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Interaction of an Atom or More with Nano-Mechanical Resonators

A Thesis

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summary

General conclusions

In this thesis, we have considered the interaction between two-level atom and a time-dependent electromagnetic cavity field.

In chapter 2, we have investigated the Hamiltonian for a two-level atom interacting with one-mode in the one-photon process in (RWA), in the presence of two arbitrary functions. We have derived in detail the probability amplitudes. We also have given the reduced atomic density operator of the system. We have studied the effect of detuning parameter on the atomic population inversion, Pancharatnam phase, Phase properties, and Von-Neumann Entropy vs. the scaled time. The atom in different initial states of the electromagnetic field of coherent in the one-photon process. The results of this chapter may be summed as follows.

In chapter 3, we investigated the JCM of two-level atoms with a single-mode EMF in an dissipative cavity. We vestigated the atomic population inversion and we note that the oscillation baseline shifts below, the oscillation amplitude decreases and spreading of revival fluctuation and revivals be squeezed, due to the increase in the value of the Stark parameter $r = \frac{\beta_1}{\beta_2}$, also by increasing the Kerr-like parameter χ, the oscillation baseline shifts above, and increasing the number of the revival and collapses. We studied the Pancharatnam phase, we observe that by increasing the value of the Kerr parameter χ respectively the chaotic behavior becomes more observable. conversely, we see that by the increasing of Stark parameter r the phase jumps is decreasing. We studied the Von Neumann entropy, we observe that the maximum value of entanglement decreasing by increasing Kerr parameter χ and the fluctuations increases. conversely, by increasing the Stark parameter r, entanglement is very weak but the maximum value of entanglement is increasing.

In chapter 4, we have introduced the model Hamiltonian for a two-level atom interacting with a time-dependent electromagnetic cavity field with one-mode in the two-photon process in (RWA), in the presence of two arbitrary functions. We have derived in detail the probability amplitudes. We also have given the reduced atomic density operator of the system. After taking into Stark effect and Kerr Like-Medium parameters, we have studied the evolution of the atomic population inversion, Pancharatnam phase, Phase properties, and Von-Neumann Entropy vs. the scaled time. The atom in different initial states of the electromagnetic field of coherent in the two-photon process. The results of this chapter may be summed as follows

1. By increasing the effect of detuning parameter Δ, the concurrence rapidly reaches to the disentangled state (death of entanglement). On the contrary, the atomic decay parameter Γ has no effect on the concurrence.

2. The effect of the time-variation function appears as the frequency modulation effect in the electromagnetic waves (radio waves). The system reaches disentangled state in the same period of scaled time, but the evolution itself changes by the presence of $\$$.

3. By increasing the effect of field decay parameter γ, the concurrence rapidly reaches to the disentangled state (death of entanglement). On the contrary, the atomic decay parameter Γ has no effect on the concurrence.

Outlook

The following studies may include:

- Generalization of the systems to deal with higher-level atoms.
- Generalization of the systems to deal with more than one atom