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Charting the design landscape of circuit QED for optimal gates

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We map out the experimentally reachable design landscape of circuit QED in terms of achievable fidelity of universal gate sets for arbitrary perfectly entangling two-qubit gate. Using state-of-the-art control techniques, we exhaustively explore the landscape for creation and removal of entanglement, needed respectively for two- and single-qubit gates. Our approach is valid for both fixed- and tunable-frequency qubits, where in the tunable case a separation between points of a few 100MHz is allowed for different gates. We also compare to the case where the qubits are driven directly with dedicated lines. We find a system-wide global optimal regime in the parameter space where multiple transition paths destructively interfere so that net static coupling is suppressed but microwave-activated coupling can still attain high values. This regime allows for a significant speedup compared to using static coupling to entangle qubits, and over working in the usual strongly dispersive regime.

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