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Towards quantum-enhancement of an atomic gradiometer with multipass cells VITO GIOVANNI LUCIVERO, NATHANIEL DAVID MCDONOUGH, WONJAE LEE, NEZIH DURAL, MICHAEL ROMALIS, Princeton University, ATOMIC PHYSICS GROUP TEAM — A major challenge in atomic quantum metrology is the use of squeezing to beat classical sensitivity of atomic sensors under optimal conditions i.e. within a high-density regime. In the context of optical magnetometry, it has been known for some time that spin squeezing induced by a quantum non demolition measurement cannot improve the long-term sensitivity, in the presence of a constant decoherence rate. However, it has been recently predicted that spin-exchange collisions in dense atomic vapor can cause nonlinear evolution of the atomic density matrix and improvement of long-term sensitivity by spin squeezing. Here we discuss recent progress towards the experimental implementation of spin squeezing to improve the sensitivity of an atomic gradiometer using multipass cells. We report nonlinear evolution of 87Rb dense ensembles, with strong polarization and high spin correlation, by using a new generation of multipass cells. The design maintains a large effective interaction volume and significantly reduces the diffusion component of the spin time-correlation function, the latter being a requirement for the suppression of atomic spin noise by spin squeezing.

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