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Logic gates for superconducting qubits M. STEFFEN, R. MCDERMOTT, K.B. COOPER, M. ANSMANN, J.M. MARTINIS, UC Santa Barbara, R. SIMMONDS, K. CICAK, K. OSBORN, S. OH, D.P. PAPPAS, National Institute of Standards and Technology, Boulder — Owing to the recent impressive progress, superconducting qubits are closer than ever to demonstrating simple quantum algorithms. A wide variety of coupling and gate schemes has been previously proposed. However, as part of initial tests it is advantageous to consider the straightforward case of using fixed couplings between on-resonance qubits. For many systems, including the current biased phase qubit, the natural interaction is the XY-interaction, which easily generates the i-SWAP gate in a time of t = T/2 with T defined as the inverse coupling strength. Building on the i-SWAP gate, I will describe a detailed sequence of operations to implement a CNOT (t $\sim$ T/2), a SWAP (t $\sim$ 3T/4), a combination CNOT/SWAP (t $\sim$ T/2), and a controlled Z-rotation (t $\sim$ rotation angle).

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