Squeezed-light enhancement of sensitivity and signal bandwidth in an optically-pumped magnetometer

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Optical and atomic quantum noise in magnetometry can be reduced by optical squeezing and spin squeezing, respectively. Here we study how squeezed light probing affects the sensitivity spectrum of a high-density quantum noise limited OPM with 300 fT/$\sqrt{\ }$Hz sensitivity. Using off-resonant polarization squeezed light generated in a subthreshold optical parametric oscillator [1] we probe a polarized ensemble of ~10^{13} atoms/cm^3 and increase the signal to noise ratio. [2] In contrast to previous squeezed-light enhanced magnetometers [3], [4], [5], the atomic Bell Bloom excitation along with the dispersive readout of this setup enable independent optimization of the spin preparation and probing while supporting continuous QND measurements. At the same time, it allows clear theoretical understanding of the different quantum noise contributions. The use of squeezed probe light is shown (both experimentally and theoretically) to improve the high-frequency sensitivity as well as the signal bandwidth of the OPM while also evading back action noise.

References

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