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Anomalous switching curves in a dc SQUID phase qubit[1] HYEOKSHIN KWON, A. J. PRZYBYSZ, B. K. COOPER, J. R. ANDERSON, C. J. LOBB, F. C. WELLSTOOD, University of Maryland, Collge Park, HANHEE PAIK, Yale University, K. D. OSBORN, B. S. PALMER, Laboratory for Physical Sciences —
We have measured switching curves (s-curves), Rabi oscillations (T'$\sim$160ns) and relaxation (T_1 $\sim$280ns) in a dc SQUID phase qubit with an LC filter that provides good isolation from the bias leads at the operating frequency (3.5 GHz). The device is built on sapphire and has a 2 μm^2 Al/AlO_x/Al qubit junction shunted by a low-loss SiN_x capacitor. To measure an s-curve, we apply microwaves to pump to a specific state and then find the probability that the device switches to the voltage state after a short ($\sim$2ns) current pulse is applied. As expected, the switching probability increases with the amplitude of the current pulse, is smallest in the ground state |0> and largest in the excited state |1>. However, the s-curves for superposition states of |0> and |1> are anomalous - they are not the weighted sum of the |0> and |1> s-curves and the probability to switch is not linear in the excited state probability. Instead, the s-curves shift continuously along the current axis as the amplitude to be in |1> increases. We will discuss the likely cause of this behavior and its implication for measurements in phase qubits.

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Hyeokshin Kwon
University of Maryland, Collge Park

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