Strong Field Effect in Rabi Oscillations of Frequency Emission in Free Space

[1]Dr. Rajeev Kr. Srivastava, [2]Dr. Vivek Kumar

[1]Associate Professor, [2]Assistant Professor
GSPG College, Sultanpur

J.M. Martinis [5] had observed strong field effect in Rabi oscillations of frequency emission in free space. But could not calculate Rabi frequency, Probability, magnetic and coulomb energies for spherical system. Authors have used Rabi - Oscillations to calculate these value [1,2].

Introduction: The first observation of vaccum Rabi Oscillation was made with a large number of atoms in microwave cavity. The observation of vacuum Rabi - Oscillation for a few atoms and finally for a single atom.

On the other hand, when there are n-photons in cavity the Rabi - Oscillation frequency becomes.

$$\Omega_R(n) = \Omega_{ef} \sqrt{n+1}$$

Theory:

We start with spontaneous emission in free space, consider a one electron atom two electronic levels e and f seperated by an energy interval $E_e - E_f = \hbar\omega$ the spontaneous emission appears a jump of the electron from level e to f by the emission of a photon. This process can be understood as resulting from the coupling of the atomic electron to the electromagnetic field in its vacuum state.

A radiation field in space is usually described in terms of an infinite set of harmonic oscillators one for each mode of the radiation the levels of each oscillator corresponds to states with 0,1,2, …….. n photon of energy $\hbar\omega$. In its ground state each oscillator has a zero point energy $\hbar\omega/2$ with its quantum fluctuations.

The r.m.s. vcuum electric field amplitude E_{vac} in a mode of frequency ω is

$$E_{vac} = \left(\frac{h\omega}{2\epsilon_0 v}\right)^{1/2} \qquad ……………………….(1)$$

Where ϵ_0 is the permittivity in free space, V is size of an arbitrary quantization volume and the units are S.I. the coupling of an atom to a field mode is described by the frequency.

$$\Omega_{ef} = \frac{D_{ef} E_{vac}}{\hbar} \qquad ………………………(2)$$

Where D_{ef} is the matrix element of the electric dipole of the atom between the two levels is Ω_{ef}, which is often referred as the Rabi frequency of the vacuum, An essential feature of spontaneous emission in free space is that an atom can radiate into any mode that satisfies the conservation of energy and momentum. The time of emission and the particular mode in which the photon is observed are random variable.

Conclusion: Authors, gave the theory of strong filed effect in Rabi oscillation of frequency emission in free space. Multiphoton Rabi Oscillation, a.c. stark shift and probability by Fermi-Golden Rule can also be explained.

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