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Engineering interactions between long-lived cavities YVONNE GAO, SERGE ROSENBLUM, 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 — The availability of large Hilbert dimensions and outstanding coherence properties make superconducting cavities promising systems for storing quantum information. Recent experiments in cQED has demonstrated that redundantly encoding logical qubits in such cavities is a hardware-efficient approach toward error-correctable quantum memories. In order to tap into the power of these protected memories for quantum information processing, robust inter-cavity operations are required. A simple way to realise such operations between two cavities is using the non-linearity of the Josephson junction. To do so, we adopt a multi-cavity architecture where a fixed-frequency, single junction transmon simultaneously couples to two highly coherent 3D cavities. Using only external RF drives, we demonstrate transmon-cavity as well as cavity-cavity SWAP operations and show that such interactions are essential building blocks for implementing multi-cavity conditional logics.

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