The Many Faces of Quantum Fluctuations in Driven Vibrational Systems

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Periodically driven quantum oscillators are one of the best controlled quantum systems far from thermal equilibrium. They provide a means to study generic features of quantum dynamics and quantum fluctuations away from equilibrium, including those with no analog in equilibrium systems. I will provide an overview of the theory of fluctuation phenomena in resonantly modulated nonlinear vibrational systems and describe the recent experiments. I will discuss the phenomenon of quantum activation where, even for zero temperature, switching between vibrational states occurs via a transition over the barrier in phase space rather than via quantum tunneling. The means of controlling the switching rate and revealing the features of the underlying real-time instantons in complex phase space will be outlined. I will also discuss many-body phenomena, where systems of coupled oscillators may experience quantum phase transitions, whereas disorder in such systems leads to nonreciprocal behavior, with the onset of a probability current and anomalous diffusion waves.

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