

Andrew Oakleigh Nelson

(303) 834-5364 — a.o.nelson@columbia.edu — oaknelson.com — he/him/his

RESERACH PROFILE

Research program focused on experimental work in magnetic confinement fusion, data-driven optimization and stability modeling of advanced tokamak configurations for fusion pilot plants and integration of uncertainty quantification and AI-enabled workflows into high-fidelity physics simulations.

ACADEMIC APPOINTMENTS

Associate Research Scientist – Columbia University <i>Principal investigator on DOE FES and private-industry fusion awards</i>	2022 – present
Postdoctoral Research Fellow – Columbia University <i>Focus on negative triangularity scenarios for tokamaks and fusion outreach</i>	2021 – 2022

EDUCATION

Ph.D. – Plasma Physics – Princeton University <i>Thesis: Comprehensive Dynamic Analysis of the H-mode Pedestal in DIII-D</i>	2016 – 2021
M.A. – Plasma Physics – Princeton University <i>Focus in experimental magnetic confinement fusion</i>	2016 – 2018
B.Sc. – Engineering Physics – University of Colorado, Boulder <i>Minors: Applied Mathematics, Leadership Studies</i>	2012 – 2016

SELECTED AWARDS

- 2026 — **John Dawson Award for Excellence in Plasma Physics Research (American Physical Society)**
- 2018 — US Burning Plasma Association International ITER Scholar (US ITER Organization)
- 2016 — Outstanding Graduate of the College of Engineering and Applied Science (University of Colorado, Boulder)

SELECTED PUBLICATIONS

- J. Geng, Z. Wu, K. S. Chen, S. Kim, J. Janssen, Z. Z. Wang, B. Kalita, R. Gao, A. Ho, **A. O. Nelson**, et al. “[EurekaBench: Measuring agentic ability to discover new scientific insights](#),” arXiv (2026).
- A. Jalalvand, M. Curie, S. Kim, J. Seo, P. Steiner, Q. Hu, **A. O. Nelson**, et al., “[Multimodal super-resolution: Discovering hidden physics and its application to fusion plasmas](#),” *Nature Communications* **16**, 8506 (2025).
- A. Samaddar, Q. Gong, S. Madiredy, C. J. Hansen, S. Joung, D. R. Smith, Y. Sun, F. Ebrahimi, P. Balaprakash, and **A. O. Nelson**, “[Spatiotemporal forecasting of the edge localized modes in tokamak plasmas using neural networks](#),” *Machine Learning: Science and Technology* **6**, 035041 (2025).
- I. Char, Y. Chung, W. Neiswanger, K. Kandasamy, **A. O. Nelson**, M. D. Boyer, and E. Kolenen, “[Offline contextual Bayesian optimization](#),” *NeurIPS* **32**, 4629–4640 (2019).
- A. O. Nelson**, D. T. Garnier, D. J. Battaglia, C. Paz-Soldan, I. Stewart, M. Reinke, A. J. Creely, and J. Wai, “[Implications of vertical stability control on the SPARC tokamak](#),” *Nuclear Fusion* **64**, 086040 (2024).
- A. O. Nelson**, L. Schmitz, C. Paz-Soldan, K. E. Thome, T. B. Cote, N. Leuthold, F. Scotti, M. E. Austin, A. Hyatt, and T. Osborne, “[Robust avoidance of edge-localized modes alongside gradient formation in the negative triangularity tokamak edge](#),” *Physical Review Letters* **131**, 195101 (2023).

A full list of over 120 publications (15 as first author) can be found on [Google Scholar](#) or [ORCID](#).

RESEARCH LEADERSHIP

Principal Investigator: Next Step Pulse Design <i>From: Next Step Fusion (private company); \$0.174 Mil.</i>	2026 – 2027
Principal Investigator: Interactive Simulations for Plasma Physics Education (under review) <i>Submitted to: National Science Foundation Improving Undergraduate STEM Education: Directorate for STEM Education; \$0.4 Mil.</i>	2026 – 2029
Institutional PI: Accelerating the Realization of Fusion Energy Through Integrated Physics and Advanced Data Science <i>From Department of Energy, Fusion Energy Sciences, Tokamak Research Program; \$0.765 Mil.</i>	2025 – 2029
Co-PI: Advancing Intrinsically No-ELM and Small-ELM Regimes for FPPs <i>From: Department of Energy, Fusion Energy Sciences, Tokamak Research Program; \$0.8 Mil.</i>	2025 – 2029
Co-PI: Closing Physics and Technology Gaps in Spherical Tokamaks Towards a Compact Fusion Pilot Plant <i>From: Department of Energy, Fusion Energy Sciences, Compact Toroidal Concepts Program; \$1.421 Mil.</i>	2025 – 2029
Principal Investigator: ELM-free Pedestal Modeling <i>From: Tokamak Energy (private company); \$0.08 Mil.</i>	2025
Principal Investigator: Research on Negative Triangularity Tokamak <i>From: Next Step Fusion (private company); \$0.165 Mil.</i>	2024 – 2025

RESEARCH EXPERIENCE AND TECHNICAL LEADERSHIP

Non-PI Major Research Leadership

• Project lead for fusion power plant design for Maritime Fusion (private company)	2025 – present
• Lead for ARC tokamak pulse design for Commonwealth Fusion Systems (private company)	2024 – present
• Working group leader for the EU/US negative triangularity collaboration	2023 – present
• Project lead for implementation of negative triangularly plasmas on MAST-U tokamak (U.K.)	2023 – 2025
• Working group leader for the US Joint Research Taskforce on ELM-free Regimes	2021 – 2022

Other Technical Contributions

• Development of data driven methods for analysis and modeling of fusion energy systems	2024 – present
• Fusion power plant design for Kyoto Fusioneering (private company)	2025 – present
• Development of negative triangularity scenarios on AUG tokamak (Germany)	2023 – 2025
• Development of open-source tokamak analysis pipelines	2022 – present
• Data preparation and support for AI/ML-based high-fidelity simulations for tokamak optimization	2022 – present
• Characterization of vertical stability control for SPARC and ARC (CFS – private company)	2021 – present
• Design and development of advanced negative triangularity scenarios on DIII-D tokamak	2021 – 2025
• Analysis and oversight of international non-ELM database	2021 – present
• Assessment of vertical stability control for negative triangularity scenarios	2021 – 2022
• Development of automated kinetic equilibria reconstructions for tokamaks	2019 – 2021
• Study of fast vertical motion and microturbulence on DIII-D and KSTAR tokamaks (Korea)	2018 – 2021
• Experimental and modeling studies of the plasma edge and core on the DIII-D tokamak	2016 – 2021
• Design and construction of cryogenic facility for dusty and space plasmas (IMPACT – Boulder, CO)	2014 – 2016
• Experimental and modeling work on fast ignition in laser-based inertial confinement fusion	2014 – 2015
• Experimental and modeling work in Terahertz metrology at (NIST – Boulder, CO)	2012 – 2014

COLLABORATIONS

Strong collaborations with private (General Atomics, Commonwealth Fusion Systems, Tokamak Energy, Next Step Fusion, Kyoto Fusion Engineering, Maritime Fusion) and public (Princeton Plasma Physics Laboratory, Princeton University, United Kingdom Atomic Energy Authority, Massachusetts Institute of Technology, Max Planck Institute for Plasma Physics) fusion programs.

TEACHING AND MENTORING EXPERIENCE

Research and Academic Mentor – Columbia University

- Direct research advisor for three Ph.D. students 2021 – present
- Direct research advisor for 15 undergraduate and masters students 2021 – present
- Interdisciplinary curriculum development 2023 – present
- Guest Lecturer – Columbia Plasma II and PPPL SULI Program 2021 – present
- Instructor – joint Columbia, Princeton and MIT design courses 2021, 2023
- Founder – weekly graduate-level seminar course on plasma physics 2021

Research and Academic Mentor – Princeton University

- Direct research advisor for three undergraduate students 2019 – 2022
- Direct academic mentor for “PreDoc” Graduate Preparation Program 2019 – 2022
- Guest lecturer for plasma physics seminar and introductory fusion courses 2021 – 2022
- Teaching fellow with the Princeton Writing Center and McGraw Center for Teaching and Learning 2020 – 2022
- Teaching assistant for one undergraduate lecture course and one graduate lab course 2019, 2020

LEADERSHIP AND OUTREACH

Outreach Chair – MagNetUS Executive Committee 2026 – present

MagNetUS establishes programs for education and training in magnetized plasmas

Co-chair – General Atomics Personnel Development Committee 2023 – present

Oversight for efforts to improve community and pedagogy at the DIII-D tokamak in San Diego

Co-chair – Fusion Energy Week 2023 – present

Primary organizer for Fusion Energy Week, a global fusion outreach series recurring every May

Co-chair – USFusionEnergy.org and US Fusion Outreach Team 2023 – present

Leadership and logistics for outreach websites and grass-roots fusion pedagogy organizations

Minigrant Recipient – APS Forum on Outreach & Engaging the Public 2023 – 2024

Received \$2.5k from the American Physical Society to develop and distribute Fusion Trading Cards

Principal Investigator – ORFEAS Student Fusion Design Contest 2022

Led a group of eight graduate students in a research contest, winning the maximum prize of \$20k

Ally – APS Division of Plasma Physics (DPP) 2022 – present

Trained and active resource for diversity, equity and inclusion within US physics communities

Chair – APS-DPP Student Day 2021 – 2024

Responsible for a student-oriented mini-conference at each national APS-DPP convention

Chair – APS-DPP CONNECT Committee 2020 – present

National organization to address the concerns of students and early career plasma scientists

Board of Directors – Fusion EP Seminar Series 2021 – 2022

US contact for the international student-led plasma physics seminar series