

Curriculum Vitae

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## OVERVIEW

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- Third-year Ph.D. Student and NSF Graduate Research Fellow in the Department of Physics at Yale University using numerical simulations of dark matter halo evolution to constrain the nature of dark matter.
- My research is statistical in nature, employing tools from machine learning (random forests and convolutional neural networks) and topological data analysis (persistent homology).
- Experienced with Python (four years) and distributed computing systems and familiar with C/C++ and parallel/GPU-computing.
- Since beginning graduate school, I have lead-authored four scientific publications and co-authored an additional four; I am very capable of remaining productive while collaborating on several research projects simultaneously.

## EDUCATION

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**Doctor of Philosophy, Physics** expected 2022

**Master of Philosophy, Physics** expected 2020

**Master of Science, Physics** 2018  
*Yale University*

Dissertation: “The tidal evolution of dark matter substructure: a data-driven semi-analytical model and its applications to small-scale cosmology”

Advisor: Prof. [Frank C. van den Bosch](#)

Committee: Profs. [Daisuke Nagai](#) and [Nikhil Padmanabhan](#)

GRE Physics: 990/990 (94%)

**Bachelor of Science, Physics and Mathematics** 2017

*The University of North Carolina at Chapel Hill*

Concentration in Astrophysics

Highest honors in physics, highest distinction, GPA: 3.93/4.00

Thesis: “[Constraining an Early Matter-Dominated Era through Cosmological Simulations](#)”

Advisor: Prof. [Adrienne L. Erickcek](#)

## RESEARCH INTERESTS

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Constraining cosmology and probing the nature of dark matter with idealized numerical simulations and analytical approaches, dark matter substructure, ultralight bosonic dark matter, applications of machine learning, artificial intelligence, and topological data analysis to cosmology and (extra)galactic astrophysics

## HONORS AND AWARDS

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- 2019 [McDougal Teaching Fellowship](#) (Yale)
- 2019 [National Science Foundation Graduate Research Fellowship](#)
- 2017 [Paul E. Shearin Outstanding Senior Award in Physics](#) (UNC-Chapel Hill)
- 2013–2017 [Dean’s List Honoree](#) (UNC-Chapel Hill)
- 2016 [Skynet Undergraduate Research Scholarship](#) (UNC-Chapel Hill)
- 2016 [Designated a Carolina Research Scholar](#)
- 2016 [Elected to Phi Beta Kappa Academic Honor Society](#)
- 2015 [NOAA Ernest F. Hollings Undergraduate Scholarship](#)

## PUBLICATIONS [[scholar](#)][[ADS](#)][[arXiv](#)][[ORCID](#)]

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### PEER-REVIEWED ARTICLES

4. **Sheridan B. Green**, Michelle Ntampaka, Daisuke Nagai, Lorenzo Lovisari, Klaus Dolag, Dominique Eckert, and John A. ZuHone, “[Using X-Ray Morphological Parameters to Strengthen Galaxy Cluster Mass Estimates via Machine Learning](#)”, *The Astrophysical Journal* **884**, 33 (2019).
3. **Sheridan B. Green** and Frank C. van den Bosch, “[The tidal evolution of dark matter substructure – I. Subhalo density profiles](#)”, *MNRAS* **490**, 2091 (2019).
2. Xin Xu, Jessi Cisewski-Kehe, **Sheridan B. Green**, and Daisuke Nagai, “[Finding filament loops and cosmic voids using topological data analysis](#)”, *Astronomy and Computing* **27**, 34 (2019).
1. Go Ogiya, Frank C. van den Bosch, Oliver Hahn, **Sheridan B. Green**, Tim B. Miller, and Andreas Burkert, “[DASH: a library of dynamical subhalo evolution](#)”, *MNRAS* **485**, 189 (2019).

### SUBMITTED PRE-PRINTS

2. **Sheridan B. Green**, Han Aung, Daisuke Nagai, and Frank C. van den Bosch, “[Scatter in Sunyaev–Zel’dovich effect scaling relations explained by inter-cluster variance in mass accretion histories](#)”, *arXiv:2002.01934*, submitted to *MNRAS*.
1. Tim B. Miller, Frank C. van den Bosch, **Sheridan B. Green**, and Go Ogiya, “[Dynamical self-friction: how mass loss slows you down](#)”, *arXiv:2001.06489*, submitted to *MNRAS*.

### MANUSCRIPTS IN PREP

5. Han Aung, **Sheridan B. Green**, Michelle Ntampaka, Daisuke Nagai, and John A. ZuHone, “Galaxy cluster mock observations generated by a variational autoencoder”, to be submitted to *The Astrophysical Journal*.
4. Dhruva Dutta Chowdhury, **Sheridan B. Green**, Uddipan Banik, Frank C. van den Bosch, and Hsi-Yu Schive, “Constraining fuzzy dark matter via the dynamical friction on globular clusters”, to be submitted to *MNRAS*.
3. **Sheridan B. Green**, Jack Ross, Han Aung, Michelle Ntampaka, Daisuke Nagai, and John A. ZuHone, “Neural network-based galaxy cluster mass estimation via Sunyaev–Zel’dovich effect Compton- $\gamma$  maps”, to be submitted to *The Astrophysical Journal Letters*.
2. **Sheridan B. Green** and Frank C. van den Bosch, “The tidal evolution of dark matter substructure – II. A physical model of subhalo mass loss”, to be submitted to *MNRAS*.
1. Jessi Cisewski-Kehe, **Sheridan B. Green**, Mike Wu, Brittany T. Fasy, Wojciech Hellwing, Mark R. Lovell, Alessandro Rinaldo, and Larry Wasserman, “Topological Hypothesis Tests for the Large-Scale Structure of the Universe”, to be submitted to *Annals of Applied Statistics*.

### OTHER PUBLICATIONS

2. **Sheridan B. Green**, Abby Mintz, Xin Xu, and Jessi Cisewski-Kehe, “[Topology of Our Cosmology with Persistent Homology](#)”, *CHANCE* **32:3**, 6 (2019).
1. Jenny Farmer, **Sheridan B. Green**, and Donald J. Jacobs, “[Distribution of volume, microvoid percolation, and packing density in globular proteins](#)”, *arXiv:1810.08745*, software *whitepaper and technical report*.

## PRESENTATIONS

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12. “Scatter in Sunyaev–Zel’dovich effect scaling relations explained by inter-cluster variance in mass accretion histories”, European Astronomical Society Annual Meeting, Leiden, The Netherlands, June 30, (2020)
11. “On the tidal evolution of dark matter substructure”, Yale Wright Lab Weak Interaction Discussion Group, New Haven, CT, May 5, (2020)

10. “[Introduction to Topological Data Analysis and Persistent Homology](#)”, Yale Graduate Analytical and Numerical Research Methods Seminar, New Haven, CT, October 22, (2018)
9. “[Simulations of Microhalo Formation After an Early Matter-Dominated Era](#)”, American Physical Society April Meeting, Columbus, OH, April 14-17, (2018)
8. “The Dark Matter Annihilation Boost from an Early Matter-Dominated Era”, Honors thesis defended at UNC-Chapel Hill, Chapel Hill, NC, April 8, (2017)
7. “A Comparison of Two Chemical Mechanisms Using Data from the Southern Oxidant and Aerosol Study”, 16th Annual AMS Student Conference, Seattle, WA, January 22 - 26, (2017)
6. “A Comparison of Two Chemical Mechanisms Using Data from the Southern Oxidant and Aerosol Study”, 2016 American Geophysical Union Fall Meeting, San Francisco, CA, Dec. 12-16, (2016)
5. “A Comparison of Two Chemical Mechanisms Using Data from the Southern Oxidant and Aerosol Study”, 2016 NOAA Student Science & Education Symposium, Silver Spring, MD, Aug. 2 - 4, (2016)
4. “On-Sky and Laboratory Characterizations of Next-Generation Evryscope Prototype”, UNC Society of Physics Students Panel Talks, Chapel Hill, NC, August 29, (2016)
3. “On-Sky and Laboratory Characterizations of Next-Generation Evryscope Prototype”, UNC Celebration of Undergraduate Research Symposium, Chapel Hill, NC, April 18, (2016)
2. “The Effects of an Early Matter-Dominated Era on Microhalo Populations and Substructure”, UNC Society of Physics Students Panel Talks, Chapel Hill, NC, March 28, (2016)
1. “[Analysis of Cavity Volumes in Proteins Using Percolation Theory](#)”, American Physical Society March Meeting, Baltimore, MD, March 14-18, (2016)

## SELECTED COURSEWORK

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|---------------------------------------|-----------------------------|
| • Bayesian Probability and Statistics | • Time Series with R/Python |
| • Group Theory                        | • Financial Markets         |
| • Linear Algebra                      | • SQL for Data Science      |
| • Mathematical Methods of Physics     | • Data Structures           |
| • Real Analysis                       |                             |

## TEACHING

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### COURSES TAUGHT

- Graduate Teaching Fellow at Yale University (Fall 2017 – Summer 2020)
  7. Summer 1 2020: **PHYS 165L: General Physics Laboratory I**
  6. Summer 2 2019: **PHYS 166L: General Physics Laboratory II**
  5. Summer 1 2019: **PHYS 165L: General Physics Laboratory I**
  4. Spring 2019: **PHYS 166L: General Physics Laboratory II**  
**Head Teaching Fellow**  
[Course evaluations](#) (received rating 4.8/5 by students)
  3. Fall 2018: **PHYS 165L: General Physics Laboratory I**  
**Head Teaching Fellow**  
[Course evaluations](#) (received rating 4.8/5 by students)
  2. Spring 2018: **PHYS 166L: General Physics Laboratory II**  
[Course evaluations](#) (received rating 4.9/5 by students)
  1. Fall 2017: **PHYS 165L: General Physics Laboratory I**  
[Course evaluations](#) (received rating 4.6/5 by students)

- Undergraduate Learning Assistant at UNC-Chapel Hill
  - Spring 2017: **PHYS 119: Introductory Calculus-based Electromagnetism and Quanta**
  - Spring 2017: **Peer Tutor Staff in UNC Mathematics & Physics Help Center**

## TEACHING PRACTICE DEVELOPMENT

- **McDougal Teaching Fellow at the Yale Poorvu Center for Teaching and Learning** (Fall 2019 – Present), having taught the following:
  4. Teaching Quantitative Reasoning (Spring 2020)
  3. Contemporary Controversies in Pedagogy Advanced Series (Spring 2020)
  2. Teaching and Mentoring in the Laboratory Environment (Fall 2019)
  1. Fundamentals of Teaching Physics Series (Fall 2019)
- Pursuing the **Certificate of College Teaching Preparation at Yale University**
- Pursuing the CIRTl Scholar qualification at the Center for the Integration of Research, Teaching, and Learning

## STUDENTS SUPERVISED

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2. Jack Ross – BS 05/22 “Neural network-based galaxy cluster mass estimation via Sunyaev–Zel’dovich effect Compton- $\gamma$  maps” *Yale*
1. **Abby Mintz** – BS 05/21 “Topology of Our Cosmology with Persistent Homology” *Yale*

## EXTERNAL FUNDING

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1. XSEDE Startup Grant TG-AST190030: “Dynamical signatures of fuzzy dark matter: core-stalling and the dispersion of stellar streams”, awarded 2,500 GPU-hours on Comet GPU (value of \$889)

## PROFESSIONAL ACTIVITIES

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### COLLOQUIUM & SEMINAR ORGANIZATION

- **Yale Graduate Analytical and Numerical Research Methods Seminar** (Fall 2018 – Spring 2019)
- **Yale Special Topics in Cosmology Graduate Seminars** (Summer 2018 – Fall 2018)

### PUBLIC OUTREACH

- Volunteer College Admissions Mentor at UStrive for College (Fall 2019 – Present)
- Volunteer at **Yale Girls’ Science Investigations** (Spring 2019 – Present)
- Volunteer at **CT SEED: Students Exploring Engineering Day** (Spring 2019 – Present)
- Contributor to Science Haven community outreach initiative (Summer 2018 – Present)
- Volunteer at the **Yale Physics Olympics** (Fall 2017 – Present)

### RESEARCH WORKSHOPS ATTENDED

- **2019 Santa Cruz Galaxy Workshop** (Santa Cruz, CA; Aug. 5–9, 2019)
- **GANocracy: Workshop on Theory, Practice and Artistry of Deep Generative Modeling** (MIT–IBM Watson AI Lab; May 31, 2019)

## TEACHING WORKSHOPS ATTENDED

- CIRTTL Course: [Advancing Learning Through Evidence-Based STEM Teaching](#) (Jan. 31 – Mar. 31, 2018)
- Yale Poorvu Center for Teaching and Learning Advanced Teaching Workshops *attended*:
  - Gender in the Classroom (Nov. 30, 2017)
  - Peer Observation Strategies (Oct. 5, 2017)
  - Undergraduate Mentorship Strategies (Oct. 26, 2017)
  - Transitioning to Instructor of Record (Apr. 18/25, 2018)
  - Teaching as Research (Jan. 31, 2018)
  - Writing Across the Disciplines (Feb. 18, 2020)

## REFEREE

[CHANCE](#) (*Special Edition on Astrostatistics*)

## UNIVERSITY SERVICE

- Member of Student Advisory Committee for the Yale Poorvu Center for Teaching and Learning (Fall 2019 – Present)
- Member of Student Advisory Committee for the Yale Office of Career Strategy (Fall 2019 – Present)
- [Senator in the Yale Graduate and Professional Student Senate](#) (Fall 2019 – Present)
  - Member of [Professional Development committee](#)
    - \* Organized “A Day in the Life” program for Yale undergraduates to shadow graduate/professional students (Spring 2020)
- [Graduate Affiliate of Yale Benjamin Franklin College](#) (Spring 2018 – Present)

## DEPARTMENTAL SERVICE

- Member of Yale Physics Graduate Student Advisory Committee (Spring 2020 – Present)
- Volunteer for [2020 Conference for Undergraduate Women in Physics hosted by Yale Physics](#) (Jan. 17–19, 2020)
- Lead Instructor for the *Fundamentals of Teaching Physics for First-Year PhD Students* short seminar series (Fall 2018 – Present)
- Yale Physics Happy Hour organizer (Fall 2018 – Summer 2019)

## PROFESSIONAL SOCIETY MEMBERSHIP

- Nomination to Associate Membership, Sigma Xi (2019)
- Member, American Physical Society (2015 – Present)
- Member, Society of Physics Students
  - Resource Officer for UNC SPS Chapter (2015 – 2016)

## LANGUAGES

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- Natural – English (native), French (limited)
- Programming – Python, C/C++, UN\*X, Bash, Mathematica,  $\text{\LaTeX}$ , R
- Scientific Computing – Slurm, NumPy, SciPy, matplotlib, scikit-learn, Numba, pandas, seaborn, git

## REFERENCES

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- **Prof. Frank C. van den Bosch**  
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Yale University  
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203-432-0196  
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- **Prof. Daisuke Nagai**  
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- **Prof. Jessi Cisewski-Kehe**  
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- **Dr. Michelle Ntampaka**  
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