RON NISSIM

PhD Student of Mathematics
Massachusetts Institute of Technology

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Research Interests

Currently I am primarily interested in lattice Yang–Mills theory and related lattice statistical physics models, as well as topics in random matrix theory such as the Weingarten calculus and β ensembles.

Papers

1. **Deconfinement for $\mathrm{SO}(3)$ Lattice Yang–Mills at Strong Coupling**. arXiv:2605.16162
2. **Formalization of QFT: Osterwalder–Schrader Axioms for the Free Field in Lean 4** (with Michael R. Douglas, Sarah Hoback, and Anna Mei). 3rd AI for Math Workshop at the 43rd International Conference on Machine Learning (ICML), Seoul, South Korea, 2026 · Poster paper. arXiv:2603.15770
3. **$\mathrm{U}(N)$ lattice Yang-Mills in the 't Hooft regime**. Submitted. arXiv:2510.22788
4. **Dynamical approach to area law for lattice Yang-Mills** (with Sky Cao and Scott Sheffield). To appear in Proceedings of the American Math Society. arXiv:2509.04688
5. **Expanded regimes of area law for lattice Yang–Mills theories** (with Sky Cao and Scott Sheffield). In revisions for Annals of Probability. arXiv:2505.16585
6. **Sharp estimates for large N Weingarten functions**. In revisions for Letters in Mathematical Physics. arXiv:2502.15892
7. **On the Limit of the Tridiagonal Model for β–Dyson Brownian Motion** (with Alan Edelman and Sungwoo Jeong). Submitted. arXiv:2411.01633
8. **Geometric Derivation of the Finite N Master Loop Equation** (with Omar Abdelghani). arXiv:2309.07399
9. **Edgeworth-type expansion for the one-point distribution of the KPZ fixed point with a large height at a prior location** (with Ruixuan Zhang). Ann. Inst. H. Poincaré Probab. Statist. 62(2): 1455-1477 (May 2026). arXiv:2210.04999

Seminar and Conference Talks

1. 'Expanded Regime of Area Law for Lattice Yang–Mills Theories' **International Congress of Mathematics** (July 2026)
2. 'Confinement and Deconfinement in Lattice Yang–Mills Theory' **Peking Summer in Probability** (June 2026)
3. 'Area Law and Mass Gap for Lattice Yang–Mills at Strong Coupling' – **MIT Probability Seminar** (May 2026)
4. 'From Weingarten Functions to Random Trees and the Brownian CRT' **Northeast American Math Society Sectional Meeting** (March 2026)
5. 'Area Law and Mass Gap for Lattice Yang–Mills at Strong Coupling' – **Brin Math Research Center: Statistical Mechanics of Lattice Systems** (March 2026)
6. 'Lattice Yang–Mills at Strong Coupling' – **Northeast Probability Seminar** (November 2025)
7. 'Lattice Yang–Mills at Strong Coupling' – **University of Chicago Probability Seminar** (October 2025)
8. 'Lattice Yang–Mills at Strong Coupling' – **UC San Diego Probability Seminar** (September 2025)

9. 'On the Limit of the Tridiagonal Model for β–Dyson Brownian Motion' – **Northeast Probability Seminar** (November 2024)
10. 'Asymptotics of the one-point distribution of the KPZ fixed point conditioned on a large height at an earlier point.' – **MIT Integrable Probability Seminar** (April 2023)

Conference Posters

1. 'Formalization of QFT: Osterwalder–Schrader Axioms for the Free Field in Lean 4' **International Conference for Machine Learning** (July 2026)
2. 'From Weingarten Functions to Random Trees and the Brownian CRT' **Random Explorations: From Random Walks to Random Geometry IMSI** (July 2026)
3. 'Area Law and Mass Gap for Lattice Yang–Mills at Strong Coupling' **Probabilistic Paths to Quantum Field Theory, Simon's Collaboration Annual Meeting** (May 2026)

Education

2022–present *PhD in Mathematics*, Massachusetts Institute of Technology
Advisor: Scott Sheffield
GPA: 4.9 (out of 5)

2018–2022 *B.A. in Honors Mathematics*, New York University, May 2022
GPA: 3.83 (out of 4), Math GPA: 3.98

Teaching and Mentorship

January 2026 *Directed Reading Program*, Mentored two undergraduate students, Diego Caballero, Davit Kldiashvili, reading Berestycki and Powell's book *Gaussian free field and Liouville quantum gravity*.

Fall 2025 *Recitation Leader*, 18.02 Multivariable Calculus.

Summer 2024 *Summer Program in Undergraduate Research*, Mentored undergraduate student Enrique Rivera in project titled '$\mathrm{U}(1)$ lattice gauge theory and random height functions'

Spring 2024 *Teaching Assistant/Grader*, 18.676 Stochastic Calculus.

January 2024 *Directed Reading Program*, Mentored three undergraduate students, Brandon Wang, Enrique Rivera, Matija Delic, reading Le Gall and Miermont's notes *Scaling limits of random trees and planar maps*.

Fall 2023 *Teaching Assistant/Grader*, 18.338 Random Matrix Theory.

Summer-Fall 2023 *Undergraduate Research Opportunity*, Mentored undergraduate student Omar Abdelghani in project titled, 'Geometric Derivation of the Finite N Master Loop Equation'

January 2023 *Directed Reading Program*, Mentored an undergraduate student, Saba Lepsveridze, reading Van Handel's book *High Dimensional Probability*.

Academic Service
I served as a reviewer for the following journals:

1. Annales Henri Poincaré
2. Bulletin of the American Math Society
3. Communications in Mathematical Physics
4. Courant Journal of Pure and Applied Math
5. Electronic Journal of Probability