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Experimental Monte Carlo Quantum Process Certification LARS STEFFEN, ARKADY FEDOROV, MATTHIAS BAUR, ETH Zurich, MARCUS PALMER DA SILVA, Raytheon BBN Technologies, ANDREAS WALLRAFF, ETH Zurich — Experimental implementations of quantum information processing have now reached a state, at which quantum process tomography starts to become impractical, since the number of experimental settings as well as the computational cost of the post processing required to extract the process matrix from the measurements scales exponentially with the number of qubits in the system. In order to determine the fidelity of an implemented process relative to the ideal one, a more practical approach called Monte Carlo quantum process certification was proposed in Ref. [1]. Here we present an experimental implementation of this scheme in a circuit quantum electrodynamics setup. Our system is realized with three superconducting transmon qubits coupled to a coplanar microwave resonator which is used for the joint-readout of the qubit states. We demonstrate an implementation of Monte Carlo quantum process certification and determine the fidelity of different two- and three-qubit gates such as CPHASE-, CNOT-, 2CPHASE- and Toffoli-gates. The obtained results are compared with the values obtained from conventional process tomography and the errors of the obtained fidelities are determined.

[1] M. P. da Silva, O. Landon-Cardinal and D. Poulin, arXiv:1104.3835(2011)

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