Roan Alexander James

Talks, Lectures, Conferences, and Schools

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TALKS AND LECTURES

Summer Lecture Series: Introduction to Polymer Models

A six-lecture introductory series on directed polymers in a random environment, aimed at graduate students with a background in basic probability. The series developed the model from first principles and built toward the modern picture of the weak-disorder/strong-disorder phase transition.

- **Lecture 1: Directed Polymers in a Random Environment**
  Summer Lecture Series, University of Rochester
  The polymer measure on nearest-neighbour paths, the random environment $\{\omega(n,x)\}$, and the partition function
  $$Z_n = \mathbb{E}_S\left[\exp\left(\beta\sum_{k=1}^{n}\omega(k,S_k)\right)\right].$$
  Motivation from statistical mechanics and first examples.

- **Lecture 2: The Partition Function as a Martingale**
  Summer Lecture Series, University of Rochester
  The normalised partition function $W_n = Z_n/\mathbb{E}[Z_n]$, its martingale property with respect to the environment filtration, and the almost-sure limit W_∞.

- **Lecture 3: The Zero–One Law and the Phase Transition**
  Summer Lecture Series, University of Rochester
  The dichotomy $\mathbb{P}(W_\infty = 0) \in \{0,1\}$, the definition of the weak- and strong-disorder phases, and the critical inverse temperature β_c.

- **Lecture 4: Weak Disorder and L^2 Techniques**
  Summer Lecture Series, University of Rochester
  Second moment computations, the replica overlap $\sum_n \mathbb{P}(S_n = \widetilde{S}_n)$, and uniform integrability of W_n in dimensions $d \geq 3$.

- **Lecture 5: Strong Disorder, Localisation, and Low Dimensions**
  Summer Lecture Series, University of Rochester
  Why strong disorder holds for all $\beta > 0$ when $d = 1, 2$; localisation of the path measure and the role of the free energy.

- **Lecture 6: Scaling Limits and Connections to the KPZ Class**
  Summer Lecture Series, University of Rochester
  Intermediate-disorder scaling, convergence of the rescaled partition function to the solution of the stochastic heat equation, and an outlook on KPZ universality.

Graduate Student Seminar: The Stochastic Heat Equation

Two talks for the Graduate Student Seminar introducing the stochastic heat equation and its role as a scaling limit in random-environment models.

- **The Stochastic Heat Equation, Part I: Construction and Mild Solutions**
  Graduate Student Seminar, University of Rochester
  Space–time white noise, the multiplicative stochastic heat equation

  $$\partial_t u = \tfrac{1}{2}\Delta u + \beta u \dot{W},$$

  Walsh stochastic integration, and existence and uniqueness of mild solutions via Picard iteration.

- **The Stochastic Heat Equation, Part II: Chaos Expansion and the KPZ Connection**
  Graduate Student Seminar, University of Rochester
  The Wiener chaos expansion of the solution, positivity and moment bounds, the Hopf–Cole transform $h = \log u$ linking the stochastic heat equation to the KPZ equation, and intermittency.

Probability Seminar and Workshops

- **The Second Moment Method for the Partition Function**
  Probability Seminar, University of Rochester
  A talk on the second moment method as a tool for establishing weak disorder. Starting from the Paley–Zygmund inequality

  $$\mathbb{P}(W > 0) \geq \frac{(\mathbb{E}W)^2}{\mathbb{E}[W^2]},$$

  the second moment of the normalised partition function was expressed in terms of the expected overlap of two independent copies of the underlying random walk. The talk explained how transience in $d \geq 3$ leads to uniform L^2 bounds for sufficiently small β, and also discussed the limitations of the method in low dimensions.

- **Simple Random Walks and Discrete Stochastic Differential Equations**
  Vertical Integration Workshop, University of Rochester April 18, 2026
  Simple random walk models in random environments and their connection to stochastic partial differential equations. Suitably scaled partition functions were interpreted as discrete analogues of solutions to the Parabolic Anderson Model, providing a natural framework for constructing SPDE solutions through discrete models. Joint work with Arjun Krishnan.

CONFERENCE AND SCHOOL ATTENDANCE

Date	Conference or School	Location	Financial Support
September 2024	Conference on New Developments in Probability	Centre de Recherches Mathématiques, Montreal	$1,000 in travel expenses
October 2024	44th Midwest Probability Conference	Northwestern University, Evanston, Illinois	$750 in travel expenses
November 2024	Northeast Probability Seminar	Columbia University, New York	$700 in travel expenses
June 2025	School on Interacting Particle Systems and Random Matrix Theory	Alfréd Rényi Institute, Budapest	Accommodation and $1,000 in travel expenses
November 2025	Northeast Probability Seminar	New York University, New York	$700 in travel expenses
June 2026	MSRI Summer School: Random Growth Models and Hamilton–Jacobi Equations	University of California, Berkeley	Accommodation and $850 in travel expenses
July 2026	Seminar on Stochastic Processes 2026	Union College, Schenectady, New York	Accommodation and $250 in travel expenses