Research Highlight: Two-dimensional Kardar-Parisi-Zhang (KPZ) equation in the subcritical regime

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The KPZ equation is a stochastic partial differential equation (SPDE) driven by a space-time white noise, which models the growth of a large class of random surfaces. It is one of the best-known singular SPDE's due to the presence of singular terms that cannot be defined via conventional means.

In spatial dimension 1, a solution theory for the KPZ equation has been developed by M. Hairer, known as regularity structures. However, in spatial dimension 2, a solution theory is still lacking. Previously, in joint work with F. Caravenna and N. Zygouras [1], we identified a phase transition for the two-dimensional KPZ equation on an intermediate disorder scale, as the mollification of the driving noise is gradually removed. In this work [2], we show that in the entire subcritical regime, the solution of the mollified KPZ equation converges to a Gaussian limit that solves a SPDE known as the Edwards-Wilkinson equation. In a sense, this gives a meaning to the solution of the 2-dimensional KPZ in the subcritical regime.

References:

[1] Francesco Caravenna, Rongfeng Sun, and Nikos Zygouras. Universality in marginally relevant disordered systems. *Ann. Appl. Probab.* **27**, 3050-3112, 2017.

[2] Francesco Caravenna, Rongfeng Sun, and Nikos Zygouras. The two-dimensional KPZ equation in the entire subcritical regime. *Annals of Probability* **48**, 1086-1127, 2020.