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Remote entanglement of transmon qubits[1] M. HATRIDGE, K. SLIWA, A. NARLA, S. SHANKAR, Z. LEGHTAS, Applied Physics Department, Yale University, M. MIRRAHIMI, Applied Physics Department, Yale University and INRIA Paris Rocquencourt, S.M. GIRVIN, R.J. SCHOELKOPF, M.H. DEVORET, Applied Physics Department, Yale University — An open challenge in quantum information processing with superconducting circuits is to entangle distant (non-nearest neighbor) qubits. This can be accomplished by entangling the qubits with flying microwave oscillators (traveling pulses), and then performing joint operations on a pair of these oscillators. Remarkably, such a process is embedded in the act of phase-preserving amplification, which transforms two input modes (termed signal and idler) into a two-mode squeezed output state. For an ideal system, this process generates heralded, perfectly entangled states between remote qubits with a fifty percent success rate. For an imperfect system, the loss of information from the flying states degrades the purity of the entanglement. We show data on such a protocol involving two transmon qubits imbedded in superconducting cavities connected to the signal and idler inputs of a Josephson Parametric Converter (JPC) operated as a nearly-quantum limited phase-preserving amplifier. Strategies for optimizing performance will also be discussed.

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