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Temporal shaping of quantum states released from a superconducting cavity memory L. BURKHART, C. AXLINE, W. PFAFF, C. ZOU, M. ZHANG, A. NARLA, L. FRUNZIO, M.H. DEVORET, L. JIANG, R.J. SCHOELKOPF, Yale University — State transfer and entanglement distribution are essential primitives in network-based quantum information processing. We have previously demonstrated an interface between a quantum memory and propagating light fields in the microwave domain: by parametric conversion in a single Josephson junction, we have coherently released quantum states from a superconducting cavity resonator into a transmission line. Protocols for state transfer mediated by propagating fields typically rely on temporal mode-matching of couplings at both sender and receiver. However, parametric driving on a single junction results in dynamic frequency shifts, raising the question of whether the pumps alone provide enough control for achieving this mode-matching. We show, in theory and experiment, that phase and amplitude shaping of the parametric drives allows arbitrary control over the propagating field, limited only by the drives bandwidth and amplitude constraints. This temporal mode shaping technique allows for release and capture of quantum states, providing a credible route towards state transfer and entanglement generation in quantum networks in which quantum states are stored and processed in cavities.

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