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Driving qubit phase gates with sech shaped pulses JUNLING LONG, HSIANG-SHENG KU, XIAN WU, RUSSELL LAKE, National Institute of Standards and Technology, EDWIN BARNES, SOPHIA ECONOMOU, Virginia Tech, DAVID PAPPAS, National Institute of Standards and Technology — As shown in 1932 by Rozen and Zener, the Rabi model has a unique solution whereby, for a given pulse length or amplitude, a sech(t/sigma) shaped pulse can be used to drive complete oscillations around the Bloch sphere that are independent of detuning with only a resultant detuning-dependent phase accumulation. Using this property, single qubit phase gates and two-qubit CZ gates have been proposed [S Economou, E Barnes. PRB 91 (16), 161405, 2015]. In this work we explore the effect of different drive pulse shapes, i.e. square, Gaussian, and sech, as a function of detuning for Rabi oscillations of a superconducting transmon qubit. An arbitrary, single-qubit phase gate is demonstrated with the sech(t/sigma) pulse, and full tomography is performed to extract the fidelity. This is the first step towards high fidelity, low leakage two qubit CZ gates, and illustrates the efficacy of using analytic solutions of the qubit drive prior to optimal pulse shaping.

Junling Long
National Institute of Standards and Technology

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