

# Yufei Zhao

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## Current Position

**Department of Mathematics, Massachusetts Institute of Technology**  
Class of 1956 Career Development Assistant Professor  
Assistant Professor

Cambridge, MA  
2018—  
2017—2018

## Previous Positions

**Simons Institute for the Theory of Computing, UC Berkeley**  
Simons-Berkeley Research Fellow

Berkeley, CA  
Spring 2017

**New College, University of Oxford**  
Esmée Fairbairn Junior Research Fellow in Mathematics

Oxford, UK  
2015—2017

## Education

**Massachusetts Institute of Technology**  
Ph.D. Mathematics. Advisor: Jacob Fox

Cambridge, MA  
2011—2015

**University of Cambridge**  
M.A.St. Mathematics with Distinction

Cambridge, UK  
2010—2011

**Massachusetts Institute of Technology**  
S.B. Mathematics, with minor in Economics  
S.B. Computer Science and Engineering

Cambridge, MA  
2006—2010

## Research Interests

Extremal/probabilistic/additive combinatorics; graph theory and graph limits

## Selected Awards and Honors

**Sloan Research Fellowship**, 2019

MIT Future of Science award, 2018

**SIAM Dénes König Prize**, 2018

Johnson Prize, MIT Mathematics Department, 2015

Microsoft Research PhD Fellowship, 2013–2015

Morgan Prize Honorable Mention, 2011

Gates Cambridge Scholarship, 2010–2011

MIT Jon A. Bucsela Prize in Mathematics, 2010

Putnam Math Competition: Three-time Putnam Fellow (top five rank) 2006, 2008, 2009; 7th Place 2007

International Mathematical Olympiad: Gold Medal 2005; Silver Medal 2006; Bronze Medal 2004

## Grants

|                                     |           |
|-------------------------------------|-----------|
| MIT Solomon Buchsbaum Research Fund | 2018—     |
| NSF award DMS-1764176               | 2018—2021 |
| NSF award DMS-1362326               | 2017—2018 |

## Research Internships

|                                 |                                |
|---------------------------------|--------------------------------|
| Microsoft Research New England  | Cambridge, MA                  |
| Mentor: Henry Cohn              | Summers 2010, 2011, 2013, 2014 |
| Microsoft Research Theory Group | Redmond, WA                    |
| Mentor: Eyal Lubetzky           | Summer 2012                    |

## Papers

44. Hung-Hsun Hans Yu and Yufei Zhao  
Joints tightened, [arXiv:1911.08605](#)
43. Jonathan Tidor and Yufei Zhao  
Testing linear-invariant properties, [arXiv:1911.06793](#)
42. Jacob Fox, Jonathan Tidor, Yufei Zhao,  
Induced arithmetic removal: complexity 1 patterns over finite fields, [arXiv:1911.03427](#)
41. Jacob Fox, Huy Tuan Pham, and Yufei Zhao,  
Common and Sidorenko linear equations, [arXiv:1910.06436](#)
40. Yang Liu and Yufei Zhao,  
On the upper tail problem for random hypergraphs, [arXiv:1910.02916](#)
39. Zilin Jiang, Jonathan Tidor, Yuan Yao, Shengtong Zhang, and Yufei Zhao,  
Equiangular lines with a fixed angle, [arXiv:1907.12466](#)
38. Yufei Zhao and Yunkun Zhou,  
Impartial digraphs, [arXiv:1906.10482](#)
37. Ashwin Sah, Mehtaab Sawhney, David Stoner, and Yufei Zhao,  
Exponential improvements for superball packing upper bounds, [arXiv:1904.11462](#)
36. Jacob Fox, Ashwin Sah, Mehtaab Sawhney, David Stoner, and Yufei Zhao,  
Triforce and corners,  
*Math. Proc. Cambridge Philos. Soc.*, to appear. [arXiv:1903.04863](#)
35. Ashwin Sah, Mehtaab Sawhney, David Stoner, and Yufei Zhao,  
A reverse Sidorenko inequality, [arXiv:1809.09462](#)
34. David Conlon, Jonathan Tidor, and Yufei Zhao,  
Hypergraph expanders of all uniformities from Cayley graphs, [arXiv:1809.06342](#)
33. Asaf Ferber, Vishesh Jain, and Yufei Zhao,  
On the number of Hadamard matrices via anti-concentration, [arXiv:1808.07222](#)
32. Ashwin Sah, Mehtaab Sawhney, David Stoner, and Yufei Zhao,  
The number of independent sets in an irregular graph,  
*J. Combin. Theory Ser. B* 138 (2019), 172–195. [arXiv:1805.04021](#).
31. Jacob Fox, László Miklós Lovász, and Yufei Zhao,  
A fast new algorithm for weak graph regularity,  
*Combin. Probab. Comput.* 28 (2019), 777–790. [arXiv:1801.05037](#)

30. Noga Alon, Jacob Fox, and Yufei Zhao,  
Efficient arithmetic regularity and removal lemmas for induced bipartite patterns,  
*Discrete Anal.* 2019:3, 14 pp. [arXiv:1801.04675](#)
29. Yufei Zhao, Group representations that resist worst-case sampling. [arXiv:1705.04675](#)
28. Yufei Zhao, Extremal regular graphs: independent sets and graph homomorphisms,  
*Amer. Math. Monthly* 124 (2017), 827–843. [arXiv:1610.09210](#)
27. Bhaswar B. Bhattacharya, Shirshendu Ganguly, Xuancheng Shao, and Yufei Zhao,  
Upper tails for arithmetic progressions in a random set,  
*Int. Math. Res. Not. IMRN*, to appear. [arXiv:1605.02994](#)
26. Jacob Fox, László Miklós Lovász, and Yufei Zhao,  
On regularity lemmas and their algorithmic applications,  
*Combin. Probab. Comput.* 26 (2017), 481–505. [arXiv:1604.00733](#)
25. David Conlon and Yufei Zhao,  
Quasirandom Cayley graphs,  
*Discrete Anal.* 2017:6, 14 pp. [arXiv:1603.03025](#)
24. Bhaswar B. Bhattacharya, Shirshendu Ganguly, Eyal Lubetzky, and Yufei Zhao,  
Upper tails and independence polynomials in random graphs,  
*Adv. Math.* 319 (2017), 313–347. [arXiv:1507.04074](#)
23. László Miklós Lovász and Yufei Zhao,  
On derivatives of graphon parameters,  
*J. Combin. Theory Ser. A* 145 (2017), 364–368. [arXiv:1505.07448](#)
22. Yufei Zhao, On the lower tail variational problem for random graphs,  
*Combin. Probab. Comput.* 26 (2017), 301–320. [arXiv:1502.00867](#)
21. Christian Borgs, Jennifer T. Chayes, Henry Cohn, and Yufei Zhao,  
An  $L^p$  theory of sparse graph convergence II: LD convergence, quotients, and right convergence,  
*Ann. Probab.* 46 (2018), 337–396. [arXiv:1408.0744](#)
20. David Conlon, Jacob Fox, and Yufei Zhao,  
The Green-Tao theorem: an exposition,  
*EMS Surv. Math. Sci.* 1 (2014), 249–282. [arXiv:1403.2957](#)
19. Eyal Lubetzky and Yufei Zhao,  
On the variational problem for upper tails in sparse random graphs,  
*Random Structures Algorithms* 50 (2017), 420–436. [arXiv:1402.6011](#)
18. Christian Borgs, Jennifer T. Chayes, Henry Cohn, and Yufei Zhao,  
An  $L^p$  theory of sparse graph convergence I: limits, sparse random graph models, and power law distributions,  
*Trans. Amer. Math. Soc.* 372 (2019), 3019–3062. [arXiv:1401.2906](#)
17. Yufei Zhao, An arithmetic transference proof of a relative Szemerédi theorem,  
*Math. Proc. Cambridge Philos. Soc.* 156 (2014), 255–261. [arXiv:1307.4959](#)
16. Jacob Fox and Yufei Zhao,  
A short proof of the multidimensional Szemerédi theorem in the primes,  
*Amer. J. Math.* 137 (2015), 1139–1145. [arXiv:1307.4679](#)
15. David Conlon, Jacob Fox, and Yufei Zhao,  
A relative Szemerédi theorem,  
*Geom. Funct. Anal.* 25 (2015), 733–762. [arXiv:1305.5440](#)

14. Yufei Zhao, Hypergraph limits: a regularity approach,  
*Random Structures Algorithms* 47 (2015), 205–226. [arXiv:1302.1634](#)
13. Henry Cohn and Yufei Zhao,  
Sphere packing bounds via spherical codes,  
*Duke Math. J.* 163 (2014), 1965–2002. [arXiv:1212.5966](#)
12. Henry Cohn and Yufei Zhao,  
Universally optimal error-correcting codes,  
*IEEE Trans. Inform. Theory* 60 (2014), 7442–7450. [arXiv:1212.1913](#)
11. Eyal Lubetzky and Yufei Zhao,  
On replica symmetry of large deviations in random graphs,  
*Random Structures Algorithms* 47 (2015) 109–146. [arXiv:1210.7013](#)
10. Jacob Fox, Po-Shen Loh, and Yufei Zhao,  
The critical window for the classical Ramsey-Turán problem,  
*Combinatorica* 35 (2015) 435–476. [arXiv:1208.3276](#)
9. David Conlon, Jacob Fox, and Yufei Zhao,  
Extremal results in sparse pseudorandom graphs,  
*Adv. Math.* 256 (2014), 206–290. [arXiv:1204.6645](#)
8. Yufei Zhao, The bipartite swapping trick on graph homomorphisms,  
*SIAM J. Discrete Math.* 25 (2011), 660–680. [arXiv:1104.3704](#)
7. Yufei Zhao, Sets characterized by the number of missing sums and differences,  
*J. Number Theory* 11 (2011), 2107–2134. [arXiv:0911.2292](#)
6. David Galvin and Yufei Zhao,  
The number of independent sets in graphs with small maximum degree,  
*Graphs Combin.* 27 (2011), 177–186. [arXiv:1007.4803](#)
5. Yufei Zhao, Counting MSTD sets in finite abelian groups,  
*J. Number Theory* 130 (2010), 2308–2322. [arXiv:0911.2288](#)
4. Yufei Zhao, Constructing numerical semigroups of a given genus,  
*Semigroup Forum* 80 (2010), 242–254. [arXiv:0910.2075](#)
3. Yufei Zhao, Constructing MSTD sets using bidirectional ballot sequences,  
*J. Number Theory* 130 (2010), 1212–1220. [arXiv:0908.4442](#)
2. Yufei Zhao, The number of independent sets in a regular graph,  
*Combin. Probab. Comput.* 19 (2010), 315–320. [arXiv:0909.3354](#)
1. Yufei Zhao, The coefficients of a truncated Fibonacci power series,  
*Fibonacci Quart.* 46/47 (2009), 53–55.

## Invited Talks

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|------|---|----------------------|
| 2020 | Cumberland Conference on Combinatorics, Graph Theory, and Computing               | Williamsburg, VA     |
|      | Workshop on Critical and Collective Effects in Graphs and Networks (CEGN-V)       | Cape Cod, MA         |
|      | Oberwolfach workshop: Combinatorics   | Oberwolfach, Germany |
| 2019 | Shanghai Center for Mathematical Sciences (Fudan) Discrete Math. Seminar          | Shanghai, China      |
|      | Conference on Graph Theory and its Applications: A Tribute to Professor Fan Chung | Sanya, China         |
|      | Atlanta Lectures Series in Combinatorics and Graph Theory at Emory                | Atlanta, GA          |
|      | Princeton Discrete Mathematics Seminar  | Princeton, NJ        |

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|      | Banff workshop: Probabilistic and Extremal Combinatorics                     | Banff, AB                |
|      | ETH Zurich Theory of Combinatorial Algorithms Mittagsseminar                 | Zürich, Switzerland      |
|      | Oberwolfach workshop: Combinatorics, Probability and Computing               | Oberwolfach, Germany     |
|      | Rutgers Discrete Math Seminar  | Piscataway, NJ           |
|      | Yale Combinatorics Seminar   | New Haven, CT            |
|      | Stanford Combinatorics Seminar   | Stanford, CA             |
| 2018 | Clay Math Institute workshop: Recent Advances in Extremal Combinatorics      | Oxford, UK               |
|      | ICM satellite workshop — Combinatorics: Extremal, Probabilistic and Additive | São Paulo, Brazil        |
|      | Simons Institute workshop: Pseudorandomness Reunion                          | Berkeley, CA             |
|      | MIT Workshop on Local Algorithms (WOLA 2018)                                 | Cambridge, MA            |
|      | MIT workshop on Sublinear Algorithms: bootcamp tutorial                      | Cambridge, MA            |
|      | SIAM Conference on Discrete Mathematics: minisymposium                       | Denver, CO               |
|      | SIAM Conference on Discrete Mathematics: Dénes König Prize Lecture           | Denver, CO               |
|      | Georgia Tech workshop: Algorithms and Randomness                             | Atlanta, GA              |
|      | Northeastern U. Network Science Institute Talk                               | Boston, MA               |
|      | AMS Sectional Meeting at Northeastern University                             | Boston, MA               |
|      | Rutgers Discrete Math Seminar  | Piscataway, NJ           |
|      | Tsinghua YMSC minicourse   | Beijing, China           |
|      | CMU ACO Seminar  | Pittsburgh, PA           |
|      | Harvard CMSA workshop: Probabilistic and Extremal Combinatorics              | Cambridge, MA            |
|      | UCLA Combinatorics Seminar   | Los Angeles, CA          |
| 2017 | Harvard CMSA workshop: Additive Combinatorics                                | Cambridge, MA            |
|      | Birmingham workshop: Interactions with Combinatorics                         | Birmingham, UK           |
|      | BGSMath workshop: Random Discrete Structures and Beyond                      | Barcelona, Spain         |
|      | SFSU: ACG Seminar  | San Francisco, CA        |
|      | Stanford Math Department Colloquium  | Stanford, CA             |
|      | Simons Institute workshop: Structure and Randomness                          | Berkeley, CA             |
|      | MIT Combinatorics Seminar  | Cambridge, MA            |
|      | UC Berkeley Combinatorics Seminar  | Berkeley, CA             |
|      | Simons Institute workshop: Pseudorandomness Boot Camp                        | Berkeley, CA             |
|      | Stanford Combinatorics Seminar   | Stanford, CA             |
|      | Oberwolfach workshop: Combinatorics  | Oberwolfach, Germany     |
| 2016 | Turing Institute workshop: Large-scale structures in random graphs           | London, UK               |
|      | Birmingham Combinatorics Seminar   | Birmingham, UK           |
|      | IHÉS Seminar   | Bures-sur-Yvette, France |
|      | Warwick DIMAP Seminar  | Coventry, UK             |

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|      | LSE/Queen Mary Colloquia in Combinatorics  | London, UK             |
|      | Oberwolfach workshop: Combinatorics, Probability and Computing                             | Oberwolfach, Germany   |
|      | Simons Symposium: Analysis of Boolean Functions  | Kr n, Germany          |
|      | British Mathematical Colloquium: Combinatorics Workshop                                    | Bristol, UK            |
|      | Oxford Mathematical Institute North meets South Colloquium                                 | Oxford, UK             |
|      | AMS-MAA Joint Mtgs: AMS Spec. Session on Pseudorandomness and Its Applications             | Seattle, WA            |
| 2015 | London School of Economics Discrete Mathematics and Game Theory Seminar                    | London, UK             |
|      | Queen Mary Combinatorics Seminar   | London, UK             |
|      | Warwick Combinatorics Seminar  | Coventry, UK           |
|      | Oxford Combinatorial Theory Seminar  | Oxford, UK             |
|      | Northeastern U. workshop: Random Graphs, Simplicial Complexes, and their Appl'ns           | Boston, MA             |
|      | U. of Chicago Combinatorics and Theoretical Computer Science Seminar                       | Chicago, IL            |
|      | Rutgers Discrete Math Seminar  | Piscataway, NJ         |
|      | ICERM workshop: Crystals, Quasicrystals and Random Networks                                | Providence, RI         |
| 2014 | Atlanta Lectures Series in Combinatorics and Graph Theory at Emory                         | Atlanta, GA            |
|      | GSU Colloquium   | Atlanta, GA            |
|      | CRM workshop: New Topics in Additive Combinatorics   | Montreal, QC           |
|      | IMA workshop: Additive and Analytic Combinatorics  | Minneapolis, MN        |
|      | Clay Math Institute workshop: Extremal and Probabilistic Combinatorics                     | Oxford, UK             |
|      | Georgia Tech Combinatorics Seminar   | Atlanta, GA            |
|      | IAS Computer Science/Discrete Mathematics Seminar  | Princeton, NJ          |
|      | Oxford Combinatorial Theory Seminar  | Oxford, UK             |
|      | London School of Economics Discrete Mathematics and Game Theory Seminar                    | London, UK             |
|      | Eurandom: Minicourse on Graph Limits<br>(6-hour minicourse co-taught with Christian Borgs) | Eindhoven, Netherlands |
|      | Oberwolfach workshop: Combinatorics  | Oberwolfach, Germany   |
| 2013 | Simons Institute workshop: Neo-Classical Methods in Discrete Analysis                      | Berkeley, CA           |
|      | Rutgers Discrete Math Seminar  | Piscataway, NJ         |
|      | MIT Combinatorics Seminar  | Cambridge, MA          |
|      | Yale Combinatorics and Probability Seminar   | New Haven, CT          |
|      | Microsoft Research Theory Reading Group  | Cambridge, MA          |
|      | Oberwolfach workshop: Combinatorics and Probability  | Oberwolfach, Germany   |
| 2012 | MIT Combinatorics Seminar  | Cambridge, MA          |
|      | SIAM Conference on Discrete Mathematics  | Halifax, NS            |
| 2009 | MIT Combinatorics Seminar  | Cambridge, MA          |

## Teaching

[U = Undergraduate, G = Graduate]

|               |           |   |  |
|---------------|-----------|---|--|
| <b>MIT</b>    | Fall 2019 | G | 18.217 Graph Theory and Additive Combinatorics       |
|               | Fall 2019 | U | 18.A34 Mathematical Problem Solving (Putnam Seminar) |
|               | Spr 2019  | G | 18.218 The Probabilistic Method                      |
|               | Fall 2018 | U | 18.A34 Mathematical Problem Solving (Putnam Seminar) |
|               |           | U | 18.211 Combinatorial Analysis                        |
|               | Fall 2017 | U | 18.A34 Mathematical Problem Solving (Putnam Seminar) |
|               |           | G | 18.S997 Graph Theory and Additive Combinatorics      |
| <b>Oxford</b> | MT 2016   | U | Geometry (tutorial)                                  |
|               | TT 2016   | G | Polynomial Method in Combinatorics                   |

## Advising

Current PhD students:

Aaron Berger  
Benjamin Gunby  
Jonathan Tidor

Undergraduate research supervised:

Yang Liu (2018)  
Ryan Alweiss (2018)  
Yunkun Zhou (2018–2019)  
Mehtaab Sawhney (2018– )  
Ashwin Sah (2018– )  
David Stoner (2018–2019)  
Yuan Yao (2019– )  
Shengtong Zhang (2019– )  
Hung-Hsun Yu (2019– )  
Mihir Singhal (2019– )  
Zachary Chroman (2019– )

## Service

Co-organizer of MIT Combinatorics Seminar, Fall 2017—current

Organizer of the MIT team for the Putnam Competition, Fall 2017—current

## Other Experiences and Activities

Quantitative Research Intern, D. E. Shaw & Co., New York

MIT Lusztig PRIMES Mentor

Research Experience for Undergraduates at Duluth participant (mentor: Joe Gallian)

Deputy Leader for Canadian IMO Team

Instructor at Canadian IMO Training Camps

Mentor at AwesomeMath Summer Program, Dallas

Trainer at US Math Olympiad Summer Program, Lincoln, Nebraska

Teacher at Spirit of Math Schools, Toronto