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Fluctuations of a parametric oscillator: from the semiclassical to a strongly quantum regime YAXING ZHANG, MARK DYKMAN, Michigan State University — A semiclassical parametric oscillator has two dynamically stable vibrational states with equal amplitudes and with phases differing by π. The rate of switching between these states is exponentially small, and the oscillator displays fluctuations with the reciprocal correlation time given by this rate. It also displays critical slowing down near the excitation threshold. The parameter of the "quantumness" is the ratio of the nonequidistance $\hbar V$ of the oscillator energy levels due to the nonlinearity and the level width $\hbar\Gamma$ due to decay. In the strongly-quantum regime where $V/\Gamma \gg 1$ and driving is not too strong, the picture of coexisting vibrational states with opposite phases does not apply. An insight into the transition from the semiclassical to strongly-quantum regime can be gained by studying the quasienergy spectrum and the decay of quantum fluctuations. An analogue of the critical slowing down in the strongly-quantum regime is a sharp increase of the fluctuation correlation time that occurs at a hypersurface in the oscillator parameter space. We find that the quasienergy spectrum and the ratio of the level spacing to their width also sensitively depend on the parameters, in particular on V/Γ.

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