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Protocol for efficient qubit initialization with a tunable environment[1] JANI TUORILA[2], MATTI PARTANEN[3], TAPIO ALA-NISSILÄ[4], MIKKO MÖTTÖNEN[5], Aalto Univ — Fast and on-demand thermalization to milliKelvin temperatures presents a major technological challenge for superconducting quantum bits. We develop an efficient initialization protocol for a superconducting qubit by coupling it to a thermal bath through two LC resonators. The inductance of the resonator, which is coupled to the bath, is dynamically adjustable, allowing control over its natural resonance frequency. The relaxation rate of the qubit can be increased this way by several orders of magnitude by sweeping the tunable resonator into resonance with the qubit. Such setup is a part of environmental quantum state engineering by dissipation, where one aims to drive the system into a desired steady state by using a carefully tailored environment. We solve the quantum dynamics corresponding our protocol with a Markovian master equation and show that the ground-state occupation of our system is well protected during fast sweeps of the environmental coupling. Consequently, we obtain a lower bound for the duration of the protocol. Our results suggest that the current experimental state of the art for the initialization speed of superconducting qubits at a given fidelity can be considerably improved.

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