Abstract Submitted
for the DAMOP10 Meeting of
The American Physical Society

Femtotesla atomic magnetometry in a microfabricated vapor cell
W. CLARK GRIFFITH, SVENJA KNAPPE, JOHN KITCHING, Time and Frequency Division, NIST-Boulder — Chip-scale atomic magnetometers developed at NIST are based around microfabricated vapor cells, consisting of an etched hole in a silicon wafer and anodically bonded pyrex windows. The vapor cells typically contain ^{87}Rb atoms and several atmospheres of nitrogen buffer gas. Using a 3x2x1 mm vapor cell we have demonstrated a magnetometer with sensitivity better than 5 fT/Hz$^{1/2}$. The magnetometer is operated in the spin-exchange relaxation free (SERF) regime and uses two perpendicular light beams: a circularly polarized pump beam and an off-resonant linearly polarized probe beam. Magnetic fields are detected by analyzing the polarization direction of the probe beam. The measurement volume for this result is 1 mm^3, defined by the overlap of the pump and probe beams, giving a magnetic field energy resolution of $VB^2/2\mu_0 = 95\hbar$, within about a factor of two of the best result for an atomic magnetometer[1]. Achieving this sensitivity level in a millimeter scale vapor cell compared to larger cells requires special consideration of thermal magnetic noise due to the electrical conductivity of the silicon cell body and condensed alkali atoms on the cell walls.

[1]H. B. Dang, A. C. Maloof, and M. V. Romalis, arXiv:0910.2206

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Date submitted: 25 May 2010 Electronic form version 1.4