Abstract Submitted
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Sub-femto-Tesla Scalar Atomic Magnetometer with Spin-squeezing[1] DONG SHENG, SHUGUANG LI, NEZIH DURAL, MICHAEL ROMALIS, Physics Department, Princeton University — Atomic shot noise sets the fundamental limit on precision of atomic frequency measurements. Spin-squeezing techniques can reduce long-term atomic shot noise for systems with non-linear spin-relaxation processes [1]. Magnetometers using dense hot alkali-metal vapors are naturally limited by such non-linear relaxation due to spin-exchange collisions. We have developed a scalar atomic magnetometer utilizing a multi-pass atomic cell [2] to interact with 10^{13} atoms with an optical density of 5000. By operating the magnetometer in a pulsed mode with high initial spin polarization and two probe measurement pulses, we have realized magnetic field sensitivity of 0.5 fT/$\sqrt{Hz}$, already more than an order of magnitude better than previous state-of-the-art for scalar atomic magnetometers. We are continuing to refine this system to realize an improvement in the long-term sensitivity from spin-squeezing measurements beyond the present magnetic field sensitivity records.

[1] G. Vasilakis, V. Shah, M. V. Romalis, Phys. Rev. Lett. 106, 143601 (2011).
[2] S. Li, P. Vachaspati, D. Sheng, N. Dural, M. V. Romalis, Phys. Rev. A 84, 061403R (2011).

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