Justin Ko

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Research High-dimensional probability, spin glasses, random matrices.

Employment

Syracuse University 2025 -
- Assistant Professor
- Department: Mathematics
- Research Groups: Probability and Statistics

University of Waterloo 2023 - 2025
- Postdoctoral Researcher
- Supervisor: Aukosh Jagannath

École Normale Supérieure de Lyon 2020 - 2023
- Postdoctoral Researcher
- Supervisors: Alice Guionnet, Florent Krzakala, and Lenka Zdeborová

Education

University of Toronto 2015 - 2020
- PhD Mathematics
- Thesis: The Free Energy of Spherical Vector Spin Glasses
- Advisor: Dmitry Panchenko

University of Toronto 2014 - 2015
- MSc Mathematics
- Research Project: Diluted spin glass models

University of British Columbia 2009 - 2014
- Bachelor of Commerce, Finance Co-op, Minor Mathematics

Papers

1. The Free Energy of an Enriched Continuous Random Energy Model in the Weak Correlation Regime (with A. Alban and F. Ho)
   arXiv: 2508.17313 (2025)
2. Dynamical mean-field analysis of adaptive Langevin diffusions: Replica-symmetric fixed point and empirical Bayes (with Zhou Fan, Bruno Loureiro, Yue M. Lu and Yandi Shen)
   arXiv:2504.15558 (2025)
3. Dynamical mean-field analysis of adaptive Langevin diffusions: Propagation-of-chaos and convergence of the linear response (with Zhou Fan, Bruno Loureiro, Yue M. Lu and Yandi Shen)
   arXiv:2504.15556 (2025)
4. Pseudo-Maximum Likelihood Theory for High-Dimension Rank One Inference (with Curtis Grant and Aukosh Jagannath)
   arXiv:2503.01708 (2024) *Submitted*
5. On the phase diagram of extensive-rank symmetric matrix denoising beyond rotational invariance (with Jean Barbier, Francesco Camilli, Koki Okajima)
   Phys. Rev. X. 2025, Vol 15, 021085

6. A multiscale cavity method for sublinear-rank symmetric matrix factorization. (with Jean Barbier and Anas Rahman)
International Zurich Seminar on Information and Communication (IZS 2024)
7. Fundamental limits of Non-Linear Low-Rank Matrix Estimation. (with Florent Krzakala, Pierre Mergny and Lenka Zdeborová)
Proceedings of Thirty Seventh Conference on Learning Theory (COLT 2024), PMLR 247:3873-3873
8. Spectral Phase Transition and Optimal PCA in Block-Structured Spiked models. (with Florent Krzakala and Pierre Mergny)
Proceedings of the 41st International Conference on Machine Learning (ICML 2024), PMLR 235:35470-35491
9. Spectral Phase Transitions in Non-Linear Wigner Spiked Models. (with Alice Guionnet, Florent Krzakala, Pierre Mergny and Lenka Zdeborová)
arXiv:2310.14055 (2023) *Submitted.*
10. Estimating rank-one matrices with mismatched prior and noise: universality and large deviations. (with Alice Guionnet, Florent Krzakala and Lenka Zdeborová),
Commun. Math. Phys. 406, 9 (2025)
11. TAP variational principle for the constrained multiple spherical SK model. (with David Belius and Leon Fröber)
arXiv:2304.04031 (2023) *Submitted. Major Revisions at the Annals of Applied Probability*
12. Optimal Algorithms for the Inhomogeneous Spiked Wigner Model (with Florent Krzakala and Aleksandr Pak)
Advances in Neural Information Processing Systems 36 (NeurIPS 2023)
13. Low-rank Matrix Estimation with Inhomogeneous Noise (with Alice Guionnet, Florent Krzakala and Lenka Zdeborová)
Inf. Inference. 2025, Vol 14, Issue 2, 1 - 80
14. Spherical Integrals of Sublinear Rank (with Jonathan Husson)
Probab. Theory Relat. Fields 2025, Vol 193, pages 1–88
15. The Crisanti–Sommers Formula for Spherical Spin Glasses with Vector Spins,
arXiv:1911.04355 (2019) *Under Revision.*
16. Free Energy of Multiple Systems of Spherical Spin Glasses with Constrained Overlaps,
Electron. J. Probab. 2020, Vol. 25, No. 28, 1-34
17. MAX κ-CUT and the inhomogeneous Potts spin glass (with Aukosh Jagannath and Subhabrata Sen),
Ann. Appl. Probab. 2018, Vol. 28, No. 3, 1536-1572

Invited Talks

1. Cornell Probability Seminar	Oct 2025
2. Syracuse HETCOSMO Seminar	Sept 2025
3. Log Gasses in Caeli Australi	Aug 2025
4. INFORMS Applied Probability Society Conference	July 2025
5. Phase Transitions and Dynamics in Random Media	June 2025
6. University of Toronto Probability Seminar	Nov 2024
7. Georgia Tech Stochastic Seminar	Sep 2024
8. Rockin' AI Conference in Roccella	Sep 2024
9. Conference on Learning Theory (COLT) 2024	Jun 2024

10. CMS Winter Session on Random Matrix Theory — Dec 2023
11. Northwestern University Probability Seminar — Oct 2023
12. University of Waterloo Probability Seminar — Oct 2023
13. Cargese Summer School: Statistical physics and machine learning — Aug 2023
14. ICTP Learning and Inference from Structured Data — Jul 2023
15. LN-UMN Joint Probability Seminar — Feb 2023
16. LPSM Probability Seminar — Feb 2023
17. Grenoble-Lyon-Geneva Probability Meeting — Nov 2022
18. Les Diablerets Spin Glass Workshop — Oct 2022
19. St Flour Probability School — Jul 2022
20. ICTP Youth In High Dimensions — Jun 2022
21. University of Toulouse III Probability Seminar — Jun 2021
22. University of Waterloo Probability Seminar — Mar 2021
23. University of Basel Probability Seminar — Mar 2020

Teaching

Course Instructor

- MAT521 - Introduction to Probability — 2025
- ACTSC624 - Stochastic Processes for Actuarial Science — 2025
- STAT230 - Probability — 2024
- APM346 - Partial Differential Equations — 2020
- MAT186 - Calculus I — 2019
- MAT136 - Calculus I(B) — 2019
- MAT186 - Calculus I — 2018

Teaching Assistant

- MAT377, MAT1600, APM346 — 2019 - 2020
- MAT377, APM346 — 2018 - 2019
- MAT1600, MAT1601, MAT133, MAT223, APM346 — 2017 - 2018
- MAT457, MAT236, MAT267, MAT244, MAT232, APM346 — 2016 - 2017
- MAT133, MAT237, MATA35, STAB52, STA256 — 2015 - 2016
- MAT135, MAT136, MAT133 — 2014 - 2015

Awards

1. Ida Bulat Teaching Award for Graduate Students, UofT — 2020
2. Queen Elizabeth II Graduate Scholarship, UofT — 2019 - 2020
3. Scotiabank Scholarship, UBC — 2009 - 2013
4. Sauder School of Business Dean's Scholarship, UBC — 2010

Conferences & Seminars Organized

1. Waterloo Probability Seminar (Co-organizer) — 2023 - 2025
   - Waterloo, Canada
2. High Dimensional Statistics and Random Matrices (Co-organizer) — 2023
   - Porquerolles, France
3. Large Deviations and Random Matrices Working Group — 2022 - 2023
   - Lyon, France

Industry Experience

Economist (SmartWay Program) — 2013 - 2014

- Natural Resources Canada, Ottawa, On