Spin noise spectroscopy of an alignment-based atomic magnetometer

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Optically pumped magnetometers (OPMs) are revolutionising the task of magnetic-field sensing due to their extremely high sensitivity combined with technological improvements in miniaturisation which have led to compact and portable devices. OPMs can be based on spin-oriented or spin-aligned atomic ensembles which are spin-polarised through optical pumping with circular or linear polarised light, respectively. Characterisation of OPMs and the dynamical properties of their noise is important for applications in real-time sensing tasks. In our work, we experimentally perform spin noise spectroscopy of an alignment-based magnetometer. Moreover, we propose a stochastic model that predicts the noise power spectra exhibited by the device when, apart from the strong magnetic field responsible for the Larmor precession of the spin, white noise is applied in the perpendicular direction aligned with the pumping-probing beam. By varying the strength of the noise applied as well as the linear-polarisation angle of incoming light, we verify the model to accurately predict the heights of the Larmor-induced spectral peaks and their corresponding linewidths. Our work paves the way for alignment-based magnetometers to become operational in real-time sensing tasks.

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