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Robustness of error-suppressing entangling gates in cavity-coupled transmon qubits XIU-HAO DENG, EDWIN BARNES, SOPHIA ECONOMOU, Department of Physics, Virginia Tech, Blacksburg, Virginia 24061, USA — Superconducting transmon qubits are one of the most promising platforms for quantum information processing due to their long coherence times and to their scalability into larger qubit networks. However, their weakly anharmonic spectrum leads to spectral crowding in multiqubit systems, making it challenging to implement fast, high-fidelity gates while avoiding leakage errors. To address this challenge, we have developed a protocol known as SWIPHT, which yields smooth, simple microwave pulses designed to suppress leakage without sacrificing gate speed through spectral selectivity. Here, we demonstrate that SWIPHT systematically produces two-qubit gate fidelities for cavity-coupled transmons in the range 99.0%-99.9% with gate times in the 15-200ns regime. These high fidelities persist over a wide range of qubit frequencies and other system parameters that encompasses many current experimental setups. Our results are obtained from full numerical simulations that include current experimental levels of relaxation and dephasing.

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