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Multi-pass cells for quantum non-demolition Faraday rotation measurements in Rb vapor PRANJAL VACHASPATI, Princeton High School, MICHAEL ROMALIS, Princeton University — Quantum non-demolition spin measurements using paramagnetic Faraday rotation benefit from a large optical depth. Optical cavities have traditionally been used for increasing the rotation signal. However, optical cavities have a small mode volume and are very sensitive to alignment and laser frequency. We explore the use of multi-pass cavities using cylindrical mirrors with a hole for the entrance and exit of the laser beam. Such cavities are much less sensitive to mirror quality and alignment and do not require laser frequency locking or power coupling matching. We have developed analytical models for Gaussian beam propagation in such cavities to optimize the uniformity of cell illumination. Experimentally, beam patterns with 38 and 70 passes have been realized. We have also fabricated Rb cells with high quality anti-reflection windows and performed optical absorption and polarization rotation measurements with 38 passes through the cell. Latest progress toward measurements of quantum spin fluctuations in this arrangement will be reported.

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