Experiments on open quantum systems made of superconducting qubits with tunable coupling to their environment

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We present a quantum-circuit refrigerator [1,2], i.e., a tunneling device that can be used to adjust on demand the dissipation of a superconducting quantum electric circuit. In our most recent experiments, we were able to operate this device in a full rf mode [3], where the energy needed for such refrigeration is provided by microwaves. In addition, we present ultrasensitive bolometers based on superconducting proximity effect [4]. Our bolometers have reached measured noise equivalent powers of a few tens of zeptojoules per square-root hertz at thermal time constants of a few hundred nanoseconds. In the calorimetric mode, these sensors show potential for energy resolutions of a single zeptojoule and well below. These bolometers could be used in the future as measurement and characterization devices of engineered environments such as those based on the quantum-circuit refrigerator.

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