Estimation of excited atoms relaxation time by using coherent scattering of intense laser beams at interface between transparent dielectric and dense resonant gas

Vilshanskaya E V[1,2,@], Sautenkov V A[1], Saakyan S A[1,3], Bobrov A A[1], Nazarov A A[3] and Zelener B B[1,3]

[1] Joint Institute for High Temperatures of the Russian Academy of Sciences, Izhorskaya 13 Bldg 2, Moscow 125412, Russia

[2] National Research University Moscow Power Engineering Institute, Krasnokazarmennaya 14, Moscow 111250, Russia

[3] National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Kashirskoe Shosse 31, Moscow 115409, Russia

[@] VilshanskyaYV@mpei.ru

In this work we study resonances in a self-broadened line of selective reflection of intense laser radiation from the interface between the window of a cell and atomic vapors of high-density rubidium, where the dipole broadening much larger than the Doppler width. The formation of coherent resonances is caused by coherent scattering of the intense probe and saturating pump optical fields on the oscillations of the populations of the ground and excited states of atoms at the beat frequency. The width of each resonance depends on the decay rate of the population difference which is caused by non-radiative excitation transport and quenching of atomic excitation at the window surface. Within a simple model, we found the conditions to observe resonances with the Lorentz spectral profile. We estimated the effective relaxation time of excited atoms from the measured spectral width as 3 ns which is much less than the natural lifeitime 26 ns of $5P_{3/2}$ state of rubidium.
The research is supported by the Russian Science Foundation, Grant No. 23-22-00200.