Jaynes-Cummings model of a pair of two-level atoms with dipole interaction

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We study interaction between a pair of two-level atoms and the single-mode cavity field [1]. In present Jaynes-Cummings model with dipole interaction two-level atoms are supposed to be distinguishable and localized in optical cavity in the ground vibrational state (Fig. 1), in which vibrational quantum number $\langle n_v \rangle = 0$.

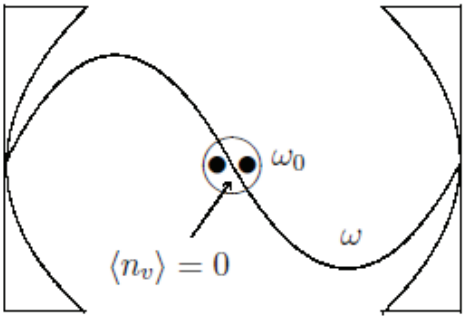

Figure. 1 The schematic of the model: a pair of two-level atoms possessing the transition frequency ω_0 embedded in a single-mode cavity with frequency ω. In proposed model atomic pair is laser cooled and trapped in the ground vibrational state with vibronic quantum number $\langle n_v \rangle = 0$.

We have assumed that atoms are placed in given positions of the standing wave of cavity. Based on modern optical achievements it is possible to localize a small number of emitters (atoms, ions, molecules and even nuclei) in various geometrical systems like optical cavities, quantum dots, optical lattices and dielectric or disordered media.

It is supposed that at initial moment $t = 0$ pair of atoms is prepared in superposition of ground state $|g\rangle$, first excited $|e_1\rangle$, second $|e_2\rangle$ and third excited $|e_3\rangle$ states and quantized cavity field in coherent state $|\xi\rangle$. By using exact analytical solution for state-vector of the coupled atom-field system found with the help of Schrodinger equation quantum-statistical properties of the quantized cavity field are examined as a function of the $|\xi|$ parameter. Exact analytical solutions for the atomic population inversion $\langle S_z \rangle$, mean photon number $\langle n \rangle$ and their fluctuations σ are obtained by using this solution. In this situation quantum statistics of cavity field has the tendency towards oscillations, but exact periodicity of these oscillations is violated by the analogy with the micromaser model [2] and two-photon JCM of a three-level atom [3].

References

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