Alignment to orientation conversion of rubidium atoms under D_2 excitation in an external magnetic field: experiment and theory

M. Auzinsh[1], A. Berzins[1], R. Ferber[1], F. Gahbauer[1], L. Kalvans[1], A. Mozers[1], and A. Spiss[1]

[1]*Laser Centre, University of Latvia, Rainis Blvd. 19, LV - 1586 Riga, Latvia*

Presenting Author: marcis.auzins@lu.lv

We present results from a theoretical and experimental investigation of level-crossing spectra of rubidium atoms at D_2 excitation for crossings of levels whose projection m_F of the total angular momentum F on the quantization axis differ by one ($\Delta m = 1$). The crossings occur when the levels are shifted by the nonlinear Zeeman effect in an external magnetic field $\mathbf{B}$ whose direction defines the quantization axis. When two levels with $\Delta m = 1$ cross they can be coherently excited by linearly polarized laser radiation whose polarization vector $\mathbf{E}$ forms an angle of $\pi/4$ with respect to the magnetic field $\mathbf{B}$. In this geometrical configuration, we observe laser induced fluorescence (LIF) emitted in the direction that is perpendicular to both $\mathbf{E}$ and $\mathbf{B}$ in order to observe the LIF signal as a function of magnetic field. The level-crossings lead to the emission of partially circularly polarized fluorescence light in the observation direction. The change in the detected circularly polarized LIF implies that the aligned angular momentum state created by the exciting laser radiation has been transformed into an oriented state under the influence of the external magnetic field.

We have extended the theoretical model and improved the experiment in comparison to previous studies [1], in particular so as to be able to study excitation at higher laser power densities while observing the individual circularly polarized light components. The theoretical model is based on the optical Bloch equations and takes into account all neighbouring hyperfine levels, the splitting of magnetic sublevels in the external magnetic field, and the Doppler effect [2]. The theoretical model is able to describe the experimentally measured signals for magnetic fields up to 85 G and laser power densities of 6 mW/cm^2.
We thank Latvian Council of Science project 119/2012 for financial support.

References

[1] J.Alnis *et al.* Phys.Rev.A **63**, 023407 (2001)
[2] M.Auzinsh *et al.* Phys.Rev.A **79**, 053404 (2009)