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Circuit QED with superconducting qubits — a multi-pole approach DAVID C. MCKAY, RAVI NAIK, Physics Department and James Franck Institute, University of Chicago, LEV S. BISHOP, JQI and CMTC, University of Maryland, College Park, DAVID I. SCHUSTER, Physics Department and James Franck Institute, University of Chicago — Circuit quantum electrodynamics — superconducting Josephson junction "transmon" qubits coupled via microwave cavities — is a promising route towards scalable quantum computing. Here we report on experiments coupling two transmon qubits through multiple strongly coupled planar superconducting cavities — the multi-pole cavity QED architecture. The main feature of this architecture is that the on/off ratio is expected to scale exponentially in the number of cavities (poles). In this talk we will discuss our gate protocol — the adiabatic multi-pole (AMP) gate — and report on producing a high fidelity Bell state ($|gg\rangle + |ee\rangle$) measured from state and process tomography. We will also report on measurements of the off-resonant coupling rate. Finally, we will discuss future plans for scaling this architecture beyond two qubits and our progress towards implementing multi-pole QED with flux insensitive qubits in 3D microwave cavities.

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