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Investigations of Surface Magnetic Defects in Superconducting Thin Film Devices STEVEN SENDELBACH, UMESHKUMAR PATEL, DAVID HOVER, ROBERT MCDERMOTT, UW-Madison — Recent experiments indicate that there is a high density of unpaired spins residing on the surfaces of the superconducting thin films used to implement SQUIDs and superconducting qubits. Fluctuations of these spins give rise to low frequency flux noise and dephasing of the qubit state. Realization of phase and flux qubits with improved dephasing times will require a deeper understanding of the microscopic physics that governs fluctuations of the surface spins. Here we present data on the complex frequency-and temperature-dependent inductance of dc SQUIDs at millikelvin temperatures, which can be directly related to the complex susceptibility of the surface spin system. We observe low-frequency noise in the SQUID inductance, with a 1/f power spectrum. We investigate the statistics of the low-frequency flux and inductance fluctuations, and examine spatial correlations of the magnetic fluctuators. Finally, we describe experiments that probe the microscopic nature of the magnetic defect states.

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