EIT resonance inverted in magnetic field by influence of the alignment effect

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The electromagnetically induced transparency (EIT) effect still attracts great interest, partly through the development of chip-scale atomic clocks, such as micro-fabricated atomic clocks. Here we present for the first time (to our knowledge) the influence of alignment on the EIT resonances. In Fig. 1a the

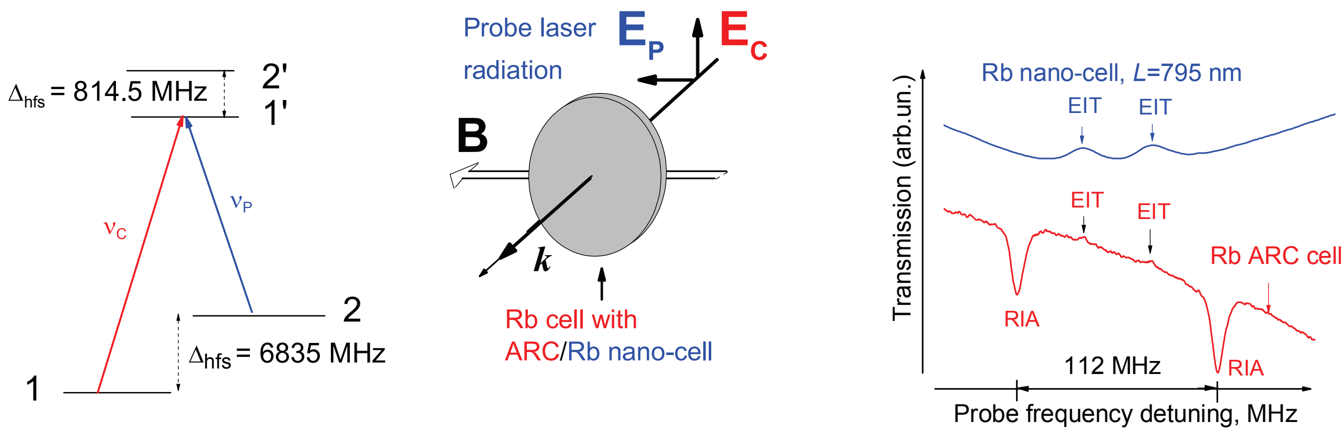

Figure 1: *a) Λ-system of the ^{87}Rb D_1 line, powers P_c and P_p are 14 and 0.5 mW, respectively; b) the configuration of $\boldsymbol{B}$, $\boldsymbol{k}$, $\boldsymbol{E_p}$ and $\boldsymbol{E_c}$ ($B = 27$ G); c) the upper and lower spectra show EIT-resonances for NC and ARC, respectively.*

system of the ^{87}Rb, D_1 line is shown. The coupling laser frequency is in resonance with the $1 \rightarrow 1'$ transition, while the probe laser frequency is scanned through the $2 \rightarrow 1'$ transition. Two cells filled with Rb are used: an 8 mm-long cell having anti-relaxation coating (ARC) and a nano-cell (NC) with thickness $L = \lambda = 795$ nm. An external magnetic **B**-field is directed along the probe E_p field, while E_c is perpendicular to the B-field (see Fig. 1b). Due to the Zeeman optical pumping (ZOP) effect the whole population of level $F_g = 2$ is concentrated in the sublevels $m_F = \pm 2$, i.e. alignment occurs [1]. In this case the population $N(F_g = 2, m_F = 2) > N(F_g = 1, m_F = 0, \pm 1)$ and a strong absorption of the probe radiation ν_p occurs via a two-photon Raman-type process. ZOP efficiency is proportional to Ω_p/R, where Ω_p is the probe Rabi-frequency and R is the relaxation time ($\gamma_R < 1$ kHz for the ARC cell, and $\gamma_R > 1$ MHz for the NC). In Fig. 1c), the upper and lower spectra show EIT-resonances for the cases of NC and ARC, respectively. We see that in the upper spectrum the EIT-resonances show a reduction in the absorption (ZOP is absent due to the large value of γ_R), while the resonances in the lower spectrum show an increase in absorption, that is why we call them resonances inverted by alignment (RIA). A theoretical model explaining RIA formation is developed. The results of other configurations of **B**, **k**, $\mathbf{E_p}$ and $\mathbf{E_c}$ are presented.

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References

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