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**Analysis of qubit dynamics under strong resonant pulses using Floquet theory** CHUNQING DENG, FEIRUO SHEN, JEAN-LUC ORGIAZZI, University of Waterloo, SAHEL ASHHAB, Qatar Foundation, ADRIAN LUPASCU, University of Waterloo — Resonant driving is the most common way of implementing single-qubit gates in various quantum systems. Most of the experiments and optimization of such gates are performed in the weak-driving regime, where the qubit dynamics is relatively slow and well described using the rotating wave approximation. However, the implementation of qubit gates with strong driving, which in principle promises a higher speed, has not been studied extensively. In this work, we consider the dynamics of a qubit driven by strong resonant pulses in the framework of Floquet theory. We analyze the role of pulse shaping in the dynamics, as determined by nonadiabatic transitions between the Floquet states. By suppressing the nonadiabatic transitions, we show that high-fidelity single-qubit operations can be achieved in very short times. This work provides the theoretical basis for optimizing strong pulses for single-qubit gates. These results are particularly relevant for the implementation of single-qubit gates in superconducting qubits, where strong driving with shaped pulses has been demonstrated experimentally.

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