Exploring the Unruh effect for N oscillating detectors inside a cavity; an acoustic circuit QED realization

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Abstract

In the Unruh Effect an uniformly accelerating photon detector is expected to observe thermal photons while an inertial observer would observe none. A longstanding challenge to demonstrate the UE in the lab is that the requirement of a detector's proper acceleration is impossibly high for any current or planned table top experiment. We consider both one and several relativistic, oscillating centre of mass photon detectors modeled as harmonic oscillators that are coupled to a single cavity mode. Through a series of approximations, we map the relativistic detector-cavity system onto a non-degenerate parametric amplifier model which affords accurate, analytical solutions, as well as suggests a feasible acoustic-microwave circuit realization. Including detector and cavity loss, we solve for the quantum dynamics, which is completely specified by the first and second moments of the detector and cavity quadrature coordinates. Under certain resonant conditions between the cavity mode and oscillating detector frequencies, we observe significant enhancements in their average, steady state photon numbers. We also characterize the correlations between the detector and cavity mode using the logarithmic negativity entanglement measure. We also describe work in progress that establishes a connection between the driven Dicke model in its superradiant phase and an enhanced Unruh effect for a large number of oscillating detectors.