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Gate Set Tomography of a 3D Transmon Qubit YUDAN GUO, Dept. of Physics, Reed College, SERGEY NOVIKOV, Dept. of Physics, University of Maryland-College Park, DANIEL GREENBAUM, ANDREW SKINNER, Altamira Technologies Corporation, B.S. PALMER, Lab. for Physical Sciences — Quantum gate set tomography[1,2] is a recently developed tool for characterizing quantum gates that does not suffer from the inaccuracies inherent in standard quantum process tomography. We present the results of a gate set tomography (GST) experiment done on a superconducting 3D transmon qubit. π and $\pi/2$ rotations over the x- and y-axes were used as the initial calibrated gates. We performed linear inversion on data from a 4-fiducial experiment to obtain an initial tomographic estimate, which was then used as the starting point for a maximum likelihood procedure. The calibrated gates all achieved fidelity above 98%, which was further verified by randomized benchmarking. The robustness of GST was also examined by introducing errors deliberately. We show that GST with maximum likelihood estimation is able to discern errors due to a mixed initial state, as well as due to a tilted rotation axis in our gate operation.

[1]Blume-Kohout *et al.*, arXiv: 1310.4492 (2013).
[2]Merkel *et al.*, Phys. Rev. A., **87**, 062119 (2013).

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