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Macroscopic fluctuation theory on a lattice and its connection to classical integrable systems

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Macroscopic fluctuation theory (MFT) is a general theory for studying large deviations of interacting particle systems. A central object in the theory is the MFT equations, whose solution gives the rate function for certain rare events. A few years ago, we have found a mapping from the MFT equations for the symmetric simple exclusion process to the AKNS system, which is a well-known classical integrable system [1]. In this talk we first review this and discuss a lattice version of the theory.

In recent years several interacting particle systems which have a parameter called a "spin"have been introduced and studied. They include the partial exclusion process, inclusion process and the harmonic model. For this class of models, we propose a new type of large deviation for large spin. We first explain the basic formulation based on the scheme of Feng-Kurtz and calculate the associated Hamiltonian for a few examples. We also discuss connections to the conventional macroscopic fluctuation theory (MFT) and show how one can calculate the rate function exactly by mapping to a classical integrable system on a lattice.

The talk is based on collaborations with Cristian Giardina, Hayate Suda, Kirone Mallick and Hiroki Moriya.

Reference:
[1] K. Mallick, H. Moriya, T. Sasamoto,
Exact solution of the macroscopic fluctuation theory for the symmetric exclusion process,
Phys. Rev. Lett. 118, 160601 (2022).

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