Noise Properties of Cavity-Driven Mechanical Oscillations

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Parametric coupling between a mechanical resonator and a driven optical or microwave cavity provides an effective way of suppressing thermal fluctuations in the mechanical resonator. When the cavity is driven below resonance, quanta are absorbed from the resonator by the cavity and the low level of photon noise in the cavity means that the mechanical resonator can in principle be cooled almost all the way to its ground state. However, in this talk I will focus on the case where the cavity is instead driven above resonance and energy is absorbed by the resonator. In this regime the resonator can undergo dynamical transitions to states of self-sustaining oscillation. Interestingly, the amplitude fluctuations in the resulting oscillating states are suppressed in the sense that they can be substantially less than in a corresponding state produced by simply applying a pure harmonic drive, the counterpart of the cooling that occurs in the stable regime.