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Universal Quantum Gates in Josephson Junction Phase Qubits RADOSLAW BIALCZAK, M. ANSMANN, M. HOFHEINZ, E. LUCERO, M. NEE-LEY, A. O'CONNELL, D. SANK, U.C. Santa Barbara, M. STEFFEN, IBM T.J. Watson Research Center, H. WANG, J. WENNER, A. CLELAND, J. MARTINIS, U.C. Santa Barbara — Josephson junction phase qubits are at a point where they can be used to create more complex operations such as quantum gates. Here we present work where we have tuned capacitively coupled Josephson junction phase qubits on and off resonance to generate and characterize a SQiSW gate using quantum process tomography (QPT). The SQiSW is the most fundamental universal gate for our system because it arises directly from the Hamiltonian for the physical circuit of our coupled qubits. In order to create more complex gates such as the CNOT, the SQiSW gate must be used to generate the entanglement. We perform QPT and obtain the Chi matrix, from which quantitative measures such as the gate fidelities can be calculated. We also show how to correct for measurement crosstalk and reduced visibilities present in our system and we perform measurements that quantitatively characterize the on/off ratio of our coupling scheme.

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