Theory of quasiparticle-induced errors in driven-dissipative Schrodinger cat qubits

Understanding the mechanisms of qubit decoherence is a crucial prerequisite for improving the qubit performance. In this work, we discuss the effects of residual Bogolyubov quasiparticles in Schrodinger cat qubits, either of the dissipative or Kerr type. The major difference from previous studies of quasiparticles in superconducting qubits is that the Schrödinger cat qubits are operated under nonequilibrium conditions. Indeed, an external microwave drive is needed to stabilize cat states, which are superpositions of coherent degenerate eigenstates of an effective stationary Lindbladian in the rotating frame. We present a microscopic derivation of the master equation for cat qubits and express the effect of the quasiparticles as dissipators acting on the density matrix of the cat qubit. This enables us to determine the conditions under which the quasiparticles give a substantial contribution to the qubit errors.