# Level-mixing magnetometry in rubidium vapour at room temperature

Marcis Auzinsh, Laima Busaite, Ruvin Ferber, Arturs Mozers, Valters L. Muzikants, Dace Osite

University of Latvia, Laser Centre, Jelgavas Street 3, LV-1004 Riga, Latvia

Recent results have shown that the dependence of fluorescence signals on magnetic field can become a promising way to advance the development of optically pumped magnetometers [1]. One such way is to observe level-crossing signals in alkali vapour for the D2 transition [2]. In the present study we show that also the fluorescence from D1 line of rubidium can be used to measure magnetic field, as it provides expressive signal dependence on external magnetic field. We have observed both experimentally and theoretically two oppositely circularly polarised laser-induced fluorescence (LIF) component dependence on the magnetic field (Fig.1.). The exciting electric field $\mathbf{E}$ is in a $\pi/4$ angle with respect to the magnetic field $\mathbf{B}$, and the observation direction is perpendicular to the plane of $\mathbf{E}$ and $\mathbf{B}$. We set this geometry as the main goal of our project is to observe angular-momentum alignment-to-orientation conversion in the ground state of rubidium atoms. Nevertheless, in the fluorescence signal some profound structures at particular magnetic field values appear. The formation of these structures can be attributed to magnetic sub-level scanning in the external magnetic field. When the energy difference between two particular magnetic sub-levels coincides with the set laser frequency, an increase in the fluorescence signal can be observed. The amplitude of the peaks is proportional to the transition probability and the width is proportional to the Doppler broadening. Possible increase of magnetic field resolution can be achieved if Doppler effect is suppressed, for example using nanocells [3]. A. Mozers acknowledges support from ERAF PostDoc Latvia project No. 1.1.1.2/16/117 "Experimental and theoretical signals of ground-state angular momentum alignment-to-orientation conversion by the influence of laser radiation and external magnetic field in atomic alkali metal vapour".

[1] H. Zheng, G. Chatzidrosos, A. Wickenbrock, L. Bougas, R. Lazda, A. Berzins, F. H. Gahbauer, M. Auzinsh, R. Ferber, and D. Budker, Level anti-crossing magnetometry with color centers in diamond, (International Society for Optics and Photonics), **p. 101190X.** (2017)
[2] M. Auzinsh, A. Berzins, R. Ferber, F. Gahbauer, L. Kalvans, A. Mozers, and A. Spiss, Alignment-to-orientation conversion in a magnetic field at nonlinear excitation of the D2 line of rubidium: Experiment and theory, Phys. Rev. A **91**, 053418 (2015).
[3] A. Sargsyan, E. Klinger, A. Tonoyan, C. Leroy, and D. Sarkisyan, Hyperfine Paschen-Back regime of potassium D2 line observed by Doppler-free spectroscopy, J. Phys. B At. Mol. Opt. Phys. **51**, 145001 (2018).