EPJ Web of Conferences **161**, 02028 (2017) DOI: 10.1051/epjconf/201716102028
PECS-2017

Effects of manifestations of the initial quantum correlations in the coherent scattering of the atom in the standing wave

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Abstract. Some effects of the initial quantum correlations between the atom and the quantum mode of the standing wave of electromagnetic field in the condition of coherent scattering are considered.

A number of quantum effects of the coherent scattering atom in the field of a standing low frequency electromagnetic wave [1] is demonstrated. Here, the nature of the quantum dynamics of a two-level atom strongly depends on the initial conditions of the preparation of interacted systems [2-4]. This initial separable and inseparable state of systems are prepared by broadband parametrical sources. The effective scattering optical potential is made by a quantized field and two coherently classical counter-advancing waves of the optical frequency range. The interaction of the atom with each field happens in the wing of the absorption line of the working transition. However, we assume that the conditions of the Raman and two-photon resonances at the same transition are satisfied. Under these approximations the optical quantum scattering potential can be presented in the form of

$$U(x) = g^2\hbar^{-1}\left[\Pi_+(\omega_c)(a^+aS_z + S_z) + \Pi_-(\omega_c)(2)^{-1}\right]\sin^2(kx). \quad (1)$$

Here g is coupling constant of the interaction between the quantum cavity mode and a two-level atom, the operator a^+a is number of photon operator for cavity mode with frequency ω_c and wave vector k is wave vector, S_z is the inversion operator for two level atom with transition frequency ω_0. The spectroscopy functions is $\Pi_\pm(\omega)=(\omega_0-\omega)^{-1}\pm(\omega_0+\omega)^{-1}$. Because the physical values in (1) are the integrals of motions, thus the average values are constant, and they are defined by initial conditions. We demonstrate that in the scattering of the atom only on quantized standing wave, scattering is absent, when the atom and the field are independent and thus the initial state is separable. On the contrary, the absence of scattering for the initial inseparable state is observed when the optical potential is formed by all three electromagnetic fields.

The effect of the quantum deviation of the atom is discovered. It is observed when the optical potential is produced by the quantum standing wave and the coherently classically field, localized in a small space. This space is produced by the optical fiber. The optical potential for this case is determined by conditions of a two-photon interaction. And in this case the different nature of the dynamics of the atom is captured by the optical potential,

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different ways of preparing the initial atomic field system is addressed. In particular, if the wave functions in the coordinate representation have the Gaussian packet, the average position of the interacting atom and the average values of variances of the coordinate and momentum are determined by the initial conditions.

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