The effect of experimental geometry and initial population of the fine-structure levels of thallium atoms and alkali atoms on the shape of coherent population trapping resonances and magnetooptical rotation of the plane of polarization

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Numerical experiments were performed for investigation of the coherent population trapping (CPT) in the generalized Λ-system whose lower levels are the magnetic sublevels of the fine structure levels of the thallium atom for the case of nontrivial initial populations of the upper metastable fine structure level. Such population may be obtained, for example, due to the photodissociation of *TlBr* molecules. The possibility of reducing the number of resonances of the CPT in a multilevel system, which may be useful for high-resolution spectroscopy, is demonstrated. It is shown that the magnitude and shape of the resonances can be controlled by varying the orientation of the polarization vectors of the light field components with respect to each other and to a magnetic field. In addition, studying the shape of the CPT resonances for the atoms obtained by photodissociationof molecules may provide informationabout about these molecules. [1].

Also the dependence of the shape of CPT resonances on the polarization of the radiation fields has been numerically studied. The cases of linear, elliptical, and circular polarizations have been considered.The shape and the number of CPT resonances for different polarizations have been compared. It has been concluded that the electromagnetically induced transparency can be changed by changing the polarization properties of the laser radiation [2].

The spectra of magnetooptical rotation and magnetic circular dichroism have been obtained for the first time for the nontrivial initial population of magnetic sublevels of excited electronic states of an alkali atom, as well as under conditions of two-photon resonance. The decrease in the amplitude of resonances of initially populated fine structure levels is explained by population transfer, taking place in strong fields. This transfer affects the rotation of the plane of polarization. The lower the initial population, the more effective is the population transfer. [3].

Our investigations can be used for creating lecture demonstrations for courses of nonlinear optical interactions in quantum systems.

References:
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