

Eric Samperton

Curriculum Vitae (updated October 3, 2024)

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Employment

- 2022– **Assistant Professor**, *Purdue University*, Departments of Mathematics (75%) and Computer Science (25%). Member of Purdue Quantum Engineering and Science Institute (PQSEI).
- 2019–2022 **J.L. Doob Research Assistant Professor**, *University of Illinois at Urbana-Champaign*.
- 2018–2019 **Visiting Assistant Professor**, *University of California, Santa Barbara*.

Education

- 2012–2018 **Ph.D.**, *University of California, Davis*, Mathematics.
Advisor: Greg Kuperberg.
- 2008–2012 **B.S.**, *California Institute of Technology*, Mathematics with a minor in English.

Research interests

My research focuses on interactions between topology and theoretical computer science. I am most interested in 3-dimensional geometric topology and topological quantum field theories, topological quantum computation, quantum and classical algorithms, and complexity.

Awards and grants

- 2024–2026 PI for NSF CCF 2330130, **FET: SMALL: Quantum algorithms and complexity for quantum algebra and topology**, \$590,886
- 2022 Collaborate@ICERM team with Neil Hoffman (OK State) and Kate Petersen (UMN Duluth), **PSL(2, \mathbb{F}_p) representations of homology spheres**
- 2020–2023 PI for NSF DMS 2038020, **EAGER-QIA: Detecting Knottedness with Quantum Computers**, \$145,008
- 2019–2022 AMS-Simons Travel Grant, \$4,800
- 2015 Alice Leung Award for excellent promise in mathematical research, UC Davis

Writing

Links to publications and preprints are available on my webpage, which you can browse to by clicking the link in my contact info above.

10. **An algorithm for Tambara-Yamagami quantum invariants of 3-manifolds, parameterized by the first Betti number.** With Colleen Delaney and Clément Maria. [arXiv:2311.08514](https://arxiv.org/abs/2311.08514).
9. **Topological quantum computation is hyperbolic.** *Communications in Mathematical Physics* (2023), Volume 402, pp. 79–96. [arXiv:2201.00857](https://arxiv.org/abs/2201.00857).
8. **Oriented and unitary equivariant bordism of surfaces.** With Andrés Ángel, Carlos Segovia and Bernardo Uribe. Accepted for publication in *Algebraic & Geometric Topology*. [arXiv:2111.02693](https://arxiv.org/abs/2111.02693).

7. **Free actions on surfaces that do not extend to arbitrary actions on 3-manifolds.** *Comptes Rendus - Mathématique* (2020), Volume 360, pp. 161-167. arXiv:2107.06982.
6. **Coloring invariants of knots and links are often intractable.** With Greg Kuperberg. *Algebraic & Geometric Topology* (2021), Volume 21, Issue 6, pp. 1479–1510. arXiv:1907.05981.
5. **Haah codes on general three manifolds.** With Kevin Tian and Zhenghan Wang. *Annals of Physics* (2020), Volume 412, pp. 168014. arXiv:1812.02101.
4. **Schur-type invariants of branched G-covers of surfaces.** *Topological Phases of Matter and Quantum Computation* (2020), *Contemp. Math.*, Volume 747, pp.173–197. arXiv:1709.03182.
3. **Computational complexity and 3-manifolds and zombies.** With Greg Kuperberg. *Geometry & Topology* (2018), Volume 22, Issue 6, pp. 3623–3670. arXiv:1707.03811.
2. **Spaces of invariant circular orders of groups.** With Hyungryul Baik. *Groups, Geometry and Dynamics* (2018), Volume 12, Issue 2, pp. 721–763. arXiv:1508.02661.
1. **On laminar groups, Tits alternatives, and convergence group actions on S^2 .** With Juan Alonso and Hyungryul Baik. *Journal of Group Theory* (2019), Volume 22, Issue 3, pp. 359-381. arXiv:1411.3532.

Invited talks

- 2024 Topology Seminar, University of Arkansas.
- Primer Encuentro Colombiano de Geometría y Topología (ECOGyT), Universidad Nacional de Colombia, sede Bogotá.
 - Great Lakes Mathematical Physics Meeting (GLAMP), Michigan State University.
 - Yau Mathematical Sciences Center Topology Seminar (online), Tsinghua University.
 - Mathematics Colloquium for the Associated Colleges of the Chicago Area (ACCA), Trinity Christian College.
- 2023 Topology Seminar, CUNY Graduate Center.
- Mathematics Department Colloquium, CUNY Medgar Evers College.
 - Operator Algebras & Mathematical Physics Seminar, Michigan State University.
 - Topology Seminar, Michigan State University.
 - Topology Seminar, Notre Dame University.
 - Workshop on Topological Quantum Computation, International Centre for Mathematical Sciences, Edinburgh.
 - Midwest Quantum Collaboratory meeting, Purdue University.
 - Conference on Higher Invariants in Equivariant and Geometric Topology, Institute of the Mathematical Sciences of the Americas, University of Miami.
 - Topolodays Student Seminar, Purdue University.
- 2022 Knots and Machine Learning workshop, Dublin Institute for Advanced Studies.
- Colloquium, UNAM Oaxaca.
 - Special Session on Geometry and Representation Theory of Quantum Algebras and Related Topics, AMS Fall Western Sectional.
 - Topology Seminar, Purdue University.
 - Special Session on Quantum Algebra and Quantum Topology, AMS Spring Central Sectional (online).
 - Colloquium, Purdue University.
 - Algebraic Topology Seminar (online), Princeton University.

- Geometry & Topology Seminar (online), Virginia Commonwealth University.
 - Quantum Topology Seminar (online), Indiana University.
 - Colloquium (online), University of Ljubljana.
- 2021 IX Bavarian Geometry & Topology Meeting (online).
- Topology Seminar, University of Wisconsin–Milwaukee.
 - Sesión en Teoría de bordismo y acciones de grupos finitos (online), VI Congreso Latinoamericano de Matemáticos.
- 2020 Geometry and Topology Seminar (online), Caltech.
- Geometry and Topology Seminar (online), Michigan State University.
 - Geometry and Topology Online, Warwick Mathematics Institute.
 - Redbud Geometry/Topology Conference, University of Arkansas.
 - Logic seminar, University of Colorado Boulder.
- 2019 Quantum Symmetries Conference, University of Illinois at Urbana-Champaign.
- Modern Analysis and Geometry Seminar, Indiana University–Purdue University Indianapolis.
 - Geometry and Topology Seminar, Washington University in Saint Louis.
 - Topology seminar, Purdue University.
 - Mini-symposium on computational problems in low-dimensional topology II, Okinawa Institute of Science and Technology.
- 2018 Topology Seminar, Cornell University.
- Geometry, Groups and Dynamics Seminar, University of Illinois at Urbana-Champaign.
 - Redbud Geometry/Topology Conference, Oklahoma State University.
 - Special Session on Mathematics of Quantum Computing and Topological Phases of Matter, JMM, San Diego.
- 2017 Workshop on computation in geometric topology, University of Warwick.
- Topology Seminar, University of California, Berkeley.
 - Quantum Algebra and Topology Seminar, University of California, Santa Barbara.
 - Topology Seminar, University of California, Berkeley.
 - Davis Math Conference, University of California, Davis.
 - Special Session on Mapping Class Groups and their Subgroups, JMM, Atlanta.
- 2016 Special Session on Topological Phases of Matter and Quantum Computation, AMS Eastern Section, Bowdoin College.
- Quantum Topology Seminar, University of California, Santa Barbara.
- 2015 Oberseminar Differentialgeometrie, Universität Bonn.
- 13th Annual Graduate Student Topology and Geometry Conference, University of Illinois Urbana-Champaign.

Service

- 2025 (scheduled) Co-organizer w/ Colleen Delaney (UC Berkeley), Carmen Rovi (Loyola), Carlos Segovia (UNAM-Oaxaca), Bernardo Uribe (Universidad del Norte). Banff International Research Station (BIRS) workshop **25w5402: Equivariant topological quantum field theory** at Casa Matemática Oaxaca.
- 2023 Guest lecture on quantum computing. Purdue CS584 Theory of Computation.
- Quantum Computing Primer (two lectures). Purdue CS Theory Seminar.

- Outreach talk on quantum error correction. Purdue Quantum Student Organization.
- Co-organizer w/ Colleen Delaney (Indiana), Rolando Jiménez (UNAM), Carlos Segovia (UNAM-Oaxaca), Bernardo Uribe (Universidad del Norte). Banff International Research Station (BIRS) workshop **23w5138: Equivariant bordism theory and applications** at Casa Matemática Oaxaca.
- 2022 Co-organizer w/ Greg McShane (Grenoble) and Saul Schleimer (Warwick). AMS-SMF-EMS Joint International Meeting Special Session on Combinatorial and Computational Aspects in Topology.
- 2021-2022 Member, Illinois Quantum Information Science and Technology Center (IQUIST).
- 2021 Supported multiple undergraduate and graduate research assistants in the summer and fall with my DMS #2038020 grant.
 - Faculty mentor. Two Illinois Geometry Lab projects titled "Building a computer by braiding colorful knots (part II)" and "Detecting knottedness with quantum computers." Two 4 student undergraduate teams (Gargee Japtap, Nikhil Richard, Ivan Schweiger, Xiaohan Wang; Anshul Arunachalam, Yuxuan Chen, Suchetan Dontha, Jay Reiter), each with 1 graduate team leader (Rocco Davino; Joseph Malione).
- 2020 Faculty mentor. Illinois Geometry Lab project titled "Building a computer by braiding colorful knots." 4 student undergraduate team (Suchetan Dontha, Aishani Dutta, Yixiao Liu, Qingyu Meng) and 1 graduate team leader (William Linz).
- 2018-2019 Co-organizer. UCSB Quantum Algebra and Topology Seminar.

I have served as a referee for several mathematics journals and computer science conference proceedings, as well as a few physics journals. More info available by request.

Professional development

- 2024 Invited participant. Simons Collaboration on Global Categorical Symmetries Annual Meeting, New York City.
 - Participant. International Conference, Thematic Program in Field Theory and Topology, Notre Dame University.
 - Participant. Midwest Topology Seminar, Loyola University.
 - Contributed talk, Atlantic Category Theory Seminar, Dalhousie University.
 - Contributed talk, Mathematics Physics Seminar, Purdue University.
 - Participant. Inclusive Research Workshop, Purdue University Office of Diversity, Inclusion and Belonging.
- 2023 Invited participant. Simons Collaboration on Global Categorical Symmetries Annual Meeting, New York City.
 - Participant. Research Program on quantum computing, Park City Mathematics Institute.
 - Participant. Computational Problems in Low-dimensional Topology III, Rutgers University - Newark.
 - Participant. Faculty Success Program Boot Camp, National Center for Faculty Development and Diversity.
- 2022 Summer Program participant. Aspen Center for Physics.
 - Contributed talk. Categorical Methods in Representation Theory and Quantum Topology. University of Virginia.
 - Participant. Quantum Information Processing 2022. Caltech.
- 2020 Workshop participant. Tensor categories and topological quantum field theories. Mathematical Sciences Research Institute, Berkeley.

- Submitted paper session. Joint Mathematics Meeting, Denver.
- 2018 Local participant. Quantum Knot Invariants and Supersymmetric Gauge Theories. Kavli Institute for Theoretical Physics, UC Santa Barbara.
- 2016 Participant. 52nd Cornell Topology Festival.
 - Participant. Geometry, Topology and Complexity of Manifolds, and applications to Biology (Joelfest), UC Berkeley.
 - Participant. 14th Annual Graduate Student Topology and Geometry Conference, Indiana University Bloomington.
- 2015-2016 Student representative. Graduate Program Committee, UC Davis Math Department.
 - 2015 Participant. Introductory School, Hausdorff Research Institute for Mathematics. "Homotopy theory, manifolds, and field theories."
- 2013-2015 Co-organizer w/ G. Mossessian. UC Davis Student-Run Geometry & Topology Seminar.
 - 2014 Co-organizer w/ B. Schiffman and D. Weber. Fifth Annual UC Davis Math Conference.
 - Participant. 5-Day Workshop, Banff International Research Station. "Quantum Curves and Quantum Knot Invariants."
 - Participant. Albert Schwarz's birthday conference, UC Davis. "The Mathematics of Quantum Theory."
- 2013-2014 Representative. General Assembly, UC Davis Graduate Student Association.
 - 2013 Co-organizer w/ K. Schenthal. Fourth Annual UC Davis Math Conference.
 - Participant. Séminaire de Mathématiques Supérieures, Centre de Recherches Mathématiques. "Physics and Mathematics of Link Homology."
 - Participant. Hot Topics Workshop, MSRI. "Surface subgroups and cube complexes."
- 2012-2013 Volunteer. Math Café, UC Davis Women's Research and Resource Center.

Teaching and past employment

Purdue University

Assistant Professor.

- 2024 Fall
 - MATH 56200, Introduction to Differential Geometry and Topology.
- 2024 Spring
 - MATH 26500, Linear Algebra.
 - CS 59300/MATH 59500, Intro to Quantum Computing.
- 2023 Spring
 - MATH 26500, Linear Algebra. 2 sections.

University of Illinois at Urbana-Champaign

J. L. Doob Research Assistant Professor.

- 2021 Fall
 - MATH 402, Non-Euclidean Geometry.
Made campus-wide List of Teachers Ranked as Excellent By Their Students.
- 2021 Spring
 - MATH 402, Non-Euclidean Geometry.
 - MATH 595, Advanced Topics in Mathematics: Quantum, Complexity and Topology.
- 2020 Fall
 - MATH 402, Non-Euclidean Geometry. 2 sections.
- 2020 Spring
 - MATH 417, Intro to Abstract Algebra. 2 sections.
Made campus-wide List of Teachers Ranked as Excellent By Their Students.
- 2019 Fall
 - MATH 213, Basic Discrete Mathematics.

UC Santa Barbara

Visiting Assistant Professor.

- 2019 Spring
 - MATH 4A, Linear Algebra with Applications.
- 2019 Winter
 - MATH 8, Transition to Higher Mathematics.
- 2018 Fall
 - MATH 117, Methods in Analysis.

UC Davis

Associate Instructor.

- 2017 Summer Session I
 - MATH 115A, Number Theory.
- 2015 Summer Session I
 - MATH 115A, Number Theory.
- 2014 Summer Session I
 - MATH 17A, Calculus for Biosciences.

Extensive TA experience.

Caltech

Teaching Assistant.

- 2012 Winter
 - Writing Science for the Public, with Professor Leonard Mlodinow.