Andrew Oakleigh Nelson

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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 2022 – present

Principal investigator on DOE FES and private-industry fusion awardsx

Postdoctoral Research Fellow – Columbia University 2021 – 2022

Focus on negative triangularity scenarios for tokamaks and fusion outreach

Education

Ph.D. – Plasma Physics – Princeton University 2016 – 2021

Thesis: Comprehensive Dynamic Analysis of the H-mode Pedestal in DIII-D

M.A. – Plasma Physics – Princeton University 2016 – 2018

Focus in experimental magnetic confinement fusion

B.Sc. – Engineering Physics – University of Colorado, Boulder 2012 – 2016

Minors: Applied Mathematics, Leadership Studies

Research Funding

Principal Investigator: Next Step Pulse Design 2026 – 2027

From: Next Step Fusion (private company); $0.174 Mil.

Principal Investigator: Interactive Simulations for Plasma Physics Education (*under review*) 2026 – 2029

Submitted to: National Science Foundation Improving Undergraduate STEM Education: Directorate for STEM Education; $0.4 Mil.

Institutional PI: Accelerating the Realization of Fusion Energy Through Integrated Physics and Advanced Data Science 2025 – 2029

From Department of Energy, Fusion Energy Sciences, Tokamak Research Program; $0.765 Mil.

Co-PI: Advancing Intrinsically No-ELM and Small-ELM Regimes for Fusion Pilot Plants 2025 – 2029

From: Department of Energy, Fusion Energy Sciences, Tokamak Research Program; $0.8 Mil.

Co-PI: Closing Physics and Technology Gaps in Spherical Tokamaks Towards a Compact Fusion Pilot Plant 2025 – 2029

From: Department of Energy, Fusion Energy Sciences, Compact Toroidal Concepts Program; $1.421 Mil.

Principal Investigator: ELM-free Pedestal Modeling 2025

From: Tokamak Energy (private company); $0.08 Mil.

Principal Investigator: Research on Negative Triangularity Tokamak 2024 – 2025

From: Next Step Fusion (private company); $0.165 Mil.

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 microturbuelnce 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 Fusioneering, 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

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

Founder + Chair – Plasma Graduate Student Committee, Princeton University 2019 – 2021
Established a committee to amplify student voices and support development of the graduate program

Organized graduate curriculum reform, Princeton University 2019 – 2021
Led a student effort to dramatically reform a graduate-level plasma diagnostics course

President – Princeton Plasma Student Leadership 2018 – 2019
Bridge between graduate students and faculty and program management

Volunteer – Princeton Plasma Physics Laboratory 2016 – 2021
PPPL Lab tour guide; frequent volunteer at PPPL-led science education and outreach events

Selected Awards

2018 — US Burning Plasma Association International ITER School Scholar

2016 — CU Boulder Outstanding Graduate of the College of Engineering and Applied Science

2016 — CU Boulder Engineering Physics Distinguished Graduate

2016 — CU Boulder Engineering Physics Distinguished Graduate for Research

2016 — Hertz Foundation Scholarship Finalist

2015 — Astronaut Scholarship Foundation Scholar

Publications and Invited Talks

Over 90 publications (14 as first author) and 17 invited talks and seminars.

A full list of publications is included on the following pages, or on Google Scholar or ORCID.

Publications List

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

First Author Publications

[1] **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". In: *Nuclear Fusion* 64.8 (2024), p. 086040. URL: https://doi.org/10.1088/1741-4326/ad58f6.

[2] **A. O. Nelson**, C. Vincent, H. Anand, J. Lovell, J. F. Parisi, H. S. Wilson, K. Imada, W. P. Wehner, M. Kochan, S. Blackmore, G. McArdle, S. Guizzo, L. Rondini, S. Freiberger, and Carlos Paz-Soldan. "First Access to ELM-free Negative Triangularity at Low Aspect Ratio". In: *Nuclear Fusion* 64 (2024), p. 124004. URL: https://doi.org/10.1088/1741-4326/ad89db.

[3] **A. O. Nelson** et al. "Characterization of the ELM-free Negative Triangularity Edge on DIII-D". In: *Plasma Physics and Controlled Fusion* 66 (2024), p. 105014. URL: https://doi.org/10.1088/1361-6587/ad6a83.

[4] 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". In: *Physical Review Letters* 131 (2023), p. 195101. URL: https://doi.org/10.1103/PhysRevLett.131.195101.

[5] **A. O. Nelson**, A. W. Hyatt, W. P. Wehner, A. S. Welander, C. Paz-Soldan, T. H. Osborne, H. Anand, and K. E. Thome. "Vertical Control of DIII-D Discharges with Strong Negative Triangularity". In: *Plasma Physics and Controlled Fusion* 65 (2023), p. 044002. URL: https://doi.org/10.1088/1361-6587/acbe65.

[6] **A. O. Nelson**, Carlos Paz-Soldan, and Samuli Saarelma. "Prospects for H-mode inhibition in negative triangularity tokamak reactor plasmas". In: *Nuclear Fusion* 62 (2022), p. 096020. URL: https://doi.org/10.1088/1741-4326/ac8064.

[7] **A. O. Nelson**, F. M. Laggner, A. Diallo, D. R. Smith, Z. A. Xing, R. Shousha, and E. Kolemen. "Time-dependent experimental identification of inter-ELM microtearing modes in the tokamak edge on DIII-D". In: *Nuclear Fusion* 61 (2021), p. 116083. URL: https://doi.org/10.1088/1741-4326/ac27ca.

[8] **A. O. Nelson**, Z. A. Xing, O. Izacard, F. M. Laggner, and E. Kolemen. "Interpretative SOL modeling throughout multiple ELM cycles in DIII-D". In: *Nuclear Materials and Energy* 26 (2021), p. 100883. URL: https://doi.org/10.1016/j.nme.2020.100883.

[9] **A. O. Nelson**, F. M. Laggner, R. J. Groebner, B. A. Grierson, O. Izacard, D. Eldon, M. Shafer, A. W. Leonard, D. Shiraki, A. C. Sontag, and E. Kolemen. "Setting the H-mode pedestal structure: variations of particle source location using gas puff and pellet fueling". In: *Nuclear Fusion* 60 (2020), p. 046003. URL: https://doi.org/10.1088/1741-4326/ab5e65.

[10] **A. O. Nelson**, N. Logan, E. Choi, E. J. Strait, and E. Kolemen. "Experimental evidence of ECCD-based NTM suppression threshold reduction during mode locking on DIII-D". In: *Plasma Physics and Controlled Fusion* 62 (2020), p. 094002. URL: https://doi.org/10.1088/1361-6587/ab9b3b.

[11] **A. O. Nelson**, M. E. Austin, and E. Kolemen. "Electron cyclotron emission based q-profile measurement and concept for equilibrium reconstruction". In: *Plasma Physics and Controlled Fusion* 61 (2019), p. 085013. URL: https://doi.org/10.1088/1361-6587/ab24a4.

[12] **A. O. Nelson**, R. J. La Haye, M. E. Austin, A. S. Welander, and E. Kolemen. "Simultaneous detection of neoclassical tearing mode and electron cyclotron current drive locations using electron cyclotron emission in DIII-D". In: *Fusion Engineering and Design* 141 (2019), pp. 25–29. URL: https://doi.org/10.1016/j.fusengdes.2019.02.089.

[13] **A. O. Nelson**, R. Dee, M. S. Gudipati, M. Horányi, D. James, S. Kempf, T. Munsat, Z. Sternovsky, and Z. Ulibarri. "New experimental capability to investigate the hypervelocity micrometeoroid bombardment of cryogenic surfaces". In: *Review of Scientific Instruments* 871.87 (2016), pp. 24502–24502. URL: https://doi.org/10.1063/1.4941960.

[14] **A. O. Nelson** and E. N. Grossman. "Advanced designs for non-imaging submillimeter-wave Winston cone concentrators". In: *Proceedings of SPIE* 9102 (2014), 91020U. URL: https://doi.org/10.1117/12.2050833.

Invited Talks and Seminars

[15] **A. O. Nelson**. "Applied plasma physics: the magnetic pursuit of fusion energy". In: *CIPS Seminar at CU Boulder*. 2026.

[16] **A. O. Nelson**. "Design and Optimization of Tokamaks for Fusion Energy". In: *Energy Frontier Seminars at the Institute of Renewable Energies in Mexico*. 2026.

[17] **A. O. Nelson**. "Using Magnets to Build a Star on Earth". In: *Caltech Astronomy on Tap*. 2025.

[18] **A. O. Nelson**. "The Negative Triangularity Edge". In: *Physics World Webinar: Negative triangularity tokamaks: a power plant plasma solution from the core to the edge?* 2024.

[19] **A. O. Nelson**. "The Negative Triangularity Tokamak: Power Handling in a Fusion Power Plant". In: *CU Boulder Saturday Physics Series*. 2024.

[20] **A. O. Nelson**. "The Negative Triangularity Tokmak: Ensuring Robust Access to a High-Performance, ELM-Free Fusion Power Plant". In: *UCI Physics Seminar Series*. 2024.

[21] **A. O. Nelson**. "The Negative Triangularity Tokmak: Ensuring Robust Access to a High-Performance, ELM-Free Fusion Power Plant". In: *Symposium on Plasma And Nuclear Systems (SPANS-2024)*. Ontario, Canada, 2024.

[22] **A. O. Nelson**. "Negative Triangularity: The Holy Grail for Tokamak Core-Edge Integration?" In: *UCLA Plasma Science and Technology Institute Seminar Series*. 2023.

[23] **A. O. Nelson**. "Plasma Waves". In: *Introduction to Fusion Energy and Plasma Physics Course*. 2023. URL: https://suli.pppl.gov/2023/course/.

[24] **A. O. Nelson**. "Robust avoidance of edge localized modes alongside pedestal formation in negative triangularity plasmas". In: *65th Annual Meeting of the APS Division of Plasma Physics*. 2023.

[25] **A. O. Nelson**, L. Schmitz, T.B. Cote, C. Paz-Soldan, N. Leuthold, K. E. Thome, M. E. Austin, G. Yu, G. Kramer, and S. Stewart. "Robust avoidance of peeling-ballooning instabilities through gradient reduction in the negative triangularity edge". In: *2023 US Transport Task Force Workshop*. 2023.

[26] **A. O. Nelson** et al. "Initial Experimental Results from the DIII-D Negative Triangularity Campaign". In: *2nd International Fusion and Plasma Conference*. Busan, Korea, 2023.

[27] **A. O. Nelson**. "H-mode Inhibition in Negative Triangularity Tokamak Reactors (Topical Plenary)". In: *6th Asia-Pacific Conference on Plasma Physics*. 2022.

[28] **A. O. Nelson**. "Experimental identification of inter-ELM pedestal MTMs through edge current perturbations". In: *2021 US Transport Task Force Workshop*. 2021.

[29] **A. O. Nelson**. "A practical introduction to the H-mode pedestal: ELMs and ELM-free regimes". In: *Fusion-EP Seminar Series*. 2020.

[30] **A. O. Nelson**. "Introduction to Outstanding Problems in Magnetic Confinement Fusion". In: *APS-DPP Student Day*. 2020.

[31] **A. O. Nelson**, R J La Haye, M E Austin, A S Welander, and E Kolemen. "ECE-based Tearing Mode Suppression and Equilibrium Reconstruction". In: *24th Workshop on MHD Stability Control*. 2019.

Co-Author Publications

2026

[32] N. Cao, D. R. Hatch, C. Michoski, T.A. Oliver, D. Eldon, **A. O. Nelson**, and M. Waller. "Quantifying Resolution Limits in Pedestal Profile Measurements with Gaussian Process Regression". In: *Nuclear Fusion* 66 (2026), p. 026016.

[33] J. C. Hillesheim, A. J. Creely, T. Eich, N. T. Howard, N. Leuthold, R. Sweeny, A. LeViness, **A. O. Nelson**, L. Nichols, R. A. Tinguely, M. Usoltseva, D.J. Battaglia, T.A.J. Body, C. Hansen, N. C. Logan, R.T. Mumgaard, P. Rodriguez Fernandez, P.B. Snyder, B.N. Sorbom, and J.C. Wright. "Overview of the physics basis for the ARC fusion power plant". In: *Journal of Plasma Physics* (2026), in review.

[34] S Ku, C.S. Chang, R. Hager, L. Schmitz, and A.O. **Nelson**. "Difference in Neoclasscial Edge Flows Between Strongly Negative and Positive Triangularities in the XGC Gyrokinetic Simulation". In: *Physics of Plasmas* (2026), in press.

[35] A. Kumar, C. Clauser, F. Carpanese, T. Golfinopoulos, A.O. **Nelson**, J. Wai, D. Battaglia, D. Boyer, D.T. Garnier, and R. Granetz. "Axisymmetric n = 0 Growth Rate Modeling in Alcator C-Mod and SPARC: Rigid vs. Non-Rigid Body Approaches". In: *Plasma Phys. Control. Fusion* (2026), in press.

[36] N. Leuthold, N.C. Logan, D.A. Burgess, A.O. **Nelson**, S.R. Benjamin, C. Hansen, A. Kumar, C. F. B. Zimmermann, F. Carpanese, A. J. Creely, J. C. Hillesheim, M. Muraca, and C Paz-Soldan. "ARC Physics Basis - MHD". In: *Journal of Plasma Physics* (2026), in review.

[37] J. Li, F. Ebrahimi, R. Hager, and **A. O. Nelson**. "Core turbulence during nonlinear total-f simulations of DIII-D negative triangularity regime". In: *Physics of Plasmas* (2026), in review.

[38] A. Marinoni et al. "Non-dimensional confinement scaling in similar negative triangularity plasmas on the DIII-D and TCV tokamaks". In: *Proceedings of the 29th IAEA Fusion Energy Conference* (2026), in press.

[39] Steven McNamara et al. "Physics Basis for the Reference Flat-Top Plasma Scenario in the ST-E1 Fusion Power Plant". In: *Nuclear Fusion* (2026), in review.

[40] S. Munaretto et al. "Spherical tokamak physics research in preparation for the operation of NSTX-U". In: *Nuclear Fusion* 66 (2026), p. 035001.

[41] T. Slendebroek, A.O. **Nelson**, O. M. Meneghini, G. Dose, A. G. Ghiozzi, J. Harvey, B. C. Lyons, J. McClenaghan, T. F. Neiser, D. B. Weisberg, M. G. Yoo, E. Bursch, and C. Holland. "Exploring the fusion power plant design space: comparative analysis of positive and negative triangularity tokamaks through optimization". In: *Nuclear Fusion* 66 (2026), p. 026032. URL: http://arxiv.org/abs/2507.19668.

[42] R. Sweeney et al. "ARC Disruption Physics and Strategy". In: *Journal of Plasma Physics* (2026), in review.

[43] B. Vanovac, J. Hobirk, **A. O. Nelson**, O. Sauter, M. Dunne, M. Faitsch, T. Puetterich, F. Rainer, D. Stieglitz, E. Strumberger, L. Xianzi, O. Grover, A. Kappatou, P. David, G. Tardini, P. Mantica, and A. White. "ELM suppression and confinement in negative triangularity with stronger shaping in ASDEX Upgrade". In: *Nuclear Fusion* (2026), in review.

[44] A. M. Wang, Z. Keith, M. D. Boyer, **A. O. Nelson**, A. Saperstein, A. Pau, and C. Rea. "Technical Aspects of Plasma Operational Simulation (POPSIM): A Framework for Data-Driven Simulation and Control". In: *IEEE Transactions on Plasma Science* (2026), in review.

[45] J Willis et al. "Tokamak Energy's Pre-Concept Design for a Fusion Power Plant: An Overview of ST-E". In: *Nuclear Fusion* (2026), in review.

[46] X. Zhang, N. A. Lopez, **A. O. Nelson**, L. Rondini, and F. M. Poli. "Application of the Scrape-Off-Layer Fast Ion (SOLFI) code to assess particle motion in mirrors and tokamaks". In: *Fusion Engineering and Design* (2026), in review.

2025

[47] T. Bechtel Amara et al. "Accelerating Discoveries at DIII-D With the Integrated Research Infrastructure". In: *Frontiers of Physics* 12 (2025), p. 1524041. URL: https://doi.org/10.3389/fphy.2024.1524041.

[48] L Casali, D Eldon, T Odstrcil, R Mattes, A Welsh, K Lee, A O **Nelson**, C Paz-Soldan, F Khabanov, T Cote, A G McLean, F Scotti, and K E Thome. "Achievement of highly radiating plasma in negative triangularity and effect of reactor-relevant seeded impurities on confinement and transport". In: *Plasma Physics and Controlled Fusion* 67.2 (2025), p. 025007. URL: https://iopscience.iop.org/article/10.1088/1361-6587/ada1ca.

[49] L. Casali, D. Eldon, T. Odstrcil, A. Welsh, K. Lee, **A. O. Nelson**, C Paz-Soldan, M. G. Burke, T. Cote, F. Khabanov, C. Lasnier, A. McLean, F. Scotti, K. E. Thome, and D. Truong. "Progress towards Integrated Tokamak Scenarios for Exhaust: experiments and new self-consistent core-edge modeling framework". In: *2025 IAEA 5th TM on Divertor Concepts*. 2025.

[50] T Cote, G Yu, A O **Nelson**, N Leuthold, N Richner, S Stewart, F Khabanov, Y Zhu, F Ebrahimi, J King, C Paz-Soldan, L Schmitz, K E Thome, M E Austin, and F Scotti. "First observations of edge instabilities in strongly shaped negative triangularity plasmas on DIII-D". In: *Plasma Physics and Controlled Fusion* 67.3 (2025), p. 035033. URL: https://iopscience.iop.org/article/10.1088/1361-6587/adb5ba.

[51] D Eldon, L Casali, I Bykov, C Chrystal, K Erickson, A W Hyatt, A W Leonard, A L Moser, A O **Nelson**, T Odstrčil, C Paz-Soldan, T Pederson, F Scotti, H Shen, K E Thome, H Q Wang, A Welsh, and T M Wilks. "Characterization and controllability of radiated power via extrinsic impurity seeding in strongly negative triangularity plasmas in DIII-D". In: *Plasma Physics and Controlled Fusion* 67.1 (2025), p. 015018. URL: https://iopscience.iop.org/article/10.1088/1361-6587/ad9e71.

[52] M E Fenstermacher and L R Baylor. “Progress in pedestal and edge physics Chapter 3 of the special issue: on the path to tokamak burning plasma operation”. In: *Nucl. Fusion* 65 (2025), p. 053001.

[53] Sophia Guizzo, Mikhail A. Drabinskiy, Christopher Hansen, Aleksandr G. Kachkin, Eduard N. Khairutdinov, Andrew O. **Nelson**, Maxim R. Nurgaliev, Matthew Pharr, Georgy F. Subbotin, and Carlos Paz-Soldan. “Electromagnetic System Conceptual Design for a Negative Triangularity Tokamak”. In: *Fusion Engineering and Design* 219 (2025), p. 115257. URL: https://doi.org/10.1016/j.fusengdes.2025.115257.

[54] Azarakhsh Jalalvand, Max Curie, SangKyeun Kim, Jaemin Seo, Peter Steiner, Qiming Hu, Andrew Oakleigh **Nelson**, Egemen Kolemen, M. Curie, and Y.-S Na. “Multimodal Super-Resolution: Discovering hidden physics and its application to fusion plasmas”. In: *Nature Communications* 16 (2025), p. 8506. URL: https://www.nature.com/articles/s41467-025-63492-1.

[55] G. Kramer, **A. O. Nelson**, and K.E. Thome. “On the formation of edge electric fields in negative triangularity plasmas”. In: *Plasma Phys. Control. Fusion* 67 (2025), p. 105010.

[56] A Lvovskiy, H Anand, A S Welander, M Kochan, C Vincent, G McArdle, J Lovell, Z A Xing, J L Barr, E Cho, B Sammuli, D A Humphreys, N W Eidietis, V Soukhanovskii, A W Leonard, A O **Nelson**, A Thornton, and J Harrison. “Framework for assessment of magnetic equilibrium controller performance on the MAST upgrade spherical tokamak”. In: *Plasma Physics and Controlled Fusion* 67.7 (2025), p. 075003. URL: https://iopscience.iop.org/article/10.1088/1361-6587/ade3fd.

[57] J F Parisi, J W Berkery, A. Sladkomedova, S. Guizzo, M. R. Hardman, J. R. Ball, **A. O. Nelson**, S. M. Kaye, M. Anastopoulos-Tzanis, S McNamara, J. Dominski, S. Janhunen, M. Romanelli, D. Dickinson, A. Diallo, A. Dnestrovskii, W. Guttenfelder, C. Hansen, O. Myatra, and H. R. Wilson. “Doubling fusion power with volumetric optimization in magnetic confinement fusion devices”. In: *Physical Review Research* 7 (2025), p. 013139. URL: https://doi.org/10.1103/PhysRevResearch.7.013139.

[58] R Perillo, J A Boedo, C J Lasnier, A McLean, C Marini, I Bykov, F Glass, A Kapat, A O **Nelson**, and D L Rudakov. “First-wall fluxes from large and small ELMs”. In: *Physics of Plasmas* 32 (2025), p. 022501. URL: https://doi.org/10.1063/5.0243880.

[59] A Rothstein, V Ailiani, K Krogen, A O **Nelson**, X Sun, M S Kim, W Boyes, N C Logan, Z A Xing, E Kolemen, and the DIII-D Team. “Assessing the numerical stability of physics models to equilibrium variation through database comparisons on DIII-D”. In: *Plasma Physics and Controlled Fusion* 67.11 (2025), p. 115006. URL: https://iopscience.iop.org/article/10.1088/1361-6587/ae163e.

[60] Anirban Samaddar, Qian Gong, Sandeep Madireddy, Christopher J Hansen, Semin Joung, David R Smith, Yixuan Sun, Fatima Ebrahimi, Prasanna Balaprakash, and Andrew Oakleigh **Nelson**. “Spatiotemporal Forcasting of the Edge Localized Modes in Tokamak Plasmas Using Neural Networks”. In: *Machine Learning: Science and Technology*. Springer Series in Plasma Science and Technology 6 (2025), p. 035041. URL: https://iopscience.iop.org/article/10.1088/2632-2153/adfb41.

[61] Filippo Scotti et al. “Divertor characterization and access to dissipative divertor conditions in Negative Triangularity discharges in DIII-D”. In: *Plasma Physics and Controlled Fusion* 67 (2025), p. 095030. URL: https://iopscience.iop.org/article/10.1088/1361-6587/adf881.

[62] R. Shousha, C. Hansen, A. Maan, **A. O. Nelson**, D. P. Boyle, S. Banerjee, and R. Majeski. “Systematic analysis of magnetic equilibrium reconstruction with eddy currents on LTX-”. In: *Nuclear Fusion* 65 (2025), p. 116009. URL: https://doi.org/10.1088/1741-4326/ae0a6b.

[63] R. Shousha et al. “Unified ELM Suppression on KSTAR and DIII-D via Adaptive Feedback Control Strategies”. In: *Nuclear Fusion* 65 (2025), p. 086021. URL: https://doi.org/10.1088/1741-4326/adeda0.

[64] S. Stewart, G. McKee, C. Chrystal, T. Cote, B. Geiger, F. Khabanov, **A. O. Nelson**, X. Qin, C. Paz-Soldan, L. Schmitz, K. E. Thome, and Z. Yan. “Characterization of Turbulence Properties in Negative Triangularity DIII-D Plasmas”. In: *Plasma Physics and Controlled Fusion* 67 (2025), p. 025032. URL: https://doi.org/10.1088/1361-6587/ada823.

2024

[65] W. Boyes, F. Turco, J. Hanson, G.A. Navratil, A. Turnbull, A. Hyatt, T. Luce, W. Meyer, A.O. **Nelson**, T. Odstrcil, T. Osborne, F. Scotti, A. Welander, and A. Wingen. “Novel intrinsic helical cores and MHD dynamo flux pumping evidence in DIII-D”. In: *Nuclear Fusion* 64.12 (2024), p. 124005. URL: https://doi.org/10.1088/1741-4326/ad89d9.

[66] Colin Chrystal, Max E Austin, Tomas Odstrcil, Carlos Paz-Soldan, Kathreen E Thome, Alessandro Marinoni, William Samuel Boyes, Thomas H Osborne, Nikolas Logan, A W Hyatt, and Andrew Oakleigh **Nelson**. "Effect of rotation on negative triangularity plasmas in DIII-D". In: *Plasma Physics and Controlled Fusion* 66 (2024), p. 105004. URL: https://doi.org/10.1088/1361-6587/ad6d89.

[67] S. Guizzo, **A. O. Nelson**, C. Hansen, F. Logak, and C. Paz-Soldan. "Assessment of vertical stability for negative triangularity pilot plants". In: *Plasma Physics and Controlled Fusion* 66 (2024), p. 065018. URL: https://doi.org/10.1088/1361-6587/ad4175.

[68] C. Hansen, I G Stewart, D. Burgess, M. Pharr, S. Guizzo, F. Logak, **A. O. Nelson**, and C. Paz-Soldan. "TokaMaker: An open-source time-dependent Grad-Shafranov tool for the design and modeling of axisymmetric fusion devices". In: *Computer Physics Communications* 298 (2024), p. 109111. URL: https://doi.org/10.1016/j.cpc.2024.109111.

[69] J.R. Harrison et al. "Overview of physics results from MAST upgrade towards core-pedestal-exhaust integration". In: *Nuclear Fusion* 64.11 (Nov. 1, 2024), p. 112017. URL: https://iopscience.iop.org/article/10.1088/1741-4326/ad6011.

[70] C.T. Holcomb et al. "DIII-D research to provide solutions for ITER and fusion energy". In: *Nuclear Fusion* 64.11 (2024), p. 112003. URL: https://iopscience.iop.org/article/10.1088/1741-4326/ad2fe9.

[71] S. K. Kim et al. "Highest fusion performance without harmful edge energy bursts in tokamak". In: *Nature Communications* 15.1 (2024), p. 3990. URL: https://www.nature.com/articles/s41467-024-48415-w.

[72] J McClenaghan, A Marinoni, A O **Nelson**, T Neiser, L L Lao, G M Staebler, S P Smith, O M Meneghini, B C Lyons, P B Snyder, and M Austin. "Examining transport and integrated modeling predictive capabilities for negative-triangularity scenarios". In: *Plasma Physics and Controlled Fusion* 66.11 (2024), p. 115008. URL: https://doi.org/10.1088/1361-6587/ad7d38.

[73] Craig Michoski, Todd A Oliver, David R Hatch, Ahmed Diallo, Mike Kotschenreuther, David Eldona, Matthew Wallerb, Richard Groebnera, and **A. O. Nelson**. "A Gaussian Process Guide for Signal Regression in Magnetic Fusion". In: *Nuclear Fusion* 64 (2024), p. 035001. URL: https://doi.org/10.1088/1741-4326/ad1af5.

[74] M A Miller, D Arnold, M Wigram, A O **Nelson**, J Witham, G Rutherford, H Choudhury, C Cummings, C Paz-Soldan, and D G Whyte. "Power handling in a highly-radiative negative triangularity pilot plant". In: *Plasma Physics and Controlled Fusion* 66.12 (2024), p. 125004. URL: https://doi.org/10.1088/1361-6587/ad867a.

[75] J F Parisi, A O **Nelson**, R Gaur, S M Kaye, F I Parra, J W Berkery, K Barada, C Clauser, A J Creely, A Diallo, W Guttenfelder, J W Hughes, L A Kogan, A Kleiner, A Q Kuang, M Lampert, T Macwan, J E Menard, and M A Miller. "Kinetic-ballooning-bifurcation in tokamak pedestals across shaping and aspect-ratio". In: *Physics of Plasmas* 31 (2024), p. 030702. URL: https://doi.org/10.1063/5.0190818.

[76] J.F. Parisi, W. Guttenfelder, A.O. **Nelson**, R. Gaur, A. Kleiner, M. Lampert, G. Avdeeva, J.W. Berkery, C. Clauser, M. Curie, A. Diallo, W. Dorland, S.M. Kaye, J. McClenaghan, and F.I. Parra. "Kinetic-ballooning-limited pedestals in spherical tokamak plasmas". In: *Nuclear Fusion* 64.5 (2024), p. 054002. URL: https://doi.org/10.1088/1741-4326/ad39fb.

[77] J.F. Parisi, A.O. **Nelson**, W. Guttenfelder, R. Gaur, J.W. Berkery, S.M. Kaye, K. Barada, C. Clauser, A. Diallo, D.R. Hatch, A. Kleiner, M. Lampert, T. Macwan, and J.E. Menard. "Stability and transport of gyrokinetic critical pedestals". In: *Nuclear Fusion* 64.8 (2024), p. 086034. URL: https://doi.org/10.1088/1741-4326/ad4d02.

[78] C. Paz-Soldan, C. Chrystal, P. Lunia, A.O. **Nelson**, K.E. Thome, M.E. Austin, T.B. Cote, A.W. Hyatt, N. Leuthold, A. Marinoni, T.H. Osborne, M. Pharr, O. Sauter, F. Scotti, T.M. Wilks, and H.S. Wilson. "Simultaneous access to high normalized density, current, pressure, and confinement in strongly-shaped diverted negative triangularity plasmas". In: *Nuclear Fusion* 64.9 (2024), p. 094002. URL: https://doi.org/10.1088/1741-4326/ad69a4.

[79] F. Scotti et al. "High performance power handling in the absence of an H-mode edge in negative triangularity DIII-D plasmas". In: *Nuclear Fusion* 64.9 (2024), p. 094001. URL: https://doi.org/10.1088/1741-4326/ad5f41.

[80] The MANTA Collaboration et al. "MANTA: a negative-triangularity NASEM-compliant fusion pilot plant". In: *Plasma Physics and Controlled Fusion* 66.10 (2024), p. 105006. URL: https://doi.org/10.1088/1361-6587/ad6708.

[81] Kathreen E Thome et al. "Overview of results from the 2023 DIII-D Negative Triangularity campaign". In: *Plasma Physics and Controlled Fusion* 66 (2024), p. 105018. URL: https://doi.org/10.1088/1361-6587/ad6f40.

[82] Haley S Wilson, Andrew Oakleigh **Nelson**, Joseph McClenaghan, Pablo Rodriguez-Fernandez, Jason F Parisi, and Carlos Paz-Soldan. "Characterizing the negative triangularity reactor core operating space with integrated modeling". In: *Plasma Physics and Controlled Fusion* 67 (2024), p. 015026. URL: https://doi.org/10.1088/1361-6587/ad9be5.

[83] J. Yang, A.C.C. Sips, P. De Vries, J. Sinha, H.T. Kim, F. Glass, M. Austin, M. Van Zeeland, J.L. Herfindal, M. Shafer, A.O. **Nelson**, C. Marini, and M.G. Yoo. "Toroidal injection angle dependence of EC assisted plasma initiation at DIII-D". In: *Nuclear Fusion* 64.12 (2024), p. 126065. URL: https://doi.org/10.1088/1741-4326/ad8a6f.

2023

[84] R. Singh, P. Diamond, and **A. O. Nelson**. "Geometric dependencies of the mean E × B shearing rate in negative triangularity tokamaks". In: *Nuclear Fusion* 63 (2023), p. 126053. URL: https://doi.org/10.1088/1741-4326/ad0605.

[85] G. Yu, Z. Li, G. Kramer, F. Scotti, **A. O. Nelson**, A. Diallo, C. Lasnier, M. E. Austin, X. Qin, Y. Chen, Y. Zheng, Y. Zhu, and N. C. Luhmann. "Understanding the negative triangularity ELM trigger and ELM free state on DIII-D with ECE-imaging". In: *Physics of Plasmas* 30 (2023), p. 062505. URL: https://doi.org/10.1063/5.0144711.

2022

[86] T. A. Bechtel, **A. O. Nelson**, L. L. Lao, Z. A. Xing, S. P. Smith, R. Nazikian, S. Flanagan, D. Schissel, L. Stephey, R. Thomas, S. Williams, O. Antepara, E. Dart, E. Koleman, and W. Tang. "Accelerated Workflow for Advanced Kinetic Equilibria". In: *2022 First Combined International Workshop on Interactive Urgent Supercomputing (CIW-IUS)* (2022), pp. 1–5. URL: https://ieeexplore.ieee.org/document/10025485/.

[87] M. Curie, J. L. Larakers, D. Hatch, **A. O. Nelson**, A. Diallo, E. Hassan, W. Guttenfelder, M. Halfmoon, M. Kotschenreuther, R. D. Hazeltine, S. M. Mahajan, R. J. Groebner, J. Chen, C. Perez von Thun, L. Frassinetti, S. Saarelma, C. Giroud, and M. Tennery. "A survey of pedestal magnetic fluctuations using gyrokinetics and a global reduced model for microtearing stability". In: *Physics of Plasmas* 29 (2022), p. 042503. URL: https://doi.org/10.1063/5.0084842.

[88] M. E. Fenstermacher et al. "DIII-D research advancing the physics basis for optimizing the tokamak approach to fusion energy". In: *Nuclear Fusion* 62.4 (2022), p. 042024. URL: https://doi.org/10.1088/1741-4326/ac2ff2.

[89] Samuel Frank, Conor J Perks, Andrew Oakleigh **Nelson**, Tony Qian, Suying Jin, Amelia J Cavallaro, Adam Rutkowski, Allan H Reiman, Jeffrey P Freidberg, Pablo Rodriguez-Fernandez, and Dennis G Whyte. "Radiative pulsed L-mode operation in ARC-class reactors". In: *Nuclear Fusion* 62 (2022), p. 126036. URL: https://doi.org/10.1088/1741-4326/ac95ac.

[90] M R Halfmoon, D R Hatch, M T Kotschenreuther, S. M. Mahajan, **A. O. Nelson**, E. Kolemen, M. Curie, A. Diallo, R. J. Groebner, E. Hassan, E. A. Belli, and J. Candy. "Gyrokinetic analysis of inter-edge localized mode transport mechanisms in a DIII-D pedestal". In: *Physics of Plasmas* 29 (2022), p. 112505. URL: https://doi.org/10.1063/5.0102152.

[91] Ehab Hassan, D. R. Hatch, M. R. Halfmoon, M. Curie, M. T. Kotschenreuther, S. M. Mahajan, G. Merlo, R. J. Groebner, **A. O. Nelson**, and A. Diallo. "Identifying Microtearing Modes in the pedestal of DIII-D H-modes in Gyrokinetic Simulations". In: *Nuclear Fusion* 62 (2022), p. 026008. URL: https://doi.org/10.1088/1741-4326/ac3be5.

[92] A. Jalalvand, A. A. Kappatou, A. V. Garcia, **A. O. Nelson**, J. Abbate, M. Austin, G. Verdoolaege, S. L. Brunton, W. W. Heidbrink, and E. Kolemen. "Alfvén eigenmode classification based on ECE diagnostics at DIII-D using deep recurrent neural networks". In: *Nuclear Fusion* 62 (2022), p. 026007. URL: https://doi.org/10.1088/1741-4326/ac3be7.

[93] S. K. Kim, R. Shousha, S. H. Hahn, **A. O. Nelson**, J. Wai, S. M. Yang, J. K. Park, R. Nazikian, Y. M. Jeon, Y. In, J. H. Lee, J. Kim, Y.-S. Na, and E. Kolemen. "Optimization of 3D controlled ELM-free state with recovered global confinement for tokamak fusion plasmas". In: *Nuclear Fusion* 62 (2022), p. 026043. URL: https://doi.org/10.1088/1741-4326/ac4369.

[94] **A. O. Nelson**, S. Freiberger, H S Wilson, L. Rondini, and C. Paz-Soldan. "Initial Simulations of Negative Triangularity Plasmas on MAST-U". In: *21st International Spherical Torus Workshop*. 2022.

[95] J. A. Schwartz, **A. O. Nelson**, and E. Kolemen. "To dee or not to dee: costs and benefits of altering the triangularity of a steady-state DEMO-like reactor". In: *Nuclear Fusion* 62 (2022), p. 076006. URL: https://doi.org/10.1088/1741-4326/ac62f6.

[96] R. Shousha, S. K. Kim, K. G. Erickson, S. H. Hahn, **A. O. Nelson**, S M Yang, J.-K. Park, J. Wai, Y. M. Jeon, J. H. Lee, J. Jang, D. C. Seo, and E. Kolemen. "Design and experimental demonstration of Feedback Adaptive RMP ELM Controller towards complete long pulse ELM suppression on KSTAR". In: *Physics of Plasmas* 29 (2022), p. 032514. URL: https://doi.org/10.1063/5.0081928.

2021

[97] S. K. Kim, R. Shousha, S. H. Hahn, **A. O. Nelson**, J. Wai, S. M. Yang, J. K. Park, Y. In, J. H. Lee, J. Kim, and E. Kolemen. "Effect of n=1 RMP-driven Turbulence on Ion Pedestal and its role in Adaptive ELM control in KSTAR". In: *Proceedings of 47th EPS Conference on Plasma Physics* P4 (2021), p. 1067. URL: http://ocs.ciemat.es/eps2021pap/pdf/P4.1067.pdf.

[98] Viraj Mehta, Ian Char, Willie Neiswanger, Youngseog Chung, **A. O. Nelson**, Mark D Boyer, Egemen Kolemen, and Jeff Schneider. "Neural Dynamical Systems: Balancing Structure and Flexibility in Physical Prediction". In: *2021 60th IEEE Conference on Decision and Control (CDC)* (2021), pp. 3735–3742. URL: https://doi.org/10.1109/CDC45484.2021.9682807.

[99] E. J. Strait, S. Munaretto, R. M. Sweeney, N. C. Logan, and **A. O. Nelson**. "Electromagnetic torque measurements in DIII-D using internal/external magnetic field decomposition". In: *Review of Scientific Instruments* 92 (2021), p. 043516. URL: https://doi.org/10.1063/5.0040598.

[100] Z.A. Xing, D. Eldon, **A. O. Nelson**, M. A. Roelofs, W. J. Eggert, O. Izacard, A.S. Glasser, N.C. Logan, O. Meneghini, S. P. Smith, R. Nazikian, and E. Kolemen. "CAKE: Consistent Automatic Kinetic Equilibrium reconstruction". In: *Fusion Engineering and Design* 163 (2021), p. 112163. URL: https://doi.org/10.1016/j.fusengdes.2020.112163.

2020

[101] Youngseog Chung, Ian Char, Willie Neiswanger, Kirthevasan Kandasamy, **A. O. Nelson**, Mark D Boyer, Egemen Kolemen, and Jeff Schneider. "Offline Contextual Bayesian Optimization for Nuclear Fusion". In: *Machine Learning and the Physical Sciences Workshop at the 33rd Conference on Neural Information Processing Systems (NeurIPS)* (2020), pp. 1–12. URL: http://arxiv.org/abs/2001.01793.

[102] R. Fitzpatrick and **A. O. Nelson**. "An improved theory of the response of DIII-D H-mode discharges to static resonant magnetic perturbations and its implications for the suppression of edge localized modes". In: *Physics of Plasmas* 27 (2020), p. 072501. URL: https://doi.org/10.1063/5.0011738.

[103] F. M. Laggner, David Eldon, **A. O. Nelson**, Carlos Paz-Soldan, Alessandro Bortolon, Todd E Evans, Max E Fenstermacher, Brian A Grierson, Qiming Hu, Dave A Humphreys, A W Hyatt, Raffi Nazikian, O Meneghini, Philip B Snyder, Ezekial A Unterberg, and Egemen Kolemen. "Real-time pedestal optimization and ELM control with 3D fields and gas flows on DIII-D". In: *Nuclear Fusion* 60 (2020), p. 076004. URL: https://doi.org/10.1088/1741-4326/ab88e1.

[104] J. T. Wai, P. J. Vail, **A. O. Nelson**, Z. A. Xing, C. Lasnier, and E. Kolemen. "Infrared Constrained Equilibria and Application to Snowflake Divertor Studies". In: *Nuclear Materials and Energy* 25 (2020), p. 100835. URL: https://doi.org/10.1016/j.nme.2020.100835.

2010 - 2019

[105] L. Buzi, **A. O. Nelson**, Y. Yang, R. Kaita, P. S. Krstić, and B. E. Koel. "Sputtering of lithium and lithium compound films under deuterium and helium ion bombardment". In: *Nuclear Materials and Energy* 19 (2019), pp. 411–415. URL: https://doi.org/10.1016/j.nme.2019.02.037.

[106] Ian Char, Youngseog Chung, Willie Neiswanger, Kirthevasan Kandasamy, **A. O. Nelson**, Mark D Boyer, and Egemen Kolemen. "Offline Contextual Bayesian Optimization". In: *Advances in Neural Information Processing Systems 32* (2019), pp. 4629–4640. URL: https://proceedings.neurips.cc/paper/2019/file/7876acb66640bad41f1e1371ef30c180-Paper.pdf.

[107] Y. Yang, L. Buzi, **A. O. Nelson**, R. Kaita, and B. E. Koel. "Post exposure time dependence of deuterium retention in lithium and lithium compounds". In: *Nuclear Materials and Energy* 19 (2019), pp. 161–165. URL: https://doi.org/10.1016/j.nme.2019.01.031.

[108] L. Buzi, Y. Yang, F. J. Domínguez-Gutiérrez, **A. O. Nelson**, M. Hofman, P. S. Krstić, R. Kaita, and B. E. Koel. "Hydrogen retention in lithium and lithium oxide films". In: *Journal of Nuclear Materials* 502 (2018), pp. 161–168. URL: https://doi.org/10.1016/j.jnucmat.2018.02.010.

[109] E. N. Grossman, O. D. Friedman, and **A. O. Nelson**. "Non-Imaging Winston Cone Concentrators for Submillimeter-Wave, Overmoded Waveguide". In: *IEEE Transactions on Terahertz Science and Technology* 4.1 (2014), pp. 65–74. URL: https://doi.org/10.1109/TTHZ.2013.2283371.

Conference Contributions

A full list of contributions to conferences can be found on my website: oaknelson.com.