Gregory J. Parker

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American | Citizenship

Employment

Stanford University 2023 –
Szegö Assistant Professor of Mathematics

Stanford University 2023 –
NSF Postdoctoral Research Fellow

Simons-Laufer Mathematical Sciences Institute (MSRI) 2022 –2023
Postdoctoral Fellow

Education

Massachusetts Institute of Technology 2017 – 2022
Ph.D. in Mathematics
Advisors: Prof. C.H. Taubes and Prof. T. Mrowka.
Thesis: Gluing $\mathbb{Z}_2$-Harmonic Spinors

Harvard University 2013 – 2017
Bachelor of Science, *Summa cum Laude*.
Sc.B. - Mathematics with honors, Sc.B. - Physics
Honors Thesis: *Lefschetz Fibrations on 4-Manifolds*

Reserach Interests

My research focuses on singular and non-linear elliptic PDEs and their applications in geometric analysis, including gauge theory and minimal surfaces. I also work on various topics in applied PDE and computational physics.

Honors and Awards

- NSF Mathematical Sciences Postdoctoral Research Fellowship, (2023–2027)
- NSF Graduate Research Fellowship (2017–2022).
- Norman Levinson Fellowship (MIT, 2018-19).
- Captain Jonathan Fay Prize for Top Senior Thesis, Harvard University (2017).
- Hoopes Prize for Outstanding Senior Thesis, Harvard University (2017).
- Hertz Foundation Fellowship Finalist (2017).
- John Harvard Scholar (2016).
- Certificate of Distinction in Teaching (2015).

Preprints & Publications (Mathematics)

Gauge-Theoretic Boundary Strata for the $SL(2,\mathbb{C})$ Character Variety of a 3-manifold
Gregory J. Parker, expected Jan 2025.
In preparation.

Minimal Surfaces with Families of Conical Singularities
Rafe Mazzeo and Gregory J. Parker, expected Nov 2024.
In preparation.

7. **$\mathbb{Z}_2$-Harmonic Spinors and 1-forms on Connect Sums and Torus Sums of 3-manifolds**
Siqi He and Gregory J. Parker, July 2024.
arXiv:2407.10922 | In review.

6. **Gluing $\mathbb{Z}_2$-Harmonic Spinors and Seiberg–Witten Monopoles on 3-manifolds**
Gregory J. Parker, February 2024.
arXiv:2402.03682 | In review.

5. **Concentrating Dirac Operators and Generalized Seiberg–Witten Equations**
Gregory J. Parker, July 2023.
arXiv:2307.00694 | In review.

4. **Deformations of $\mathbb{Z}_2$-Harmonic Spinors on 3-Manifolds**
Gregory J. Parker, Jan. 2023.
arXiv:2301.06245 | In review.

3. **Concentrating Local Solutions of the Two-Spinor Seiberg–Witten Equations on 3-Manifolds**
Gregory J. Parker, October 2022.
arXiv:2210.08148 | In review.

Preprints & Publications (Applied Mathematics, Physics)

Fully Implicit Coupling with Differentiable Monte-Carlo Methods
Gregory J. Parker, Maxim V. Umansky, Benjamin D. Dudson, Nov. 2024.
In preparation.

2. **Coupling Fluid Plasma and Kinetic Neutral Models using Correlated Monte-Carlo Methods**
Gregory J. Parker, Maxim V. Umansky, Benjamin D. Dudson, July 2024.
arXiv:2407.10936 | In review.

1. **LIBS and ablation threshold analysis using a megahertz Yb fiber laser oscillator.**
Gregory J. Parker, Daniel E. Parker, Bai Nie, Vadim Lozovoy, Marcos Dantus.
Spectrochimica Acta Part B: Atomic Spectroscopy., May 2015.
arXiv:n/a | DOI: 10.1016/j.sab.2015.02.011

Seminars, Posters, & Conferences (Mathematics)

- *$\mathbb{Z}_2$-Harmonic Spinors and 1-forms II: Gluing* (joint with Siqi He), Qingtian Geometry and Topolgoy Conference, Qingtian, China, 5 June 2024.
- *$\mathbb{Z}_2$-Harmonic 1-forms and Flat $SL(2, C)$ Connections on 3-Manifolds*, Rutgers Geometric Analysis Conference, Rutgers University (virtual), 15 May 2024.
- *A Fredholm Framework for Singular Deformation Problems*, Simons Collaboration on Special Holonomy, Duke University, 14 May 2024.
- *$\mathbb{Z}_2$-harmonic spinors as limiting objects in geometry and topology*, Representation Theory and Mathematical Physics Seminar, Louisiana State University, 22 April 2024.
- *Gluing, Excision, and the Alternating Method*, Rutgers Geometric Analysis and Gauge Theory Learning Seminar, Jan 2024.
- *Compactness and Wall-Crossing Formulas in Gauge Theory*, Stanford Topology Seminar. Sep. 2023.
- *Deformations of $\mathbb{Z}_2$-Harmonic Spinors*, Summer School in Geometric Analysis at ULB. Aug. 2023.
- *Deformations of $\mathbb{Z}_2$-Harmonic Spinors*, Stanford University Geometry Seminar. Jan. 2023.
- *Concentrating Local Solutions of the Two-Spinor Seiberg–Witten Equations*, New Four-Dimensional Gauge Theories Conference, MSRI. Oct. 2022.
- *Gluing $\mathbb{Z}_2$-Harmonic Spinors.* Weekly Colloquium Talk, Simons Center for Geometry and Physics, Simons Collaboration on Special Holonomy. Sep. 2022.
- *Variations of the $\mathbb{Z}_2$-Dirac Operator.* Geometric Analysis Seminar, Rutgers University. May 2022.
- *Gluing $\mathbb{Z}_2$-harmonic spinors.* Low-Dimensional Topology, Gauge Theory, and Symplectic Topology Seminar, Simons Center for Geometry and Physics. April 2022.
- *Gluing $\mathbb{Z}_2$-harmonic spinors.* AMS Special Session on Gauge Theory, Geometric Analysis, and Low-Dimensional Topology. Tufts University. March 2022.
- *Existence of $\mathbb{Z}_2$-harmonic spinors* (expository talk on work of A. Doan and T. Walpuski). Harvard graduate student gauge theory seminar. Nov 2019.
- *Chern-Weil Theory and Equivariant Cohomology.* MIT Juvitop Seminar on Differential Cohomology, Sep. 2019.
- *Seiberg-Witten Monopoles, Fueter Sections, and G_2-instantons.* British Isles Graduate Workshop III: gauge theory with a view towards higher-dimensions. June 2019.
- *Generalized Seiberg-Witten Equations.* British Isles Graduate Workshop III: gauge theory with a view towards higher-dimensions. June 2019.
- *The Maslov Index.* Kylerec Workshop for Graduate Students in Symplectic Topology. May 2018.

Seminars, Posters, & Conferences (Applied Mathematics, Physics)

- *Differentiable Monte-Carlo and Implicit Coupling Methods*, Princeton Plasma Physics Lab, Computation Seminar, 1 August 2024.
- *Differentiable Monte-Carlo and Implicit Coupling* (Poster), 26^{th} Plasma Surface Interaction Conference, Marseilles, France, 4 June, 2024.
- *Coupling Fluid-Plasma and Kinetic-Neutral Models using Differentaible Monte-Carlo Methods*, UEDGE and Magnetic Fusion Theory Seminar, Lawrence Livermore National Lab, 29 Nov. 2023.
- *Coupling Fluid-Plasma and Kinetic-Neutral Models using Correlated Monte-Carlo Methods* (Poster), APS Fall Meeting Division of Plasma Physics. Denver, CO. 1. Nov. 2023.

Teaching

Math 171: Measure Theory and Fourier Analysis Stanford Fall 2024
Measure theory and Fourier analysis course for advanced math majors and graduate students.

Math 116: Complex Analsis Stanford Fall 2024
Undergraduate Complex Analysis course for mathematics majors.

Math 20: Calculus II Stanford Spring 2023
Course head. Second quarter of Stanford's main undergraduate calculus sequence.

Outreach

Seminar XL Facilitator, MIT Office of Minority Education. Instructor for Math 18.02 (Multivariable calculus), and Math 18.03 (Differential Equations).

Petey Greene Program / MIT Prison Initiative 2019–2022
Teaching assistant and instructor, Massachusetts Correctional Institutions at Concord and Souza Baranowski. Instructor for courses for incarcerated students through Emerson Prison Initiative, Concord Prison Outreach, and other organizations. Designed and taught courses on business mathematics, creative writing, and other topics.