

EDUCATION

Ph.D Candidate in Physics | *Rutgers, The State University of New Jersey* August 2020 – Present

B.S *summa cum laude* Physics | *The University of New Mexico* September 2016 – May 2020

RESEARCH FOCUS

Machine Learning for Galactic Dynamics

January 2021 – Present

PhD Thesis | Advisor: Dr. Matthew Buckley

Rutgers | New Brunswick, New Jersey

- Fully data-driven measurement of the local Milky Way's gravitational potential and dark matter density.
- Training normalizing flows to learn the six-dimensional kinematic phase space of nearby stars from Gaia DR3 to solve the general equilibrium collisionless Boltzmann equation.
- Developed novel technique for unbiasing the kinematic phase space of stars obscured by dust extinction.
- Developed non-parametric Jeans analysis for benchmarking our flows technique in a hydrodynamically-simulated galaxy.

Neutrino Flavor Dynamics in Core-Collapse Supernovae

October 2018 – May 2020

Undergraduate Honors Thesis | Advisor: Dr. Huaifu Duan

UNM | Albuquerque, New Mexico

- Analyzed the evolution of dense neutrino gases evolving in supernovae.
- Compared numerical simulations of neutrino oscillations in dense matter to analytic predictions.

GBAR Positronium Excitation Laser

June 2019 – August 2019

NSF REU | Advisor: Dr. Pauline Comini

CERN | Geneva, Switzerland

- Calibrated the positronium excitation beam stabilization and thermal management, delivered beamline to the positronium chamber to produce neutral antihydrogen.
- Implemented remote instrumentation of the positronium excitation laser.

PRESENTATIONS AND PUBLICATIONS

Publications

- 2025 February (*in prep*) | Mapping Dark Matter Through the Dust of the Milky Way Part II: Gravitational Potential and Dark Matter Density | [astro-ph 2502.XXXXX](#)
- 2024 December | Mapping Dark Matter Through the Dust of the Milky Way Part I: Dust Correction and Phase Space Density | [astro-ph 2412.14236](#)
- 2023 May | Mapping Dark Matter in the Milky Way using Normalizing Flows and Gaia DR3 | JCAP, [astro-ph 2305.13358](#)
- 2022 May | Measuring Galactic Dark Matter through Unsupervised Machine Learning | MNRAS, [astro-ph 2205.01129](#)
- 2021 November | What Dark Matter Halos Tell Us About Dark Matter | Candidacy exam (unpublished)
- 2020 May | Numerical Analysis of Collective Neutrino Oscillations in Dense Neutrino Media. Honors thesis (unpublished)
- 2019 June | Measurement of the radial matrix elements for the $6s^2S_{1/2} \rightarrow 7p^2P_J$ transitions in cesium | Physical Review A, [physics 1904.06362](#)

Presentations

- 2024 November | Sweeping the Dust Away: An Unbiased Map of the Milky Way’s Dark Matter and Gravitational Potential with Unsupervised Machine Learning | [Abstract](#), [Slides](#), [Recording](#)
- 2024 May | Sweeping the Dust Away: An unbiased map of the Milky Way’s gravitational potential using unsupervised ML | DPF-PHENO 2024, University of Pittsburgh | [Abstract](#), [Slides](#)
- November 2023 | Mapping Dark Matter in the Milky Way using Normalizing Flows and Gaia DR3 | ML4Jets 2023, DESY. [Abstract](#), [Slides](#)
- 2023 May | Measuring Galactic dark matter through unsupervised machine learning | May 2023, Phenomenology 2023 Symposium, University of Pittsburgh. [Abstract](#), [Slides](#)
- 2023 January | Measuring Galactic Dark Matter through Unsupervised Machine Learning | 241st AAS Meeting, Seattle WA. [Abstract](#)
- 2021 November | What Dark Matter Halos Tell Us About Dark Matter | PhD Candidacy Exam, Rutgers, the State University of New Jersey | [Slides](#)
- 2020 April | Numerical Analysis of Collective Neutrino Oscillations in Dense Neutrino Media | Undergraduate Honors Thesis, University of New Mexico | [Slides](#), [Poster](#)
- 2019 August | Laser Control for the Production of Excited Positronium in GBAR | CERN Summer School | [Slides](#)
- 2019 April | Numerical Analysis of Collective Neutrino Oscillations in Core-Collapse Supernovae with Multidimensional Models | University of New Mexico Physics Day | [Slides](#)
- 2018 October | Precision Measurement of the $6S \rightarrow 7P_{1/2}$ Cesium Transition Radial Matrix Element via Simultaneous Absorption Spectroscopy | 2018 APS Four Corners, University of Utah | [Abstract](#), [Slides](#)
- 2017 October | Analysis of Diffusion of a Rhodium Adatom on a Tungsten (111) Surface. | 2017 APS Four Corners, Colorado State University | [Abstract](#), [Poster](#)

SCHOLARSHIPS AND AWARDS

- 2021 Rutgers Academic Fellowship
- 2020 Eion Gray Scholarship
- 2020 UNM Feynman Award
- 2019 Goldwater Scholar
- 2019 Rayburn Outstanding Student in Laboratory Physics and Astronomy

SERVICE

Rutgers Chapter of the AAUP-AFT

Graduate Worker Organizer

- | | |
|--|--------------------------|
| • Physics and Astronomy Department Representative | December 2022 – Present |
| • Fellows Organizing Committee Co-Chair | January 2024 – Present |
| • Graduate Steering Committee and Executive Council Member | September 2024 – Present |
| • Short Term Staff Organizer for Clinically Focused University Practitioners | January 2025 – Present |

Rutgers Physics & Astronomy Graduate Student Organization

President September 2023 – June 2024

Rutgers Graduate Student Association

Treasurer January 2025 – Present

REFERENCES

Dr. Matthew Buckley

Rutgers, The State University of New Jersey, Department of Physics and Astronomy
mbuckley@physics.rutgers.edu

Dr. David Shih – Rutgers, The State University of New Jersey

shih@physics.rutgers.edu

Dr. Huaiyu Duan

The University of New Mexico, Department of Physics and Astronomy
duan@unm.edu