A pulsed vector optically pumped magnetometer operating in the SERF regime

Joonas Iivanainen¹, Kaleb Campbell¹-², Bethany J. Little¹, Amir Borna¹, Tony R. Carter¹, Peter D.D. Schwindt¹

¹. Sandia National Laboratories, 1515 Eubank SE, 87123 Albuquerque, USA
². Department of Physics and Astronomy, University of New Mexico, 1919 Lomas Blvd NE, Albuquerque, USA

We describe a vector optically pumped magnetometer operating in the SERF regime. By applying short pulses of 795 nm light using a high-power multimode laser diode (2.5 W), we generate spin polarization in a hot $^{87}$Rb vapor. We monitor the free precession of the spin polarization by observing the Faraday rotation of a linearly polarized 780 nm probe beam (TA pro, Toptica Photonics AG) collinear to the pump beam [1]. One or multiple components of the magnetic field can be detected by rotating the spin polarization using magnetic field pulse sequences of different designs produced by an H-bridge circuit [2].

Fig. 1A shows a 5-ms pulse sequence used to detect $B_y$ with pump/probe along z-axis. A 25 µs $\pi/2$-pulse along $y$-axis is used to rotate the initial spin polarization from z-axis to x-axis. A $\pi$-pulse also along the $y$-axis is used in the midway of the sequence to rotate the polarization around the $y$-axis to facilitate demodulation of the probe rotation signal with a bipolar waveform. The demodulated signal is linear with respect to small changes of $B_y$ (Fig. 1B). Sensitivity of ~40 fT/Hz has been achieved (Fig. 1C). We are currently working to reduce the technical noise of the magnetometer.

References

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