Electromagnetically induced transparency with different profile of the laser beam – case study with Rb buffer gas cell

S N Nikolić, M Radonjić, A J Krmpot, N M Lučić, B V Zlatković and B M Jelenković[1]

[1]*Institute of Physics, University of Belgrade, Pregrevica 118, 11080 Belgrade, Serbia*

bojan@ipb.ac.rs

We investigated electromagnetically induced transparency (EIT) due to Zeeman coherences in the Rb buffer gas cell using laser beams with the Gaussian and the Π profiles for radial intensity distributions. The laser intensities were from 0.1 to10 mW/cm^{-2}.

Distinct differences were obtained for both line shape and line widths of the EIT with two different laser profiles. Observed results depend on the laser intensity and the laser beam diameter. We worked with laser beams with 6.5 and 1.3 mm in diameter.

For the low laser intensity and wider laser diameters, both Gaussian and Π laser beam profiles gave EIT line shapes which can be approximated by the Lorentzian.

For the narrower Gaussian laser beam we observed a non-Lorentzian profile of the EIT. The new feature on the EIT waveform is a very narrow central part. This might be due the contribution of diffusion-induced Ramsey narrowing [1]. Correlation was indeed shown between such EIT profile and diffusion of atomic coherence out of the laser beam and return, after some time in a dark and evolution, to the laser beam [2].

The EIT line widths have very similar dependence of laser intensity for the entire range of the cell temperature (60 – 90 0). The EIT line width, estimated at extrapolated zero laser intensity, is about 50 nT or 0.7 kHz, which refers to 1.5 ms relaxation times of Zeeman coherences in 87Rb atoms in our buffer gas cell.

About six-fold increase in EIT contrast for higher laser intensities with a considerable decrease in linewidth was obtained by blocking the central part of the wide Gaussian laser beam, just in front of the photo detector. Such effects are attributed to the decreased optical pumping to the non-coupled ground state level F_g = 1 and reduced power broadening in the low intensity beam wings [3].

References:

[1] Xiao Y, Novikova I, Phillips D F and Walsworth R L, *Opt. Express* **16** 14128 (2008)

[2] Xiao Y, Novikova I, Phillips D F and Walsworth R L, *Phys. Rev. Lett.* **96** 043601 (2006)

[3] S N Nikolić, M Radonjić, A J Krmpot, N M Lučić, B V Zlatković and B M Jelenković, *J. Phys. B: At. Mol. Opt. Phys.* **46** (2013) 075501 (2013)