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Integrating superconducting qubit systems for improved quantum operations[1] STEFAN FILIPP, SARAH SHELDON, EASWAR MAGESAN, LEV S. BISHOP, MATTHIAS STEFFEN, JERRY M. CHOW, JAY M. GAMBETTA, IBM TJ Watson Research Center, Yorktown Heights NY, USA — Recent progress in the field of superconducting circuits has led to qubit coherence times exceeding by far typical single and two-qubit gate times. In this regime, in which relaxation (T_1) and dephasing (T_2) times are above 40 and 50 microseconds, respectively, quantum gates are not limited by intrinsic noise sources. We enter this regime by optimizing the design of coplanar transmon qubits to reduce the influence of surface loss. Furthermore, we have eliminated spurious microwave resonances which we can detect by monitoring the qubit coherence while sweeping the frequency of an external microwave drive applied to the system. To improve T_2 times, we minimize dephasing caused by thermal photons in coupled resonator modes by increasing the attenuation of the readout drive lines. To maintain the ability to drive fast gates with strong microwave signals while preserving coherence, we employ weakly capacitively coupled control lines providing independent control of the qubits and allowing for improved two-qubit entangling gate operations.

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Stefan Filipp
IBM TJ Watson Research Center, Yorktown Heights NY, USA

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