Christian B. Mendl (Technische Universität Dresden):

(Nonlinear) Fluctuating Hydrodynamics and Physics on Mesoscopic Scales

Abstract:

The topic of the lecture are surprising connections between statistical physics on mesoscopic scales and a nonlinear extension of fluctuating hydrodynamics elevated to a stochastic PDE, which is then identified as the famous Kardar-Parisi-Zhang (KPZ) equation. Specifically, the framework starts from a microscopic (Fermi-Pasta-Ulam type) model of interacting particles in one dimension, and then uses the microscopic conservation laws to arrive at a stochastic description on a mesoscopic scale. Intuitively, one assumes that local regions of the system are close to thermal equilibrium. The stochastic description predicts dynamical correlation functions in the long-time limit, which are of large interest since they determine (heat) transport properties, for example. We find good agreement between the prediction and microscopic molecular dynamics simulations. Furthermore, the framework reveals how the Tracy-Widom distribution emerges from the microscopic dynamics with carefully prepared domain-wall initial conditions.

References:

C. B. Mendl and H. Spohn (2016) *Searching for the Tracy-Widom distribution in nonequilibrium processes.* Phys. Rev. E 93, 060101(R)

H. Spohn (2016) *Fluctuating hydrodynamics approach to equilibrium time correlations for anharmonic chains.* In: S. Lepri (eds) *Thermal Transport in Low Dimensions.* Lecture Notes in Physics, vol 921. Springer, Cham (arXiv:1505.05987)

H. Spohn (2015) *The Kardar-Parisi-Zhang equation - a statistical physics perspective.* In: Stochastic Processes and Random Matrices: Lecture Notes of the Les Houches Summer School, vol. 104 (arXiv:1601.00499)

C. B. Mendl, H. Spohn (2013): *Dynamic correlators of Fermi-Pasta-Ulam chains and nonlinear fluctuating hydrodynamics.* Phys. Rev. Lett. 111, 230601