

Improved performance of ultra-narrow atomic bandpass filters via magneto-optic rotation in an unconstrained geometry

James Keaveney, Charles Adams, Ifan G. Hughes

Joint Quantum Centre (JQC) Durham-Newcastle, Department of Physics, Durham University, South Road, Durham, DH1 3LE, United Kingdom

Atomic bandpass filters are widely used in a variety of applications, owing to their high peak transmission and narrow bandwidth. Much of the previous literature has used the Faraday effect to realise such filters [1-5], where an axial magnetic field is applied across the atomic medium. Here we show that by using a nonaxial magnetic field, the performance of these filters can be increased in comparison to the Faraday geometry. We optimise the performance of these filters using a numerical model [6,7] and verify their performance by direct quantitative comparison with experimental data. We find excellent agreement between experiment and theory. These optimised filters could find use in many of the areas where conventional Faraday filters are currently used [8,9] with little modification to the optical setup, allowing for an increase in performance with relatively little change.

- [1] Y. Öhman, *Stockholms Obs. Ann* **19** 4, 3 (1956)
- [2] M. A. Zentile et. al., *Opt. Lett.* **40**, 2000 (2015)
- [3] M. A. Zentile et. al., *J. Phys. B* **48**, 185001 (2015)
- [4] W. Kiefer et. al., *Sci. Rep.* **4**, 6552 (2014)
- [5] S. Portalupi et. al., *Nature Commun.* **7** 13632 (2016)
- [6] M. A. Zentile et. al., *Com. Phys. Commun.* **189**, 162-174 (2015)
- [7] J. Keaveney et. al., *Com. Phys. Commun.* **224**, 311-324 (2018)
- [8] J. Keaveney et. al., *Rev. Sci. Inst.* **87**, 095111 (2016)
- [9] X. Miao et. al., *Rev. Sci. Inst.* **82** 086106 (2011)