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Fluctuation-induced switching and the switching path distribution.

MARK DYKMAN, Michigan State University

Fluctuation-induced switching is at the root of diverse phenomena currently studied in Josephson junctions, nano-mechanical systems, nano-magnets, and optically trapped atoms. In a fluctuation leading to switching the system must overcome an effective barrier, making switching events rare, for low fluctuation intensity. We will provide an overview of the methods of finding the switching barrier for systems away from thermal equilibrium. Generic features of the barrier, such as scaling with the system parameters, will be discussed. We will also discuss the motion of the system in switching and the ways of controlling it. Two major classes of systems will be considered: dynamical systems, where fluctuations are induced by noise, and birth-death systems. Even though the motion during switching is random, the paths followed in switching form a narrow tube in phase space of the system centered at the most probable path. The paths distribution is generally Gaussian and has specific features, which have been seen in the experiment [1]. Finding the most probable path itself can be reduced to solving a problem of Hamiltonian dynamics of an auxiliary noise-free system. The solution also gives the switching barrier. The barrier can be found explicitly close to parameter values where the number of stable states of the system changes and the dynamics is controlled by a slow variable. The scaling of the barrier height depends on the type of the corresponding bifurcation. We show that, both for birth-death and for Gaussian noise driven systems, the presence of even weak non-Gaussian noise can strongly modify the switching rate. The effect is described in a simple explicit form [2,3]. Weak deviations of the noise statistics from Gaussian can be sensitively detected using balanced dynamical bridge, where this deviation makes the populations of coexisting stable states different from each other; a realization of such a bridge will be discussed. We will also discuss the sharp anisotropy of fluctuations induced by Poisson noise in overdamped systems and how it is changed with decreasing damping.

[1] H. B. Chan, M. I. Dykman, and C. Stambaugh , Phys. Rev. Lett. **100**, 130602 (2008).
[2] M. I. Dykman, I. B. Schwartz, A. S. Landsman, Phys. Rev. Letts. **101,** 078101 (2008).
[3] L. Billings, M. I. Dykman, and I. B. Schwartz, Phys. Rev. E **78** (2008).