

Abstract Submitted
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Efficient Toffoli Gate in Circuit Quantum Electrodynamics¹

MATTHEW REED, Department of Applied Physics and Physics, Yale University, New Haven, Connecticut 06520, USA, LEONARDO DICARLO, Kavli Institute of Nanoscience, Delft University of Technology, Delft, The Netherlands, LUYAN SUN, LUIGI FRUNZIO, ROBERT SCHOELKOPF, Department of Applied Physics and Physics, Yale University, New Haven, Connecticut 06520, USA — The fidelity of quantum gates in circuit quantum electrodynamics is typically limited by qubit decoherence. As such, significant improvements can be realized by shortening gate duration [1, 2]. The three-qubit Toffoli gate, also called the controlled-controlled NOT, is an important operation in basic quantum error correction. We report a scheme for a Toffoli gate that exploits interactions with non-computational excited states of transmon qubits which can be executed faster than an equivalent construction using one- and two-qubit gates. The application of this gate to efficient measurement-free quantum error correction will be discussed.

[1] DiCarlo, et al. *Nature* 467, 574 (2010).

[2] Chow, et al. *Phys. Rev. Lett.* 102, 090502 (2009).

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