

Positions

- Starting 2023 **Assistant Professor of Statistics**, *Harvard University*.
2022-2023 **Member**, *Institute for Advanced Study*.
2022-2023 **Postdoctoral Scientist**, *Amazon*.

Education

- 2018-2022 **PhD in Mathematics**, *Stanford University*.
Advised by Andrea Montanari and Sébastien Bubeck
2017-2018 **M.A.St. in Mathematics with Distinction**, *University of Cambridge*.
2014-2017 **B.S. in Mathematics**, *MIT*.

Selected Fellowships and Awards

- NeurIPS: Outstanding Paper Award 2021
- Symposium on Discrete Algorithms (SODA): Best Paper Award 2020
- Symposium on Discrete Algorithms (SODA): Best Student Paper Award 2020
- William R. and Sara Hart Kimball endowed Stanford Graduate Fellowship 2018-2022
- NSF Graduate Research Fellowship 2017-2022
- William Lowell Putnam Competition: 1st place 2014
- International Mathematical Olympiad: Gold Medalist 2013, 2014
- MathCounts National Competition: 1st place 2010

Research

- Improved Lower Bound for the Union-Closed Sets Conjecture. With Ryan Alweiss and Brice Huang. [arXiv:2211.11731](#)
- Free Energy Subadditivity for Symmetric Random Hamiltonians. [arXiv:2208.11279](#)
- Tight Bounds for State Tomography with Incoherent Measurements. With Sitan Chen, Brice Huang, Jerry Li, and Allen Liu. [arXiv:2206.05265](#)
- Sampling from the Sherrington-Kirkpatrick Gibbs measure via algorithmic stochastic localization. With Ahmed El Alaoui and Andrea Montanari. **FOCS 2022**. [arXiv:2203.05093](#)
- The Pareto Frontier of Instance-Dependent Guarantees in Multi-Player Multi-Armed Bandits with no Communication. With Allen Liu. **COLT 2022**. [arXiv:2202.09653](#)
- Local algorithms for Maximum Cut and Minimum Bisection on locally treelike regular graphs of large degree. With Ahmed El Alaoui and Andrea Montanari. [arXiv:2111.06813](#)

26. Tight Lipschitz Hardness for Optimizing Mean Field Spin Glasses. With Brice Huang. **FOCS 2022**. arXiv:2110.07847
25. Iterative Feature Matching: Toward Provable Domain Generalization with Logarithmic Environments. With Yining Chen, Elan Rosenfeld, Tengyu Ma, and Andrej Risteski. **NeurIPS 2022**. arXiv:2106.09913
24. A Universal Law of Robustness via Isoperimetry. With Sébastien Bubeck. **NeurIPS 2021. Outstanding Paper Award**. arXiv:2105.12806
23. Optimizing Mean-Field Spin Glasses with External Field. arXiv:2105.03506
22. Tensor Quasi-Random Groups. **Proceedings of the AMS Series B**, Vol. 9 (2022), pp. 12-21. arXiv:2103.11048
21. Cutoff for the Asymmetric Riffle Shuffle. **Annals of Probability**, Vol. 50 (2022) no. 6, 2244-2287. arXiv:2103.05068
20. Metric Transforms and Low Rank Matrices via Representation Theory of the Real Hyperrectangle. With Josh Alman, Timothy Chu, Gary Miller, Shyam Narayanan, and Zhao Song. arXiv:2011.11503
19. Cooperative and Stochastic Multi-Player Multi-Armed Bandit: Optimal Regret With Neither Communication Nor Collisions. With Sébastien Bubeck and Thomas Budzinski. **COLT 2021**. arXiv:2011.03896.
18. Algorithmic Pure States for the Negative Spherical Perceptron. With Ahmed El Alaoui. **Journal of Statistical Physics** Vol. 189 (2022), no. 27. arXiv:2010.15811.
17. Approximate Ground States of Hypercube Spin Glasses are Near Corners. **Comptes Rendus Mathématiques**, Vol. 359 (2021) no. 9, pp. 1097-1105. arXiv:2009.09316
16. Metrical Service Systems with Transformations. With Sébastien Bubeck, Niv Buchbinder, and Christian Coester. **ITCS 2021**. arXiv:2009.08266
15. Vertex Sparsification for Edge Connectivity. With Parinya Chalermsook, Syamantak Das, Bundit Laekhanukit, Yunbum Kook, Yang P. Liu, Richard Peng, and Daniel Vaz. **SODA 2021**. arXiv:2007.07862.
14. Online Multiserver Convex Chasing and Optimization. With Sébastien Bubeck and Yuval Rabani. **SODA 2021**.
13. Covering $Irrep(S_n)$ With Tensor Products and Powers. **Mathematische Annalen**, accepted. arXiv:2004.05283
12. The Price of Incentivizing Exploration: A Characterization via Thompson Sampling and Sample Complexity. With Aleksandrs Slivkins. **Operations Research**, accepted (2022). Conference version in **EC 2021**. arXiv:2002.00558
11. Optimization of Mean-field Spin Glasses. With Ahmed El Alaoui and Andrea Montanari. **Annals of Probability**, Vol. 49 (2021) no. 6, 2922-2960. arXiv:2001.00904
10. Chasing Convex Bodies Optimally. **GAFSA Seminar Notes**, accepted. Conference version in **SODA 2020. Best Paper and Best Student Paper**. arXiv:1905.11968

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9. Non-Stochastic Multi-Player Multi-Armed Bandits: Optimal Rate With Collision Information, Sublinear Without. With Sébastien Bubeck, Yuanzhi Li, and Yuval Peres. **COLT 2020**. arXiv:1904.12233
8. First-Order Bayesian Regret Analysis of Thompson Sampling. With Sébastien Bubeck. **IEEE Transactions on Information Theory**, accepted (2022). Conference version in **ALT 2020**. arXiv:1902.00681
7. Competitively Chasing Convex Bodies. With Sébastien Bubeck, Yin Tat Lee, and Yuanzhi Li. **STOC 2019**. To appear in the **SICOMP special issue**. arXiv:1811.00887
6. Chasing Nested Convex Bodies Nearly Optimally. With Sébastien Bubeck, Bo'az Klartag, Yin Tat Lee, and Yuanzhi Li. **SODA 2020**. arXiv:1811.00999
5. Exact minimum number of bits to stabilize a linear system. With Victoria Kostina, Yuval Peres, and Gireeja Ranade. **IEEE Transactions on Automatic Control**, November 2021. Conference version in **IEEE Conference on Decision and Control 2018**. arXiv:1807.07686
4. Stabilizing a system with an unbounded random gain using only a finite number of bits. With Victoria Kostina, Yuval Peres, and Gireeja Ranade. **IEEE Transactions on Information Theory**, Vol. 67, no. 4, pp. 2554-2561, Apr. 2021. Conference version in **IEEE International Symposium on Information Theory 2018**. arXiv:1805.05535
3. Approximating Continuous Functions by ReLU Nets of Minimal Width. With Boris Hanin. arXiv:1710.11278
2. The Saxl Conjecture for Fourth Powers via the Semigroup Property. With Sammy Luo. **Journal of Algebraic Combinatorics**, 45 (2017), 33-80. arxiv:1511.02387
1. On the Number of 2-protected Nodes in Tries and Suffix Trees. With Mark Daniel Ward, Jeffrey Gaither, and Yushi Homma. **Discrete Mathematics and Theoretical Computer Science**, Vol. AQ (2012), 381-398.

Other Research

2. A Novel Accelerated Fatigue Testing System for Pulsatile Applications of Cardiac Devices Using Widely Translatable Cam and Linkage-Based Mechanisms. With Matthew H. Park, Annabel M. Imbrie-Moore, Yuanjia Zhu, Mateo Marin-Cuartas, Robert Wilkerson, and Y. Joseph Woo. **Medical Engineering & Physics**, Vol. 109 (2022), 103896.
1. Biomimetic Six-Axis Robots Replicate Human Cardiac Papillary Muscle Motion: Pioneering the Next Generation of Biomechanical Heart Simulator Technology. With Annabel M. Imbrie-Moore, Matthew H. Park, Michael J. Paulsen, Rohun Kulkarni, Hanjay Wang, Yuanjia Zhu, Justin M. Farry, Alexandra T. Bourdillon, Christine Callinan, Haley J. Lucian, Camille E. Hironaka, Daniela Deschamps Y. Joseph Woo. **Journal of the Royal Society Interface**, Vol. 17 (2020), no. 173.

Invited Talks

54. IAS Computer Science and Discrete Mathematics: Algorithmic Stochastic Localization for the SK Model (2022/11)
53. Harvard Statistics: Algorithmic Stochastic Localization for the SK Model (2022/11)

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52. Columbia Probability: Algorithmic Stochastic Localization for the SK Model (2022/10)
51. Duke Statistical Science: Algorithmic Stochastic Localization for the SK Model (2022/10)
50. Stony Brook Information Geometry and Machine Learning Webinar: Chasing Convex Bodies (2022/09)
49. IAS Probability: Algorithmic Thresholds in Mean-Field Spin Glasses (2022/9)
48. MIT EECS Group Meeting: Algorithmic Thresholds in Mean-Field Spin Glasses (2022/08)
47. Youth in High Dimensions: A Universal Law of Robustness via Isoperimetry (2022/06)
46. Simons Workshop *Multi-Agent Reinforcement Learning and Bandit Learning*: Multi-Player Bandits without Communication (2022/05)
45. Oxford Statistics Group Meeting: A Universal Law of Robustness via Isoperimetry (2022/04)
44. Google Algorithms: A Universal Law of Robustness via Isoperimetry (2022/04)
43. Lawrence Livermore National Lab: A Universal Law of Robustness via Isoperimetry (2022/03)
42. SIAM Imaging Science Minisymposium *Recent Advances on Stable Neural Networks*: A Universal Law of Robustness via Isoperimetry (2022/03)
41. Purdue Industrial Engineering: A Universal Law of Robustness via Isoperimetry (2022/03)
40. MIT Probability: Tight Algorithmic Thresholds in Mean-Field Spin Glasses (2022/03)
39. Yale Statistics and Data Science: Algorithmic Thresholds in Mean-Field Spin Glasses (2022/03)
38. CMU Computer Science: Geometric Aspects of Optimization, Old and New (2022/02)
37. MIT Group Meeting: Algorithmic Thresholds in Mean-Field Spin Glasses (2022/02)
36. Harvard Statistics: Algorithmic Thresholds in Mean-Field Spin Glasses (2022/02)
35. Wharton Statistics: Algorithmic Thresholds in Mean-Field Spin Glasses (2022/02)
34. Columbia IEOR: Geometric Aspects of Optimization, Old and New (2022/01)
33. NYU Math and Data: Geometric Aspects of Optimization, Old and New (2022/01)
32. MIT Sloan OR/Stat Seminar: Geometric Aspects of Optimization, Old and New (2022/01)
31. Columbia Statistics: Geometric Aspects of Optimization, Old and New (2022/01)
30. University of Chicago Probability: Cutoff for the Asymmetric Riffle Shuffle (2022/01)
29. Simons *Probability, Geometry, and Computation in High Dimensions* Reunion Workshop: Tight Lipschitz Hardness for Optimizing Mean-Field Spin Glasses (2022/01)
28. Yale Statistics and Data Science: Algorithmic Thresholds in Mean-Field Spin Glasses (2021/11)
27. NSF-Simons Collaboration on the Theoretical Foundations of Deep Learning: A Universal Law of Robustness via Isoperimetry (2021/11)

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26. UCLA Probability: Algorithms and Hardness for Optimizing Mean-Field Spin Glasses (2021/10)
25. INFORMS Session on *Learning and Optimization in Decision Making: Chasing Convex Bodies* (2021/10)
24. Stanford Probability Seminar: Cutoff for the Asymmetric Riffle Shuffle (2021/10)
23. Stanford ML Group Meeting: A Universal Law of Robustness via Isoperimetry (2021/10)
22. Simons Workshop *Rigorous Evidence for Information-Computation Trade-offs: Tight Algorithmic Thresholds for Optimizing Mean-Field Spin Glasses* (2021/09)
21. BIRS: Algorithmic Pure States for the Negative Spherical Perceptron (2021/08)
20. MSR Redmond: Pareto-Optimal Collision-Free Regret for Multi-Player Bandit (2021/08)
19. Stanford Statistics Group Meeting: A Universal Law of Robustness via Isoperimetry (2021/08)
18. MSR Redmond: The Price of Incentivizing Exploration (2021/07)
17. Montréal MLOpt: A Universal Law of Robustness via Isoperimetry (2021/07)
16. Berkeley EECS Group Meeting: The Price of Incentivizing Exploration (2021/06)
15. NSF-Simons Collaboration on the Theoretical Foundations of Deep Learning: Algorithmic Pure States for the Negative Spherical Perceptron (2021/04)
14. Cornell Probability: Algorithmic Pure States for the Negative Spherical Perceptron (2020/11)
13. Berkeley Theory Lunch: Chasing Convex Bodies (2020/11)
12. Online Geometric Analysis Seminar: Chasing Convex Bodies (2020/11)
11. MIT Algorithms and Complexity Seminar: Chasing Convex Bodies (2020/02)
10. Stanford Theory Lunch: Chasing Convex Bodies (2019/10)
9. TCS+ September 2019: Chasing Convex Bodies (2019/09)
8. University of Washington Theory Lunch: Chasing Convex Bodies (2019/08)
7. MSRI Mathematics of Machine Learning Summer School: Chasing Convex Bodies (2019/08).
6. Microsoft Research NYC: Chasing Convex Bodies (2019/07)
5. Microsoft Research Redmond: Chasing Convex Bodies (2019/07)
4. Microsoft Research Redmond: Small Loss Bounds for Thompson Sampling (2018/09)
3. Brown University: How Wide Does a Neural Net Need to be? (2018/05)
2. Microsoft Research Redmond: How Wide Does a Neural Net Need to be? (2017/09)
1. Purdue Combinatorics Group Meeting: The Saxl Conjecture for Fourth Powers (2015/08)

Conference, Workshop, and Other Presentations

19. FOCS 2022: Algorithmic Stochastic Localization for the Sherrington-Kirkpatrick Model
18. IAS Postdoctoral Short Talk: Algorithmic Spin Glass Theory
17. COLT 2022: The Pareto Frontier of Instance-Dependent Guarantees in Multi-Player Multi-Armed Bandits with no Communication
16. NeurIPS 2021: A Universal Law of Robustness via Isoperimetry (poster and oral)
15. NeurIPS 2021 StratML Workshop: The Price of Incentivizing Exploration (poster)
14. Simons/IFML Joint Symposium 2021: A Universal Law of Robustness via Isoperimetry (poster)
13. Simons 2021 Annual Meeting on Mathematical and Scientific Foundations of Deep Learning: A Universal Law of Robustness via Isoperimetry (poster)
12. COLT 2021: Cooperative and Stochastic Multi-Player Multi-Armed Bandit
11. ICML 2021 Workshop *Overparameterization: Pitfalls & Opportunities*: A Universal Law of Robustness via Isoperimetry (oral spotlight presentation)
10. EC 2021 Workshop *Operations of People-Centric Systems*: The Price of Incentivizing Exploration
9. EC 2021: The Price of Incentivizing Exploration
8. Math Olympiad Program 2021: Introduction to Belief Propagation
7. SODA 2021: Online Multiserver Convex Chasing and Optimization
6. ALT 2020: First-Order Bayesian Regret Analysis of Thompson Sampling
5. SODA 2020: Chasing Convex Bodies Optimally
4. SODA 2020: Chasing Nested Convex Bodies Nearly Optimally
3. STOC 2019: Competitively Chasing Convex Bodies
2. Joint Math Meetings 2016: The Saxl Conjecture for Fourth Powers
1. MIT SPUR 2015: The Saxl Conjecture for Fourth Powers

Reviewer Service

Journals: Forum of Math Pi, Communications in Mathematical Physics, Journal of the ACM, Discrete and Computational Geometry, Mathematics of Operations Research, IEEE Transactions on Information Theory, American Economic Review Insights.

Conferences:

2023. STOC, ITCS
2022. STOC, FOCS, NeurIPS, American Control Conference

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2021. STOC, FOCS, COLT, ITCS, NeurIPS (expert reviewer),

2020. ICML (**top reviewer**), COLT, SPAA

2019. NeurIPS (**top reviewer**)

Other Activities

- Summers '18, '19, '21 **Microsoft Research AI, Research Intern**, Redmond, WA.
Theoretical research in machine learning and optimization. Mentor: Sébastien Bubeck.
- Summer 2021 **Ghana International Math Olympiad Program**, Instructor, Remote.
Coached a member of the Ghana IMO team and lectured to younger students. Program organized by the MISE foundation: <https://misemaths.wordpress.com/olympiad/>.
- Spring 2021 **Stanford University, Teaching Assistant**, Remote.
Office hours, discussion sections, and grading for Math 52 (multivariable calculus)
- Summer 2020 **D.E. Shaw & Co., Quantitative Research Intern**, Remote (pandemic).
- Summers '15, '17, '18, '21 **Math Olympiad Summer Program, Instructor**, Pittsburgh, PA.
Coached top American high school students for the International Mathematical Olympiad
- Fall 2019 **Stanford Kiddie Colloquium, Organizer**.
Organized weekly lectures on a variety of topics by math PhD students
- 2018 **Brazil National Math Olympiad Program, Instructor**, Colégio Etapa, Sao Paulo.
Personally coached entire Brazilian IMO team for one week
- 2016-present **Contest Math Tutoring, Founder**.
Online tutoring service providing students with personalized instruction in contest math
- January 2015 **Jane Street Capital, Trading Intern**.
Analyzed a statistical model for mergers and acquisitions, learned fundamentals of trading
- 2011-2012 **William Henry High School, Course Instructor**, West Layayette, IN.
Gave half of the lectures for a year-long course in multivariable calculus and linear algebra