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Noise activated switching in a driven, nonlinear micromechanical torsional oscillator

HO BUN CHAN, University of Florida

We study noise induced switching in an underdamped micromechanical torsional oscillator driven into the nonlinear regime, a system that is far from equilibrium. Within a certain range of driving frequencies, the oscillator possesses two stable dynamical states with different oscillation amplitudes. We induce the oscillator to escape from one dynamical state into the other by introducing noise in the excitation. Close to the birfucation point, the activation energy for switching is expected to display system-independent scaling. By measuring the rate of random transitions at different noise intensities, we deduce the activation energy as a function of frequency detuning and measure a critical exponent that is in good agreement with theoretical predictions. While the oscillator predominately resides in one of the two states for most excitation frequencies, a narrow range of frequencies exist where the occupations of the two states are approximately equal. At these frequencies, the oscillator undergoes 'kinetic phase transition' that resembles phase transition of thermal equilibrium systems. We observe a supernarrow peak in the power spectral densities of fluctuations in the measured oscillation amplitude. This peak is centered at the driving frequency and arises as a result of noise-induced transitions between the two dynamic states.