

Spontaneous Symmetry Breaking in Fluctuations of High-Dimensional Driven Diffusive Systems

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Understanding the physics of nonequilibrium systems is one of the major challenges of modern theoretical physics. The general consensus nowadays is that this challenge can be cracked in part by investigating the macroscopic fluctuations of the currents characterizing nonequilibrium behavior, their statistics, associated structures and microscopic origin. In this way, during the last years a new powerful and general theory has been developed to analyze and understand rare events in nonequilibrium systems: the Macroscopic Fluctuation Theory (MFT). The central objects of this theory are Large Deviation Functions (LDFs) measuring the probability of occurrence of a given fluctuation, and the optimal paths sustaining these rare events.

MFT establishes a highly complex variational problem for the optimal profiles. In order to simplify the complexity of this problem, previous studies have introduced a powerful conjecture, the (strong) Additivity Principle (sAP), which results in a simpler variational problem which indeed can be solved in many cases. In high dimensions, the sAP amounts to assume that the optimal paths associated to a given fluctuation are time-independent, with the optimal current field constant across space. Using this principle, new structures and hidden symmetry relations have been discovered in high-dimensional driven diffusive systems, such as Weakly Asymmetric Exclusion Process (WASEP) or Kipnis-Marchioro-Presutti (KMP) model.

Nevertheless, assuming the optimal current field to be constant is very restrictive hypothesis. In this talk we will present a weak version of the Additivity Principle (wAP) for current fluctuations in high-dimensional systems. The wAP offers new predictions on the probability and optimal paths associated to a given fluctuation, as well as on dynamic phase transitions between these structures in high-dimensional driven diffusive, agreeing with high accuracy with simulation results.

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