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Sensitive and stable vector magnetometer for operation in zero and finite fields

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We report on a Hanle-type magnetometer that uses the same physics package as the free spin preccession magnetometer published in [1]. The magnetometer is most sensitive at zero magnetic field and uses four laser beams to gain measurements of the magnetic field vector components along two orthogonal directions. The influence of the common mode power fluctuations in the laser beams is greatly suppressed due to a differential detection scheme. This leads to high magnetometric sensitivity even at low detection frequencies.

Sensitivities of better than 60 fT/√Hz could be demonstrated simultaneously
for both measurement channels in a well shielded environment. A minimum Allan deviation, limited by residual field fluctuations, of better than 40 fT was observed for integration times of 2s. The magnetometer is ideal for sensitive low-frequency field measurements in offset fields and close to zero field. Among the possible applications for this system is the determination of quasi-static shielding factors of passive magnetic shields and the search for undesired magnetic field correlations in fundamental physics experiments such as EDM searches.

[1] S. Afach et al., Opt. Express 23, 22108 (2015)
[2] G.Bison et al., Opt. Express 26, 17350 (2018)

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