Free-Induction-Decay Atomic Magnetometer with a MEMS Cesium Vapor Cell

C Hegde[1†], T Augustin[2] and G Rajalakshmi[1]

[1]Tata Institute of Fundamental Research Hyderabad, Sy No 36/P, Serilingampally Mandal, Hyderabad 500046, India

[2]QuBeats, Institution of Eminence (IoE), University of Hyderabad, Prof. C R Rao Road, Gachibowli, Hyderabad - 500046, India

Synopsis Compact optical magnetometers are attractive for portable, unshielded applications such as geophysical surveying, biomagnetic sensing and navigation. Microfabricated vapor cells make these sensors small and scalable, while a free-induction-decay (FID) based operation gives the measurement of the field directly from the Larmor frequency. The FID magnetometers can also be operated in ambient field conditions and are self calibrating. We present our first steps towards building such a sensor and characterizing its performance.

We report the initial characterization of a free-induction-decay (FID) optical magnetometer based on a microfabricated (MEMS) Cesium vapor cell with Argon buffer gas. In this scheme, a single light beam is used both as pump and probe by separating the phases in the time domain. During pumping, atomic spin polarization is created and during the probing the spin-polarized Cesium atoms precess freely at the Larmor frequency while decaying exponentially [1]. The atomic spins are prepared by amplitude-modulated optical pumping with elliptically polarized light from a laser tuned to the Cesium D_2 line.

The light is then reduced to a weak probe level, and the resulting optical rotation is recorded with polarimetry setup. The Larmor frequency, and hence the magnetic field, is obtained by measuring the frequency of the FID signal. This system is being developed towards a compact, single beam magnetometer for Earth-field operation [2]. This experiment is ongoing, and the latest developments and results will be presented in the poster. These include temperature dependent studies for optimizing the detected optical rotation.

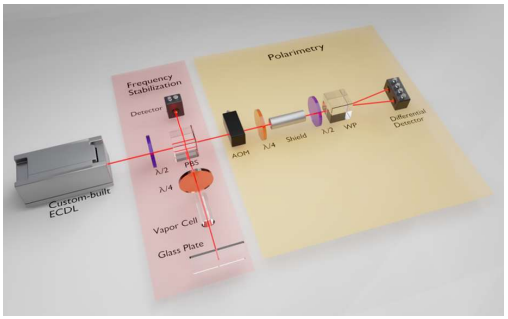

Figure 1. Optical schematic of the FID magnetometer setup. AOM: Acousto-optic modulator, WP: Wollaston Prism

References

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†E-mail: chandankumarh@tifrh.res.in