Daniel Eric Parker

1-517-648-6952 | Phone
daniel_parker@berkeley.edu | Email
danielericparker.github.io | Website
American | Citizenship

Employment

University of California at San Diego 2024 –
Assistant Professor of Physics

Postdoctoral Positions

University of California at Berkeley Fall 2023
Simons Ultra-Quantum Matter Postdoctoral Fellowship
Postdoctoral Mentor: Prof. Michael Zaletel

Harvard University 2020 – 2023
Gordon and Betty Moore Foundation Postdoctoral Fellowship.
Postdoctoral Mentor: Prof. Ashvin Vishwanath

Education

University of California at Berkeley 2015 – 2020
Ph.D. in Physics
Advisor: Prof. Joel Moore.
Thesis: Local Operators and Quantum Chaos

Brown University 2011 – 2015
Bachelor of Science, *Magna cum Laude.*
Sc.B. - Mathematics, Sc.B. - Physics with Honors. GPA: 3.94.
Senior Thesis: *Cluster Algebra Structures for Scattering Amplitudes in $\mathcal{N} = 4$ Super Yang-Mills.*

Honors and Awards

- Gordon and Betty Moore Foundation Postdoctoral Fellowship at Harvard University. 2020 – 2023
- Pappalardo Postdoctoral Fellowship at Massachusetts Institute of Technology (declined).
- Gordon and Betty Moore Foundation Postdoctoral Fellowship at the Kavli Institute for Theoretical Physics (UCSB) (declined).
- Stanford Institute for Theoretical Physics Postdoctoral Fellowship (declined).
- Graduate Research Fellowship Program, National Science Foundation. 2017 – 2020
- Outstanding Graduate Student Instructor Award, UC Berkeley. 2017
- R. Bruce Lindsay Prize for Excellence in Physics, Brown University Physics Department. 2015

Preprints & Publications

26. **Anomalous Hall Crystals in Rhombohedral Multilayer Graphene II: General Mechanism and a Minimal Model**
Tomohiro Soejima*, Junkai Dong*, Taige Wang, Tianle Wang, Michael P. Zaletel, Ashvin Vishwanath, and Daniel E. Parker, March 2024.
arXiv:2403.05522 | In review.

25. **Higher vortexability: zero field realization of higher Landau levels**
Manato Fujimoto, Daniel E. Parker, Junkai Dong, Eslam Khalaf, Ashvin Vishwanath, Patrick Ledwith, March 2024.
arXiv:2403.00856 | In review.

24. **Anomalous Hall Crystals in Rhombohedral Multilayer Graphene I: Interaction-Driven Chern Bands and Fractional Quantum Hall States at Zero Magnetic Field**
Junkai Dong, Taige Wang, Tianle Wang, Tomohiro Soejima, Michael P. Zaletel, Ashvin Vishwanath, and Daniel E. Parker , November 2023.
arXiv:2311.05568 | In review.

23. **Superconductivity in a Topological Lattice Model with Strong Repulsion**
Rahul Sahay, Stefan Divic, Daniel E. Parker, Tomohiro Soejima, Sajant Anand, Johannes Hauschild, Monika Aidelsburger, Ashvin Vishwanath, Shubhayu Chatterjee, Norman Y. Yao, and Michael P. Zaletel, August 2023.
arXiv:2306.01719 | In review.

22. **Composite Fermi Liquid at Zero Magnetic Field in Twisted MoTe2**
Junkai Dong, Jie Wang, Patrick J. Ledwith, Ashvin Vishwanath, and Daniel E. Parker.
Physical Review Letters **(Editor's Suggestion)**, September 2023.
arXiv:2306.01719 | DOI: https://doi.org/10.1103/PhysRevLett.131.136502

21. **Kekulé spiral order in magic-angle graphene: a density matrix renormalization group study**
Tianle Wang, Daniel E. Parker, Tomohiro Soejima, Johannes Hauschild, Sajant Anand, Nick Bultinck, and Michael P. Zaletel.
Physical Review B, December 2023.
arXiv:2211.02693 | DOI: https://doi.org/10.1103/PhysRevB.108.235128

20. **Untwisting moiré physics: Almost ideal bands and fractional Chern insulators in periodically strained monolayer graphene**
Qiang Gao, Junkai Dong, Patrick Ledwith, Daniel E. Parker, and Eslam Khalaf.
Physical Review Letters **(Cover)**, August 2023.
arXiv:2211.00658 | DOI: https://doi.org/10.1103/PhysRevLett.131.096401

19. **Vortexability: A Unifying Criterion for Ideal Fractional Chern Insulators**
Patrick J. Ledwith, Ashvin Vishwanath, Daniel E. Parker.
Physical Review B **(Editor's Suggestion)**, November 2023.
arXiv:2209.15023 | DOI: https://doi.org/10.1103/PhysRevB.108.205144

18. **Optically-induced Umklapp shift currents in striped cuprates**
Pavel E. Dolgirev, Marios H. Michael, Jonathan B. Curtis, Daniel E. Parker, Daniele Nicoletti, Michele Buzzi, Michael Fechner, Andrea Cavalleri, Eugene Demler.
Physical Review B, January 2024.
arXiv:2203.04687 | DOI: https://doi.org/10.1103/PhysRevB.109.045150

17. **Field-tuned and zero-field fractional Chern insulators in magic angle graphene**
Daniel Parker, Patrick Ledwith, Eslam Khalaf, Tomohiro Soejima, Johannes Hauschild, Yonglong Xie, Andrew Pierce, Michael P. Zaletel, Amir Yacoby, Ashvin Vishwanath, December 2021.
arXiv:2112.13837 | In review.

16. **Fractional Chern insulators in magic-angle twisted bilayer graphene**
Yonglong Xie, Andrew T. Pierce, Jeong Min Park, Daniel E. Parker, Eslam Khalaf, Patrick Ledwith, Yuan Cao, Seung Hwan Lee, Shaowen Chen, Patrick R. Forrester, Kenji Watanabe, Takashi Taniguchi, Ashvin Vishwanath, Pablo Jarillo-Herrero, Amir Yacoby.
Nature, December 2021.
arXiv:2107.10854 | DOI: https://doi.org/10.1038/s41586-021-04002-3

15. **Unusual magnetotransport in twisted bilayer graphene**
Joe Finney, Aaron L. Sharpe, Eli J. Fox, Connie L. Hsueh, Daniel E. Parker, Matthew Yankowitz, Shaowen Chen, Kenji Watanabe, Takashi Taniguchi, Cory R. Dean, Ashvin Vishwanath, Marc Kastner, David Goldhaber-Gordon.
Proceedings of the National Academy of Sciences, April 2022.
arXiv:2105.01870 | DOI: https://doi.org/10.1073/pnas.211848211

14. **Unconventional sequence of correlated Chern insulators in magic-angle twisted bilayer graphene**
Andrew T. Pierce, Yonglong Xie, Jeong Min Park, Eslam Khalaf, Seung Hwan Lee, Yuan Cao, Daniel E. Parker, Patrick R. Forrester, Shaowen Chen, Kenji Watanabe, Takashi Taniguchi, Ashvin Vishwanath, Pablo Jarillo-Herrero, Amir Yacoby.
Nature Physics, September 2021.
arXiv:2101.04123 | DOI: https://doi.org/10.1038/s41567-021-01347-4

13. **Strain-induced quantum phase transitions in magic angle graphene**
Daniel E. Parker, Tomohiro Soejima, Johannes Hauschild, Michael P. Zaletel, Nick Bultinck.
Physical Review Letters (Editor's Suggestion), July 2021.
arXiv:2012.09885 | DOI: https://doi.org/10.1103/PhysRevLett.127.027601

12. **Efficient simulation of moire materials using the density matrix renormalization group**
Tomohiro Soejima, Daniel E. Parker, Nick Bultinck, Johannes Hauschild, Michael P. Zaletel.
Physical Review B **(Editor's Suggestion)**, September 2020.
arXiv:2009.02354 | DOI: 10.1103/PhysRevB.102.205111

11. **Half-magnetization plateau and the origin of threefold symmetry breaking in a triangular frustrated antiferromagnet**
Shannon C. Haley, Eran Maniv, Taylor Cookmeyer, Nikola Maksimovic, Daniel E. Parker, Caolan John, Spencer Doyle, Sophie F. Weber, Jeffrey B. Neaton, John Singleton, James G. Analytis.
October 2020, Physical Review Research.
arXiv:2002.02960 | DOI: 10.1103/PhysRevResearch.2.043020

10. **Local Matrix Product Operators: Canonical Form, Compression, & Control Theory**
Daniel E. Parker, Xiangyu Cao, Michael P. Zaletel.
September 2019, Physical Review B.
arXiv:1909.06341 | DOI: 10.1103/PhysRevB.102.035147

9. **A Universal Operator Growth Hypothesis**
Daniel E. Parker, Xiangyu Cao, Alexander Avdoshkin, Thomas Scaffidi, Ehud Altman.
December 2019, Physical Review X.
arXiv:1812.08657 | DOI: 10.1103/PhysRevX.9.041017

8. **Topologically-Protected Long Edge Coherence Times in Symmetry-Broken Phases**
Daniel E. Parker, Romain Vasseur, Thomas Scaffidi.
Physical Review Letters, June 2019.
arXiv:1808.07485 | DOI: 10.1103/PhysRevLett.122.240605

7. **Diagrammatic approach to nonlinear optical response with application to Weyl semimetals**
Daniel E. Parker, Takahiro Morimoto, Joseph Orenstein, Joel E. Moore.
Physical Review B, January 2019.
arXiv:1807:09285 | DOI: 10.1103/PhysRevB.99.045121

6. **Resonance-enhanced optical nonlinearity in the Weyl semimetal TaAs**
Shreyas Patankar, Liang Wu, Baozhu Lu, Manita Rai, Jason D. Tran, T. Morimoto, D. Parker, Adolfo Grushin, N. L. Nair, J. G. Analytis, J. E. Moore, J. Orenstein, Darius H. Torchinsky.
Physical Review B, October 2018.
arXiv:1804.06973 | DOI: 10.1103/PhysRevB.98.165113

5. **Topological Luttinger liquids from decorated domain walls**
Daniel E. Parker, Thomas Scaffidi, Romain Vasseur.
Physical Review B, April 2018.
arXiv:1711.09106 | DOI: 10.1103/PhysRevB.97.165114

4. **Gapless Symmetry Protected Topological Order**
Thomas Scaffidi, Daniel E. Parker, Romain Vasseur.
Physical Review X, October 2017.
arXiv:1705.01557 | DOI: 10.1103/PhysRevX.7.041048

3. **Entanglement Entropy in Excited States of the Quantum Lifshitz Model**
Daniel E. Parker, Romain Vasseur, J.E. Moore.
Journal of Physics A: Mathematical and Theoretical, May 2017.
arXiv:1702.07433 | DOI: 10.1088/1751-8121/aa70b3

2. **Hedgehog Bases for A_n Cluster Polylogarithms and An Application to Six-Point Amplitudes**
Daniel E. Parker, Adam Scherlis, Marcus Spradlin, Anastasia Volovich.
Journal of High Energy Physics, Nov 2015.
arXiv:1507.01950 | DOI: 10.1007/JHEP11(2015)136

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, Schools, & Conferences

- *Classification of Vortexable Bands.* Conference talk. APS March Meeting 2024, Minneapolis, MN. 5 March 2024.
- *From Vortexable Bands to Composite Fermi Liquids.* Invited talk. Condensed Matter Seminar. Carnegie Mellon University, Pittsburg, PA. 16 February 2024.
- *Physical Review Journal Club: Composite Fermions Form and Flow without a Magnetic Field.* Invited webinar. 17 November 2023.
- *From Vortexable Bands to Composite Fermi Liquids.* Invited talk. Condensed Matter Seminar. Stanford University, Palo Alto, CA. 26 October 2023.
- *From Vortexable Bands to Composite Fermi Liquids.* Invited talk. Quantum Material Seminar (290K), Physics Department, Berkeley, CA. 4 October 2023.
- *Building Tools for the Quantum Many-Body Problem: The Case of Fractional Chern Insulators.* Invited Talk. Condensed Matter Seminar. University of California at Davis Physics Department. 16 March, 2023.
- *Vortexable bands: A unifying perspective on band geometry.* Conference talk. APS March Meeting 2023, Las Vegas, NV. 10 March 2023.
- *Building Tools for the Quantum Many-Body Problem: The Case of Fractional Chern Insulators.* Invited Talk. Condensed Matter Seminar. University of Illinois at Urbana-Champaign Physics Department. 23 February, 2023.
- *Building Tools for the Quantum Many-Body Problem: The Case of Fractional Chern Insulators.* Invited Talk. Condensed Matter Seminar. UC San Diego Physics Department. 13 February, 2023.
- *Building Tools for the Quantum Many-Body Problem: The Case of Fractional Chern Insulators.* Invited Talk. Condensed Matter Seminar. UW Madison Physics Department. 7 February, 2023.
- *Vortexable Bands.* Invited talk. Quantum Geometry Working Group. Flatiron Institute, New York, NY. 31 January-1 February 2023.
- *Quantum Geometry and Fractional Chern Insulators.* Invited talk. Novel electronic properties of 2D materials, San Sebastian, Spain. 11 July 2022.
- *Quantum Geometry and Fractional Chern Insulators.* Poster. 2022 Correlated Electron Systems Gordon Research Seminar, Holyoke, MA. 24 June 2022.
- *Quantum Geometry and Fractional Chern Insulators.* Invited talk. Quantum Material Seminar (290K), Physics Department, Berkeley, CA. 13 April 2022.
- *Field-tuned and zero-field fractional Chern insulators in magic angle graphene.* Conference talk. APS March Meeting, Chicago, IL. 4 March 2022.
- *Fractional Chern Insulators and Hofstadter Band Geometry in Magic-Angle Graphene.* Invited talk. Kid's Seminar, Harvard University Physics Department, Cambridge, MA. 15 September 2021.
- *Efficient simulation of moire materials using the density matrix renormalization group.* Invited talk. Condensed Matter Seminar, Perimeter Institute for Theoretical Physics, Waterloo, Ontario, Canada. 13 October 2020.
- *Efficient simulation of moire materials using the density matrix renormalization group.* Invited talk. Condensed Matter Seminar, Harvard University, Cambridge, MA. 24 September 2020.
- *A Universal Operator Growth Hypothesis.* Seminar. Condensed Matter Seminar, Harvard University, Cambridge, MA. 11 December 2019.
- *A Universal Operator Growth Hypothesis.* Seminar. Condensed Matter Seminar, Stanford University, Palo Alto, CA. 20 November 2019.
- *A Universal Operator Growth Hypothesis.* Seminar. Condensed Matter Seminar, Flatiron Institute, NYC, NY. 4 November 2019.
- *A Universal Operator Growth Hypothesis.* Poster. Les Houches summer school, "Dynamics and Disorder in Quantum Many Body Systems Far from Equilibrium". July 29th -August 23rd, 2019.

- *A Universal Operator Growth Hypothesis.* Conference Talk. APS March Meeting, Boston, MA. 4 March 2019.
- *An Universal Operator Growth Hypothesis.* Seminar. Quantum Materials Seminar (290K), Physics Department, Berkeley, CA. 23 January 2019.
- *Topologically-Protected Long Edge Coherence Times in Symmetry-Broken Phases.* Poster. Novel Approaches to Quantum Dynamics. Kavli Institute for Theoretical Physics, Santa Barbara, CA. 27-31 August 2018.
- *Topologically-Protected Long Edge Coherence Times in Symmetry-Broken Phases.* Poster. Workshop on Advances in Non-Fermi Liquids. Lawrence Berkeley National Laboratory, Berkeley, CA. 15-17 August 2018.
- *Gauge-Invariant Cumulants and Second Harmonic Generation.* Seminar. Quantum Materials Seminar (290K), Physics Department, Berkeley, CA. 4 April 2018.
- *Gapless Symmetry Protected Topological Phases.* Conference talk. APS March Meeting, Los Angeles, CA. 4 March 2018.
- *Hedgehog Bases: A taste of the mathematics and physics of scattering amplitudes.* Seminar. Math, Physics, and Gauge Theory Seminar, Mathematics Department. Michigan State University. 30 March 2017.
- *Cluster Algebra Structures for Scattering Amplitudes in $\mathcal{N} = 4$ Super Yang-Mills.* Seminar. Combinatorics Seminar, Mathematics Department. UC Berkeley. 2 November 2015.

Undergraduate Research Experience

Scattering Amplitudes Summer 2014

PIs: Prof. Anastasia Volovich & Prof. Marcus Spradlin, Dept. of Physics, Brown University.
Studied scattering amplitudes in $\mathcal{N} = 4$ Super Yang-Mills theory. Studied mathematical techniques including cluster algebras, polylogarithms, symbols, Hopf and shuffle algebras. Wrote senior thesis. Developed a "Hedgehog basis" (see publication) for efficiently representing scattering amplitudes.

Gravitational Lensing Summer 2013

PI: Prof. Ian Dell'Antonio, Dept. of Physics, Brown University.
Simulated gravitational lensing. Produced high-resolution, realistic simulations of lensed galaxy clusters to test efficacy of current techniques of cluster mass distribution measurements. Developed a novel algorithm 10^4 times faster than previous such simulations. Work presented at LSST collaboration meeting January 2014.

Femtosecond Spectroscopy Summer 2011 & 2012

PI: Prof. Marcos Dantus, Depts. of Chemistry and Physics, Michigan State University.
Summer 2012: Demonstrated Laser-Induced Breakdown Spectroscopy (LIBS) with a novel femtosecond fiber laser source, without an amplifier. Introduced a novel model and measurement technique for the ablation threshold of femtosecond LIBS. (See publication above.)
Summer 2011: Configured a 7 femtosecond laser system for single-beam Coherent Anti-Stokes Raman Spectroscopy (CARS). Developed models to perform stand-off, real-time measurements of temperature, molecular composition, and concentration.

Teaching Experience

Physics H7B Fall 2016

Honors introductory electromagnetism at UC Berkeley. Taught from Purcell. Taught one section of thirty students as a Graduate Student Instructor.

Physics 7B Fall 2015; Spring 2016; Fall 2016

Introductory electromagnetism for engineering students at UC Berkeley. Taught two sections of twenty students each as a Graduate Student Instructor.

LaTeX Workshop 2015

Taught four six-week workshop series on LaTeX through the Brown University Science Center. Developed a curriculum from scratch, created ten two-hour lectures, wrote extensive notes, supervised four other instructors, and taught dozens of students.

Service

Referee Reports 2023

Reviewed 6 papers from the following journals:

- Communications Physics
- Nature
- Physical Review Letters
- Physical Review B
- Journal of High Energy Physucs
- Physical Review B

Referee Reports 2022

Reviewed 3 papers from the following journals:

- Physical Review Letters
- Physical Review B
- Physical Review X

Outreach

GISP: Race and Gender in the Scientific Community. Fall 2015

Created and took a GISP course on Race and Gender in the Scientific Community. Brown University's "GISP" courses are created and led entirely by students; they must be meticulously planned and must pass a rigorous approval process. This GISP aimed to identify reasons why women and minorities are underrepresented in science, and determine effective solutions and interventions. Faculty advisor: Cornelia Dean, former science editor of the New York Times.