CO.CO.MAT

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Squeezing by a quantum conductor

Hybrid architectures integrating mesoscopic conductors in microwave cavities have a great potential for investigating unexplored regimes of electron-photon coupling. In this context, producing nonclassical radiation, such as a squeezed vacuum state, is a key step towards quantum communication with scalable solid-state devices. We show here that a tunnel junction is able to generate a squeezed steady state in a microwave cavity when excited parametrically by a classical AC voltage source. Photon-assisted tunneling of electrons is accompanied by the emission of pairs of photons in the cavity, thereby engineering a driven squeezed state. In contrast with parametric amplifiers, squeezing here is caused by dissipation in the electronic bath.

For a tunnel junction, we show theoretically that squeezing can be optimized by a pulse shape consisting of a periodic series of delta peaks. Squeezing is generally enhanced by non-linearities. We indeed find that perfect vacuum squeezing can be produced in an asymmetric quantum dot in the presence of a particular periodic Leviton pulse. We also find perfect squeezing in the case of a tunnel junction affected by a strong dynamical Coulomb blockade environment.

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