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Dannie Heineman Prize for Mathematical Physics Talk: Shape fluctuations of growing droplets and random matrix theory

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In 1986 Kardar, Parisi, and Zhang (KPZ) proposed a stochastic evolution equation for growing interfaces, thereby triggering an intense study of growth processes with local growth rules. Specifically we have in mind the recent spectacular experiment of Takeuchi and Sano [1] on droplet growth in a thin film of turbulent liquid crystal. Over the last ten years one has studied universal probability density functions on the basis of simplified lattice growth models. Surprisingly enough the one-point shape fluctuations are governed by the same statistical laws as the largest eigenvalue of a random matrix, Gaussian Unitary Ensemble (GUE) in case of a curved front and Gaussian Orthogonal Ensemble (GOE) for a flat front. Recently we obtained the first exact solution of the KPZ equation for initial conditions corresponding to droplet growth, thereby providing the probability density function for the height at any time [2]. For long times we recover the universal statistical properties as computed from lattice growth models.

[1] K.Takeuchi and M.Sano, Phys. Rev. Lett. **104**, 230601 (2010).
[2] T.Sasamoto and H.Spohn, Phys. Rev. Lett. **104**, 230602 (2010).