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Measurement Crosstalk in the Josephson Phase Qubit R. MCDERMOTT, K.B. COOPER, M. STEFFEN, M. ANSMANN, J.M. MARTINIS, UC Santa Barbara, K. OSBORN, K. CICAK, S. OH, D.P. PAPPAS, R.W. SIMMONDS, NIST, Boulder — In order to accurately assess the fidelilty of quantum gates, or to perform quantum state tomography and thereby definitively prove entanglement, it is necessary to measure the states of all qubits in the system (wordwise readout). In multi-qubit circuits with fixed couplings a common architecture for superconducting qubits realization of this goal is complicated by measurement crosstalk: the measurement of one qubit perturbs the states of the other qubits, destroying information about quantum correlations. For the flux-biased Josephson phase qubit, the measurement of a $|1\rangle$ state implies a tunneling transition between local minima of the qubit potential. The resulting time-varying voltage across the measured qubit junction couples a transient current to other qubits, which can induce transitions between the qubit $|0\rangle$ and $|1\rangle$ states. We present a semiclassical model which quantitatively accounts for the observed measurement crosstalk in our circuit, and describe how fast, simultaneous state measurement can circumvent this problem.

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