Andrew David Maris

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Research Experience

DOE FES Postdoctoral Fellow **2026 – Present**
Columbia University, New York, NY

Fellowship Supervisor: Prof. Carlos Paz-Soldan
The goal of this fellowship is to expand the *breadth*, *depth*, and *speed* of modeling tools for inductively-induced currents in magnetic fusion devices

- *breadth* – model eddy currents due to plasma transients in multiple magnetic fusion devices (e.g., stellarators, mirrors) using the ThinCurr code
- *depth* – couple ThinCurr to an extended MHD code (M3D-C1 or NIMROD) to enable self-consistent simulations of the tokamak current quench and accompanying vertical displacement event
- *speed* – develop accelerated, differentiable models of forces experienced by tokamaks and stellarators via machine learning surrogates and reduced-order models

PhD in Applied Plasma Physics **2020 – 2026**
MIT Plasma Science and Fusion Center, Cambridge, MA

Thesis title: Prediction and control of the tokamak density limit
Advisors: Cristina Rea, Robert Granetz, and Earl Marmar

- Developed a comprehensive multi-machine density limit (DL) database (258 L-mode DLs, 90 H-mode DLs, 4739 non-disruptive shots) spanning Alcator C-Mod, ASDEX-Upgrade, DIII-D, JET, and TCV, released publicly as the Open Density Limit Database
- Created a machine learning pipeline (Maris et al., *NF* 2025, Maris et al., *PRL* 2026) that identified simple, dimensionless power laws that more accurately predict the onset of the density limit than the Greenwald fraction. These results provide evidence for a theorized RBM-destabilization mechanism for the density limit
- Demonstrated real-time avoidance of the density limit on DIII-D via feedback control of the ML-derived stability metrics (Maris et al., *NF* 2026)
- Quantified the economic consequences of disruptions in tokamak power plants, showing that cryogenic system recovery times could be a major cost driver (Maris et al., *FS&T* 2024)

Education

Massachusetts Institute of Technology, Cambridge, MA **February 2026**
PhD in Applied Plasma Physics, Department of Nuclear Science and Engineering

- Thesis title: Prediction and control of the tokamak density limit
- Advisors: Cristina Rea, Robert Granetz, and Earl Marmar

Carleton College, Northfield, MN **June 2019**
Bachelor of Arts, major in Physics (Distinction) and minor in Public Policy

Invited Talks

Maris, Andrew D., et al. "Improved warning and control of the tokamak density limit via machine learning of an analytic stability boundary." *Theory and Simulation of Disruptions Workshop* (2025). Princeton, NJ

Maris, Andrew D., et al. "Correlation of the L-mode density limit with edge collisionality." *66th Annual Meeting of the APS Division of Plasma Physics* (2024). Atlanta, GA

Publications and Manuscripts

**Primary publications and manuscripts from PhD thesis; †Equal contribution*

First and co-first author

*Maris, Andrew D., et al. "Collisionality scaling of the tokamak density limit." *Physical Review Letters* (accepted, 2026).

*Maris, Andrew D., et al. "Real-time avoidance of the L-mode and H-mode density limit via machine-learned stability metrics." *Nuclear Fusion* (2026).

*Maris, Andrew D. "Prediction and control of the tokamak density limit." *PhD Thesis, Massachusetts Institute of Technology* (2026).

*Maris, Andrew D., et al. "Correlation of the L-mode density limit with edge collisionality." *Nuclear Fusion* (2025).

Spangher, Lucas†, Allen M. Wang†, Andrew D. Maris†, et al. "Position: Opportunities Exist for Machine Learning in Magnetic Fusion Energy." *Forty-first International Conference on Machine Learning* (2024).

*Maris, Andrew D., et al. "The impact of disruptions on the economics of a tokamak power plant." *Fusion Science and Technology* (2024).

Maris, Andrew D., et al. "Investigating boosted decision trees as a guide for inertial confinement fusion design." *Physics of Plasmas* (2023).

Maris, Andrew D., et al. "Chaos in the quantum Duffing oscillator in the semiclassical regime under parametrized dissipation." *Physical Review E* (2021).

Co-author

Benjamin, S., Z. Keith, Andrew D. Maris, et al. "Macroscopic trends of neoclassical tearing stability in high-field H-mode tokamak pilot plants." *Nuclear Fusion* (2026).

Pokornik, M., S. F. Khan, J. A. Gaffney, B. MacGowan, Andrew D. Maris, et al. "Investigating performance and variability of NIF ICF experiments with deep learning." *Nuclear Fusion* (2025).

Rutherford, Grant, […] Andrew D. Maris, et al. "MANTA: A Negative-Triangularity NASEM-Compliant Fusion Pilot Plant." *Plasma Physics and Controlled Fusion* (2024).

Cohen-Tanugi, D., R. Delaporte-Mathurin, M. Handley, S. Meschini, Andrew D. Maris, et al. "Enabling commercial fusion: venture and technology opportunities for a growing fusion industry." *Report* (2024).

Spangher, L., W. Arnold, A. Spangher, Andrew D. Maris, and C. Rea. "Autoregressive transformers for disruption prediction in nuclear fusion plasmas." *arXiv preprint* (2023).

Rath, K., D. Rügamer, B. Bischl, U. von Toussaint, C. Rea, Andrew D. Maris, R. Granetz, et al. "Data augmentation for disruption prediction via robust surrogate models." *Journal of Plasma Physics* (2022).

Woolf, R. S., B. F. Phlips, A. L. Hutcheson, Andrew D. Maris, and E. A. Wulf. "Positional dependence of pulse shape discrimination in a monolithic CLLB crystal." *IEEE Nuclear Science Symposium* (2020).

Contributed Talks

†Equal contribution

Maris, Andrew D., et al. "Critical Assessment of Plasma Prediction (CAPP): A Proposed Community Challenge for Fusion Plasma Models and Digital Twins." *Second IAEA Workshop on AI for Accelerating Fusion Energy and Plasma Science* (2026). College Station, TX

Maris, Andrew D., et al. "Calculation of induced currents and forces in W7-X utilizing ThinCurr." *68th Annual Meeting of the APS Division of Plasma Physics* (2026). Chicago, IL

Maris, Andrew D., et al. "Calculation of induced currents and forces in W7-X utilizing ThinCurr." *4th IAEA Technical Meeting on Plasma Disruptions and their Mitigation* (2026). ITER Headquarters, France

(ITER Session) Maris, Andrew D., et al. "Collisionality scaling of the tokamak density limit: data-driven analysis, cross-device prediction, and real-time avoidance." *67th Annual Meeting of the APS Division of Plasma Physics* (2025). Long Beach, CA

(ICML Oral – <2% acceptance rate) Spangher, Lucas†, Allen M. Wang†, Andrew D. Maris†, et al. "Position: Opportunities Exist for Machine Learning in Magnetic Fusion Energy." *Forty-first International Conference on Machine Learning* (2024). Vienna, Austria

Maris, Andrew D., et al. "Correlation of the L-mode density limit with edge collisionality." *3rd IAEA Technical Meeting on Plasma Disruptions and their Mitigation* (2024). ITER Headquarters, France

Maris, Andrew D., et al. "Correlation of the L-mode density limit with edge collisionality." *44th ITPA MHD, Disruptions & Control Topical Group Meeting* (2024). Remote

Maris, Andrew D., et al. "Density limit prediction at DIII-D & beyond: an offline analysis." *27th Workshop on MHD Stability Control* (2023). Boulder, CO

Maris, Andrew D., et al. "Investigating the robustness of machine learning-based disruption prediction with synthetic training data." *26th Workshop on MHD Stability Control* (2022). Spokane, WA

Maris, Andrew D., et al. "Predicting neutron yield of NIF ICF experiments by applying machine learning to a small (n<150) and heterogeneous experimental dataset." *62nd Annual Meeting of the APS Division of Plasma Physics* (2020). Remote

Maris, Andrew D., et al. "Finding correlations in inertial confinement fusion experimental data using machine learning." *61st Annual Meeting of the APS Division of Plasma Physics* (2019). Ft. Lauderdale, FL

Summer School Lectures, Seminars, and Outreach

(Summer school lecture) Maris, Andrew D., et al. "Detection & avoidance of the density limit." *DIII-D Summer School* (2026). San Diego, CA

(Summer school lecture) Maris, Andrew D., et al. "Data-mining the tokamak density limit." *William & Mary AI and Fusion Energy Summer School (AI4Fusion)* (2024). Williamsburg, VA

(Guest seminar) Maris, Andrew D. "Distilling the density limit in tokamaks using data-driven techniques." *AstroAI Journal Club, Harvard & Smithsonian Center for Astrophysics* (2024). Cambridge, MA

(Guest seminar) Maris, Andrew D. "The impact of disruptions on the economics of a tokamak power plant." *MIT Energy Initiative Fusion Study Team* (2023). Cambridge, MA

(Outreach talk) Maris, Andrew D. "What Jurassic Park gets wrong about Chaos Theory." *TEDx Asbury Park* (2019). Asbury Park, NJ

Leadership and Service

Vice-Chair, APS DPP CONNECT **2026 – Present**
American Physical Society Division of Plasma Physics

President and Co-Founder, Fusion Student Delegation (FuSD) **2023 – 2025**
Washington, DC

- Founded national graduate-student delegation connecting early-career fusion scientists with policymakers in Washington DC; served as Vice President (2024) and President (2025)
- Organized schedule for inaugural visit, including meetings with DOE FES Director J.P. Allain and Nuclear Regulatory Commissioner Chris Hansen
- Led recruitment and governance design for national delegation program (60 applicants for 10 slots in 2025 cohort)

Fellowships and Awards

DOE Fusion Energy Sciences Postdoctoral Fellowship **July 2025**
New York, NY

Outstanding Poster Award, ITER International School **December 2024**
Nagoya, Japan

Teaching Experience

Guest Lecturer, Business of Fusion Energy **January 2026**
MIT Independent Activities Period (IAP), Cambridge, MA

- Led a session and Q&A on the fusion policy landscape and how students can get involved in it

Kaufman Teaching Certificate Program **Fall 2024**
Massachusetts Institute of Technology, Cambridge, MA

- Studied modern pedagogical methods (ex. backwards course design, active learning, utilizing generative AI) in semester-long program from MIT Teaching and Learning Lab
- Practiced techniques by delivering two “microteaching” sessions and crafting a mock syllabus for course “Data science and machine learning methods in the physical sciences”

SPLASH High School Outreach Teacher **November 2020**
Massachusetts Institute of Technology, Cambridge, MA

- Led the creation of a lesson plan for Color, Light, and Perception, a class about the psychology, physics, and philosophy of color
- Co-taught two fully booked virtual classes of 30 students

Open Data and Software

Open Density Limit Database **2026**
MIT Plasma Science and Fusion Center, Cambridge, MA

- Public release of the multi-machine density limit database from PhD thesis, enabling other groups to test their own density limit scalings

Industry Experience & Research Internships

Associate Photonics Engineer **September 2019 – June 2020**
L3Harris Technologies, Palm Bay, FL

- Programmed quantum computing demo for aerospace-related optimization
- Lead author of R&D funding request for adiabatic quantum computing project

National Ignition Facility (NIF) Summer Scholar **Summer 2019 & 2020**
Lawrence Livermore National Laboratory, Livermore, CA

- Developed machine learning models to predict neutron yield of inertial confinement fusion experiments at NIF and provide an insight into yield degradation mechanisms (Maris et al. *PoP* 2023)

Quantum Chaos Research Assistant **Summer 2017 – Spring 2019**
Carleton College, Northfield, MN

- Uncovered the convergence of the Duffing oscillator's dynamical complexity in the semiclassical regime via numerical simulations (Maris et al. *PRE* 2021)

Contributed Posters

Maris, Andrew D., and Rian Chandra. "Critical Assessment of Plasma Prediction (CAPP): A Community Challenge for Fusion Plasma Models and Digital Twins." *68th Annual Meeting of the APS Division of Plasma Physics* (2026). Chicago, IL

(Outstanding Poster Award) Maris, Andrew D., et al. "Prediction and control of the tokamak density limit via edge collisionality." *13th ITER International School* (2024). Nagoya, Japan

Maris, Andrew D., et al. "Data-driven tokamak density limit boundary identification." *65th Annual Meeting of the APS Division of Plasma Physics* (2023). Denver, CO

Maris, Andrew D., et al. "Investigating the robustness of machine learning-based disruption prediction with synthetic training data." *64th Annual Meeting of the APS Division of Plasma Physics* (2022). Spokane, WA

Maris, Andrew D., et al. "Identifying physical disruption boundaries in Alcator C-Mod using linear Support Vector Machines." *63rd Annual Meeting of the APS Division of Plasma Physics* (2021). Pittsburgh, PA