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Implementing fast sideband-modulated "wah-wah" pulses for driving transmon qubits with tight frequency separation[1] V. VESTERINEN[2], O.-P. SAIRA, A. BRUNO, Kavli Institute of Nanoscience, Delft University of Technology, D.J. EGGER, F.K. WILHELM, Universität des Saarlandes, L. DICARLO, Kavli Institute of Nanoscience, Delft University of Technology — Packing multiple transmon qubits in a narrow frequency band is challenging due to the limited transmon anharmonicity: control drives targeting one qubit may drive the leakage transition of another. This cross-driving effect grows with decreasing gate time, potentially imposing a quantum speed limit. The widely used DRAG (derivative removal by adiabatic gate) technique only suppresses leakage in the targeted transmon. Adding a modulation tone to a Gaussian pulse envelope in one quadrature, and complementing with DRAG in the other, has been predicted [1] to reduce both intrinsic and cross-driving leakage. We have experimentally verified the performance of this new pulse-shaping method, termed "wah-wah," with two transmons in a 2D circuit QED architecture. We optimize the modulation frequency and amplitude, and characterize the gate fidelity using randomized benchmarking (RB) and quantum process tomography. Pulses on the two qubits are characterized separately and simultaneously by interleaving the RB sequences. Wah-wah pulses show decoherence-limited fidelity at gate speeds where DRAG pulses add significant error.

[1] R. Schutjens *et al.* arXiv:1306.2279

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