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Large rare fluctuations in systems with delayed dissipation MARK DYKMAN, Michigan State University, IRA SCHWARTZ, U.S. Naval Research Laboratory — We study the probability distribution and the escape rate in noise-driven nonlinear systems with delayed dissipation. Accounting for the delay requires a significant modification of the conventional rare events theory. We develop the corresponding general formulation and find explicit results in the limiting cases. To logarithmic accuracy in the fluctuation intensity, the problem is reduced to a variational problem. It describes the most probable path followed by the system in the random rare event of interest. In contrast to Markov systems, the equations for the most probable paths are acausal due to the delay. If the dissipation and noise come from the coupling to a thermal bath, they are related by the fluctuation-dissipation relation, but our results are not limited to this case. In thermal equilibrium, the most probable path passing through a remote state has time reversal symmetry. However, again in contrast to Markov systems, one cannot uniquely define a path that starts from a state with given system coordinate and momentum. The corrections to the logarithm of the probability distribution and the escape activation energy for small dissipation delay and small noise correlation time are obtained in explicit form.

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