Free-induction-decay magnetometry using a dual-laser configuration

A. McWilliam[1], D. Hunter[1], T. E. Dyer[1], P. F. Griffin[1] and E. Riis[1]

[1] Department of Physics, SUPA, University of Strathclyde, 107 Rottenrow East, Glasgow

Optically pumped magnetometers (OPMs) provide extremely sensitive magnetic field measurements in both research and real-world environments. The free-induction-decay (FID) magnetometer, a type of total-field OPM can be relatively simple to implement in comparison to other schemes and has recently demonstrated both high bandwidths and sensitivities [1, 2]. These scalar sensors operate in a pulsed mode in a similar configuration to the Bell-Bloom magnetometer. The all-optical nature of the FID sensor provides an obvious advantage in accuracy over other magnetometry schemes as a direct estimate of the field is obtained. This approach may prove beneficial in areas where accuracy is essential, such as in MEG and MCG studies.

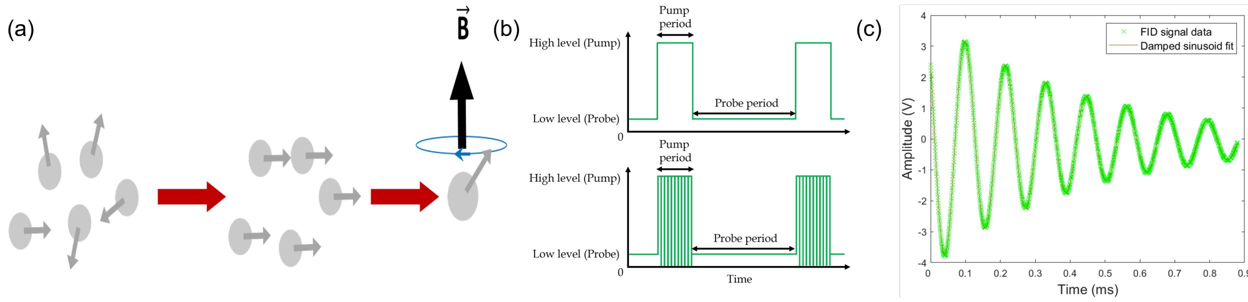

Figure 1: (a) Polarised atoms precess around a transverse magnetic field after absorbing resonant laser light. (b) Amplitude modulation regimes used for optical pumping. Single pulse (above), synchronous (below). (c) Experimentally obtained FID signal and corresponding fit.

We explore the accuracy and sensitivity of an FID sensor in a laboratory environment using a co-propagating dual-laser configuration with strong optical pumping in order to achieve a high polarisation. We examine the impact of this system on the amplitudes and decay rates of the obtained FID signals, where there is a clear correlation to the atomic relaxation rate. We also showcase the routes taken towards the ultimate goal of lowering the noise floor below the $\mathrm{pT}/\sqrt{\mathrm{Hz}}$ level performed previously [3].

References

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