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The Dependence of Heat Fluctuation Theorem on an Initial Distribution KWANGMOO KIM, HYUNGGYU PARK, School of Physics, Korea Institute for Advanced Study, Seoul, South Korea, CHULAN KWON, Department of Physics, Myongji University, Yongin, South Korea — The fluctuation theorem (FT) proven for work does not hold for heat even in the long time limit. As the two quantities differ by the change in energy at the initial and final times, we suspect that the memory of an initial distribution may remain in the heat production accumulated for a long time. We investigate the dependence of the large deviation function (LDF) and FT on the temperature of the initial equilibrium distribution for the motion of a Brownian particle in a harmonic potential dragged with a constant velocity. The conventional saddle point integration for the LDF used in van Zon and Cohen, Phys. Rev. Lett. **91**, 110601 (2003) is found to fail as the saddle point approaches asymptotically the singularity at the branch point in the long time limit. We develop a new mathematical method to resolve this problem and confirm it with numerical simulations. As a result, the tail of LDF, i.e., a region of rare events, is shown to depend remarkably on the initial temperature and also causes more types of modifications of FT's than the so called extended FT proposed by van Zon and Cohen. We expect that our method can be applied to the investigation of the dependence of initial memories in other nonequilibrium systems.

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