Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Characterizing Quantum Gates with Iterated Randomized Benchmarking on Superconducting Qubits[1] SARAH SHELDON, LEV S. BISHOP, STEFAN FILIPP, MATTHIAS STEFFEN, JERRY M. CHOW, JAY M. GAMBETTA, IBM T.J. Watson Research Center, Yorktown Heights, NY, USA
— With coherence times exceeding 40us and single qubit gate fidelities of 0.9996, we find our current calibration schemes and DRAG pulse shaping fall short of the coherence limit. It is therefore necessary to develop new methods of finding and addressing errors in the qubit control. We present a method for characterizing small errors using a variation of interleaved randomized benchmarking to identify sources of systematic errors. Our new scheme, iterative randomized benchmarking, interleaves repetitions of gates in a randomized benchmarking sequence to determine the type of error on the target gate. The scaling of the fidelity with the number of interleaved gates reveals if the gate errors are coherent or incoherent. Experimental data indicates that our system is sensitive to an over-rotation by an angle of pi/128. We also apply this technique to identify sources of coherent errors that may be reducing our randomized benchmarking error rates.

[1]This work is supported by ARO under contract W911NF-14-1-0124.

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Date submitted: 14 Nov 2014 Electronic form version 1.4