

Charlie Mace

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EDUCATION

The Ohio State University (OSU) | 2020 – Summer 2026 (Expected)

PhD Student in the Department of Physics

Presidential Fellow | Fall 2025 - Present

University of North Carolina at Chapel Hill (UNC) | 2016 – 2020

Bachelor of Science in Astrophysics and Mathematics

Minor in Music

RESEARCH EXPERIENCE

Dark Matter Simulation and Observation | Spring 2021 – Present

Advisor: Annika Peter | The Ohio State University Department of Physics

- Awarded the dissertation-year Presidential Fellowship by the OSU Graduate School for research in gravitational substructure lensing
- Used N-body and hydrodynamical simulations, including Arepo and GIZMO-SIMBA, to study the dynamics of self-interacting dark matter (SIDM) halos and subhalos
- Performed rigorous tests of numerical errors and convergence in SIDM N-body simulations, publishing general guidelines on numerical parameter selection
- Developed a gravitational lens analysis pipeline in Python, connecting SIDM simulations to observations of strongly gravitationally lensed systems
- Participated in remote observations with the Merian Survey, a study of dark matter, star formation, and feedback in dwarf galaxies

Early Universe Cosmology | Spring 2019 – Spring 2020

Advisor: Adrienne Erickcek | The University of North Carolina at Chapel Hill

- 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 simulations of WIMP scattering
- Culminated in an honors thesis in the above topics, published and successfully defended in the Spring of 2020

Observational White Dwarf Astrophysics | Spring 2017 – Fall 2018

Advisor: Chris Clemens | The University of North Carolina at Chapel Hill

- 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 remote observations with the Goodman HTS

SERVICE WORK

OSU Council of Graduate Students

Elected delegate 2020 – Present

Government Affairs Committee Chair 2022 – 2023 & 2024 – Present

Representative to the OSU Senate Council on Academic Affairs 2023 – 2025

Representative to the OSU Senate Council on Government Affairs 2025 – Present

- Awarded the Committee Member Award for work in the CGS Government Affairs committee
- Represented and advocated for physics graduate students in graduate student government and various University Senate committees
- Collaborated with university staff and leadership to evaluate academic program changes
- Led a team in composing, editing, and distributing newsletters on legislative news as the Government Affairs Committee Chair
- Authored multiple pieces of draft legislation and official statements that were approved by the graduate student body

OSU Physics Graduate Studies Committee

Elected member 2024 – 2025

- Worked with faculty, staff, and students to improve the physics graduate student experience
- Developed a plan to collect data on student workload in the core graduate physics courses, and to use these data to recommend uniform practice across the courses

OSU Physics Graduate Student Council

Elected Representative 2021 – 2023

- Awarded the Physics Service Award in recognition of PGSC service
- Composed survey questions and collected data on the graduate student experience
- Presented analysis of Likert data and written responses, and suggested courses of action to department administration
- Collaborated with students and department staff to plan career development and social events

UNC Society of Physics Students

Member 2016 – 2020

Room Manager 2018 – 2020

- Responsible for upkeep and replacement of supplies, furniture, and computers in the dedicated SPS common room, managing the largest portion of the SPS chapter budget
- Worked with students and department staff to organize department-funded group trips to two regional APS meetings, as well as many social and networking events

TEACHING EXPERIENCE

The Ohio State University

Instructor: Taught recitation and lab sections, alongside grading and course coordination 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 & Fall 2024
- Physics 1271 (E&M, Thermal Physics, Waves, and Quantum Physics for Majors), Spring 2023

Grader: Graded problem sets and exams

- 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

Ray Travel Award for Service and Scholarship | February 2024

Travel funding awarded for department, university, and community service (\$1,000) | 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

PUBLICATIONS & PRESENTATIONS

[Live Publication List Available Online](#)

First Author Publications

1. **Charlie Mace**, Birendra Dhanasingham, Carton Zeng, Francis-Yan Cyr-Racine, Xiaolong Du, Annika Peter, Andrew Benson. *The Sensitivity of Substructure Lensing to Variations in SIDM Core-collapse Modeling*, in prep, expected publication April 2026
2. **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>
3. **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

Presentations and Other Work

1. **Charlie Mace**, Annika Peter. *The Sensitivity of Substructure Lensing to SIDM Core-collapse Model Variation*, dissertation talk presented at the 247th Meeting of the American Astronomical Society, January 2026
2. **Charlie Mace**, Shengqi Yang, Annika H. G. Peter, Zhichao Carton Zeng, Xiaolong Du, Andrew Benson. *Calibrating the SIDM Gravothermal Catastrophe with N-body Simulations*, poster presented at Gravity in the Local Group (Carnegie Mellon University) and Galactic Frontiers II (Dartmouth College), June 2025
3. **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

4. **Charlie Mace**, Zhichao Carton Zeng, Shengqi Yang, Birendra Dhanasingham, Annika Peter, Francis-Yan Cyr-Racine. *Convergence Tests and Applications of SIDM Core-Collapse Simulations*, talk presented at the 242nd Meeting of the American Astronomical Society, June 2023
5. **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>
6. **Charlie Mace**, Bart Dunlap, Chris Clemens. *Calculating White Dwarf Stellar Parameters from Survey Data*. Poster presented at 2018 SESAPS Conference in Knoxville

Co-authored Publications

1. Merian collaboration (including **Charlie Mace**). *First Data Release of the Merian Survey: A Wide-field Imaging Survey of Dwarf Galaxies at $z \sim 0.06-0.10$* , The Astrophysical Journal, Volume 993, Issue 1, id.110, 20 pp. (2025)
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*, Phys. Rev. D vol. 112 issue 6, September 2025
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. *Evolution and properties of self-interacting dark matter subhalos until core collapse*, Phys. Rev. D, vol. 111 issue 6, March 2025
4. 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>
5. 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
6. 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>
7. 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>
8. 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)