

MARISA PETRUSKY

PhD Candidate at Nonequilibrium Gas & Plasma Dynamics Laboratory

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EDUCATION

University of Colorado Boulder

Doctor of Philosophy in Aerospace Engineering Sciences

Thesis: *Kinetic Modeling of Plasma Electrostatics in Hypersonic Flows*

Advisor: Iain D. Boyd

Boulder, CO

Expected Spring 2026

Master of Science in Aerospace Engineering Sciences, with Certificate in Hypersonics

2023

Stony Brook University

Bachelor of Science in Physics, Summa Cum Laude

Stony Brook, NY

2021

RESEARCH INTERESTS

Hypersonic Aerodynamics

Simulate and analyze gas dynamics in flowfields exceeding at least five times the speed of sound, especially nonequilibrium and rarefied flows. Applications of interest include mitigation of radio communications blackout, electron transpiration cooling, global parameter sensitivity analysis.

Partially Ionized Gases and Plasmas

Develop and apply theoretical models and numerical methods for simulation of physical phenomena in plasma flows. Expertise in kinetic modeling methods such as discrete-velocity methods, Particle-in-Cell, and Direct Simulation Monte Carlo (DSMC). Applications of interest include hypersonic flight environments, electric propulsion, low temperature plasmas, magnetohydrodynamics.

AWARDS AND HONORS

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| 2023 | Micheal Springman Aerospace Graduate Fellowship Award, Smead Aerospace Engineering Sciences Department, University of Colorado Boulder. |
| 2021 | National Science Foundation Graduate Research Fellowship. |
| 2021 | John S. Toll Prize, Department of Physics and Astronomy, Stony Brook University. |
| 2020 | Undergraduate Recognition Award for Outstanding Achievement in Community Service, Stony Brook University. |
| 2020 | Sigma Pi Sigma, American honor society for physics and astronomy. |
| 2019 | Summer Research Award, Department of Physics and Astronomy, Stony Brook University. |
| 2019 | Researcher of the Year, Women in Science and Engineering Honors College, Stony Brook University. |

JOURNAL PUBLICATIONS

5. **M. Petrusky**, I.D. Boyd. Characterization of Plasma Diffusion in Hypersonic Flows. *In preparation*.
4. **M. Petrusky**, I.D. Boyd. Discrete-Velocity Simulation of a One-Dimensional Hypersonic Stagnation Streamline. 2025. *In review*.
3. D. Adihikari, et al. [The CREX Collaboration, including **M. Petrusky**].[†] Precision Determination of the Neutral Weak Form Factor of ⁴⁸Ca. *Physical Review Letters*, 129(4), 2022. DOI: 10.1103/PhysRevLett.129.042501
2. D. Adihikari, et al. [The PREX and CREX Collaborations, including **M. Petrusky**].[†] New Measurements of the Beam-Normal Single Spin Asymmetry in Elastic Electron Scattering over a Range of Spin-0 Nuclei. *Physical Review Letters*, 128(14), 2022. DOI: 10.1103/PhysRevLett.128.142501

[†]Indicates alphabetical ordering.

1. D. Adihikari, et al. [The PREX Collaboration, including **M. Petrusky**].[†] Accurate Determination of the Neutron Skin Thickness of ^{208}Pb through Parity-Violation in Electron Scattering. *Physical Review Letters*, 126(17), 2021. DOI: 10.1103/PhysRevLett.126.172502

PEER-REVIEWED CONFERENCE PROCEEDINGS

2. **M. Petrusky**, I.D. Boyd. Evaluation of the Ambipolar Diffusion Approximation using an Eulerian Boltzmann-Poisson-BGK Solver. *To appear in Rarefied Gas Dynamics: Proceedings of the 33rd International Symposium*, 2025.
1. I. Petrushina, R. Zgadaj, **M. Petrusky**, et al. Characterization of the Fields Inside the CO_2 -Laser-Driven Wakefield Accelerators using Relativistic Electron Beams. *2022 IEEE Advanced Accelerator Concepts Workshop (AAC)*, 1–6, 2022. DOI: 10.1109/AAC55212.2022.10822933

PAPERS PRESENTED AT PROFESSIONAL MEETINGS

1. **M. Petrusky**, I.D. Boyd. A Novel Stagnation Streamline Model for Discrete-Velocity Simulation of Hypersonic Flows. *AIAA AVIATION FORUM AND ASCEND 2025*, AIAA 2025-3475, 2025. DOI: 10.2514/6.2025-3475

ABSTRACTS PRESENTED AT PROFESSIONAL MEETINGS

Not including papers and proceedings listed above.

7. **M. Petrusky**, I.D. Boyd. Guidelines for Use of the Ambipolar Diffusion Approximation in Rarefied Hypersonic Flows. DSMC 2025 Conference, Santa Fe, NM, September 28-October 1, 2025.
6. A.S. Gaikwad, I. Petrushina, I.V. Pogorelsky, K. Kusche, W. Li, K.G. Miller, E. Trommer, B. Romasky, **M. Petrusky**, et al. Field Mapping of CO_2 -laser-driven LWFA at Low Density using Electron Beam Probing. 66th Annual Meeting of the APS Division of Plasma Physics, Atlanta, Georgia, October 7-11, 2024.
5. **M. Petrusky**, W.R. Chan, I.D. Boyd. Assessing the Ambipolar Diffusion Approximation for Rarefied Hypersonic Plasma Shock Layers. 65th Annual Meeting of the APS Division of Plasma Physics, Denver, CO, October 30-November 3, 2023.
4. **M. Petrusky**, I.D. Boyd. Direct Kinetic Modeling of the Plasma Generated in a Rarefied Hypersonic Shock Layer. 2023 International Conference on Plasma Science, Santa Fe, NM, May 21-25, 2023.
3. **M. Petrusky**. An Analysis of Academic Culture and its Impact on Young Professionals. Symposium on Advancing Equity in Higher Education on Long Island, online, April 9, 2021.
2. **M. Petrusky**, T. Ye, C. Ghosh, A. Deshpande, K. Kumar. Determining the Position Dependency of Cherenkov Radiation in Quartz. APS Conference for Undergraduate Women in Physics, Philadelphia, PA, January 19, 2020.
1. **M. Petrusky**, T. Ye, C. Ghosh, A. Deshpande, K. Kumar. Determining the Angular Dependency of Cherenkov Radiation in Quartz. Scientista Symposium Poster Competition, Boston, MA, March 30, 2019.

RESEARCH EXPERIENCE

Nonequilibrium Gas and Plasma Dynamics Laboratory

Graduate Research Assistant

Boulder, CO

2021–Present

- ◆ Primary maintainer of in-house discrete-velocity solver, which solves Boltzmann-BGK-Poisson equations for discretized probability density function. Refactored code, implemented 1D3V dimensionality and Parallel Kinetic Perpendicular Moment method, added multiple new physical processes.
- ◆ Characterize electrostatic field formation in hypersonic flows in rarefied atmospheres.
- ◆ Establish general guidelines for use of ambipolar diffusion and free diffusion approximations and quantify impact on quantities of interest for hypersonic flows.

RESEARCH EXPERIENCE, CONTINUED

Analytical Mechanics Associates

Aerothermodynamics Intern at NASA Ames

Moffett Field, CA

Summer 2024

- ♦ Extended Data Parallel Line Relaxation Code's (DPLR) 1D subsonic shock space marcher to simulate supersonic region of shock tube.
- ♦ Developed computational framework for including viscous effects in DPLR's space marcher.
- ♦ Software will be used to perform sensitivity analysis on Nonequilibrium Radiative Transport and Spectra Program's chemical database.

Plasma Accelerator Group

Undergraduate Research Assistant

Stony Brook, NY

2020–2021

- ♦ Wrote open-source 3D3V Quasi-static Electron Propagation (QuEP) Monte Carlo particle solver.
- ♦ Developed proof of concept for experimental diagnostics of electron beam through laser-induced plasma wakefields using QuEP.

Lead (Pb-208) Radius Experiment (PREX) Collaboration

Undergraduate Research Assistant

Newport News, VA

2017–2019

- ♦ Conducted studies of particle position and angular dependencies in Cherenkov detectors.
- ♦ Wrote Gas Electron Multiplier detector alignment software for PREX experiment.

TEACHING

Teaching Areas

- ♦ Aerospace Engineering: Thermodynamics, Hypersonic Aerothermodynamics, Fluid Mechanics, Compressible Flows, Molecular Dynamics.
- ♦ Physical Sciences: Electromagnetic Theory, Statistical Mechanics, Plasma Physics.
- ♦ Applied Mathematics: Numerical Analysis, Partial Differential Equations, Computer and Programming Fundamentals.

Teaching Experience

Spring 2025	ASEN 5151: Fundamentals of Gas Dynamics. Sole graduate teaching facilitator, 50 students.
Summer 2023	ARSC 3700: McNair Seminar: Research Design. Graduate part time instructor (Instructor of record), re-designed course, 10 students.
Summer 2022	ARSC 3700: McNair Seminar: Research Design. Co-graduate teaching facilitator, 16 students.

Pedagogical Development

Spring 2025	Dialogic Pedagogy of Practice Program, CU Dialogues Program and the Center for Teaching and Learning, Boulder, CO.
Fall 2024	DEI-Informed Dialogic Pedagogy Micro-Credential, CU Dialogues Program and the Center for Teaching and Learning, Boulder, CO. Badge issued via Credly.
Spring 2019	JRN 365: Talking Science, School of Communication and Journalism and the Alan Alda Center for Communicating Science, Stony Brook, NY.

PROFESSIONAL SERVICE

Professional society memberships

- ♦ American Institute of Aeronautics & Astronautics
2025 Workshop Volunteer, Girls Exploring Science, Technology, Engineering, and Math.
- ♦ American Physical Society
2021–Present Member, Division of Plasma Physics Pride.
2022 Guest Physicist, Physicist-to-Go Program.

PROFESSIONAL SERVICE, CONTINUED

Symposia

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| 2025–Present | Organizing Committee, International Symposium on Rarefied Gas Dynamics Next Generation |
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Service at University of Colorado Boulder

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| Fall 2024 | Volunteer, First-Year Aerospace Boot Camp Seminar Series. |
| 2023, 2024 | Fall Admissions Master of Science Application Review Committee, Aerospace Engineering Sciences Department. |
| 2021–2024 | Graduate Student Mentor, McNair Scholars Program. |
| 2021–2023 | Inclusive Culture Committee, Aerospace Engineering Sciences Department. |
| 2021–2023 | Diversity, Equity, and Inclusion Chair, Aerospace Graduate Student Government. |
| Fall 2022 | Lead, Aerospace Engineering Sciences PhD Applicant Mentoring Pilot Program. |
| Spring 2022 | Critical Needs Faculty Search Committee, Aerospace Engineering Sciences Department. |

Service at Stony Brook University

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| 2018–2021 | Vice President, Stony Brook Society of Physics Students chapter. |
| 2018–2020 | Peer Mentor, Women in Science and Engineering Honors College. |

SEMINARS AND TALKS

5. Applying to Graduate School in Aerospace Engineering. Rarefied Gas Dynamics Next Generation Talks, online, August 18, 2025.
4. Evaluation of Charged Species Diffusion in Hypersonic Flows. Rarefied Gas Dynamics Next Generation Talks, online, June 18, 2025.
3. Charting Your Course In Undergrad. Honors Alumni Speaker Series, Stony Brook University, online, March 5, 2025.
2. Modeling Plasma Dynamics during Hypersonic Entry. 2024 Future Leaders in Aerospace Symposium, Stanford, CA, May 15-17, 2024.
1. The Art of Flexible Science Communication. Aerospace Engineering Sciences Fluids-Structures-Materials Seminar Series, Boulder, CO, September 20, 2023.

SELECT WORKSHOPS AND COURSES

7. DSMC and Beyond: Modeling Nonequilibrium Flow in Aerospace Application, DSMC 2025 Conference Short Course, Santa Fe, NM, September 28, 2025.
6. Conference for Graduate Women and Gender Minorities in Physics. Washington, D.C., September 25-26, 2025.
5. University of Colorado – Rocky Mountain Advanced Computing Consortium AI Workshop, Boulder, CO, August 5-6, 2025.
4. Plasma Communication and Assessment Tools for Public Engagement Workshop, Morgantown, WV, June 1, 2025.
3. Future Leaders in Aerospace Symposium, Stanford, CA, May 15-17, 2024.
2. Mini Course on Plasma Propulsion, IEEE International Conference on Plasma Science, Seattle, WA, May 26-27, 2022.
1. US ITER Research Program Research Needs Workshop, online, February-April 2022.

References available upon request.