Control of the dispersion properties of the optically dense medium with closed contour of excitation

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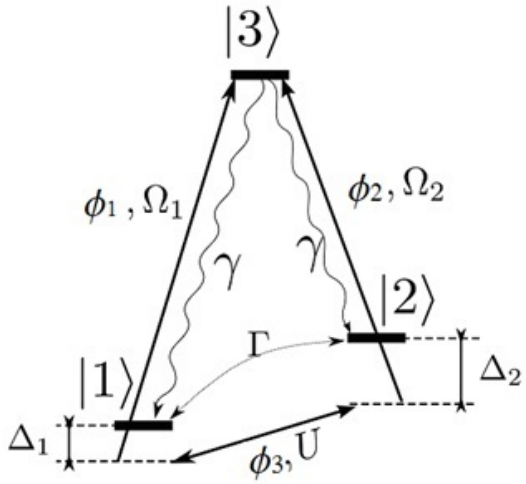
The interaction of light with medium is determined by index of refraction and absorption. Photonic band may take place in the structures with periodic spatial dependence of index of refraction. Such structures are called photonic crystals [1-2]. But variation of optical properties is possible only during creation of the crystals. Therefore the mediums, photonic band of which is able to be conrtolled by electromagnetic fields in effect of electromagnetically induced transparency (EIT) [3], are of interest.

Our work is devoted to research of EIT in the optically thin and dense medium of the atoms which are excited along closed contour of excitation by three frequency radiation (see the figure). The extremum of index of refraction for the certain initial phases $\phi_{1,2,3}$ of the optical waves was found in the optically thin medium. Also there is the range of two photon detuning where amplification of one of the fields takes place [4]. Our calculation for the optically dense medium shows that the difference between phases accumulates in volume of medium, and its index of refraction acquires spatially quasiperiodical dependence. Such dependencies were considered for different conditions of excitation. We found the conditions which give the most contrasty quasiperiodical dependence. It was proposed to use this effect for creation of the medium with controllable photonic band. Such schemes can be implemented in atoms as well as in crystals.



System of atomic levels with closed contour of excitation (Δ-scheme). Here $\Omega_{1,2}$ and U are Rabi frequencies of fields; $\Delta_{1,2}$ - one photon detuning; $\phi_{1,2,3}$ - initial phases of the fields; γ, Γ - rates of spontaneous decay.

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