ARTIFICIAL TUNABLE ENVIRONMENTS FOR SUPERCONDUCTING QUANTUM BITS

P. J. Jones,\textsuperscript{a} J. A. M. Huhtamäki,\textsuperscript{a} K. Y. Tan,\textsuperscript{a} M. Partanen,\textsuperscript{a} and M. Möttönen\textsuperscript{a,b}

\textsuperscript{a}QCD Labs, COMP Centre of Excellence, Department of Applied Physics, Aalto University, PO Box 13500, 00076 Aalto, Finland.
\textsuperscript{b}Low Temperature Laboratory (OVLL), Aalto University, PO Box 13500, 00076 Aalto, Finland.

email: mikko.mottonen@aalto.fi

We report our recent work on developing artificial electromagnetic environments for superconducting devices. Previously, we have showed that single-photon heat conduction between two resistors embedded in a superconducting cavity can be achieved \cite{1}. Here, we modify this setup to provide in-situ control of the photonic heat power \cite{2} and open up the possibility to tune the coupling strength between the artificial environment and the desired component in the cavity by several orders of magnitude. Our results provide an efficient pathway to control the lifetime of a superconducting quantum bit, qubit, allowing for rapid initialization to the ground state at will and unhindered normal operation as desired \cite{3}.

Figure 1: Coplanar waveguide cavity which consists of a central conducting strip located between two ground planes. Here, the cavity has been modified by adding a resistor $R$, a capacitor $C_c$, and a qubit into the line at positions $x_r$, $x_c$, and $x_q$, respectively. In addition, one or more superconducting quantum interference devices (SQUIDs) with inductance $L_{J}$ are positioned into the left side of cavity to tune the coupling between the resistor and qubit.


\[3\] Manuscript in preparation.