Hyperfine Paschen-Back regime of Potassium D_2 line studied by selective reflection from a nanocell

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Recently it was shown that the selective reflection (SR) of laser radiation from the interface between a dielectric window and the atomic vapors confined in a nanocell (NC) of several hundred nanometers thick is a new and convenient tool for atomic spectroscopy [1]. We have implemented the derivative of SR (dSR) to study the atomic transitions of *K* D_2 line in external magnetic fields. In strong longitudinal magnetic field two groups by eight (*1–8*) transitions contained in each group are formed by σ^+ and σ^- circularly polarized light. Each group contains one so called Guiding Transition (GT). A feature of the GT is that the probability as well as the frequency slope (MHz/G) remains the same in the whole range 0–10 kG of magnetic fields. In the case of π-polarised laser radiation among eight transitions there are two forbidden transitions for B = 0, with the probabilities undergoing giant modification under the influence of magnetic field. For magnetic *B*-fields > 400 G practically the complete hyperfine Paschen-Back regime is observed. Theoretical models describe the experiment very well.

In Fig.1a) the red curve is dSR experimental spectrum for σ^+ circularly polarized light and for longitudinal magnetic fields, which are increasing from the bottom to the top: 530, 590, 680 and 800 G. Atomic transition linewidth is ≈80 MHz. As we see there are two groups 1–4 and 5–8. Transition labeled by digit 8 in circle is a so called guiding transition (GT) and its probability as well as frequency slope remain the same in the whole range of applied B-fields. Other features of *K* D_2 line behavior in magnetic field also will be presented.

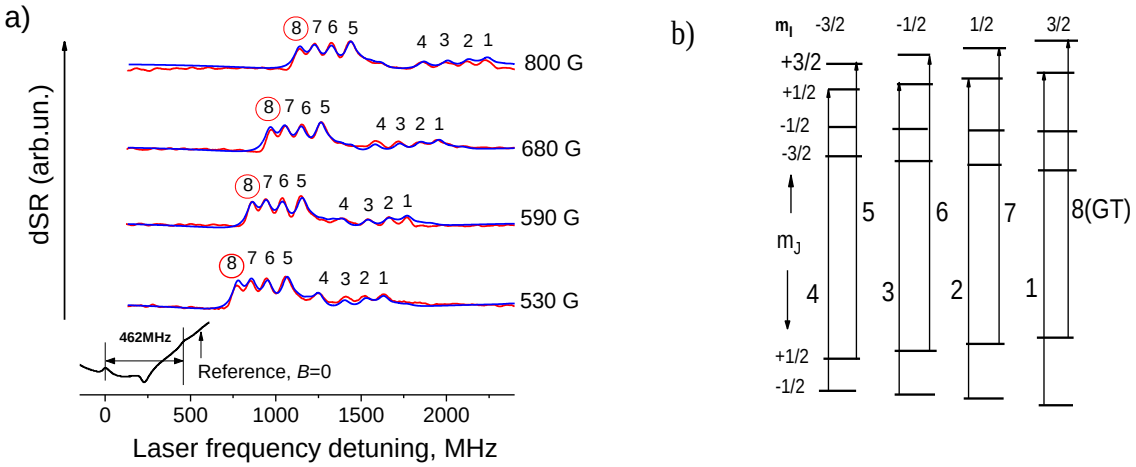

Figure 1 a) ^{39}K, D_2 line, σ^+ laser radiation. The red and blue curves show experimental and calculated dSR signal spectra for the nanocell thickness *L*=350 nm. The lower curve is the Saturated Absorption spectrum. b) diagram of the atomic transitions in the bases of m_J and m_I.

[1] A. Sargsyan, A.Papoyan, I. G. Hughes, Ch. S. Adams, and D.Sarkisyan, Opt. Lett. **42**, 1476 (2017).