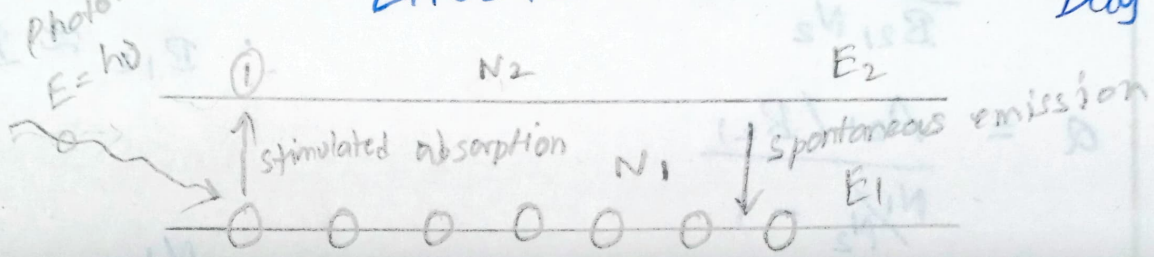
17/11/23

LASER

Day 46



$N_1 > N_2$ → Normal population

$E \propto \nu$

* Stimulated Absorption

$R_{st} = B_{12} N_1 Q$ → ①

* Spontaneous Emission

$R_{sp} = A_{21} N_2$ → ②

* Inverted population

$N_2 > N_1$

* Stimulated Emission $R_{se} = B_{21} N_2 Q$ → ③

① = ② + ③

$R_{st} = B_{12} N_1 \rho$ — ①

$R_{sp} = A_{21} N_2$ → ②

$R_{se} = B_{21} N_2 \rho$ ⇒ ③

$B_{12} N_1 \rho = A_{21} N_2 + B_{21} N_2 \rho$

$B_{12} N_1 \rho - B_{21} N_2 \rho = A_{21} N_2$

$\rho [B_{12} N_1 - B_{21} N_2] = A_{21} N_2$

$\rho = A_{21} N_2 / B_{12} N_1 - B_{21} N_2 \times \frac{B_{21} N_2}{B_{21} N_2}$

$$\rho = \frac{A_{21} N_2 / B_{21} N_2}{B_{12} N_1 - B_{21} N_2 / B_{21} N_2}$$

$$\rho = \frac{A_{21} / B_{21}}{\frac{B_{12} N_1}{B_{21} N_2} - 1}$$

$\therefore B_{12} \approx B_{21}$

$$\rho = \frac{A_{21} / B_{21}}{N_1 / N_2 - 1}$$

$\therefore \frac{N_1}{N_2} = e^{h\nu / KT}$

$\rho = A_{21} / B_{21} \times \frac{1}{e^{h\nu/KT} - 1}$

$$\rho = \frac{8\pi h\nu^3}{c^3} \frac{1}{e^{h\nu/KT} - 1}$$

$$\frac{A_{21}}{B_{21}} \frac{1}{e^{h\nu/KT} - 1} = \frac{8\pi h\nu^3}{c^3} \frac{1}{e^{h\nu/KT} - 1}$$

$$\frac{A_{21}}{B_{21}} = \frac{8\pi h\nu^3}{c^3} \Rightarrow \frac{A_{21}}{B_{21}} \propto \nu^3$$