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Cavity-cavity conditional logic SERGE ROSENBLUM, YVONNE Y. GAO, PHILIP REINHOLD, CHEN WANG, CHRISTOPHER AXLINE, LUIGI FRUNZIO, STEVEN M. GIRVIN, LIANG JIANG, Yale University, MAZYAR MIRRAHIMI, INRIA Paris-Rocquencourt, MICHEL H. DEVORET, ROBERT J. SCHOELKOPF, Yale University — In a superconducting circuit architecture, the highest coherence times are typically offered by 3D cavities. Moreover, these cavities offer a hardware-efficient way of redundantly encoding quantum information. While single-qubit control on a cavity has already been demonstrated, there is a need for a universal two-qubit gate between such cavities. In this talk, we demonstrate a cavity-cavity gate by parametric pumping on a fixed-frequency transmon interacting with the two cavities. Every gate application lowers the state fidelity by only $\sim$1%, while maintaining an entangling rate on-off ratio of $\sim$29dB. Additionally, we show that the gate is applicable not only to qubits consisting of single photons, but also to more complex encodings. These results illustrate the usefulness of cavities beyond the mere storage of quantum information, and pave the way towards gates between error-corrected logical qubits.

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