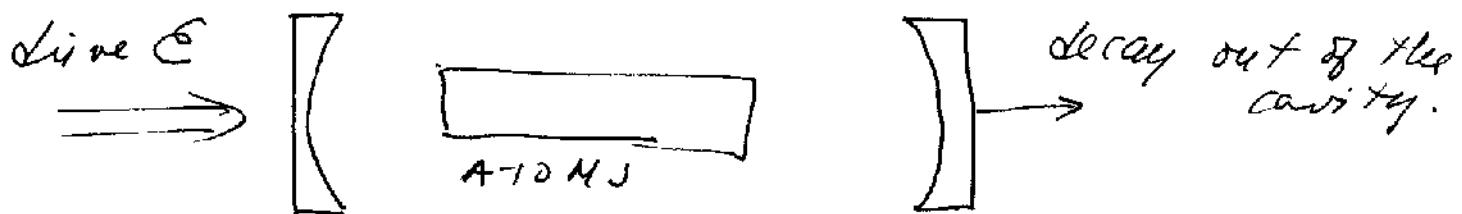


Homework 2

Sept 11, 2003



Take a collection of N two-level atoms very little in a single mode of an optical resonator.

We are going to study some of the properties of the Maxwell-Bloch equations that describe this system:

$\alpha \Rightarrow$ in quadrature field inside the cavity

$\beta \Rightarrow$ out of quadrature field inside the cavity

$\epsilon \Rightarrow$ in quadrature drive outside the cavity

$\epsilon^* \Rightarrow$ out of quadrature drive outside the cavity

$v =$ polarization

$u =$ polarization

$\delta =$ inversion

Rates:

$g =$ dipole coupling between atoms and the field of a single photon.

$\gamma_L =$ decay polarization; $\delta_L =$ decay inversion; $k =$ decay cavity.

the MB equations (RWA are

$$\begin{aligned}\dot{\alpha} &= \epsilon - \kappa\alpha + g\nu & } & \text{FIELD} \\ \dot{\beta} &= \epsilon^* - \kappa\beta + g\mu & } & \\ \dot{\nu} &= -\delta_\perp\nu + g\alpha D & } & \text{POLARIZATION} \\ \dot{\mu} &= -\delta_\perp\mu + g\beta D & } & \\ \dot{D} &= -\delta_{11}(D+N) - 2g(\alpha u + \beta v) & } & \text{INVERSION}\end{aligned}$$

1) This is a driven system so find the steady state solution for $\underline{\alpha}, \beta, \nu, \mu, D$.

Plot the intracavity intensity $X = \frac{\alpha\beta}{n_0}$ as a function of the drive $Y = \frac{|\epsilon|^2}{K^2 n_0}$

where $n_0 = \frac{\delta_\perp\delta_{11}}{4|g|^2}$ for different $C = \frac{g^2 N}{2K\delta_\perp}$

when $C = 0, 1, C = 4$ and $C = 20$

2) Explain what you observe in 1.