A high-performance 852 nm Voigt anomalous dispersion optical filter for external-cavity diode laser

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Voigt anomalous dispersion optical filter[1] (VADOF) plays a very important role in optical communication and precision measurement because of its narrow bandwidth and high transmittance. Compared with the traditional Faraday anomalous dispersion optical filter (FADOF), the VADOF has a simpler structure and smaller size. The magnets of VADOF don't need to be punched, and the whole pieces of magnets can be directly placed on the two sides of the atomic vapor cell. It is easier to realize a larger and more uniform magnetic field with this structure, which makes the magneto-optical effect more significant and stable. We measure and investigate the characteristics of 852 nm VADOF under different magnetic fields, optical powers, and temperatures. Meanwhile, the VADOF also demonstrates its great value as a frequency selecting element for external-cavity diode lasers (ECDLs), because the transmittance spectra of VADOF correspond to atomic transition lines, and the bandwidth of the transmittance spectra of VADOF can reach several GHz. Thus, they can be well immune to mechanical vibrations and current and temperature variations, avoiding the drawbacks of conventional ECDLs. The laser frequency is also directly aligned with the atomic transition lines.

As shown in Fig. 1, we investigate the characteristics of 852 nm VADOF, which consists of a cesium vapor cell, magnets, and two polarization beam splitters (PBSs). The diameter of the cesium vapor cell is 10 mm, and its length is 30 mm. The vapor cell is heated by a heating wire and thermally isolated by Teflon. We measure the transmittance spectra of the VADOFs at different magnetic fields, e.g., 2000 Gs, 2500 Gs, 3000 Gs, and 3500 Gs, and measure the transmission spectra of the VADOF at different laser intensities and temperatures, respectively. Then we select a VADOF with high transmittance of the transmission peaks at the atomic transition lines and few stray peaks to build a ECDL, and the ECDL shows excellent performance.

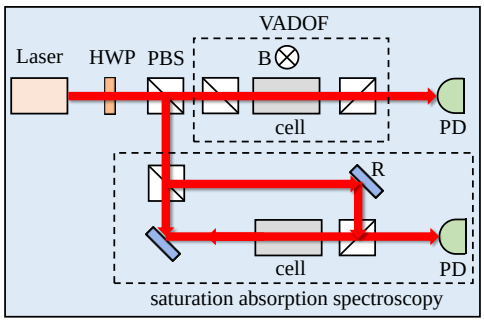

Fig. 1: Schematic of the experiment setup.

[1] J. Menders, et al., "Blue cesium Faraday and Voigt magneto-optic atomic line filters," Opt. Lett., vol. 17, no. 19, pp. 1388–1390, 1992.