

# Charlie Mace

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## **EDUCATION**

### **The Ohio State University (OSU) | 2020 - Present**

*PhD Student in the Department of Physics*

### **University of North Carolina at Chapel Hill (UNC) | 2016 - 2020**

*Bachelor of Science in Astrophysics and Mathematics*

*Minor in Music*

## **RESEARCH EXPERIENCE**

### **Annika Peter Group | Spring 2021 – Present**

*Dark Matter Theory and Observation | The Ohio State University Department of Physics*

*Graduate researcher*

- Investigating the behavior of dark matter structure with the inclusion of self-interactions (SIDM)
- Using the Arepo N-body simulation code to study the dynamics of SIDM dark matter halos and subhalos
- Working with inter-institution collaborators to connect gravitational lensing predictions to observations
- Assisted with remote observations with the Merian Survey, a study of dark matter, star formation, and feedback in dwarf galaxies

### **Adrienne Erickeck Group | Spring 2019 – Spring 2020**

*Theoretical cosmology | The University of North Carolina at Chapel Hill*

*Undergraduate researcher*

- Investigated how an early dark matter-dominated era could have affected the velocity distribution of weakly interacting massive particle (WIMP) dark matter in the early Universe, and how that would affect today's astronomical observations
- Research involved applications of statistical mechanics to cosmology, numerically solving partial differential equations, the particle physics of weak interactions, and numerical simulations of WIMP scattering
- Culminated in an honors thesis in the above topics, published and successfully defended in the Spring of 2020

### **Chris Clemens Group | Spring 2017 – Fall 2018**

*Observational White Dwarf Astrophysics | The University of North Carolina at Chapel Hill*

*Undergraduate researcher*

- Developed a Python program for the estimation of white dwarf parameters from observational data
- Regularly used data from the SDSS and GAIA surveys, queried using SQL
- Developed a Python program to test ZZ Ceti models by comparison of expected stellar parameters to observational data

- Assisted with several remote observation nights with the Goodman HTS, and received instruction on how to conduct observations

## **PUBLICATIONS & PRESENTATIONS**

### **Peer-reviewed Publications**

1. **Charlie Mace**, Zhichao Carton Zeng, Annika H. G. Peter, Xiaolong Du, Shengqi Yang, Andrew Benson, and Mark Vogelsberger. *Convergence Testing in Self-Interacting Dark Matter Simulations*, Phys. Rev. D vol. 110 issue 12, December 2024
2. Shengqi Yang, Fangzhou Jiang, Andrew Benson, Yi-Ming Zhong, **Charlie Mace**, Xiaolong Du, Zhichao Carton Zeng, Annika H. G. Peter. *Constraining SIDM cross section models with a joint analysis of galaxies and clusters*, Monthly Notices of the Royal Astronomical Society, Volume 533, Issue 4, October 2024, Pages 4007–4022, <https://doi.org/10.1093/mnras/stae2038>
3. Xiaolong Du, Andrew Benson, Zhichao Carton Zeng, Tommaso Treu, Annika H. G. Peter, **Charlie Mace**, Fangzhou Jiang, Shengqi Yang, Charles Gannon, Daniel Gilman, Anna. M. Nierenberg, Ethan O. Nadler. *Tidal evolution of cored and cuspy dark matter halos*, Phys. Rev. D vol. 110 issue 2, July 15 2024
4. Merian collaboration (including **Charlie Mace**). *The Merian Survey: Design, Construction, and Characterization of a Filter Set Optimized to Find Dwarf Galaxies and Measure their Dark Matter Halo Properties with Weak Lensing*, Monthly Notices of the Royal Astronomical Society, Volume 530, Issue 4, June 2024, Pages 4988–5005, <https://doi.org/10.1093/mnras/stae925>
5. Birendra Dhanasingham, Francis-Yan Cyr-Racine, **Charlie Mace**, Annika H. G. Peter, Andrew Benson. *Anisotropic strong lensing as a probe of dark matter self-interactions*, Monthly Notices of the Royal Astronomical Society, Volume 526, Issue 4, December 2023, Pages 5455–5470, <https://doi.org/10.1093/mnras/stad3099>
6. Joshua S. Reding, J. C. Clemens, J. J. Hermes, E. Dennihy, B. C. Kaiser, Z. Vanderbosch, **C. B. Mace**, B. H. Dunlap. *An Isolated White Dwarf with 317-Second Rotation and Magnetic Emission*. The Astrophysical Journal, Volume 894, Issue 1, id.19, 8 pp. (2020)

### **Pre-print Manuscripts**

1. **Charlie Mace**, Shengqi Yang, Zhichao Carton Zeng, Annika H. G. Peter, Xiaolong Du, Andrew Benson. *Calibrating the SIDM Gravothermal Catastrophe with N-body Simulations*, pre-print, April 17 2025, <https://doi.org/10.48550/arXiv.2504.13004>
2. Zhichao Carton Zeng, Annika H. G. Peter, Xiaolong Du, Andrew Benson, Jiaxuan Li, **Charlie Mace**, Shengqi Yang. *Diversity and universality: evolution of dwarf galaxies with self-interacting dark matter*, pre-print, February 10 2025, <https://doi.org/10.48550/arXiv.2412.14621>
3. Zhichao Carton Zeng, Annika H. G. Peter, Xiaolong Du, Shengqi Yang, Andrew Benson, Francis-Yan Cyr-Racine, Fangzhou Jiang, **Charlie Mace**, R. Benton Metcalf. *Till the core collapses: the evolution and properties of self-interacting dark matter subhalos*, pre-print, November 4 2023, <https://doi.org/10.48550/arXiv.2310.09910>
4. Merian collaboration (including **Charlie Mace**). *Merian: A Wide-Field Imaging Survey of Dwarf Galaxies at  $z \sim 0.06-0.10$* , pre-print, October 2 2024, <https://doi.org/10.48550/arXiv.2410.01884>

### **Presentations and Other Work**

1. **Charlie Mace**, Zhichao Carton Zeng, Annika H.G. Peter, *Convergence Tests of Self-Interacting Dark Matter Simulations*, poster presented at the Kavli Institute for Theoretical Physics, June 2024
2. **Charlie Mace**, Zhichao Carton Zeng, Shengqi Yang, Birendra Dhanasingham, Annika Peter, Francis-Yan Cyr-Racine. *Convergence Tests and Applications of SIDM Core-Collapse Simulations*, presented at the 242nd Meeting of the American Astronomical Society, June 2023
3. **Charlie Mace**. *Simulating the Thermal Evolution of Dark Matter During an Early Matter-Dominated Era*. Thesis defended April 17, 2020. <https://doi.org/10.17615/56er-3577>

4. **Charlie Mace**, Bart Dunlap, Chris Clemens. *Calculating White Dwarf Stellar Parameters from Survey Data*. Poster presented at 2018 SESAPS Conference in Knoxville

## **TEACHING EXPERIENCE**

### **The Ohio State University**

*Instructor:* Taught recitation and lab sections, alongside grading responsibilities

- Physics 1200 (Mechanics, Kinematics, Fluids, Waves), Fall 2020
- Physics 1250 (Mechanics, Work and Energy, Thermal Physics), Spring 2021
- Physics 1260 (Mechanics, Thermal Physics, Waves), Fall 2021
- Physics 1271 (E&M, Thermal Physics, Waves, and Quantum Physics for Majors), Spring 2023
- Physics 1260 (Mechanics, Thermal Physics, Waves), Fall 2024

*Grader:* Responsible for grading homework assignments

- Physics 5400 (Intermediate Electricity and Magnetism), Spring 2022

*Tutor:* Weekly tutoring responsibilities in the OSU Physics Bridge Program

- Quantum Mechanics, Summer 2021

## **HONORS & AWARDS**

### **CGS Committee Member Award | May 2025**

*Excellence in graduate student service award | OSU*

### **Presidential Fellowship | November 2024**

*Dissertation year fellowship | OSU*

### **Physics Service Award | April 2024**

*Graduate service award | OSU*

### **Hazel Brown Outstanding Teaching Assistant Award | April 2021**

*Graduate teaching award | OSU*

### **Inducted into the UNC chapter of the Phi Beta Kappa Honor Society | Spring 2019**

*National academic honor society | UNC*

### **Andy & Cindi Griffith Music Scholarship | Fall 2017 – Fall 2018**

*Semesterly merit-based music scholarship | UNC*

### **Kay Kyser Undergraduate Jazz Scholarship | Fall 2016 – Spring 2017**

*Semesterly merit-based music scholarship | UNC*

### **UNC Summer Study Abroad Fellowship | Fall 2016**

*One-time, merit-based award to fund a study abroad experience | UNC*

### **Alliance for Affordable Services Scholarship | Fall 2016 – Spring 2020**

*Semesterly merit-based academic scholarship | UNC*

## **PROGRAMMING LANGUAGES AND TOOLS**

Python, C, MATLAB, SQL, ADQL, Mathematica, LaTeX

## **SERVICE WORK**

### **OSU Physics Graduate Studies Committee | Fall 2024 – Present**

*Elected member*

Fall 2024 – Present

The Graduate Studies Committee is a committee in the OSU Department of Physics made up of faculty, graduate students, and the graduate program coordinator. The committee reviews all grievances and petitions from graduate students, and is responsible for all aspects of the graduate student curriculum and for all other issues pertaining to graduate study in physics.

### **OSU Council of Graduate Students | Spring 2021 - Present**

*Elected delegate*

Spring 2021 – Present

*Government Affairs Committee Chair*

Fall 2022 – Spring 2023

*Representative to the OSU Senate Council on Academic Affairs*

Fall 2023 – Present

The Council of Graduate Students (CGS) is a representative body, and part of OSU's shared governance program. CGS consists of graduate student delegates representing every department in the University. CGS works to communicate graduate student concerns and opinions to university administration, as well as to provide essential resources to graduate students. The council accomplishes this through monthly meetings and legislation, advising and maintaining representation on the University Senate, and assigning delegates to various committees devoted to more granular projects.

### **OSU Physics Graduate Student Council | Fall 2021 – Summer 2023**

*Elected Representative*

Fall 2021 – Summer 2023

The Physics Graduate Student Council (PGSC) is a representative body that advocates for graduate student interests in the OSU Department of Physics. The PGSC facilitates communication between department administration and graduate students, partially through a detailed statistical report on graduate student concerns every year. In addition, the PGSC holds regular social and professional development events, and facilitates outreach work.

### **UNC Society of Physics Students | Spring 2016 – Spring 2020**

*Member*

Spring 2016 – Spring 2020

*Room Manager*

Fall 2018 – Spring 2020

The Society of Physics Students (SPS) is a nationally recognized undergraduate physics organization. The UNC chapter of SPS organizes outreach events at local museums and science fairs, helps new undergraduates integrate into the department and find research, organizes trips to local physics conferences where undergraduates can present and participate, and helps students prepare for applying for jobs and graduate programs.