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Experimental Realization of Adaptive Qubit Tomography DYLAN H. MAHLER, CQIQC and IOS, Department of Physics, University of Toronto, JOSHUA COMBES, Department of Physics and Astronomy, University of New Mexico, LEE A. ROZEMA, ARDAVAN DARABI, CQIQC and IOS, Department of Physics, University of Toronto, CHRIS FERRIE, Institute for Quantum Computing and Department of Applied Mathematics, University of Waterloo, AEPHRAIM STEINBERG, CQIQC and IOS, Department of Physics, University of Toronto, ROBIN BLUME-KOHOUT, Theoretical Division, Los Alamos National Lab and CQuIC, University of New Mexico — In quantum state tomography, an informationally complete set of measurements is made on N identically prepared quantum systems and from these measurements the quantum state can be determined. In the limit as $N \to \infty$, the estimation of the state converges on the true state. The rate at which this convergence occurs depends on both the state and the measurements used to probe the state. To characterize the quality of a set of measurements the fidelity of the estimation with the true state, averaged over a prior distribution of states, is used as a figure of merit. It is known [1] that for states very close to the surface of the bloch sphere, the average infidelity $(1 - F)$ goes down with a rate proportional to $\frac{1}{\sqrt{N}}$. It has also been shown that there exists a gap between collective measurement protocols and local measurement protocols, but that local *adaptive* measurement protocols can come close to saturating the collective measurement bound of $\frac{1}{N}$ [2]. Here we present an experimental demonstration of one qubit tomography that achieves a rate of convergence of $\frac{1}{N}$ with only a single adaptive step and local measurements.

[1] Phys. Rev. A 78, 052122 (2008)
[2] Phys. Rev. Lett. 97, 130501 (2006)

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