Quantum Zeno effect: preventing a photon from exiting a cavity.

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The quantum Zeno effect refers to the freezing of the time evolution of a quantum system subjected to repeated measurements. In this talk we try to answer the question, as to whether the Zeno effect can stop stochastic decay events like a photon jump from a cavity. There is a time scale governing the rate at which the photon in the cavity gets entangled with the environment. Performing a projective and quantum non-demolition photon number measurement on the cavity faster than this time scale prevents the system from entangling with the environment, thereby freezing photon jumps. To demonstrate this, we use a 3D microwave resonator as the cavity and an auxiliary resonator as a toy environment. The auxiliary resonator is coupled to a transmon, which is continuously measured to detect photon jumps (see figure 1). Conditioning the evolution under “no jumps” serves to experimentally show the time scale of system-environment entanglement. Our experiments show that measuring the photon number at a rate faster than the system-environment entanglement rate freezes the decay (figure 2).

Figures

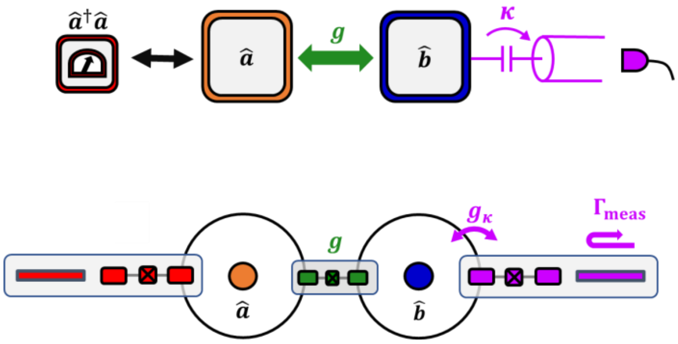

Figure 1: Schematic of the experimental setup

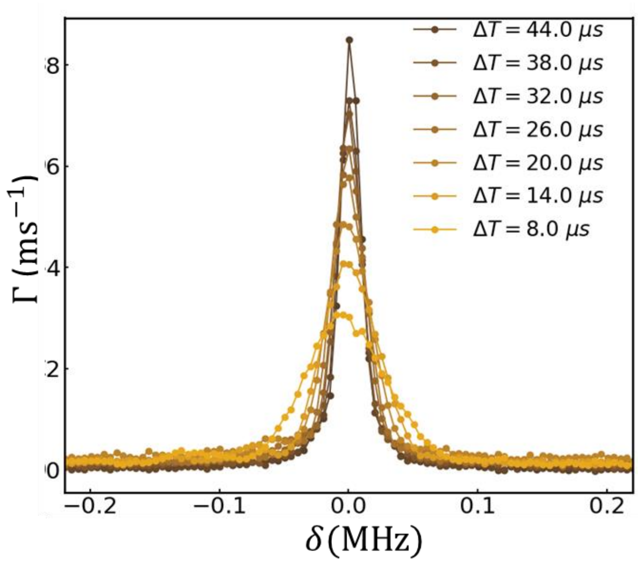

Figure 2: Decay rate of mode ‘a’ as a function of detuning from environment for different Zeno measurement rates.