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Driving two-qubit entanglement with an enhanced ZZ interaction in circuit QED[1] BLAKE R. JOHNSON, C.A. RYAN, M.P. DA SILVA, Raytheon BBN Technologies, J.M. CHOW, J.M. GAMBETTA, S. MERKEL, IBM T.J. Watson Research, T. OHKI, Raytheon BBN Technologies — The quantum bus architecture is fast becoming a popular approach for coupling superconducting qubits [1,2]. With two fixed-frequency qubits coupled by a resonator, it is possible to engineer the system's frequencies such that the qubits experience a strong ZZ interaction. This interaction can be used as a resource for creating entanglement when needed, but can also be suppressed at will using appropriate decoupling sequences. We will show measurements of a device where this ZZ interaction is enhanced by interactions with higher-levels of superconducting transmon qubits. To achieve high-fidelity control in this regime, we employ robust composite pulses and optimal control methods to decouple the two-qubit interaction during single-qubit operations. The resulting system serves as a testbed for adapting control techniques from liquid-state NMR to fixed-frequency superconducting qubits.

[1] L. DiCarlo *el al.* Nature **460**, 240-244 (2009).
[2] Matteo Mariantoni *et al.* Science **334**, 61-65 (2011).

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