

## Extended quantum Maxwell demon acting over macroscopic distances

A.V. Lebedev<sup>a</sup>, G.B. Lesovik<sup>a</sup>, V.M. Vinokur<sup>b</sup>, and G. Blatter<sup>c</sup>

<sup>a</sup>Moscow Institute of Physics and Technology, Institutskii per. 9, Dolgoprudny, 141700, Moscow District, Russia

<sup>b</sup>Materials Science Division, Argonne National Laboratory, 9700 S. Cass Avenue, Argonne, IL 60439, USA

<sup>c</sup>Theoretische Physik, Wolfgang-Pauli-Strasse 27, ETH Zurich, CH-8093 Zürich, Switzerland

A quantum Maxwell demon is a device that can lower the entropy of a quantum system by providing it with purity. The functionality of such a quantum demon is rooted in a quantum mechanical SWAP operation exchanging mixed and pure states. We describe the setup and performance of a quantum Maxwell demon that purifies an energy-isolated system from a distance. Our cQED-based design involves two transmon qubits, where the mixed-state target qubit is purified by a pure-state demon qubit connected via an off-resonant transmission line; this configuration naturally generates an iSWAP gate. Although less powerful than a full SWAP gate, we show that assuming present-day performance characteristics of a cQED implementation, such an extended quantum Maxwell demon can purify the target qubit over macroscopic distances on the order of meters and tolerates elevated temperatures of the order of a few Kelvin in the transmission line.