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A Quantum Computer based on Tunable Flux Qubits MATTHIAS STEFFEN, FREDERICO BRITO, DAVID DIVINCENZO, ROGER KOCH, IBM — Based on the experimental and theoretical results on the different types of superconducting qubits, we feel there are several features which are desirable for the development a scalable quantum computer: (1) Tunable qubits, (2) Tunable coupling, and (3) Storage. We present two and three junction versions of the IBM tunable flux qubit coupled to a harmonic oscillator which exhibit all these features. We can adiabatically move the information from the flux qubit into the harmonic oscillator for storage and back. When the information is in the harmonic oscillator, coherence times are limited by the quality factor of the harmonic oscillator which is known to be high. When the information is in the flux qubit, one and two-qubit gates are implemented using microwave pulses with gate times of about 10-20ns. Coherence times at the operating point are limited by 1/f flux noise with estimated dephasing times of about 100ns. Using shaped pulses simulations show that the overall unitary gate can be made relatively insensitive to frequency drifts, resulting in errors of about 10^{-3} even for total gate lengths similar to the dephasing time. Further improvements will most likely involve reducing flux noise.

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