

Elizabeth J. Paul

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Education

Ph.D. 2020, University of Maryland College Park, Physics

- Thesis: “Adjoint methods for stellarator shape optimization and sensitivity analysis”
- Advisor: William Dorland

A.B. 2015, Princeton University, Astrophysical Sciences, Magna Cum Laude

- Certificates in Applied and Computational Mathematics, Applications of Computing
- Thesis: “Passive tracers in ATHENA: implementation and applications for turbulent star formation”

Experience

Assistant Professor, Applied Physics, Columbia University, January 2023-present

Presidential Postdoctoral Research Fellow, Princeton University, July 2020-December 2022

Awards

- DOE Early Career Award (2023)
- American Physical Society Marshall N. Rosenbluth Outstanding Doctoral Thesis Award (2021)
- DOE Office of Workforce Development Student Mentorship Award (2021)
- UMD Physics Monroe H. Martin Graduate Research Fellowship (2020)
- ARCS Foundation Fellowship (2019)
- UMD Graduate School Outstanding Research Assistant Award (2018)
- Graduate Student Poster Prize, Sherwood Fusion Theory Conference (2017)
- UMD Physics Dean’s Fellowship (2015)

Publications [h-index: 14, Citations: 738 (April 2, 2026)]

Undergraduate students under my primary supervision

Graduate students under my primary supervision

Postdocs under my primary supervision

40. **A. Veksler**, A. Bader, H. Frerichs, **E. J. Paul** “Stellarator island divertor shape optimization for reduced peak heat fluxes,” *submitted to Nuclear Fusion* (2026)

<https://arxiv.org/pdf/2602.24049>.

39. **A. R. Knyazev**, **A. Lachmann**, A. G. Goodman, **A. S. Hyder**, M. Czekanski, D. Spong, **E. J. Paul**, "On shear Alfvén wave-induced energetic ion transport in optimized stellarators," *submitted to Journal of Plasma Physics* (2026) <https://arxiv.org/pdf/2603.03118>.
38. W. Hayashi, W. Heidbrink, G. Prechel, M. Osakabe, Y. Kawamoto, K. Ogawa, M. Isobe, H. Yamaguchi, H. Nuga, R. Seki, S. Kamio, Y. Fujiwara, **E. J. Paul**, **A. Chambliss**, "Active measurements of fast-ion confinement in quiescent plasmas in the Large Helical Device," *submitted to Nuclear Fusion* (2026).
37. R. Madan, W. Sengupta, **E. J. Paul**, **M. Haque**, R. Nies, A. Bhattacharjee, "The Geometry of Flux Surfaces with Quasi-Poloidal Symmetry," *submitted to Journal of Plasma Physics* (2026) <https://arxiv.org/abs/2601.13980>.
36. J. von der Linden, **J. A. Labbate**, **E. J. Paul**, E. Flom, D. W. Dudt, R. H. Wu, T. G. Kruger, C.P. S. Swanson, S. T. A. Kuar, D. A. Gates, "Alpha Confinement in the Quasi-Axisymmetric Helios Fusion Power Plant," *submitted to Journal of Fusion Engineering and Design* (2025).
35. C. P. S. Swanson, S. T. A. Kumar, D. W. Dudt, E. R. Flom, W. B. Kalb, T. G. Kruger, M. F. Martin, J. R. Olatunji, S. Pasmann, L. Z. Tang, J. von der Linden, J. Wasserman, M. Avida, A. S. Basurto, M. Dickerson, N. de Boer, M. J. Donovan, A. H. Doudna Cate, D. Fort, W. Harris, U. Khera, A. Koen, **J. A. Labbate**, N. Maitra, A. Ottaviano, R. K. Parmar, **E. J. Paul**, B. Reydel, A. van Riel, P. K. Romano, M. Savastianov, S. Saxena, S. Seethalla, S. Srinivasan, R. H. Wu, D. Nash, J. Priebe, M. Slepchenkov, S. Walsh, B. Berzin, D. A. Gates, and the Thea Energy team, "Overview of the Helios Design: A Practical Planar Coil Stellarator Fusion Power Plant," *submitted to Journal of Fusion Engineering and Design* (2025) <https://arxiv.org/pdf/2512.08027>.
34. T. E. Foster, F. I. Parra, R. B. White, J. L. Velasco, I. Calvo, **E. J. Paul**, "Energetic-particle orbits near rational flux surfaces in stellarators: I. Passing particles," *submitted to Journal of Plasma Physics* (2025) <https://arxiv.org/pdf/2512.03165>.
33. L. Fu, D. Panici, **E. J. Paul**, A. Kaptanoglu, A. Bhattacharjee, "A flexible and differentiable coil proxy for stellarator equilibrium optimization," *submitted to Physics of Plasmas* (2025) <https://arxiv.org/pdf/2510.16243>.
32. W. Sengupta, R. Madan, S. Buller, N. Nikulsin, **E. J. Paul**, R. Nies, A. A. Kaptanoglu, S. R. Hudson, and A. Bhattacharjee, "Periodic Korteweg–de Vries soliton potentials generate quasisymmetric magnetic field strength in a finite plasma equilibrium," *Physics of Plasmas* 32, 102509 (2025).
31. J. Halpern, N. C. Logan, **E. J. Paul**, and C. Paz-Soldan, "Determining the validity of tokamak perturbed equilibrium modeling using nonlinear equilibria," *Nuclear Fusion* 65, 106028 (2025).
30. **E. J. Paul**, **A. Hyder**, E. Rodríguez, R. Jorge, **A. Knyazev**, "The shear Alfvén continuum of quasisymmetric stellarators," *Journal of Plasma Physics* 91, E101 (2025).

29. **A. Baillod**, **E. J. Paul**, T. Elder, **J. Halpern**, “Enhancing Stellarator Accessibility through Port Size Optimization,” *Nuclear Fusion* 65, 086040 (2025).
28. **A. Chambliss**, **E. J. Paul**, S. R. Hudson, “Fast particle trajectories and integrability in quasiaxisymmetric and quasihelical stellarators,” *Journal of Plasma Physics* 91, E74 (2025).
27. P. Huslage, **E. J. Paul**, **M. Haque**, P. Gil, N. Foppiani, J. Smoniewski, E. Stenson, “Strain Optimization for ReBCO High-Temperature Superconducting Stellarator Coils in SIMSOPT,” *Journal of Plasma Physics* 91, E71 (2025).
26. A. Kaptanoglu, A. Wiedman, **J. Halpern**, S. Hurwitz, **E. J. Paul**, M. Landreman, “Reactor-scale stellarators with force and torque minimized dipole coils,” *Nuclear Fusion* 65, 046029 (2025).
25. S. Guinchard, S. Hudson, **E. J. Paul**, “Including the vacuum energy in stellarator coil design,” *Plasma Physics and Controlled Fusion* 67, 035028 (2025).
24. M. Yoshida, R. McDermott, C. Angioni, Y. Camenen, J. Citrin, M. Jakubowski, J. Hughes, Y. Idomura, P. Mantica, A. Mariani, S. Mordijck, **E. J. Paul**, T. Tala, G. Verdoolaege, A. Zocco, F. Casson, G. Dif-Pradalier, B. Duval, B. Grierson, S. Kaye, P. Manas, M. Maslov, T. Odstrcil, J. Rice, L. Schmitz, F. Sciortino, E. Solano, G. Staebler, M. Valovic, E. Wolfrum, J. Snipes, “Transport and confinement physics: Chapter 2 of the special issue: on the path to tokamak burning plasma operation,” *Nuclear Fusion* 65, 033001 (2025).
23. L. Fu, **E. J. Paul**, A. Kaptanoglu, A. Bhattacharjee, “Global stellarator coil optimization with quadratic constraints and objectives,” *Nuclear Fusion* 65, 026045 (2025).
22. **A. Baillod**, **E. J. Paul**, **G. Rawlinson**, **M. Haque**, **S. W. Freiburger**, **S. Thapa**, “Integrating novel stellarator single-stage optimization algorithms to design the Columbia Stellarator Experiment,” *Nuclear Fusion* 65, 026046 (2025).
21. **R. Nies**, **E. J. Paul**, D. Panici, S.R. Hudson, A. Bhattacharjee, “Exploration of the parameter space of quasisymmetric stellarator vacuum fields through adjoint optimization,” *Journal of Plasma Physics* 90, 905900620 (2024).
20. **E. J. Paul**, H. Mynick, A. Bhattacharjee, “Fast ion transport in quasisymmetric equilibria in the presence of a resonant Alfvénic perturbation,” *Journal of Plasma Physics* 89, 905890515 (2023).
19. W. Sengupta, N. Nikulsin, **E. J. Paul**, S. Buller, R. Nies, S. R. Hudson, A. Bhattacharjee, “Periodic Korteweg-de Vries soliton potentials generate magnetic field strength with exact quasisymmetry,” *submitted to Physical Review Letters* (2023).

18. **B. Lee**, **E. J. Paul**, G. Stadler, and M. Landreman, "Stellarator coil optimization supporting multiple magnetic configurations," *Nuclear Fusion Letters* 63, 014002 (2022).
17. **E. J. Paul**, A. Bhattacharjee, M. Landreman, D. Alex, J. L. Velasco, and R. Nies, "Energetic particle loss mechanisms in reactor-scale equilibria close to quasisymmetry," *Nuclear Fusion* 62, 126054 (2022).
16. P. Helander, S. R. Hudson, and **E. J. Paul**, "Heat conduction in an irregular magnetic field: Part I. Heat conduction in irregular magnetic fields," *Journal of Plasma Physics* 88, 905880122 (2022).
15. E. Rodriguez, **E. J. Paul**, and A. Bhattacharjee, "Measures of quasisymmetry for stellarators," *Journal of Plasma Physics* 88, 905880109 (2022).
14. **E. J. Paul**, S. R. Hudson, and P. Helander, "Heat conduction in an irregular magnetic field: Part II. Heat transport as a measure of the effective non-integrable volume," *Journal of Plasma Physics* 88, 905880107 (2022).
13. **R. Nies**, **E. J. Paul**, S. R. Hudson, and A. Bhattacharjee, "Adjoint methods for quasisymmetry of vacuum fields on a surface," *Journal of Plasma Physics* 88, 905880106 (2022).
12. M. Landreman and **E. J. Paul**, "Magnetic fields with precise quasisymmetry," *Physical Review Letters* 128, 035001 (2022). (Editor's Choice)
11. C. Hegna, D. Anderson, ..., **E. J. Paul**, and others, "Improving the stellarator through advances in plasma theory," *Nuclear Fusion* 62, 042012 (2022).
10. A. Geraldini, M. Landreman, and **E. J. Paul**, "An adjoint method for determining the sensitivity of island size to magnetic field variations," *Journal of Plasma Physics* 87, 905870302 (2021).
9. **A. Carlton Jones**, **E. J. Paul**, and W. Dorland, "Computing the shape gradient of stellarator coil complexity with respect to the plasma boundary," *Journal of Plasma Physics* 87, 905870222 (2021).
8. **E. J. Paul**, M. Landreman, and T. M. Antonsen, "Gradient-based optimization of 3D MHD equilibria," *Journal of Plasma Physics* 87, 905870214 (2021).
7. W. Sengupta, **E. J. Paul**, H. Weitzner, and A. Bhattacharjee, "Vacuum magnetic fields with exact quasisymmetry near a flux surface. Part 1: Solutions near an axisymmetric surface," *Journal of Plasma Physics* 87, 905870205 (2021).

6. **E. J. Paul**, T. Antonsen, Jr., M. Landreman, and W. A. Cooper, “Adjoint approach to calculating shape gradients for 3D magnetic confinement equilibria. Part 2. Applications,” *Journal of Plasma Physics* 86, 905860103 (2020).
5. **E. J. Paul**, I. G. Abel, M. Landreman, and W. Dorland, “An adjoint method for neoclassical stellarator optimization,” *Journal of Plasma Physics* 85, 795850501 (2019).
4. T. Antonsen, Jr., **E. J. Paul**, and M. Landreman, “Adjoint approach to calculating shape gradients for 3D magnetic confinement equilibria,” *Journal of Plasma Physics* 85, 905850207 (2019). (Editor’s Choice)
3. M. Landreman and **E. J. Paul**, “Computing local sensitivity and tolerances for stellarator physics properties using shape gradients,” *Nuclear Fusion* 58, 076023 (2018).
2. **E. J. Paul**, M. Landreman, A. Bader, and W. Dorland, “An adjoint method for gradient-based optimization of stellarator coil shapes,” *Nuclear Fusion* 58, 076015 (2018).
1. **E. J. Paul**, M. Landreman, F. M. Poli, D. A. Spong, H. M. Smith, and W. Dorland, “Rotation and neoclassical ripple transport in ITER,” *Nuclear Fusion* 57, 116044 (2017).

Monographs

L.-M. Imbert-Gerard, E. J. Paul, and A. M. Wright, “An Introduction to Stellarators: From Magnetic Fields to Symmetries and Optimization,” *SIAM* (2024).

Invited Seminars (recent)

2. IFS Seminar – Austin, TX, January 2026
3. Courant Computational Mathematics and Scientific Computing Seminar – New York, NY, April 2024
1. MIT PFSC Seminar – Cambridge, MA, May 2024

Invited Colloquia

9. University of Texas, Austin Physics Colloquium – Austin, TX, January 2026
8. Dartmouth College Physics Colloquium – Dartmouth, NH, May 2025
7. University of Greifswald Physics Colloquium – Greifswald, Germany, June 2024
6. Center for Computational Mathematics Colloquium – New York, NY, April 2024
5. University of Wisconsin Plasma Physics Colloquium – Madison, WI, March 2024
4. Cornell Center for Applied Mathematics Colloquium – Ithaca, NY, November 2022
3. University of Iowa Physics Colloquium – Remote, October 2021
2. Columbia University Plasma Physics Colloquium – Remote, September 2021
1. JPP Frontiers of Plasma Physics Colloquium – Remote, August 2020

Invited Conference Presentations

14. European Fusion Theory Conference – Aix-en-Provence, France, September 2025 (declined)
13. 16th Plasma Kinetics Working Meeting – Vienna, Austria, July 2025
12. Technical Meeting on Energetic Particles – Seville, Spain, March 2025
11. Simons Foundation Mathematical and Physical Sciences Annual Meeting – New York, New York, October 2024
10. International Stellarator and Heliotron Workshop – Hiroshima, Japan, September 2024
9. IMSI Workshop on Computational Challenges and Optimization in Kinetic Plasma Physics – Chicago, Illinois, February 2024
8. Varenna Workshop on the Theory of Fusion Plasmas – Varenna, Italy, September 2022
7. Simons Hidden Symmetries Collaboration Annual Meeting – New York, NY, March 2022
6. International Toki Conference – Remote, November 2021
5. APS Division of Plasma Physics Meeting – Pittsburgh, PA, November 2021
4. Max Planck Princeton Center Workshop – Göttingen, Germany, January 2020
3. APS Division of Plasma Physics Meeting – Fort Lauderdale, FL, October 2019
2. International Stellarator and Heliotron Workshop – Madison, WI, September 2019
1. Sherwood Fusion Theory Conference – Princeton, NJ, April 2019

Institutional Service

- Class of 2026 Applied Physics Undergraduate Advisor
- Co-organizer of APAM Research Conference (Fall 2023, Fall 2024, Spring 2026)
- Committee member for Women and Diversity in Applied Physics and Applied Mathematics (Spring 2023-2024)
- Thesis proposal committee member for Todd Elder (Spring 2023), Yumou Wei (Spring 2023), and Hari Choudhury (Spring 2026)
- Plasma Faculty hiring committee, Spring 2025

External Service

- Technical Meeting on Energetic Particles Program Committee Member (Spring 2026-Present)
- Stellarator Technology and Advanced Research Strategies (STARS) Committee member (Spring 2025–Fall 2025)
- IAEA Fusion Energy Conference Program Committee (Spring 2025)
- DOE Fusion Energy Sciences Advisory Committee: Decadal Plan Subcommittee member (Spring 2024-Summer 2025)
- Organizing committee for IPAM Long Program on Multi-Fidelity Methods for Fusion Energy (planned for Spring 2026)
- Editorial Board member for *Plasma Physics and Controlled Fusion* (Summer 2023-present)

- Sherwood Fusion Theory Conference Executive Committee member (Fall 2022-Fall 2025) and Program Committee member (Spring 2022)
- Theory Coordinating Committee – charter subcommittee member (Fall 2022-Spring 2023)
- Thesis committee member for Evan Toler (Spring 2023, NYU), Frederick Law (Summer 2023, NYU), Ralf Mackenbach (Fall 2023, TU Eindhoven), Dean Muir (Fall 2024, ANU), Frank Fu (Summer 2025, Princeton), Joona Kontula (Fall 2025, Aalto)
- Session chair at Sherwood Fusion Theory Conference (Spring 2022 and 2023), International Stellarator and Heliotron Workshop (Summer 2022)
- Advisory Board member for *Journal of Plasma Physics* (Fall 2019-Summer 2023)
- Reviewer for Plasma Physics and Controlled Fusion, Journal of Plasma Physics, Nuclear Fusion, Physics of Plasmas, Nature Scientific Reports, PRX Energy, and Engineering Optimization
- Reviewer for US Dept. of Energy Fusion Energy Sciences and NSF Plasma Physics Program grant proposals
- Member of NSF review panel (Spring 2026) and DOE FES review panel (Spring 2026)

Public lectures

- Joint ICTP-IAEA College on Plasma Physics, Fall 2022
- Guatemalan Student Congress of Physics and Mathematics, Summer 2022
- PPPL Graduate Summer School, Summer 2021 and 2024
- PPPL Introduction to Fusion Energy and Plasma Physics Course, Summer 2021 and 2023
- Simons-PPPL Summer School, Summer 2019 and 2020

Panel discussions

- Princeton University Wintersession panelist, “Advances Toward Commercial Nuclear Fusion”, Spring 2025
- Simons Collaboration on Hidden Symmetries and Fusion Energy – panelist on connections between mathematics and physics, Spring 2023
- APS DPP Women in Plasma Physics – panelist on postdoc positions, Spring 2021

Research mentorship

- *Postdocs*: Wataru Hayashi (Spring 2026-present), Alexey Knyazev (Fall 2023-present), Antoine Baillod (Summer 2023-Fall 2025)
- *Ph.D. students*: Amelia Chambliss (Spring 2023-present, DOE CSGF recipient), Abdullah Hyder (Spring 2023-present, SCGSR recipient), Rohan Lopez (Fall 2023-present, NSF GRFP recipient), Alexa Lachmann (Fall 2023-present), Avigdor Veksler (Fall 2024-present), John Labbate (Fall 2024-Fall 2025), Shreyas Seethalla (Fall 2024-present), Brandon Lee (Fall 2024-present, DOE CSGF recipient), Sam Freiburger (Fall 2023-Spring 2024)

2024), Frank Fu (co-advisor w/ A. Bhattacharjee, Fall 2023-Summer 2025), Richard Nies (co-advisor w/ A. Bhattacharjee, Fall 2020-Spring 2022)

- *Masters students:* Xueyi Bu (Summer 2023-Fall 2024, now Amazon), Mohammed Haque (Summer 2023-Fall 2025, now IPP Greifswald).
- *Undergraduate students:* Swan Yi Htet (Fall 2025-present), Kamil Syed (Fall 2025-present), Sanjar Zaman (Fall 2024-present), Michael Campagna (Summer 2025), Bill Fei (Fall 2024-Summer 2025), Henri Yoon (Summer 2024-present), Maria Garmonina (Summer 2024, Spring 2026), Analisa Wood (Summer 2024), Ekene Ezeunala (Summer 2024), Grace Rawlinson (Summer 2023-Spring 2024, now U. Chicago), Siwanta Thapa (Summer 2023-Fall 2023, now CU MS), Somin Lee (Summer 2023), Alexander Ireland (Summer 2022-Spring 2023), Daniel Alex (Fall 2021-Spring 2022), Brandon Lee (Spring 2021-Summer 2022, then Fulbright Fellow and Princeton Ph.D. student), Arthur Carlton-Jones (Summer 2019-Spring 2021, now UMD Ph.D. student), Ben Cha (Fall 2018, now U. Waterloo)