Large Fluctuations of the Dissipated Energy in a Simple Model System

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We analyze the fluctuations of the dissipated energy in a simple and general model where dissipation, diffusion and driving are the key ingredients. The large deviation function for the dissipation follows from hydrodynamic fluctuation theory and an additivity conjecture. This function is strongly non-Gaussian and has no negative branch, thus violating the fluctuation theorem as expected from the irreversibility of the dynamics. It exhibits simple, universal scaling forms in the weak- and strong-dissipation limits, with large fluctuations favoured in the former case but strongly suppressed in the latter. The typical path associated to a given dissipation fluctuation is also analyzed in detail. Our results, confirmed in extensive simulations, strongly support the validity of hydrodynamic fluctuation theory to describe fluctuating behavior in driven dissipative media.[1]

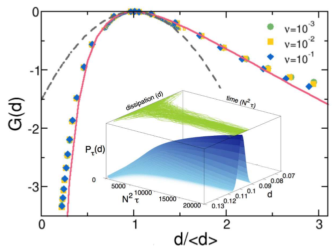

FIG. 1. Scaling of the dissipation LDF in the quasielastic limit ($\nu \ll 1$) for $N = 50$, $T = 1$, and varying ν. The solid and dashed lines are the HFT prediction and Gaussian estimation, respectively. Small points around the peak were obtained in standard simulations. Inset: Convergence of time- averaged dissipation and sketch of the probability concentration associated with the large deviation principle.

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[1] A. Prados, A. Lasanta and P. I. Hurtado, Phys. Rev. Lett. **107**, 140601 (2011)