Sarah Cannon

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APPOINTMENTS

Assistant Professor of Mathematics, July 2019-present
Department of Mathematical Sciences
Claremont McKenna College

NSF Mathematical Sciences Postdoctoral Research Fellow, August 2018 – June 2019
Computer Science Division, Department of Electrical Engineering and Computer Science
University of California, Berkeley
Supervisor: Alistair Sinclair
Project: Mathematical Foundations of Markov Chains

EDUCATION

Georgia Institute of Technology, Atlanta, GA
PhD in Algorithms, Combinatorics, and Optimization (ACO), 2018
Adviser: Dana Randall
Dissertation: "Markov Chains and Emergent Behavior for Problems from Discrete Geometry."

University of Oxford, Oxford, UK
MSc with Distinction, Mathematics and the Foundations of Computer Science (MFoCS), 2013
Adviser: Andreas Döring
Dissertation: "The Spectral Presheaf of an Orthomodular Lattice: some steps towards generalized Stone duality."

Tufts University, Medford, MA
BA in Mathematics, Summa Cum Laude with Highest Thesis Honors, 2012
Advisers: Diane Souvaine, Todd Quinto

FUNDING

- "**A Statistical Study of Alternative Representational Systems for the LA City Council**." John Randolph Haynes & Dora Haynes Foundation, Major Research Planning Grant in Governance and Democracy. $100,000, Jan. 1 2025-Dec. 31 2025. Joint with Evan Rosenman.
- "**Mathematical Foundations of Sampling Connected Balanced Graph Partitions**," Workshop at the American Institute of Mathematics, June 2025. Jointly organized with Daryl DeFord.
- "**CRII: AF: RUI: Markov Chains and Random Sampling on Graphs**." National Science Foundation, Division of Computing and Communication Foundations, Research Initiation Initiative (CRII). $174,583, 2021-2025.
- "**Connections between computational and physical phase transitions**." American Institute of Mathematics SQuaRE (Structured Quartet Research Ensemble), 2021-2023. Funding for an in-person, one week research meeting with all six participants, once per year.

- "**Mathematical Foundations of Markov Chains**. " National Science Foundation, Division of Mathematical Sciences, Postdoctoral Research Fellowship. $150,000. 2018-2021.

PUBLICATIONS

Publications marked with • have authors listed alphabetically; publications marked with ○ have authors listed in order of contribution, with lab directors listed last.

- S. Cannon, D. DeFord, and M. Duchin. "**Repetition effects in a Sequential Monte Carlo sampler**." Preprint available at https://arxiv.org/abs/2409.19017.
- S. Cannon, T. Helmuth, and W. Perkins. "**Pirogov-Sinai Theory Beyond Lattices**." Submitted. Preprint available at https://arxiv.org/abs/2411.07809.
- S. Cannon, M. Duchin, D. Randall, and P. Rule. "**Spanning Tree Methods for Sampling Graph Partitions**." Accepted to *SIAM Review*, 2024. Preprint available at https://arxiv.org/abs/2210.01401.
- S. Cannon and Z. Dhillon. "**Evaluating Methods used to Quantify Racial Segregation**." Accepted to *Journal of Humanistic mathematics*, 2024.
- S. Cannon, W. Pegden, and J. Tucker-Foltz. "**Sampling Balanced Forests of Grids in Polynomial Time**." *STOC 2024: Proceedings of the 56th Annual ACM Symposium on Theory of Computing* (STOC), pp. 1676–1687, 2024.
- S. Cannon. "**Irreducibility of Recombination Markov Chains in the Triangular Lattice**." *Discrete Applied Mathematics*, vol. 347, pp. 75-130, 2024. Conference version in: *SIAM Conference on Applied and Computational Discrete Algorithms* (ACDA), pp. 98-109, 2023.
- A. Blanca, S. Cannon, and W. Perkins. "**Fast and perfect sampling of subgraphs and polymer systems**." *Transactions on Algorithms* 20(1), no. 5, pp. 1–30, 2024. Conference version in: *Approximation, Randomization, and Combinatorial Optimization. Algorithms and Techniques* (RANDOM), pp. 4:1-4:18, 2022.
- S. Cannon, A. Goldbloom-Helzner, V. Gupta, JN Matthews, and B. Suwal. "**Voting Rights, Markov Chains, and Optimization by Short Bursts**." *Methodology and Computing in Applied Probability*. vol. 25, no. 36, 2023.
- ○ S. Li, B. Dutta, S. Cannon, J. J. Daymude, R. Avinery, E. Aydin, A. W. Richa, D. I. Goldman, and D. Randall. "**Programming Active Cohesive Granular Matter with Mechanically Induced Phase Changes**." *Science Advances*, Vol. 7, No. 17, eabe8494, pp. 1-12, 2021.
- S. Cannon and W. Perkins. "**Counting Independent Sets in Unbalanced Bipartite Graphs**." *ACM-SIAM Symposium on Discrete Algorithms* (SODA), pp. 1456-1466, 2020.
- S. Cannon, J.J. Daymude, C. Gokmen, D. Randall, and A.W. Richa. "**A local stochastic algorithm for separation in heterogeneous self-organizing particle systems**." *23rd International Workshop on Randomization and Computation* (RANDOM), pp. 54:1--54:22, 2019. Preliminary results appeared as "Brief Announcement: A local stochastic algorithm for separation in heterogeneous self-organizing particle systems" in: Proceedings of the 2018 ACM Principles of Distributed Computing (PODC '18), pp. 483-485, 2018.
- S. Cannon, D.A. Levin, and A. Stauffer. "**Polynomial Mixing of the Edge-Flip Markov Chain for Unbiased Dyadic Tilings**." *Combinatorics, Probability, and Computing* 28(3), pp. 365-387,

2019. Conference version in: *21st International Workshop on Randomization and Computation* (RANDOM), pp. 34:1-34:21, 2017.

- W. Savoie, S. Cannon, J.J. Daymude, R. Warkentin, S. Li, A.W. Richa, D. Randall, and D.I. Goldman. "**Phototactic Supersmarticles**." *Artificial Life and Robotics* 23(4), pp. 459-468, 2018. Conference version in: *The 2nd International Symposium on Swarm Behavior and Bio-Inspired Robotics* (SWARM), pp. 377-384, 2017.

- M. Andrés Arroyo, S. Cannon, J.J. Daymude, D. Randall, and A.W. Richa. "**A Stochastic Approach to Shortcut Bridging in Programmable Matter**." *Natural Computing* 17(4): 723-741, 2018. Conference version in: *23rd International Conference on DNA Computing and Molecular Programming* (DNA), pp. 122-138, 2017.

- S. Cannon, S. Miracle and D. Randall. "**Phase Transitions in Random Dyadic Tilings and Rectangular Dissections**." *SIAM Journal on Discrete Mathematics* 32(3), pp. 966-1992, 2018. Conference version in: *26th Annual ACM-SIAM Symposium on Discrete Algorithms* (SODA), pp. 1573-1589, 2015.

- S. Cannon, T.G. Fai, J. Iwerks, U. Leopold, and C. Schmidt. "**Combinatorics and complexity of guarding polygons with edge and point 2-transmitters**." *Computational Geometry*, vol. 68, pp. 89-100, 2018. Previously as "Combinatorics of edge 2-transmitter art gallery problems," *European Conference on Computational Geometry (EuroCG)*, 2015, and as "NP-hardness of the minimum point and edge 2-transmitter cover problem," *24th Fall Workshop on Computational Geometry* (FWCG), 2014.

- S. Cannon and A. Döring. "**A Generalisation of Stone Duality to Orthomodular Lattices**." *Nagoya Winter Workshop: Reality and Measurement in Algebraic Quantum Theory*. Springer Proceedings in Mathematics & Statistics, vol 261, pp. 3-65, 2018.

- S. Cannon, J.J. Daymude, D. Randall, and A.W. Richa. "**A Markov Chain Algorithm for Compression in Self-organizing Particle Systems**." In: *ACM Symposium on Principles of Distributed Computing* (PODC), pp. 279-288, 2016.

- S. Cannon and D. Randall. "**Sampling on Lattices with Free Boundary Conditions Using Randomized Extensions**." In: *27th Annual ACM-SIAM Symposium on Discrete Algorithms* (SODA), pp. 1952-1971, 2016.

- G. Barequet, S. Cannon, E. Fox-Epstein, B. Hescott, D.L. Souvaine, C.D. Tóth and A. Winslow. "**Diffuse Reflections in Simple Polygons**." *Discrete Applied Mathematics*, vol. 210, pp. 123-132, 2016. Conference version: *Latin American Algorithms, Graphs, and Optimization Symposium* (LAGOS), Electronic Notes in Discrete Mathematics, vol. 44, pp. 354-350, 2013.

- V. Bucaj, S. Cannon, M. Dorff, J. Lawson and R. Viertel. "**Embeddedness for singly periodic Scherk surfaces with higher dihedral symmetry**." *Involve: a journal of mathematics*, 6(4), pp. 383-392, 2013.

- S. Cannon, E.D. Demaine, M.L. Demaine, S. Eisenstat, M.J. Patitz, R. Schweller, S.M. Summers and A. Winslow. "**Two Hands Are Better Than One (up to constant factors): Self-Assembly In The 2HAM vs. aTAM**." In: *30th International Symposium on Theoretical Aspects of Computer Science* (STACS), pp. 172-184, 2013. Journal version under review, submitted to *Theoretical Computer Science* in February 2021.

- S. Cannon, D.L. Souvaine and A. Winslow. "**Hidden Mobile Guards in Simple Polygons**." In: *Abstracts of the 24th Canadian Conference on Computational Geometry* (CCCG), pp. 161-166, 2012. Preliminary results presented at the *Fall Workshop on Computational Geometry* (FWCG), 2011.

- S. Cannon, M. Ishaque and C.D. Tóth. "**Conflict-free Graph Orientations with Parity Constraints**." In: *6th International Conference on Fun with Algorithms* (FUN), pp. 57-68, 2012. Preliminary results presented at the *Fall Workshop on Computational Geometry* (FWCG), 2010.

TEACHING

- **Mathematics of Political Districting (Math 195)**, Claremont McKenna College, Fall 2022, Fall 2024
- **Foundations of Data Science (CSCI 036)**, Claremont McKenna College, Fall 2021, Spring 2022, Spring 2023, Spring 2024, Fall 2024, Spring 2025
- **Graph Algorithms (CSCI 148)**, Claremont McKenna College, Fall 2020, Spring 2023, Spring 2025
- **Discrete Mathematics (Math 55)**, Claremont McKenna College, Spring 2020, Fall 2020, Spring 2021
- **Probability (Math 151)**, Claremont McKenna College, Fall 2019, Spring 2020, Spring 2021, Fall 2022
- **Design and Analysis of Algorithms (CS 3510)**, Georgia Tech, Summer 2017.
- **Teaching Assistant, Honors Discrete Mathematics (CS 2051)**, Georgia Tech, Spring 2017.
- **Teaching Assistant, Advanced Algorithms (CS 4540)**, Georgia Tech, Fall 2015.

INVITED RESEARCH WORKSHOPS

- **Frontiers of Statistical Mechanics and Theoretical Computer Science**, Banff International Research Station for Mathematical Innovation and Discovery (BIRS), Canada, August 11-16, 2024
- **Mathematics of Voting and Representation (A Mathematics for Humanity Workshop)**, International Centre for Mathematical Sciences (ICMS), Edinburgh, Scotland, June 10-14, 2024.
- **Counting and Sampling: Algorithms and Complexity**, Schloss Dagstuhl – Leibniz Center for Informatics, Germany, November 28-Devember 2, 2022.
- **Quantitative Investigations of Gerrymandering and Redistricting**, Duke University, March 2-4, 2020.
- **Working Group: Limits to Inference in Networks and Noisy Data**, Santa Fe Institute, Santa Fe, NM, April 2-6, 2018.
- **Seminar on Computational Counting,** Schloss Dagstuhl – Leibniz Center for Informatics, Germany, August 21-25, 2017.
- **Seminar on Algorithmic Foundations of Programmable Matter,** Schloss Dagstuhl – Leibniz Center for Informatics, Germany, July 4-8, 2016.
- **27th Bellairs Winter Workshop on Computational Geometry**, February 11-17, 2012.

OTHER WORKSHOPS AND LONG-TERM VISITS

- **Research Member, Algorithms, Fairness, and Equity Program**, Simons-Laufer Mathematical Sciences Institute (SLMath, formerly MSRI), Fall 2023.
- **Japanese-American-German Frontiers of Science Symposium**, Kyoto, Japan, September 26-29, 2019. Invited by the National Academy of Sciences.

- **Faculty, Voting Rights Data Institute**, Tufts University, Medford, MA and Massachusetts Institute of Technology, Cambridge, MA, June 17-July 26, 2019.
- **Geometry of Polynomials**, Simons Institute, Berkeley, CA, Spring Semester 2019.
- **Rising Stars in EECS**, Massachusetts Institute of Technology, Cambridge, MA, October 28-30, 2018.
- **China Theory Week**, Institute of Theoretical Computer Science and Communications, The Chinese University of Hong Kong, Hong Kong, August 22-26, 2016.
- **Workshop on Markov Chain Mixing Times**, American Institute of Mathematics, San Jose, CA, June 6-10, 2016.
- **3rd Heidelberg Laureate Forum**, Heidelberg, Germany, August 23-28, 2015.
- **Women in Theory**, New York University, NY, May 28-30, 2014.
- **Women in Theory**, Princeton University, NJ, June 19-23, 2010.

INVITED TALKS

- "**Understanding Districting via Random Sampling**," *Mathematics of Voting and Representation (A Mathematics for Humanity Workshop)*, International Centre for Mathematical Sciences (ICMS), Edinburgh, UK, June 12, 2024
- "**Learning about Political Districting Plans via Random Sampling**." *Computer Science Colloquium*, Harvey Mudd College, March 21, 2024.
- "**Understanding Gerrymandering with Random Sampling**." *The Math/Stats Colloquium*, Department of Mathematics and Statistics, San José State University, October 11, 2023.
- "**Markov Chains and Redistricting**," *Introduction Workshop: Algorithms, Fairness, and Equity*, Simons Laufer Mathematical Sciences Institute (SLMath, formerly MSRI), August 31, 2023.
- "**Properties of Redistricting Markov Chains**," *Special Session on Applied Combinatorial Methods*, Joint Mathematics Meetings, April 8, 2022 (virtual talk).
- "**Properties of Redistricting Markov Chains**," *UCSB CS Theory Colloquium Series*, University of California, Santa Barbara, November 5, 2021.
- "**Detecting Gerrymandering via Random Sampling**," *CSULA Math Club*, California State University Los Angeles, September 3, 2020 (virtual talk).
- "**Recombination, Reversibility, and Short Bursts**", *Quantitative Investigations of Gerrymandering and Redistricting*, Duke University, March 2-4, 2020.
- "**Counting Independent Sets in Unbalanced Bipartite Graphs**," *Theory Seminar*, Computer Science Department, University of Colorado, Boulder, January 15, 2020.
- "**Counting Independent Sets in Unbalanced Bipartite Graphs**," *Special Session on Analytic and Probabilistic Combinatorics*, Joint Mathematics Meetings, January 16, 2020.
- "**Counting Independent Sets in Unbalanced Bipartite Graphs**," *Probability Seminar*, University of Southern California, September 6, 2019.
- "**Collective Intelligence via Markov Chains and Emergent Phenomena**," *Japanese-American-German Frontiers of Science Symposium*, Kyoto, Japan, September 26-29, 2019.
- "**Programmable Matter, Markov Chains, and Statistical Physics**." *Probability Seminar*, University of California, Berkeley, January 30, 2019.
- **A Markov Chain Algorithm for Compression in Self-Organizing Particle Systems**." *Discrete Math and Algorithms Seminar*, Arizona State University, January 25, 2017.

- "**Phase Transitions in Random Dyadic Tilings and Rectangular Dissections**." *30th Clemson Mini-Conference on Discrete Mathematics*, Clemson University, SC, October 23, 2015.

SELECTED HONORS AND AWARDS

- **National Science Foundation Graduate Research Fellowship**, 2013-2018.
- **Simons Award for Graduate Students in Theoretical Computer Science**, 2015-2017. Awarded to at most 10 students at US and Canadian universities each year.
- **Clare Boothe Luce Outstanding Graduate Fellow**, Georgia Tech, for "exceptional promise for making significant contributions to the worldwide advancement of science and technology" and an ability "to serve as a role model for younger generations," 2013-2015.
- **Algorithms, Combinatorics, and Optimization Fellowship**, Georgia Tech, 2013-2015.
- **Computing Research Association's Outstanding Undergraduate Researcher Award** 2012.
- **Norbert Weiner Award in Mathematics**, Tufts University, "given on those rare occasions when a student exhibits such prodigious strength in mathematics as to recall the highly unusual talents of Norbert Wiener [19]09, who went on to become one of the giants of twentieth-century mathematics," 2012.

SERVICE

- **Co-organizer** (with Daryl DeFord), **Workshop on** "**Mathematical Foundations of Sampling Connected Balanced Graph Partitions,**" American Institute of Mathematics, Pasadena, CA, June 2-6, 2025.
- **Co-organizer** (with Daryl DeFord and Ranthony Edmonds), **SIAM Minisymposium on "Mathematical and Computational Redistricting: Algorithms and Analysis,"** SIAM Annual Meeting, Spokane, WA, July 8-9, 2024.
- **Faculty Fellow** (with Helen Wong), **CMC Presidential Initiative on Anti-Racism and the Black Experience in America**, Spring 2024-Spring 2025.
- **Secretary, SIAM Activity Group on Discrete Mathematics**, 2023-2024 (elected)
- **Program Committee**:
    - RANDOM 2024 (International Conference on Randomization and Computation)
    - ACDA 2023 (SIAM Conference on Applied and Computational Discrete Algorithms)
    - RANDOM 2021 (International Conference on Randomization and Computation)
- **Advisory Board/Judge**, 2022 Science Ambassador Scholarship
- **National Science Foundation Panelist**, Division of Computing and Communication Foundations, Directorate for Computer and Information Science and Engineering, 2020
- **External Journal Reviewer** for:
    - Discrete & Computational Geometry
    - Methodology and Computing in Applied Probability
    - Theoretical Computer Science
    - Information and Computation
    - Combinatorics, Probability, and Computing
    - SIAM Journal on Applied Mathematics

    - Multiscale Modelling and Simulation
    - SIAM Journal on Discrete Mathematics
    - Electronic Journal of Probability
    - Journal of Statistical Physics
    - Journal of Parallel and Distributed Computing
    - Annales de l'Institut Henri Poincaré (B) Probabilités et Statistiques
- **External Conference Reviewer** for:
    - SODA 2023, 2021, 2020, 2014 (ACM-SIAM Symposium on Discrete Algorithms)
    - FOCS 2021, 2020, 2019 (IEEE Symposium on Foundations of Computer Science)
    - RANDOM 2020 (International Conference on Randomization and Computation)
    - STOC 2020 (ACM Symposium on Theory of Computing)
    - DISC 2018 (32nd International Symposium on Distributed Computing)
    - ICALP 2017 (44th International Colloquium on Automata, Languages and Programming)
    - CPM 2015 (26th Annual Symposium on Combinatorial Pattern Matching)
- **Girls Who Code Summer Immersion Program Speaker**, Alpharetta, GA, June 19, 2018.
- **Panelist, IEEE/WIE Women's Leadership Summit**, panel "Inspiring Lessons And Success Stories For The Undergrad," November 4, 2016.
- **Georgia Tech Graduate Women in the College of Computing**, organizing committee 2015-2018; member 2013-2018.