

THOMAS ARCHER MARKS

thomasmarks.space
marksta@umich.edu

EDUCATION

Doctor of Philosophy in Aerospace Engineering and Scientific Computing

September 2023

University of Michigan, Ann Arbor, MI, USA

Dissertation: Modeling Anomalous Electron Transport in a Fluid Hall Thruster Code

Advisor: Professor Benjamin Jorns

Bachelor of Science in Aerospace Engineering

May 2018

Texas A&M University, College Station, TX, USA

Magna cum laude

RESEARCH EXPERIENCE

Postdoctoral Research Fellow

October 2023–Present

Department of Aerospace Engineering, University of Michigan (remote)

Supervisor: Professor Alex Gorodetsky

- Applying high-performance, GPU-accelerated computing to kinetic simulations of low-temperature plasma devices.
- Developing predictive engineering models of Hall thrusters as part of the NASA's Joint Advanced Propulsion Institute (JANUS).
- Pursuing tensor-based data-compression methods for kinetic plasma simulations.

Graduate Student Research Assistant

2018–2023

Department of Aerospace Engineering, University of Michigan

Advisor: Professor Benjamin Jorns

- Simulated plasma expansion in magnetic nozzles.
- Assisted in high-power Hall thruster design and testing.
- Wrote one-dimensional open-source Hall thruster code *HallThruster.jl*.
- Developed and tested models for Hall thruster anomalous electron transport.

Intern

June–August 2020

Jet Propulsion Laboratory, Pasadena, California (remote)

Supervisor: Dr. Alejandro Lopez Ortega

- Modified Hall thruster code Hall2De to simulate magnetic nozzles.
- Assessed role of instability-induced transport in magnetic nozzle electron dynamics.

Undergraduate Research Assistant

2017–2018

Department of Aerospace Engineering, Texas A&M University

Advisor: Professor Christopher Limbach

- Aligned Nd-YAG laser for use in laser-induced fluorescence (LIF) experiments.
- Assembled and aligned infrared dye laser for use in LIF experiments.
- Performed LIF of xenon-helium glow discharge to probe metastable Xe density.

Advisor: Professor Kentaro Hara

- Wrote numerical model of electrostatic potential at plasma-liquid interface.
- Assessed depth of charge penetration into liquid to evaluate plasma medicine concept.

TEACHING EXPERIENCE

Graduate Student Instructor

January–May 2021

Department of Aerospace Engineering, University of Michigan

AEROSP 335: *Aerospace Propulsion*

- Wrote weekly homework assignments for third-year aerospace students
- Graded exams and hosted weekly office hours.

Teaching Assistant

2016–2017

Department of International Studies, Texas A&M University

GERM 101: *Beginning German I* & GERM 102: *Beginning German II*

- Taught biweekly classes to first-year students.
- Tutored students in German twice/week outside of class.

SKILLS

- **Numerical methods:** Particle and fluid methods for PDEs, Bayesian inference, and Monte Carlo methods.
- **Experimental techniques:** Hall thruster operation, plasma probe construction, laser system setup and alignment. Analysis of common plasma diagnostics.
- **Software:** Linux, MacOS, Windows. High-performance computing on SLURM clusters. LaTeX, Typst, Microsoft Office.
- **Programming languages:** Julia, C, C++, CUDA, Python, Fortran, MATLAB.
- **Human languages:** English (native), German (intermediate).

HONORS AND AWARDS

Best Paper in Session

June 2024

2024 International Electric Propulsion Conference. Toulouse, France.

T.A. Marks and A.A. Gorodetsky, *Hall thruster simulations in WarpX*.

Best Paper: Electric Propulsion

January 2023

2023 AIAA SciTech Forum. National Harbor, MD.

L.L. Su et al. *Operation and Performance of a Magnetically Shielded Hall thruster at Ultrahigh Current Densities on Xenon and Krypton*.

Best Paper: Electric Propulsion

2020

2020 AIAA Propulsion and Energy Forum. Remote.

B.A. Jorns, T.A. Marks, and E.T. Dale. *A Predictive Hall Thruster Model Enabled by Data-Driven Closure*.

JOURNAL PUBLICATIONS

- Eckels, J.D., **Marks, T.A.**, Allen, M.G., Jorns, B.A., & Gorodetsky, A.A. (2024). *Hall thruster model improvement by multidisciplinary uncertainty quantification*. Journal of Electric Propulsion, 3(19).
- Su, L.L., **Marks, T.A.**, & Jorns, B.A. (2024). *Trends in mass utilization of a magnetically shielded hall thruster operating on xenon and krypton*. Plasma Sources Science and Technology, 33(6), 065008.
- Su, L.L., Roberts, P.J., Gill, T.M., Hurley, W.J., **Marks, T.A.**, Sercel, C.L., Allen, M.G., Whittaker, C.B., Vigés, E. and Jorns, B. A. (2024). *High-current density performance of a magnetically shielded Hall thruster*. Journal of Propulsion and Power, 1-18.
- **Marks, T.A.** & Jorns, B.A. (2023). *Evaluation of algebraic models of anomalous transport in a multi-fluid Hall thruster code*. Journal of Applied Physics, 134(15), 153301.
- **Marks, T.A.** & Jorns, B.A. (2023). *Challenges with the self-consistent implementation of closure models for anomalous electron transport in fluid simulations of Hall thrusters*. Plasma Sources Science and Technology, 32 (4), 0450516.
- **Marks, T.A.**, Schedler, P. & Jorns, B.A. (2023). *HallThruster.jl: A Julia package for 1D Hall thruster discharge simulation*. Journal of Open Source Software, 8 (86), 4672.

CONFERENCE PUBLICATIONS

- **Marks, T.A.** & Gorodetsky, A.A. (2024). *HallThruster simulations in WarpX*. 38th International Electric Propulsion Conference, Toulouse, France. #409.
- Eckels, J.D., **Marks, T.A.**, Aksoy, D., Vutukury, S., & Gorodetsky, A.A. (2024). *Dynamic mode decomposition for particle-in-cell simulations of a Hall thruster and plume*. 38th International Electric Propulsion Conference, Toulouse, France. #412.
- Aksoy, D., Vutukury, S., **Marks, T.A.**, Eckels, J.D. & Gorodetsky, A.A. (2024). *Compressed analysis of electric propulsion simulations using low-rank tensor networks*. 38th international Electric Propulsion Conference, Toulouse, France. # 795.

- Lipscomb, C.P., Stasiukevicius, M.J., Boyd, I.D., Hansson, K.B., **Marks, T.A.**, Brick, D.G., & Jorns, B. A. (2024). *Evaluation of H₉ Hall thruster plume simulations using coupled thruster and facility models*. 38th International Electric Propulsion Conference, Toulouse, France. #483.
- Allen, M.G., **Marks, T.A.**, Eckels, J.D., Gorodetsky, A.A., & Jorns, B.A. (2024). *Optimal Experimental Design for Interruption of Anomalous Electron Transport in a Hall thruster*. AIAA SciTech 2024 Forum, Orlando, FL, USA. #2164.
- **Marks, T.A.** & Jorns, B.A. (2023). *Evaluation of several first-principles closure models for Hall thruster anomalous transport*. AIAA SciTech 2023 Forum, National Harbor, MD, USA. #0067.
- Su, L.L., Roberts, P.J., Gill, T.M. Hurley, W.J., **Marks, T.A.**, Sercel, C.L., Allen, M.G., Whittaker, C.B., Byrne, M., Brown, Z., Vigas, E. and Jorns, B.A. (2023). *Operation and performance of a magnetically-shielded Hall thruster at ultrahigh current densities on xenon and krypton*. AIAA Scitech 2023 Forum, National Harbor, MD, USA. #0842.
- Hurley, W.J., **Marks, T.A.**, & Jorns, B.A. (2023). *Design of an air-core circuit for a Hall thruster*. AIAA SciTech 2023 Forum, National Harbor, MD, USA. #0841.
- **Marks, T.A.** & Jorns, B.A. (2022). *Modeling anomalous electron transport in Hall thrusters using surrogate methods*. 38th International Electric Propulsion Conference, Boston, MA, USA. #344.
- Su, L.L., **Marks, T.A.**, & Jorns, B.A. (2022). *Investigation into the efficiency gap between krypton and xenon operation on a magnetically shielded Hall thruster*. 38th International Electric Propulsion Conference, Boston, MA, USA.
- Hurley, W.J., **Marks, T.A.**, Gorodetsky, A.A. & Jorns, B.A. (2022). *Application of Bayesian inference to develop an air-core magnetic circuit for a magnetically shielded Hall thruster*. 38th International Electric Propulsion Conference, Boston, MA, USA.
- **Marks, T.A.**, Lopez Ortega, A., Mikellides, I.G., & Jorns, B.A. (2021). *Self-consistent implementation of a zero-equation transport model into a predictive model for a Hall effect thruster*. AIAA Propulsion and Energy 2021 Forum, Remote. #3424.
- **Marks, T.A.**, Lopez Ortega, A., Mikellides, I.G., & Jorns, B.A. (2020). *Hall2De simulations of a magnetic nozzle*. AIAA Propulsion and Energy 2020 Forum, Remote. #3642.
- Jorns, B.A., **Marks, T.A.**, & Dale, E.T. (2020). *A predictive Hall thruster model enabled by data-driven closure*. AIAA Propulsion and Energy 2020 Forum, Remote. #3622.