Quantum bath engineering of a high impedance microwave mode through quasiparticle tunneling

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Abstract

Quantum bath engineering is considered a promising route to perform certain tasks in quantum information processing, such as state stabilization, passive error correction, or fast qubit initialization. In the context of circuit QED, bath engineering usually results from the interplay between coherent evolution and dissipation in the form of single photon loss.

In this talk, I will discuss a different approach [1], where engineered dissipation comes from the non-linear coupling of a microwave mode to a tunnel junction. Because the mode is sustained by a high kinetic inductance resonator made of granular Aluminum [2], its characteristic impedance is sufficiently large such that high order photon loss processes are allowed. As an example of engineered dissipation, I will focus on the regime where two photons loss processes dominate over single photon loss. The dynamics is then restricted by the quantum Zeno effect [3] to the subspace spanned by the zero and one photon Fock states turning the harmonic oscillator mode into a two-level system.

Because of causality, the junction induces a shift in the energy levels of the resonator [4]. I will show that these Lamb shifts are Fock state dependent and in good agreement with the predictions of the Kramers-Kronig relations for single quantum states in a regime of highly non-linear bath coupling.

References

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