The Relation of the Effects of Resonantly Excited Radiation For Atoms in Intense Laser and Magnetic Fields With the Structure of Quasienergies Spectra

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We consider effects related to the modifications of atomic spectra due to intense laser field and strong external magnetic field. Laser field, consisting of two monochromatic components differently polarized, is resonant to adjacent atomic transitions. It is well known that the resonance fluorescence (RF) spectra for two-level system have the form of triplet, the side components of which are shifted from central frequency by the Raby frequency. Raby frequency is equal to the difference of quasienergies of coupled states.

For multilevel system RF spectra has the form of multiplet. In [1] it is reported about the experimental observation for the first time of multiplet spectra of RF in sodium vapours in the intense laser wave field in the case of one-photon resonance. Theoretical investigation of the characteristics of RF spectra for multilevel system in the case of two-photon resonance in the presence of magnetic field has been made in [2]. The present work is development of these researches.

The results of computer simulations are the dependencies of frequency shifts, relative intensities and polarization of the components of RF multiplet on detunings, intensity and polarization of laser fields and also on orientation and strength of external magnetic field. As an example we consider transitions $3S_{1/2}$-$3P_{1/2(3/2)}$-$5S_{1/2}$ of sodium atoms for which some experimental data are obtained in [1]. According the selection rules the common number of RF multiplet components is 90, but not all of them are intensive. In the case of one-photon resonance with the transition $3S_{1/2}$-$3P_{1/2(3/2)}$ of laser radiation with power density 0,1 Mw/cm^2 RF spectra have from 2 till 6 shifted components depending on detuning. The analysis of quasienergy spectra permits to distinguish the types of interacted states. The including of external magnetic field modifies the number of such states. For the case of magnetic field parallel to the wave vector of laser radiation we have found that for the strong magnetic field $H = 5.10^4$ Oe and power density $I_L = 10^5$ W/cm^2 the number of components can reach 18 in dependence of detuning. In the case of two-photon resonance the number of components is more large compared to the case of one-photon resonance.

By our computer simulations we have shown how it is possible to vary the form of RF multiplet modifying the experimental conditions. Such investigations can be useful for the seeking of new principles of tuned lasers based on the effect of stimulated Raman scattering.

[1] A.G. Leonov, A.A. Panteleev, A.N. Starostin, D.I. Chehov, *Pisma v JETP*, **58** 959 (1993).
[2] T.Ya. Karagodova, *Can. J. Phys.* **77** 299 (1999).