Initial memory in heat production

Chulan Kwon, Myongji University

We investigate the dependence of heat production on initial distribution. It is a common sense that the memory of the intial distribution decays exponentially in time in the absence of any particular slowing down source. It is the case for the probability distribution function (PDF) for state variables. However, it is not true for the PDF of the quantities that depend on paths and are accumulated in time such as heat and work. Various fluctuation theorems (FT's) in fact depend on initial distributions for forward and reverse processes. The initial distribution dependence is more profound in the detail shape of the PDF of such fluctuating quantities. We calculate the PDF for heat production beyond the large deviation form. The first case to consider is the equilibration process given an intial distribution at a temperature different from the reservoir. Divided into two parts, the dissipative and injected heat productions are investigated and show a phase transition in the shape of the PDF depending on initial temperature. The second is a well known case in which the harmonic potential is dragged with a constant velocity. The PDF for heat production was previously found to be characterized by the so called extended fluctuation theorem given an initial distribution equilibrated with reservoir. By differentiating intial temperature, the PDF is found to show more complicated behaviors depending on intial temperature. In particlur for a flat intial distribution the PDF for heat production is shown to satisfy the FT, as expected, and to give a power law shape in tail without a usual large deviation behavior.