Quantum computation of populations dynamics of the resonant levels for atomic ensembles in a laser pulse: optical bi-stability effect
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Present paper has for an object (i) to carry out numerical quantum computation of a temporal dynamics of populations’ differences at the resonant levels of atoms and nuclei in a large-density medium in a non-rectangular form laser pulse and (ii) to determine possibilities that features of the effect of internal optical bi-stability at the adiabatically slow modification of effective field intensity appear in the sought dynamics. It is known that the dipole-dipole interaction of atoms in dense resonant mediums causes the internal optical bi-stability at the adiabatically slow modification of radiation intensity. The experimental discovery of bistable cooperative luminescence in some crystals showed that an ensemble of resonant atoms with high density can manifest the effect of optical bi-stability in the field of strong laser emission. The Z-shaped effect is actually caused by the first-type phase transfer. On basis of the modified Bloch equations, we simulate numerically a temporal dynamics of populations differences at the resonant levels of atoms in the field of pulse with the non-rectangular cosh form. Furthermore, we compare our outcomes with the similar results, where there are considered the interaction between the ensemble of high-density atoms and the rectangularly- and sinusoidally-shaped pulses. The modified Bloch equations describe the interaction of resonance radiation with the ensemble of two-level atoms taking into account the dipole-dipole interaction of atoms [1,2]. A fundamental aspect lies in the advanced possibility that features of the effect of internal optical bi-stability at the adiabatically slow modification of effective filed intensity for pulse of the cosh form, in contrast to the pulses of rectangular form, appear in the temporal dynamics of populations differences at the resonant levels of atoms.

References