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Towards non-adiabatic control of a superconducting qubit JONAS BYLANDER[1], MARK S. RUDNER[1], ANDREY V. SHYTOV[2], SERGIO O. VALENZUELA[1], DAVID M. BERNS[1], KARL K. BERGGREN[1], LEONID S. LEVITOV[1], WILLIAM D. OLIVER[1], [1]Massachusetts Institute of Technology, [2]University of Utah — Transitions in a qubit driven through an energy-level avoided crossing can be controlled by carefully engineering the driving protocol. With the driving rate chosen to optimize the coupling strength, an arbitrary rotation of a qubit's quantum state on the Bloch sphere can be performed. This regime, if realized experimentally, may lead to fast quantum-logic gates with times of operation much shorter than those achieved by using Rabi transition-based protocols. We have performed an experiment with a superconducting persistent-current qubit in the non- adiabatic regime, driven by a large-amplitude radio-frequency field. By applying a waveform consisting of two harmonic components generated by a digital source, we demonstrate a mapping between the amplitude and phase of the harmonics produced at the source and those received by the device. This mapping allows us to image the actual waveform at the device and accurately produce the desired time dependence. Our method constitutes a step towards non-adiabatic control with arbitrary waveforms.

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