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Sub-picotesla Scalar Atomic Magnetometer with a Microfabricated Vapor Cell RUI ZHANG, RAHUL MHASKAR, Geometrics, Inc. — We explore the sensitivity limits of scalar atomic magnetometry with a micro-fabricated Cs vapor cell. The millimeter-scale cell is fabricated using silicon Micro-Electro-Mechanical Systems (MEMS) technology. The atomic spin procession is driven by an amplitude-modulated circularly polarized pump laser resonant with the D1 transition in Cs atoms. The precession is detected by an off-resonant linearly polarized probe laser using a balanced polarimeter setup. The probe light is spatially split into two beams to perform a gradiometer measurement. In a magnetic field of magnitude within the range of the earth magnetic field, we measure a sensitivity of less than 150 fT/$\sqrt{\text{Hz}}$ in the gradiometer mode, which shows that the magnetometer by itself can achieve sub-100 fT/$\sqrt{\text{Hz}}$ sensitivitiy. In addition to its high sensitivity, the magnetometer has a bandwidth of nearly 1 kHz due to the broad magnetic resonance inside the small cell. Our experiment suggests the feasibility of a portable, low-power and high-performance magnetometer, which can be operated in the earth's magnetic field. Such a device will greatly expand the range of applications for atomic magnetometers, such as the detection of nuclear magnetic resonance in an unshielded environment.

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