Seminar of SFB 910

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Fibonacci universality of dynamic systems

Dynamical universality classes are distinguished by their dynamical exponent z and unique scaling functions encoding space-time asymmetry for, e.g. slow-relaxation modes or the distribution of time-integrated currents. Based on the discovery of superdiffusive non-KPZ modes in anharmonic chains and short range Hamiltonian systems we transfer the classification results to driven diffusive systems. Using nonlinear fluctuating hydrodynamics, mode-coupling theory and Monte-Carlo simulations, we investigate the scaling behavior of the steady state dynamical structure function for different lattice gases. So far the universality class of the Nagel-Schreckenberg (NaSch) model, which is a paradigmatic model for traffic flow on highways, was not known except for the special case $v_{max} = 1$. We show that the NaSch model also belongs to the KPZ class for general maximum velocities $v_{max} > 1$. Going beyond, we generalize the classification to any amount of conservation laws and find that all feasible dynamical exponents z_α are ratios of neighboring Fibonacci numbers, starting with either $z_1 = 3/2$ (if a KPZ mode exists) or $z_1 = 2$ (if a diffusive mode is present). If neither a diffusive nor a KPZ mode are present, all dynamical exponents correspond to the golden mean $z_\alpha = (1 + \sqrt{5})/2$. The universal scaling functions of these Fibonacci modes are asymmetric Lévy distributions, while the dynamical exponents and scaling functions are completely fixed by the macroscopic stationary current-density relation and the compressibility matrix. Using multi-species TASEP models we present numerical evidence for the presence of super diffusive Fibonacci modes in driven diffusive systems.

The Seminar will take place online via Zoom. For information on how to access the event, please contact: henning.reinken@itp.tu-berlin.de

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