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Landau-Zener tunneling: from weak to strong environment coupling

Landau-Zener tunneling, which describes the transitions in a two-level system during the passage through an anti-crossing, is a model applicable to a wide range of physical phenomena. Dissipation due to coupling between the system and environment is an important factor in determining the transition rates. Using a superconducting tunable capacitively shunted flux qubit, we observe the crossover from weak to strong coupling to the environment. The weak coupling limit corresponds to small system-environment coupling and leads to environment-induced thermalization. In the strong coupling limit, environmental polarizations dress the system and transitions occur between the dressed states. Our results confirm previous theoretical studies of dissipative Landau-Zener tunneling in the weak and strong coupling limits, and motivate further work on understanding the intermediate regime. This work is relevant for understanding the role of open system effects in quantum annealing, where Landau-Zener transitions at small gaps, occurring in large scale systems, are important to understand for improving the success probability.