High-quality electromagnetically-induced-absorption resonances in a buffer-gas-filled cesium vapor cell

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Electromagnetically induced absorption (EIA) effect leads to observation of subnatural-linewidth resonances in thermal vapor cells with steep decrease of light transmission [1]. To date, the scope of EIA applications is negligibly small compared to that of electromagnetically induced transparency (EIT) effect caused by coherent population trapping (CPT). There are many papers demonstrating relatively good contrast of EIA signals, but this is at the expense of large linewidths from tens up to many hundreds of kHz. On the other hand, the linewidth can be as small as just several hundreds of Hz, but the signals have an extremely low contrast of no more than 1%. Recently, a certain progress for observation of high-quality EIA resonances has been achieved with a rubidium vapor cell [2]. Here we continue developing this approach and present much better results for the resonance properties. The setup is shown in Fig.1a where a 2 cm long cesium vapor cell is used. It is filled with 20 Torr Ne buffer gas. The probe wave intensity is monitored after the cell as the function of longitudinal magnetic field (see Fig.1b). It is seen that the Doppler background absorption (A_D) is negligibly small compared to the EIA resonance amplitude (A) that is unique situation for narrow EIA as well as EIT resonances in thermal cells. For instance, the contrast $C_D=A/A_D$ as large as 16.3 has been measured. The narrowest linewidth is 0.77 mG (270 Hz) at I_{pump}=80 μW/cm^2. The obtained high-quality EIA resonances can be used to significantly improve sensitivity of Hanle magnetometers [3]. The work was supported by Russian Science Foundation (grant no. 17-72-20089).

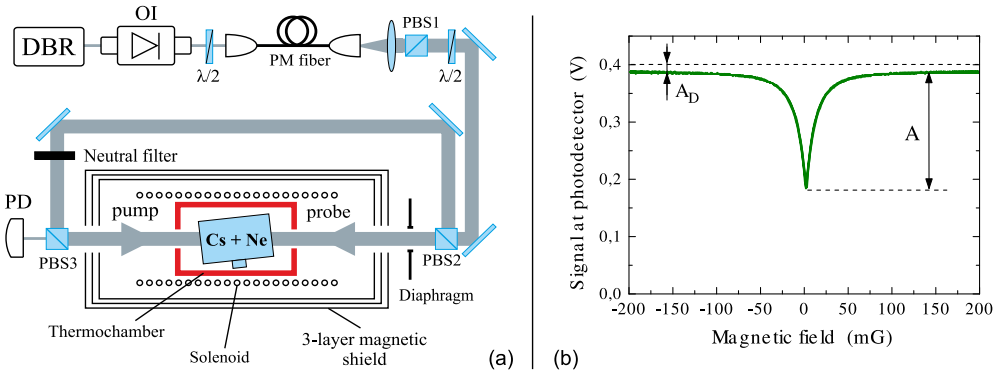

Figure 1. (a) The experimental setup. (b) An example of high-contrast EIA resonance observed on F_g=4→F_e=3 of D_1 line at T=50°C, I_{pump}=3.5 mW/cm^2, I_{probe}=3.6 μW/cm^2.

[1] A.M. Akulshin, S. Barreiro and A. Lezama, Phys. Rev. A **57**, 2996 (1998).
[2] D.V. Brazhnikov et al., Laser Phys. Lett. **15**, 025701 (2018).
[3] A. Papoyan et al., Appl. Opt. **55**, 892 (2016).