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Spectroscopy of two coupled superconducting flux qubits

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We present measurements on a system of two flux or persistent current qubits, which are coupled by a shared Josephson junction. Spectroscopy measurements reveal the four energy levels in great detail, also showing transitions involving two photons. Remarkably good agreement was found when fitting to a simple model Hamiltonian of two magnetically coupled spins. From the fit the qubit persistent currents and energy gaps as well as the qubit-qubit coupling strength and asymmetry were derived. Coherent Rabi oscillations were induced between energy states of the coupled system, from which relaxation and dephasing times could be extracted. Conditional spectroscopy was performed by manipulating one qubit coherently and measuring the excitation spectrum of the second.