Summary and Conclusion

We have studied the interaction of a two level atom and squeezed field with time varying frequency. By applying a sinusoidal variation in the frequency of the field, the randomness in population inversion is reduced and the collapses and periodic revivals are regained. Thus the field frequency modulation manipulates the population inversion in the case of squeezed light atom interaction. Also, the periodicity of revival depends on the amplitude of applied frequency modulation. By varying the periodicity of the applied frequency fluctuation the dynamics of population inversion with time can be manipulated. Two level atom field interaction has an important role in the field of quantum computation. Our results suggest a new method to control and manipulate the population of states in two level atom radiation interaction, which is very essential for quantum information processing.

We have also studied the variation of atomic population inversion with time, when a two level atom interacts with light field, where the light field has a sinusoidal frequency variation with a constant phase. In both coherent field and squeezed field cases, the population inversion variation is completely different from the phase zero frequency modulation case. It is observed that in the presence of a non zero phase $\phi$, the population inversion oscillates sinusoidally. Also the collapses and revivals gradually disappears when $\phi$ increases from 0 to $\pi/2$. When $\phi = \pi/2$ the evolution of population inversion is identical to the case when a two level atom interacts with a
Fock state. Thus, by applying a phase shifted frequency modulation
one can induce sinusoidal oscillations of atomic inversion in linear
medium, those normally observed in Kerr medium. We have con-
sidered the system consisting of a two level atom in Kerr medium
interacting with quadrature squeezed photon field in the adiabatic
limit. The frequency of the field is set to be fluctuating and phase
shifted. Evolution of population inversion and entanglement entropy
of the system is analysed by varying parameters. It is observed that in
the nonlinear medium also sinusoidal frequency fluctuation modifies
the time evolution of population inversion. These modifications are
enhanced in the presence of a phase in the frequency fluctuation. The
entanglement entropy of the system also has a close dependence on
the field frequency fluctuations. It becomes more ordered and control-
able when the frequency is sinusoidally fluctuating. We noticed that
the entanglement between the atom and field can be controlled by
varying the period of the field frequency fluctuations. Many interest-
ing behaviour in the evolution of a two level atom in Kerr medium can
also be produced in linear medium by including phase factor in the
frequency modulation. We have analysed the evolution of atom field
state probability in a coupled cavity system. Analytical formulation
for the time variation of atomic and field probability is done in a single
excitation subspace. Atomic excitation transfer between cavities for
different limits of atom-field coupling strength, $g$ and cavity-cavity
coupling strength, $A$ are investigated. It is observed that periodic
transfer of excitation probability between cavities exists. The time
period for complete excitation transfer between cavities for various
limiting cases of coupling strength are predicted. An analytical ex-
pression is obtained for the population inversion of the system which
evolves sinusoidally with time. We have also investigated the evolu-
ation of various atom field state probability amplitudes in a coupled cavity system, where cavities are filled with Kerr medium. The system has been solved numerically and the behaviour of it for different initial conditions and different susceptibility values are analysed. It is observed that, for weak cavity coupling the effect of susceptibility is minimal. In cases of strong cavity coupling, susceptibility factor modifies the nature in which the probability oscillates with time. Effect of susceptibility on probability of states is closely related to the initial state of the system.