Cavity QED, dressed atom picture, Jayne-Cummings model 10/21/2021

Energy splitting can be compared to a generalized Rabi freq $\Omega_R = \Delta^2 + \omega^2$

$\Rightarrow$ Rabi freq $\Omega = \frac{1}{\hbar} \langle e_1 | d | e_1 \rangle g = -\frac{\Delta^2 + \omega^2}{\hbar g}$

How is $n$ related to $E$?

Total energy $= n \hbar \omega = \text{energy density} \cdot V$

$\Rightarrow n = \frac{E \hbar \omega}{2 \pi} \Rightarrow \hbar g = \frac{\Delta^2 + \omega^2}{E} \frac{2 \hbar \omega}{\hbar \omega} = \frac{\Delta^2 + \omega^2}{E}$

$|2, 0>|$ couples to $|1, 1>|$ with matrix element $\langle g | V | 2 \rangle = \frac{1}{\hbar} g = \frac{1}{2} d \omega_K$

In reality $|2, 0>|$ couples to all modes with the same frequency $\omega$ coupled to vacuum fluctuation.

Fermi's golden rule gives $P_{g2} = \frac{2\pi}{\hbar} |\langle g | V | 2 \rangle|^2 \rho(E)$

$\rho(E) = \frac{\omega^2}{2\pi^2 c^3}$

$= \frac{1}{\hbar^2} 2 \pi \frac{\lambda \omega}{\omega} \frac{\omega^2}{\hbar^2 c^3}$

$= \frac{2\pi \lambda \omega^2}{3\hbar^2}$

Note $\omega^2$ dependence $\Rightarrow E \approx \frac{E}{E_0}$

$E = \frac{2\pi \lambda \omega^2}{\hbar}$ is the field of the ground state of the photon field.

It leads to spontaneous emission and couples to all modes equally.

Einstein $A, B$ coefficients.

$\downarrow A$ spontaneous emission

$\uparrow B$ stimulated absorption

$\Rightarrow$ from the above calculation

We easily conclude $Beg = Bye$

$A = B \frac{\pi \hbar \omega}{\omega}$

which Einstein derived from thermodynamics.