Spatial polarisation spectroscopy in Rb vapour cells with structured light fields

Richard Aguiar Maduro[1], Mustafa Al-Khafaji[1,2], Adam Selyem[1,2], Sonja Franke-Arnold[1]

[1] School of Physics and Astronomy, University of Glasgow, UK
[2] Fraunhofer CAP, Glasgow, UK

Polarisation spectroscopy is a well-known technique for laser locking. It is based on generating macroscopic magnetisation in an atomic vapour through optical pumping, and analysing the effect on the polarisation state of a homogeneously polarised probe beam as a function of frequency [1]. Light shaping techniques developed at Glasgow and elsewhere allow us to imprint light with spatially varying polarisation structures, including vector vortex beams [2]. The anisotropy resulting from circular dichroism in the spatially varying polarisation pattern allows us to probe the atomic resonant frequencies of the alkali vapour [3]. We aim to explore the performance enhancement due to added spatial degree of freedom for polarisation spectroscopy.

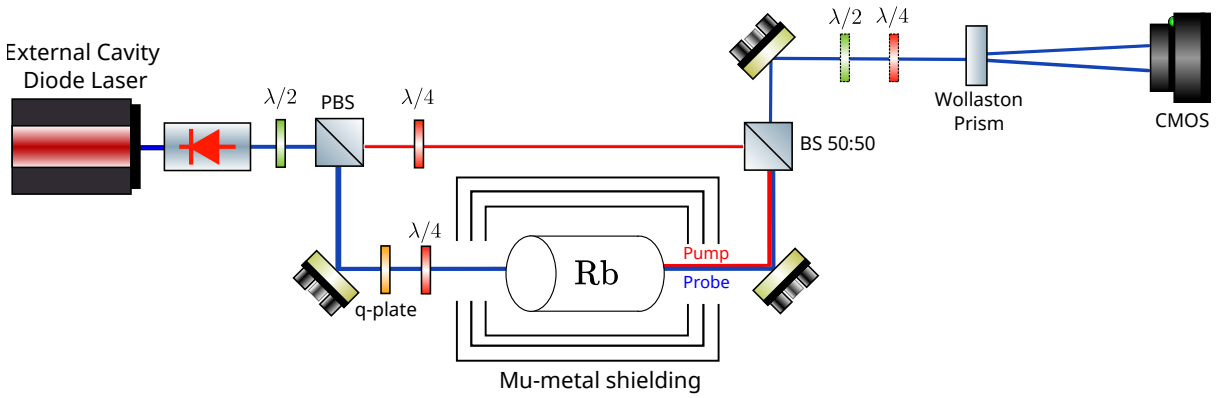

Figure 1. Schematic for spatial polarisation spectroscopy. A heated Rb cell is magnetically shielded with mu-metal and counter-propagating beams pump and probe the atomic media.

[1] P Pearman et al. 2002 J.Phys. B: At. Mol. Opt. Phys. **35** 5141
[2] F. Cardano, E. Karimi, S. Slussarenko, L. Marrucci, C. de Lisio, and E. Santamato, Appl. Opt. **51**, C1-C6 (2012)
[3] J. Wang, F. Castellucci, S. Franke-Arnold; AVS Quantum Sci. 1 October 2020; **2** (3): 031702.