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High density spin noise spectroscopy with squeezed light VITO GIOVANNI LUCIVERO, RICARDO JIMNEZ-MARTNEZ, JIA KONG, MORGAN MITCHELL, ICFO-The Institute of Photonic Sciences — Spin noise spectroscopy (SNS) has recently emerged as a powerful technique for determining physical properties of an unperturbed spin system from its power noise spectrum both in atomic and solid state physics. In the presence of a transverse magnetic field, we detect spontaneous spin fluctuations of a dense Rb vapor via Faraday rotation of an off-resonance probe beam, resulting in the excess of spectral noise at the Larmor frequency over a white photon shot-noise background. We report quantum enhancement of the signal-to-noise ratio via polarization squeezing of the probe beam up to 3dB over the full density range up to n=10^{13} atoms cm^{-3}, covering practical conditions used in optimized SNS experiments. Furthermore, we show that squeezing improves the trade-off between statistical sensitivity and systematic errors due to line broadening, a previously unobserved quantum advantage. Finally, we present a novel theoretical model on quantum limits of noise spectroscopies by defining a standard quantum limit under optimized regimes and by discussing the conditions of its overcoming due to squeezing. Reference: Lucivero, et al. arXiv:1509.05653 (2015)

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