Scaling limit of the Directed Polymer, SHE, and KPZ in dimension $2+1$

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Abstract

In this talk, we will review recent results on the scaling limit of the directed polymer model in dimension $2+1$ (2 for space, 1 for time) and closely related results for the stochastic heat equation (SHE) and the KPZ equation. The directed polymer model is a disordered system where the law of a random walk is perturbed by a space-time random environment (disorder). Whether or not small disorder perturbations will always change the diffusive nature of the walk depends on the spatial dimension d. The answer is affirmative for $d = 1$ and 2, but negative for $d \geq 3$. In $d = 1$, Alberts-Khanin-Quastel'14 showed that under a suitable weak disorder and continuum limit, the family of partition functions of the directed polymer converges to the solution of SHE. In the critical dimension $d = 2$, the picture is more complicated and a phase transition emerges. Nevertheless, in joint work with F. Caravenna and N. Zygouras, we identified the scaling limit of the directed polymer partition functions in the entire subcritical regime, with corollaries for the two-dimensional SHE and KPZ.