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Generating macroscopic superposition states by adiabatic transition

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Abstract

Since the establishment of the quantum mechanics, researchers in physics have been studying superposition states and especially proposing setups for generating macroscopic objects in a quantum superposition state. Such states are important and of interest both from a foundational perspective and for their applications in the emerging quantum technologies. Here, we propose a circuit quantum electrodynamical setup and an adiabatic scheme for preparing a macroscopic and massive object in a quantum superposition state. The scheme is based on establishing a spatial double-well potential for a macroscopic object and preparing it in the ground state of the potential via an adiabatic transition. The resulting state is a spatial superposition state where the object assumes a superposition of bulked to two opposite directions, e.g. right and left. By numerical solving of the quantum optical master equation and including the environmental effects, we show that the target cat state is achievable with a high fidelity provided the process satisfies the adiabaticity conditions.

Keywords: macroscopic object, superposition state, cat state, optomechanics, adiabatic process, double well

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