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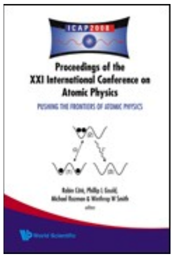

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Pushing the Frontiers of Atomic Physics

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Precision Measurements

QUANTUM CONTROL OF SPINS AND PHOTONS AT NANOSCALES

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The detection of weak magnetic fields with high spatial resolution is an outstanding problem in diverse areas ranging from fundamental physics and material science to data storage and bio-imaging. Here we describe a new approach to magnetometry that takes advantage of recently developed techniques for coherent control of solid-state spin qubits. We experimentally demonstrate this novel magnetometer employing an individual electronic spin associated with a Nitrogen-Vacancy (NV) center in diamond. Using an ultra-pure diamond sample, we achieve shot-noise-limited detection of nanotesla magnetic fields at kHz frequencies after 100 seconds of averaging. In addition, we demonstrate $0.5\ \mathrm{microtesla}/\sqrt{Hz}$ sensitivity for a diamond nanocrystal with a volume of $(30\ \mathrm{nm})^3$. This magnetic sensor provides an unprecedented combination of high sensitivity and spatial resolution – potentially allowing for the detection of a single nuclear spin's precession within one second.

Keywords: Quantum control; solid-state qubits; magnetometry