

Two-mode interaction and quantum effects in non-linear mechanical resonators

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Non-linear resonators is the mainstream research direction of nanomechanics. They facilitate engineering back-action and creation of self-sustained oscillations. They also couple different excitation modes and thus facilitate information transfer, both of classical and quantum information. In this talk, we will cover two topics. First, we consider interaction between two mechanical modes in a non-linear resonator (exemplified as a suspended beam). We will show that if only one of the modes is driven, the other one exhibits parametric resonance-like behavior. Classically, it does not get excited at all, if the driving force is below the parametric resonance threshold. We also solved the problem quantum-mechanically, and found that the response of the non-driven mode below the threshold is finite. Thus, the observation of mechanical oscillations in this regime can serve as an indicator of quantum-mechanical behavior. Next, we will consider Josephson parametric amplifier (JPA) coupled to a mechanical resonator. JPA is an inherently non-linear, bistable system. We will show how the interaction considerably modifies the properties of the oscillator and the JPA.