Influence of magnetic-field inhomogeneity on scalar potassium magnetometer

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We employ an optically-pumped potassium magnetometer with totally separated magneto-optical resonance spectrum in the dynamic range of geomagnetic field. The magneto-optical resonance signal with ultra-narrow linewidth(3 Hz at 1000 nT) is observed in an anti-relaxation coated Potassium vapor cell[1], while it broadens obviously with the growth of ambient magnetic-field strength(120 Hz at 70000 nT) which seriously deteriorates the sensitivity. According to our calculation, the magnetic-field inhomogeneity inside magnetic shield contributes most to the line broadening. By compensating the first-order gradient of axial magnetic field, the spectrum linewidth has been narrowed by 40%.

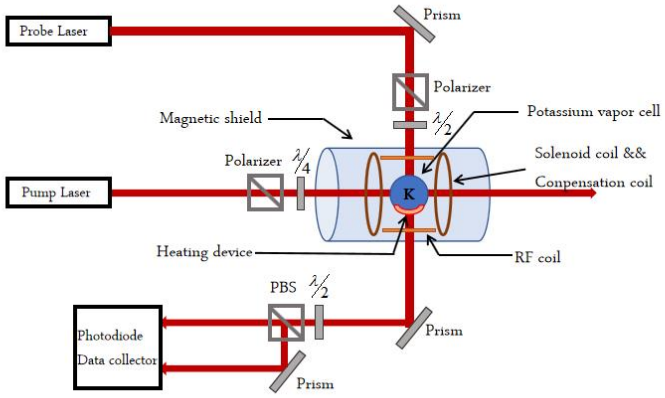

Figure 1: Experimental setup. A two-beam configuration system is employed in scaler Potassium magnetometer. Spheric vapor cell with paraffin coating has 35mm diameter and is kept warm up to 55°C. Pump light is circularly polarized generated with a K D1 (770 nm) DFB laser while probe light is linearly polarized and detuned from K D2 (766 nm). During the measurement, the pump power is chosen to be 100 μW, while the probe power is 60 μW.

[1] J. S. Guzman, A. Wojciechowski, J. E. Stalnaker, K. Tsigutkin, V. Yashchuk, D. Budker, Nonlinear magneto-optical rotation and zeeman and hyperfine relaxation of potassium atoms in a paraffin-coated cell. Phys. Rev. A. **74**, 053415 (2006)