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Coupling of ions to superconducting circuits SOENKE MOELLER, NIKOS DANIILIDIS, SEBASTIAN GERBER, HARTMUT HAEFFNER, UC Berkeley — We present experimental progress towards coupling the motion of ion strings to the resonant mode of a superconducting high-quality tank circuit. We consider such a coupling as the first step towards interfacing trapped ions with superconducting qubits. In our demonstration experiment, we aim to reduce the temperature of the resonant mode of the tank circuit by extracting energy from the circuit via laser cooling an ion string. One of the main experimental challenges is to construct a tank circuit with such a high quality factor Q that the ion-resonator coupling exceeds the environment-resonator coupling. Currently, we achieve Q = 27 000 at a frequency of $\omega = 2\pi \cdot 1.2$ MHz. For this mode, the coupling time-scale to the environment is on the order of 50 Hz. We plan to use a trap with an ion-electrode distance on the order of 100 μm resulting in an ion-resonator coupling of 1 kHz. This coupling should reduce the electronic temperature of the resonant mode by two orders of magnitude as compared to the ambient temperature. The Q of higher order resonant modes of our resonator reach the 10^5 regime. We will discuss limitations of the observed Q as well as improvements on the design such as trapping closer to the electrodes.

Soenke Moeller
UC Berkeley

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