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Experimental Estimation of Average Fidelity of a Clifford Gate on a 7-qubit Quantum Processor DAWEI LU, University of Waterloo, HANG LI, Tsinghua University, DENIS-ALEXANDRE TROTTIER, University of Waterloo, JUN LI, University of Science and Technology of China, AHARON BRODUTCH, ANTHONY KRISMANICH, AHMAD GHAVAMI, GARY DMITRIENKO, University of Waterloo, GUILU LONG, Tsinghua University, JONATHAN BAUGH, RAYMOND LAFLAMME, University of Waterloo, UNIVERSITY OF WATERLOO TEAM, TSINGHUA UNIVERSITY COLLABORATION, USTC COLLABORATION — The traditional approach of characterizing a given quantum gate via quantum process tomography (QPT) requires exponential number of experiments. Therefore, estimating the average fidelity of the quantum gate by QPT is not practical for large-scale systems. In this talk, I will discuss about how to certify a Clifford gate within polynomial complexity using a twirling protocol. In particular, we adopted this method in NMR and certified a 7-qubit quantum Clifford gate with only 1600 experiments (in contrast, QPT requires millions of experiments). This Clifford gate is important as it generates maximal coherence from single coherence, and non-trivial for benchmarking the coherent control in experiment. We show that the average fidelity of this gate is over 87% after accounting for the decoherence effect, and to date this is the largest experimental gate-characterization. This twirling protocol is efficient and scalable, and can also be extended to other systems straightforwardly.

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