

# Matthew Kwan | CV

**Citizenship**      Australian  
**Date of Birth**      8 January 1992  
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## Employment & Education

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### **Assistant Professor**

Institute for Science and Technology Austria (ISTA)  
2021 – present

### **Szegő Assistant Professor**

Stanford University  
2018 – 2021

### **Doctor of Science in Mathematics**

With ETH medal  
ETH Zürich  
2014 – 2018.  
Adviser: Benny Sudakov

### **Bachelor of Commerce and Bachelor of Science (Advanced Mathematics)**

With first-class honours and the university medal in pure mathematics  
University of New South Wales  
2010 – 2014.  
Honours adviser: Catherine Greenhill

## Awards & Scholarships

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### **Recent prizes**

- SIAM Dénes Kőnig Prize, 2020
- ETH Medal, 2019
- NWMA (New World Mathematics Awards) Silver Medal, 2019

### **Major grants and scholarships**

- European Research Council (ERC) Starting Grant, 2023 – 2028  
(project number 101076777; EUR €1 343 890)
- USA National Science Foundation (NSF) standard grant, 2020 – 2023  
(award number 1953990; US \$179 217)
- Swiss National Science Foundation (SNSF) Early Postdoc.Mobility Fellowship, 2018 – 2020  
(project number 178493; US \$75 150)

## Teaching

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### **Extremal Graph Theory (ISTA)**

Autumn 2023: instructor

### **Introduction to the Probabilistic Method (ISTA)**

Autumn 2022: instructor

### **Introduction to Combinatorics and its Applications (Stanford University)**

Spring 2021: instructor

### **Discrete Probabilistic Methods (Stanford University)**

Spring 2019, 2020, 2021: instructor

### **Graph Theory (Stanford University)**

Autumn 2019: instructor

### **Introduction To Probability (Stanford University)**

Winter 2019, 2021: instructor

### **Graph Theory (ETH Zürich)**

Spring 2018: organiser and exercise class teacher

Spring 2016, 2017: exercise class teacher

Spring 2015: creation of course materials

### **Algebraic methods in combinatorics (ETH Zürich)**

Autumn 2017: creation of course materials

### **Mathematics (for masters students in architecture; ETH Zürich)**

Autumn 2015: organiser and exercise class teacher

## Academic Service

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### **PhD students supervised**

- Yiting Wang (2023–present)

### **Postdocs mentored**

- Michael Anastos (2022 – present)
- Oliver Cooley (2022 – 2023)
- Benjamin Moore (2023 – present)
- Lyuben Lichev (2024 – present)

### **Student project/thesis supervision**

- Mihir Singhal (MIT) did a research project with me in Summer 2019. He wrote a paper “Erdős–Littlewood–Offord problem with arbitrary probabilities”, published in *Discrete Mathematics*.
- Zachary Chroman and Mihir Singhal (MIT) did a research project with me in Winter 2020. We wrote a paper “Lower bounds for superpatterns and universal sequences”, published in *Journal of Combinatorial Theory, Series A*.

- Parth Sarin (Stanford) did a small project with me in Spring 2020 to satisfy his “writing in the major” requirements. As a result he wrote an expository paper “The Rödl Nibble”.
- Philippe Pangestu (Stanford) wrote his honours thesis (on aspects of extremal and random graph theory) under my supervision, over the 2020–2021 academic year.
- Matin Ansari pour (Sharif), Zach Hunter (Oxford), Iwo Pilecki–Silva (Cambridge), and Arjun Ranganathan (IISER Pune) did internships under my supervision in 2021–2023.
- For the ISTA graduate school, I have supervised many 2-month “rotation projects” giving students a taste of research in combinatorics (Ali Asadi, Illia Babiienko, Seyda Köse, Christoph Günther, Filippo Quattrocchi, Florestan Brunck, Yiting Wang, Yijie Diao, Illya Koval, Roodabeh Safavi, Lena Wurzinger, Pavel Arkhipov).

### Other departmental responsibilities

- All faculty at ISTA are involved in faculty interviews and recruitment.
- All faculty at ISTA are involved in graduate school interviews and admissions.
- All faculty at ISTA participate in qualifying exams (as chair/examiner) for PhD students.
- Co-organiser for the ISTA Combinatorics, Geometry and Topology Seminar
- Organiser of the biannual “Danube meeting” in discrete maths (a cooperation between ISTA, TU Graz, Masaryk University and the University of Passau).
- External member of the ISTA faculty recruitment committee for “information and system sciences”, 2023
- Co-organiser for the ISTA Institute Colloquium, 2021
- Member of the ISTA Women Search Committee, 2022–2023
- Member of the ISTA Interdisciplinary Projects Committee, 2022

### Outreach

- I participated in interviews with the science writers at ISTA and with *Quanta Magazine*, regarding my resolution of Erdős’ conjecture on high-girth Steiner triple systems. This resulted in the publication of two general-audience articles on my research.
- I participated in an interview for the *Geistesblitz* column in the Austrian newspaper *der Standard*, about my general research directions.
- I gave an introductory lecture on the probabilistic method at a 2022 training camp for the Austrian, Czech, Slovak, Polish and Ukrainian teams for the International Mathematics Olympiad.
- I gave an introductory lecture on Ramsey theory at a special summer school for Ukrainian high school students (at ISTA, in 2022).
- I hosted a session of the 2023 *Kharkiv-Vienna International Science School* (for participants of the Ukrainian Science Olympiads).
- I gave a general-audience *Think and Drink* seminar for the ISTA community in 2022.

**Referee/expert opinion for many journals, conferences and grant agencies, including:** Advances in Combinatorics; Advances in Mathematics; Annals of Combinatorics; Annals of Applied Probability; Bulletin of the London Mathematical Society; Combinatorial Theory; Combinatorica; Combinatorics, Probability and Computing; Discrete Analysis; Discrete and Computational Geometry; Discrete Mathematics; Duke Mathematical Journal; Electronic Journal of Combinatorics; European Journal of Combinatorics; Forum of Mathematics, Sigma; International Mathematics Research Notices; Israel Journal of Mathematics; Journal of Combinatorial Theory, Series A; Journal of Combinatorial Theory, Series B; Journal of Graph Theory; Journal of the London Mathematical Society; Proceedings of the American Mathematical Society; Proceedings of the London Mathematical Society; Random Structures and Algorithms; SIAM Journal on Discrete Mathematics; ACM–SIAM Symposium on Discrete Algorithms (SODA); ACM Symposium on Theory of Computing (STOC); Transactions of the American Mathematical Society.

## Personal Skills

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### Languages

English (native)

German (certified as B1 level in 2016 by the Zürich Graduate School in Mathematics)

## Talks

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### Invited conferences/workshops

- Discrete Probability Days, Centre de Recerca Matemàtica (CRM Barcelona). October 2023.
- Workshop on random graphs, Technische Universität Dortmund. September 2023.
- European Conference on Combinatorics, Graph Theory and Applications (EUROCOMB 2023) (plenary speaker), Charles University. August 2023.
- Workshop on Random Graphs, Mathematisches Forschungsinstitut Oberwolfach. March 2023.
- Workshop on Combinatorics, Mathematisches Forschungsinstitut Oberwolfach. January 2023.
- Symposium on Discrete Mathematics (for the discrete mathematics group of the German Mathematical Society), Technische Universität Hamburg. September 2022.
- Recent advances in probabilistic and extremal combinatorics, Congressi Stefano Franscini (ETH Zürich). August 2022.
- Third Southwestern German Workshop on Graph Theory (plenary speaker), Heidelberg University. June 2022.
- Colloquia in Combinatorics, London School of Economics. May 2022.
- Workshop on Combinatorics, Probability and Computing, Mathematisches Forschungsinstitut Oberwolfach. April 2022.
- Interfaces of the Theory of Combinatorial Limits, Erdős Center (Rényi Institute). March 2022.
- Dénes König Prize Lecture, SIAM Conference on Discrete Mathematics (DM21). July 2021.
- Special Session on Structural and Extremal Graph Theory, AMS Fall Southeastern Sectional Meeting. October 2020.
- Probabilistic Combinatorics Online 2020 (plenary speaker). September 2020.
- Workshop on Combinatorics, Mathematisches Forschungsinstitut Oberwolfach. January 2020.
- Workshop on Probabilistic and Extremal Combinatorics, Banff International Research Station for Mathematical Innovation and Discovery (BIRS). September 2019.
- BennyFest (celebrating Benny Sudakov's 50th birthday), ETH Zürich. July 2019.
- Workshop on Combinatorics, Probability and Computing, Mathematisches Forschungsinstitut Oberwolfach. April 2019.
- Minisymposium on Analytic and Probabilistic Techniques in Combinatorics, SIAM Conference on Discrete Mathematics (DM18), University of Colorado, Denver. June 2018.

### Departmental seminars/colloquia

- Combinatorics and Discrete Probability Seminar, University of Illinois Chicago. February 2024.
- Combinatorics Seminar, Stanford University. February 2024.

- Browning group (Number Theory) Working Seminar, ISTA. January 2024.
- Spectral Geometry in the Clouds (seminar on spectral theory and geometric analysis). December 2023.
- Inn’formal Probability Seminar, University of Innsbruck. November 2023.
- Informatics and Mathematics Colloquium, University of Passau. July 2023.
- (Not So) Informal Probability Seminar, University of Vienna. April 2023.
- Groningen Probability Seminar, University of Groningen. February 2023.
- MIT–Harvard–MSR Combinatorics Seminar, Massachusetts Institute of Technology. January 2023.
- Combinatorics, Geometry and Topology Seminar, ISTA. June 2022.
- (Not So) Informal Probability Seminar, University of Vienna. May 2022.
- Discrete Mathematics Seminar, Princeton University. April 2022.
- Graz Combinatorics Seminar, Technische Universität Graz. March 2022.
- Combinatorics Seminar, University of Birmingham. February 2022.
- Discrete Seminar, Umeå University. February 2022.
- Graz Combinatorics Seminar, Technische Universität Graz. December 2021.
- Informatics Colloquium, Masaryk University. November 2021.
- Research Seminar in Combinatorics, Tel Aviv University. November 2021.
- Big Seminar, Laboratory of Combinatorial and Geometric Structures, Moscow Institute of Physics and Technology. November 2021.
- Vienna Probability Seminar. November 2021.
- Discrete Mathematics Seminar, Technische Universität Wien. October 2021.
- CMSA (Combinatorial Mathematics Society of Australasia) Seminar. September 2021.
- Copenhagen–Jerusalem Combinatorics Seminar. July 2021.
- Combinatorics and Probability Seminar, Ohio State University. March 2021.
- MIT–Stanford Combinatorics Reading Seminar. March 2021.
- Mathematics Department Colloquium, University of California, Berkeley. February 2021.
- Webinar on Applied Analysis, Max Planck institute for Mathematics in the Sciences. November 2020.
- Graph Theory Seminar, Georgia Institute of Technology. October 2020.
- Graph Theory and Combinatorics Seminar, University of Illinois. September 2020.
- MIT–Stanford Combinatorics Reading Seminar. July 2020.
- Extremal and Probabilistic Combinatorics webinar. July 2020.
- Matroid Union Seminar. June 2020.
- Probability Seminar, Stanford University. November 2019.
- Combinatorics Seminar, Massachusetts Institute of Technology. February 2019.
- Combinatorics Seminar, Emory University. November 2018.
- Mathematics Department Colloquium, Stanford University. November 2018.
- Combinatorics Reading Seminar, Stanford University. October 2018.
- Combinatorics Seminar, Stanford University. October 2018.
- Mittagssseminar (Theory of Combinatorial Algorithms), ETH Zürich. March 2018.
- Horowitz Seminar on Probability, Ergodic Theory and Dynamical Systems, Tel Aviv University. June 2017.
- Graduate Seminar in Probability, ETH Zürich. May 2017.
- Mittagssseminar (Theory of Combinatorial Algorithms), ETH Zürich. November 2016.
- Mittagssseminar (Theory of Combinatorial Algorithms), ETH Zürich. April 2016.

- Pure Mathematics Seminar, University of New South Wales. August 2015.
- Discrete Mathematics Seminar, Monash University. August 2015.
- Algebra and Topology Seminar, Australian National University. August 2015.
- Mittagssseminar (Theory of Combinatorial Algorithms), ETH Zürich. March 2015.

### Contributed conference talks

- 19th International Conference on Random structures and Algorithms, ETH Zürich. July 2019.
- European Conference on Combinatorics, Graph Theory and Applications (EUROCOMB 2017), TU Wien. August 2017.
- 18th International Conference on Random structures and Algorithms, Gniezno. August 2017.
- SIAM Conference on Discrete Mathematics (DM16), Georgia State University. June 2016.
- European Conference on Combinatorics, Graph Theory and Applications (EUROCOMB 2015), University of Bergen. August 2015.
- 17th International Conference on Random structures and Algorithms, Carnegie Mellon University. July 2015.
- 37th Australasian Conference on Combinatorial Mathematics and Combinatorial Computing, University of Western Australia. December 2013.

## Publications

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45. M Glasgow, M Kwan, A Sah and M Sawhney. A central limit theorem for the matching number of a sparse random graph. Submitted.
44. M Kwan and L Sauermann. Resolution of the quadratic Littlewood–Offord problem. Submitted.
43. M Kwan and Y Wigderson. The inertia bound is far from tight. Submitted.
42. I Koval, M Kwan. Exponentially many graphs are determined by their spectrum. Submitted.
41. M Anastos, Z Jin, M Kwan, B Sudakov. Extremal, enumerative and probabilistic results on ordered hypergraph matchings. Submitted.
40. M Anastos, O Cooley, M Kang and M Kwan. Partitioning problems via random processes. Submitted.
39. M Glasgow, M Kwan, A Sah and M Sawhney. The exact rank of sparse random graphs. Submitted.
38. M Kwan, A Sah, M Sawhney and M Simkin. High-girth Steiner triple systems. *Annals of Mathematics*, to appear.
37. F Brunck and M Kwan. Books, hallways and social butterflies: a note on sliding block puzzles. *The Mathematical Intelligencer*, to appear.
36. M Kwan, A Sah, M Sawhney and M Simkin. Substructures in Latin squares. *Israel Journal of Mathematics* 256 (2023), 363–416.
35. M Kwan, A Sah, L Sauermann and M Sawhney. Anticoncentration in Ramsey graphs and a proof of the Erdős–McKay conjecture. *Forum of Mathematics, Pi* 11:E21 (2023).
34. A Ferber, M Kwan, A Sah and M Sawhney. Singularity of the  $k$ -core of a random graph. *Duke Mathematical Journal* 172.7 (2023), 1293–1332.
33. J Fox, M Kwan and H Spink. Geometric and o-minimal Littlewood–Offord problems. *Annals of Probability* 51.1 (2023), 101–126.

32. M Kwan, A Sah and M Sawhney. Enumerating matroids and linear spaces. *Comptes Rendus Mathématique* 361 (2023), 565–575.
31. A Ferber, M Kwan, B Narayanan, A Sah and M Sawhney. Friendly bisections of random graphs. *Communications of the American Mathematical Society* 2 (2022), 380–416.
30. A Ferber and M Kwan. Dirac-type theorems in random hypergraphs. *Journal of Combinatorial Theory, Series B* 155 (2022), 318–357.
29. M Kwan, A Sah and M Sawhney. Large deviations in random Latin squares. *Bulletin of the London Mathematical Society* 54.4 (2022), 1420–1438.
28. M Kwan, L Sauermann and Y Zhao. Extension complexity of low-dimensional polytopes. *Transactions of the American Mathematical Society*, 375 (2022), 4209–4250.
27. A Ferber, M Kwan and L Sauermann. List-decodability with large radius for Reed–Solomon codes. *IEEE Transactions on Information Theory* 68.6 (2022), 3823–3828. A conference version appeared at FOCS 2021.
26. M Kwan and L Sauermann. On the permanent of a random symmetric matrix. *Selecta Mathematica* 8.15 (2022).
25. A Ferber, M Kwan and L Sauermann. Singularity of sparse random matrices: simple proofs. *Combinatorics, Probability and Computing* 31.1 (2022), 21–28.
24. J Fox, M Kwan and L Sauermann. Combinatorial anti-concentration inequalities, with applications. *Mathematical Proceedings of the Cambridge Philosophical Society* 171.2 (2021), 227–248.
23. Z Chroman, M Kwan and M Singhal. Lower bounds for superpatterns and universal sequences. *Journal of Combinatorial Theory, Series A* 156:105467 (2021).
22. J Fox, M Kwan and L Sauermann. Anticoncentration for subgraph counts in random graphs. *Annals of Probability* 49.3 (2021), 1515–1553.
21. J Fox, M Kwan and B Sudakov. Acyclic subgraphs of tournaments with high chromatic number. *Bulletin of the London Mathematical Society* 53.2 (2021), 619–630.
20. A Ferber and M Kwan. Almost all Steiner triple systems are almost resolvable. *Forum of Mathematics, Sigma* 8:E39 (2020).
19. M Bucic, M Kwan, A Pokrovskiy and B Sudakov. Halfway to Rota’s basis conjecture. *International Mathematics Research Notices* 2020.21 (2020), 8007–8026.
18. X He and M Kwan. Universality of random permutations. *Bulletin of the London Mathematical Society* 52.3 (2020), 515–529.
17. M Bucic, M Kwan, A Pokrovskiy, B Sudakov, T Tran and A Z Wagner. Nearly-linear monotone paths in edge-ordered graphs. *Israel Journal of Mathematics* 238 (2020), 663–685.
16. M Kwan and L Sauermann. An algebraic inverse theorem for the quadratic Littlewood–Offord problem, and an application to Ramsey graphs. *Discrete Analysis* 2020:12 (2020).
15. M Kwan. Almost all Steiner triple systems have perfect matchings. *Proceedings of the London Mathematical Society* 121.6 (2020), 1468–1495.
14. M Kwan, S Letzter, B Sudakov and T Tran. Dense induced bipartite subgraphs in triangle-free graphs. *Combinatorica* 40 (2020), 283–305.
13. M Kwan and B Sudakov. Ramsey graphs induce subgraphs of quadratically many sizes. *International Mathematics Research Notices* 2020.6 (2020), 1621–1638.
12. D Conlon, J Fox, M Kwan and B Sudakov. Hypergraph cuts above the average. *Israel Journal of Mathematics* 233.1 (2019), 67–111.
11. M Kwan and B Sudakov. Proof of a conjecture on induced subgraphs of Ramsey graphs. *Transactions of the American Mathematical Society* 372 (2019), 5571–5594.
10. M Kwan, B Sudakov and T Tran. Anticoncentration for subgraph statistics. *Journal of the London Mathematical Society* 99.3 (2019), 757–777.
9. M Krivelevich, M Kwan, P-S Loh and B Sudakov. The random  $k$ -matching-free process. *Random Structures and Algorithms* 53.4 (2018), 692–716.

8. A Ferber, M Kwan and B Sudakov. Counting Hamilton cycles in sparse random directed graphs. *Random Structures and Algorithms* 53.4 (2018), 592–603.
7. M Kwan, B Sudakov and P Vieira. Non-trivially intersecting multi-part families. *Journal of Combinatorial Theory, Series A* 156 (2018), 44–60.
6. M Kwan and B Sudakov. Intercalates and discrepancy in random Latin squares. *Random Structures and Algorithms* 52.2 (2018), 181–196.
5. A S Bandeira, A Ferber and M Kwan. Resilience for the Littlewood–Offord Problem. *Advances in Mathematics* 319 (2017), 292–312.
4. C Greenhill, M Isaev, M Kwan and B McKay. The average number of spanning trees in sparse graphs with given degrees. *European Journal of Combinatorics* 63 (2017), 6–25.
3. M Krivelevich, M Kwan and B Sudakov. Bounded-degree spanning trees in randomly perturbed graphs. *SIAM Journal on Discrete Mathematics* 31.1 (2017), 155–171.
2. M Krivelevich, M Kwan and B Sudakov. Cycles and matchings in randomly perturbed digraphs and hypergraphs. *Combinatorics, Probability and Computing* 25.6 (2016), 909–927.
1. C Greenhill, M Kwan and D Wind. On the number of spanning trees in random regular graphs. *Electronic Journal of Combinatorics* 21(1):P1.45 (2014).