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A Nano-Scale Scanning SQUID Susceptometer for the Measurement of Isolated Magnetic Moments NICHOLAS C. KOSHNICK, Stanford University, MARTIN E. HUBER, University of Colorado Denver, JULIE BERT, HENDRIK BLUHM, Stanford University, JEFFREY LARGE, HAL EDWARDS, Texas Instruments, KATHRYN A. MOLER, Stanford University — Superconducting Quantum Interference Devices (SQUIDs) are well known as excellent magnetic field sensors. We present a scanning DC SQUID susceptometer that is designed to couple well to nanometer-sized objects. Its gradiometric design and local field coils allow for cancellation of the applied field so that dynamic range issues do not limit the SQUID's sensitivity. Integrated modulation coils linearize the signal and allow for optimal performance at all applied fields. Planar coaxial shielding, enabled by a multi-layer niobium process, results in a low inductance (100 pH) millimeter scale design where the pickup loops can be optimized independently from the junction and shunt resistor parameters. The sensor loop is on a terraced structure so that it can be scanned approximately 100 nm from the sample surface. Focused Ion Beam milling is used to fabricate pickup loops with inner diameters between 250 nm and 2 microns with line widths of approximately 200 nm. A white noise sensitivity of 0.8 $\mu\Phi_0/\sqrt{Hz}$ gives an estimated spin sensitivity of 80 $\mu_B/\sqrt{Hz}$ at 4 Kelvin. We will also report on on-going scanning susceptometry measurements, and on the spin sensitivity at low temperatures.

Nicholas C. Koshnick
Stanford University

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