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Controlling superconducting qubits in the presence of a strong, constant ZZ interaction SETH MERKEL, IBM, IBM QUANTUM COMPUTING TEAM — We look at the problem of optimal gate design in a system of two superconducting qubits coupled by a cavity. The system is designed to have a strong "always on" ZZ interaction, which is essential for two-qubit entangling gates, but presents a challenge for single qubit manipulation. Using pulse shaping ideas from NMR we are able to analytically derive single qubit gates that remove this unwanted coupling to 3rd order in the Magnus expansion, and applying DRAG corrections prevents leakage to higher oscillator levels. In the limit of strong cross-talk these pulses break down when the qubit being manipulated has a resonance close to the higher transition frequencies of the other, however we are still able to find high fidelity pulses numerically.

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