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Fast control and Floquet state dynamics of a strongly driven superconducting qubit CHUNQING DENG, FEIRUO SHEN, JEAN-LUC ORGIAZZI, Univ of Waterloo, SAHEL ASHHAB, Qatar Environment and Energy Research Institute, ADRIAN LUPASCU, Univ of Waterloo — Floquet states are quasistationary solutions of the Schrodinger equation with a time-periodic Hamiltonian. They are the appropriate states for describing the dynamics of a qubit in the strong driving regime, where the rotating wave approximation is no longer valid. We performed experiments on strong driving of a superconducting flux qubit using pulses with sub-nanosecond duration. We explore driving strength up to 5.0 GHz, largely exceeding the qubit Larmor frequency of 2.2 GHz. Floquet state dynamics is visible in the appearance of fast oscillating components in the qubit evolution in the rotating frame. Using pulse shaping, we also demonstrate the control of adiabatic/nonadiabatic transitions between the Floquet states. The control of the Floquet states is relevant for high-fidelity single-qubit operations in the strong driving regime.

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