

JIAOYANG HUANG  
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## Employment

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<b>University of Pennsylvania</b> Assistant Professor	<i>Philadelphia, PA</i> <i>2022–now</i>
<b>Courant Institute, New York University</b> Simons Junior Fellow (Postdoc associate)	<i>New York, NY</i> <i>2020–2022</i>
<b>Institute for Advanced Study</b> Member	<i>Princeton, NJ</i> <i>2019–2020</i>

## Education

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<b>Harvard University</b> Ph.D., Mathematics Advisor: Horng-Tzer Yau	<i>Cambridge, MA</i> <i>2019</i>
<b>Massachusetts Institute of Technology (MIT)</b> B.S., Mathematics	<i>Cambridge, MA</i> <i>2014</i>
<b>Tsinghua University</b> Computer Science and Technology	<i>Beijing, China</i> <i>2010–2011</i>

## Awards

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NSF Career Award	<i>2024</i>
Sloan Research Fellowship	<i>2024</i>
Bernoulli Society New Researcher Award	<i>2024</i>
Upenn Math Department Good Teaching Awards	<i>Fall 2022</i>
Blavatnik Regional Awards	<i>2022</i>
Simons Junior Fellow	<i>2020–2022</i>
Harvard Graduate Society Term-time Research Fellowship	<i>2018–2019</i>
Gold medal in the 50th International Mathematical Olympiad	<i>2009</i>

## Teaching

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Instructor, Probability, University of Pennsylvania	<i>Spring 2025</i>
Instructor, Random Matrix Theory and Applications, University of Pennsylvania	<i>Spring 2023, 2024</i>
Instructor, Probability Theory, University of Pennsylvania	<i>Fall 2024, 2023, 2022</i>
Instructor, Calculus 2, New York University	<i>Fall 2021</i>
Lecturer, Summer School: RMT 2019 at LA, UCLA	<i>Summer 2019</i>
Instructor, Calculus, Math 1b, Harvard University	<i>Fall 2016, 2017</i>

## Invited Talks

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*2025:* University of Connecticut: AMS Special Session on Probability and Combinatorics. Princeton ORFE Wilks Memorial Seminar in Statistics. Joint IAS/Princeton Universality Groups and Dynamics Seminar.

*2024:* CIRM: Random Hyperbolic Surfaces and Random Graphs. University of Chicago: Probability and Statistical Physics Seminar. Advances in Probability Theory and Interacting Particle Systems: A

Conference in Honor of S. R. Srinivasa Varadhan. Bernoulli-IMS Worldcongress 2024: New Researcher Award Session. JSM 2024: Advances in Statistical Learning and Uncertainty Quantification: Theory and Computation. Peking University: Colloquium. Tsinghua, Yau Mathematical Sciences Center: Probability Seminar. Harvard: Statistics Colloquium Series. Harvard: The Current Developments in Mathematics (CDM) Conference.

2023: Columbia University: Informal Mathematical Physics Seminar. New York University: Probability Seminar. ICERM Workshop: Asymptotic Limits of Discrete Random Structures. University of California Berkeley: Probability Seminar. EcoSta 2023: Workshop on recent advances in high-dimensional statistics and machine learning. The second International Conference for Chinese Young Probability Scholars: Universality in Probability Theory and Statistical Physics. New Jersey Institute of Technology: Statistics Seminar. Princeton: Physics for Neural Networks. University of Pennsylvania: Student Seminar. Columbia University: Probability Seminar.

2022: Yale: Statistics and Data Science Department Seminar. Princeton: Probability Seminar. MIT: Stochastics and Statistics Seminar. University of California, Davis: QMATH 15 Conference. University of North Carolina at Chapel Hill: Southeastern Probability conference 2022. Harvard University: New Frontiers: Interactions between Quantum Physics and Mathematics. Spectral Geometry in the Clouds. Northwestern University: Laplacians on Random Hyperbolic Surfaces and on Random Graphs. University of California San Diego: Probability Seminar. University of Pennsylvania: Wharton Statistics and Data Science Seminars. Brown University: Applied Math Seminar. University of California, Los Angeles: Probability Seminar.

2021: National University of Singapore: Young Mathematician Lecture Series. University of California Berkeley: Probability seminar. Carnegie Mellon University: Probability seminar. Northwestern University: Analysis seminar. University of Washington: Probability seminar. Cornell University: Probability Seminar. University of Chicago: Probability Seminar. New Jersey Institute of Technology: Applied Math Colloquium. MSRI: Connections and Introductory Workshop. New York University: Student Probability Seminar. University of Victoria: Applied Math Seminar.

2020: Columbia University: Integrable Probability Seminar. THU-PKU-BNU Joint Probability Webinar. University of Kansas: KU Probability and Statistics Seminar. One World Probability Seminar. Stanford University: Probability Seminar. University of Minnesota: Probability Seminar. University of Wisconsin-Madison: Probability Seminar. University of Pennsylvania: Penn/Temple Probability Seminar. Columbia University: Probability Seminar.

2019: University of Michigan: Integrable Systems and Random Matrix Theory Seminar. University of Strasbourg: Probability Seminar. 8th Strasbourg/Zurich Meeting: Frontiers in Analysis and Probability. Yale University: Combinatorics Seminar. IAS Analysis-Mathematical Physics Seminar. Google. CIRM: Random Matrices and Random Graphs. Brandeis University: Brandeis-Harvard-MIT-Northeastern Joint Mathematics Colloquium. Brown University: 6th Annual AMS Grad Student Conferences at Brown. University of Chicago: Probability Seminar.

2018: Oberwolfach Workshop: Free Probability Theory. Ohio State University: Probability Seminar. MIT: FRG Integrable probability meeting. Cornell University: Probability Seminar. Princeton University: Topics in Probability Seminar. MIT: Combinatorics Seminar. Columbia University: Probability Seminar. University of Virginia: Probability Seminar. Gothenburg: Conference on Stochastic Processes and their Applications. IPAM: Workshop "Random Matrices and Free Probability Theory". Northeastern University: AMS Special Session on The Gaussian Free Field and Random Geometry.

2017: ENS Lyon: Conference "ProbabLY ON Random Matrices". University of Wisconsin-Madison: Combinatorics Seminar.

1. *Local Statistics and Concentration for Non-intersecting Brownian Bridges With Smooth Boundary Data*  
with Amol Aggarwal, Accepted by Communications in Mathematical Physics 2025.
2. *Edge Universality of Sparse Random Matrices*  
with Horng-Tzer Yau, Accepted by Annales de l'Institut Henri Poincaré 2024.
3. *Edge Statistics for Lozenge Tilings of Polygons, II: Airy Line Ensemble*  
with Amol Aggarwal, Accepted by Forum of Mathematics, Pi, 2024.
4. *Edge Rigidity of Dyson Brownian Motion with General Initial Data*  
with Amol Aggarwal, Electronic Journal of Probability, 29: 1-62, 2024.
5. *Asymptotics of Generalized Bessel Functions and Weight Multiplicities via Large Deviations of Radial Dunkl Processes*  
with Colin McSwiggen, Probability Theory and Related Fields, 190, 941–1006, 2024.
6. *Efficient, Multimodal, and Derivative-Free Bayesian Inference With Fisher-Rao Gradient Flows*  
with Yifan Chen, Daniel Zhengyu Huang, Jiaoyang Huang, Sebastian Reich and Andrew M Stuart, Inverse Problems, 40(12), 2024.
7. *Pearcey universality at cusps of polygonal lozenge tiling*  
with Fan Yang and Lingfu Zhang, Communications on Pure and Applied Mathematics, 77(9), 3708-3784, 2024.
8. *Dynamical Loop Equation*  
with Vadim Gorin, The Annals of Probability, 52(5), 1758-1863, 2024.
9. *High-dimensional SGD Aligns with Emerging Outlier Eigenspaces*  
with Gerard Ben Arous, Reza Gheissari and Aukosh Jagannath, International Conference on Learning Representations (ICLR), 2024.
10. *Spectrum of Random  $d$ -regular Graphs Up to the Edge*  
with Horng-Tzer Yau, Communications on Pure and Applied Mathematics, 77(3), 1635-1723, 2024.
11. *Edge Statistics for Lozenge Tilings of Polygons, I: Concentration of Height Function on Strip Domains*  
Probability Theory and Related Fields, 1-149, 2023.
12. *Large Deviations Asymptotics of Rectangular Spherical Integral*  
with Alice Guionnet, Journal of Functional Analysis 285 (11), 110-144, 2023.
13. *Long Random Matrices and Tensor Unfolding*  
with Gérard Ben Arous and Daniel Z Huang, Annals of Applied Probability 33 (6B), 5753-5780, 2023.
14. *How Does Information Bottleneck Help Deep Learning?*  
with Kenji Kawaguchi, Zhun Deng and Xu Ji, International Conference on Machine Learning (ICML), 2023
15. *Efficient Derivative-free Bayesian Inference for Large-Scale Inverse Problems*  
with Daniel Z Huang, Sebastian Reich and Andrew M Stuart, Inverse Problems, 2022.

16. *PatchGT: Transformer over Non-trainable Clusters for Learning Graph Representations*  
with Han Gao, Xu Han, Jian-Xun Wang and Liping Liu, Learning on Graphs Conference, 2022.
17. *Robustness Implies Generalization via Data-Dependent Generalization Bounds*  
with Kenji Kawaguchi, Zhun Deng and Kyle Luh, International Conference on Machine Learning (ICML), 2022.
18. *Eigenvalues for the Minors of Wigner Matrices*  
Annales de l'Institut Henri Poincaré, Probabilités et Statistiques, 58(4), 2201-2215, 2022.
19. *Large Deviation Principles via Spherical Integrals*  
with Serban Belinschi and Alice Guionnet,  
Accepted by Probability and Mathematical Physics, 2022.
20. *Power Iteration for Tensor PCA*  
with Guang Cheng, Daniel Z. Huang and Qing Yang, Journal of Machine Learning Research, 23(128), 1-47, 2022.
21. *Invertibility of adjacency matrices for random  $d$ -regular graphs*  
Duke Mathematical Journal 170(18): 3977-4032, 2021.
22. *Understanding End-to-End Model-Based Reinforcement Learning Methods as Implicit Parameterization*  
with Clement Gehring, Kenji Kawaguchi, and Leslie Pack Kaelbling, Advances in Neural Information Processing Systems (NeurIPS), 2021.
23. *How Shrinking Gradient Noise Helps the Performance of Neural Networks*  
IEEE International Conference on Big Data (Big Data), 1002-1007, 2021
24. *Law of Large Numbers and Central Limit Theorems by Jack Generating Functions*  
Advances in Mathematics 380, 107545, 2021
25.  *$\beta$ -Nonintersecting Poisson Random Walks: Law of Large Numbers and Central Limit Theorems*  
International Mathematics Research Notices (8), 5898-5942, 2021.
26. *Edge rigidity and universality of random regular graphs of intermediate degree*  
with Roland Bauerschmidt, Knowles Antti and Horng-Tzer Yau, Geometric and Functional Analysis, 30(3):693–769, 2020.
27. *Dyson Brownian Motion for General  $\beta$  and Potential at the Edge*  
with Arka Adhikari, Probability Theory and Related Fields, 178(3), 893–950, 2020
28. *Transition from Tracy-Widom to Gaussian fluctuations of extremal eigenvalues of sparse Erdős-Rényi graphs*  
with Benjamin Landon and Horng-Tzer Yau, Annals of Probability, 48(2), 916–962, 2020.
29. *Spectral statistics of sparse Erdős-Rényi graph Laplacians*  
with Benjamin Landon, Annales de l'Institut Henri Poincaré, Probabilités et Statistiques, 56(1), 120–154, 2020.
30. *Towards Understanding the Dynamics of the First-Order Adversaries*  
with Zhun Deng, Hangfeng He and Weijie Su, In Proceedings of the 37th International Conference on Machine Learning, 2020.
31. *Dynamics of deep neural networks and neural tangent hierarchy*  
with Horng-Tzer Yau, In Proceedings of the 37th International Conference on Machine Learning, 2020.

32. *Rigidity and Edge Universality of Discrete  $\beta$ -Ensembles*  
with Alice Guionnet, Communications on Pure and Applied Mathematics, 72(9), 1875–1982, 2019.
33. *Local Law and Mesoscopic Fluctuations of Dyson Brownian Motion for General  $\beta$  and Potentials*  
with Benjamin Landon, Probability Theory and Related Fields, 175(1-2), 209–253, 2019.
34. *Local Kesten–McKay Law for Random Regular Graphs*  
with Roland Bauerschmidt and Horng-Tzer Yau, Communications in Mathematical Physics, 369(2), 523–636, 2019.
35. *Asymptotic Expansion of Spherical Integral*  
Journal of Theoretical Probability, 32(2), 1051–1075, 2019.
36. *Gradient descent finds global minima for generalizable deep neural networks of practical sizes*  
with Kenji Kawaguchi, In Proceedings of the 57th Allerton Conference on Communication, Control, and Computing (Allerton), IEEE, 2019.
37. *Every Local Minimum Value is the Global Minimum Value of Induced Model in Non-convex Machine Learning*  
with Kenji Kawaguchi and Leslie Pack Kaelbling, Neural Computation, 31(12), 2293–2323, MIT press, 2019.
38. *Effect of Depth and Width on Local Minima in Deep Learning*  
with Kenji Kawaguchi and Leslie Pack Kaelbling, Neural Computation, 31(7), 1462–1498, MIT press, 2019.
39. *Mesoscopic Perturbations of Large Random Matrices*  
Random Matrices: Theory and Applications, 7(02), 1850004, 2018.
40. *Eigenvector Statistics of Sparse Random Matrices*  
with Paul Bourgade and Horng-Tzer Yau, Electronic Journal of Probability, 22, 2017.
41. *Bulk eigenvalue statistics for random regular graphs*  
with Roland Bauerschmidt, Antti Knowles and Horng-Tzer Yau, Annals of Probability, 45(6A), 3626–3663, 2017.
42. *Laurent Phenomenon Sequences*  
with Joshua Alman and Cesar Cuenca, Journal of Algebraic Combinatorics, 43(3), 589–633, 2016.
43. *Bulk universality of sparse random matrices*  
with Benjamin Landon and Horng-Tzer Yau, Journal of Mathematical Physics, 56(12), 123301, 2015.

## Preprints or Submitted Articles

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1. *Edge Universality of Random Regular Graphs of Fixed Degrees*  
with Theo McKenzie and Horng-Tzer Yau, arXiv preprint: 2412.20263, 2024.
2. *The Spectral Distribution of Random Graphs with Given Degree Sequences*  
with Shuyi Wang and Kevin Li, arXiv preprint: 2412.02087, 2024.
3. *A Convergence Framework For  $\text{Airy}_\beta$  Line Ensemble via Pole Evolution*  
with Lingfu Zhang, arXiv preprint: 2411.10586, 2024.

4. *Extremal Eigenvalues of Random Kernel Matrices with Polynomial Scaling*  
with David Kogan and Sagnik Nandy, arXiv preprint: 2410.17515, 2024.
5. *Asymptotics of Symmetric Polynomials: A Dynamical Point of View*  
with Alice Guionnet, arXiv preprint: 2409.04621, 2024.
6. *Fluctuations for Non-Hermitian Dynamics*  
with Paul Bourgade and Giorgio Cipolloni, arXiv preprint: 2409.02902, 2024.
7. *Fisher-Rao Gradient Flow: Geodesic Convexity and Functional Inequalities*  
with José A Carrillo, Yifan Chen, Daniel Zhengyu Huang and Dongyi Wei, arXiv preprint: 2407.15693, 2024.
8. *Convergence Analysis of Probability Flow ODE for Score-based Generative Models*  
with Daniel Zhengyu Huang and Zhengjiang Lin, arXiv preprint: 2404.09730, 2024.
9. *Fluctuation of the Largest Eigenvalue of a Kernel Matrix with application in Graphon-based Random Graphs*  
with Anirban Chatterjee, arXiv preprint: 2401.01866, 2024.
10. *Sampling via Gradient Flows in the Space of Probability Measures*  
with Yifan Chen, Daniel Zhengyu Huang, Sebastian Reich and Andrew M Stuart, arXiv preprint: 2310.03597, 2023.
11. *Strong Characterization for the Airy Line Ensemble*  
with Amol Aggarwal, arXiv preprint: 2308.11908, 2023.
12. *Edge universality of random regular graphs of growing degrees*  
with Horng-Tzer Yau, arXiv preprint: 2305.01428, 2023.
13. *Gradient Flows for Sampling: Mean-Field Models, Gaussian Approximations and Affine Invariance*  
with Yifan Chen, Daniel Zhengyu Huang, Sebastian Reich and Andrew M. Stuart, arXiv preprint: 2302.11024, 2023.
14. *Edge Universality for Nonintersecting Brownian Bridges*  
arXiv preprint: 2011.01752, 2020.
15. *Height Fluctuations of Random Lozenge Tilings Through Nonintersecting Random Walks*  
arXiv preprint: 2011.01751, 2020.

## Professional Service

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**Co-organizer for:** Upenn probability seminar (2022-now). Upenn statistics and data science department seminar (2022-2023). Harvard student probability seminar (2018-2019).

**Reviewer for:** Ann. Appl. Probab., Ann. of Math., Ann. Probab., Comm. Math. Phys., C. R. Math. Acad. Sci. Paris, Duke Math. J., Electron. Commun. Probab., Electron. J. Probab., Probab., IEEE TPAMI, IEEE Trans. Inform. Theory, Int. Math. Res. Not., Invent. math., J. Eur. Math. Soc., J. Funct. Anal., J. Theoret. Probab., Probab. Theory Related Fields, Proc. Lond. Math. Soc. Publications mathématiques de l’IHÉS,

**Ph.D. Thesis Committee:** Donghwan Lee (Upenn), Sagnik Nandy (Upenn), Mauricio Daros Andrade (Upenn), Anirban Chatterjee (Upenn), Krishnan Mody (NYU).

**Master Thesis Committee:** Kevin Li (Upenn), Arjun Shah (Upenn).