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Deterministic entanglement of two transmon qubits by parity measurement and digital feedback[1] DIEGO RISTÈ, MARCIN DUKALSKI, CHRISTOPHER WATSON, GIJS DE LANGE, MARIJN TIGGELMAN, YAROSLAV BLANTER, Kavli Institute of Nanoscience, Delft University of Technology, KONRAD LEHNERT, JILA, NIST and the University of Colorado, Boulder, RAYMOND SCHOUTEN, LEONARDO DICARLO, Kavli Institute of Nanoscience, Delft University of Technology — While quantum measurement typically collapses quantum superpositions into a basis state, a special type of joint measurement, detecting the parity of qubit excitations, can create entanglement. Building on recent developments in quantum nondemolition measurement and feedback control in circuit QED, we realize a continuous-time parity meter for two 3D-transmon qubits using a dispersively coupled cavity and Josephson parametric amplification. Starting from a maximal superposition, we first generate entanglement with up to 88% fidelity to the closest Bell state by postselecting on the odd-parity result. The infidelity is due to measurement-induced dephasing, arising from imperfect cavity resonance matching in the odd-parity subspace and finite transmission in the even. We then incorporate the parity meter into a digital qubit feedback loop to turn the generation of entanglement from probabilistic to deterministic, achieving 66% fidelity to the targeted Bell state. This combination of parity measurement and conditional qubit control is at the basis of modern error correction protocols.

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