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**Faraday rotation spectroscopy in multi-pass atomic vapor cells** SHUGUANG LI, PRANJAL VACHASPATI, NEZIH DURAL, MICHAEL ROMALIS, Princeton University — Many important applications of atomic vapors, such as quantum measurements, light storage experiments, and atomic magnetometers benefit from large optical depth of the atomic ensemble. We explore multi-pass cells using cylindrical mirrors with a hole for the entrance and exit of the laser beam to achieve very high optical depth while sampling a large number of atoms. Such cells are much less sensitive to mirror quality and alignment compared to optical cavities and do not require laser frequency locking, mode matching or power coupling matching. Cells with more than 100 passes have been fabricated using internal high-reflectivity mirrors. We have performed paramagnetic Faraday rotation measurements on Rb vapor and have observed atomic rotation angles in excess of 60 radians. Quantum spin noise from unpolarized atomic vapor has also been observed with a high signal-to-noise ratio. This system also exhibits non-linear spin relaxation due to spin-exchange collisions, opening the possibility of using spin-squeezing techniques to improve long-term sensitivity of frequency measurements. We will report on the development of a scalar atomic magnetometer using such spin-squeezing techniques.

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