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Cavity Cooling of A Mechanical Resonator in Amorphous Systems[1] LIN TIAN, University of California, Merced — The quantum backaction force generated by a cavity coupled with a mechanical resonator can be exploited to achieve sideband cooling of the mechanical mode. By applying a red-detuned driving, the quantum ground state of the mechanical mode can be reached in the resolved-sideband regime, which has recently be demonstrated in experiments. However, in many of these materials, surface defects or adsorbates can couple with the mechanical mode and impair the cavity cooling. These defects can be treated as quantum two-level system (TLS). The mechanical vibration changes the local strain tensor and generates coupling with the TLS via the deformation potential. In this work, we study the cavity cooling of the mechanical mode in the presence of a TLS. By applying the adiabatic elimination technique widely used in quantum optics, we derive the cooling master equation for the resonator-TLS system in the eigenbasis of this system. Our results show that the stationary phonon number depends non-monotonically on the energy of the TLS. We also show that the cooling depends strongly on the decoherence rate of the TLS.

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Lin Tian
University of California, Merced

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