$$\rho(\nu) = \frac{A_{21}}{B_{12}}\left[\frac{1}{e^{h\nu/KT} - B_{21}/B_{12}}\right] \quad \text{— (1)}$$

E_2

B.B

E_1

$$\rho(\nu) = \frac{8\pi h\nu^3}{c^3}\left[\frac{1}{e^{h\nu/KT} - 1}\right] \quad \text{— (2)}$$

$h\nu = E_2 - E_1$

max Planck's

$$\boxed{\frac{A_{21}}{B_{12}} = \frac{8\pi h\nu^3}{c^3}} \quad \text{— (3)}, \quad \& \quad \boxed{\frac{B_{21}}{B_{12}} = 1} \quad \text{— (4)}$$

$A_{21} \rightarrow$

$B_{21} \rightarrow$

$B_{12} \rightarrow$

$$\boxed{B_{12} = B_{21}}$$

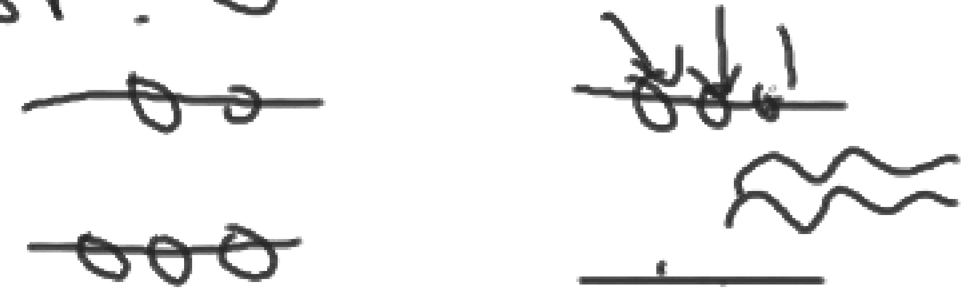
$$\frac{A_{21}}{B_{12}} \propto \nu^3$$

x-rays

ind abs

st Em

sp = 0



1. Induced absorption

2. Spontaneous Emission $= 0$

3. $\rightarrow$ St "

$$\rightarrow \frac{A_{21}}{B_{12}} = \frac{8\pi h\nu^3}{c^3}$$

10^{24} k tumy(?)

$$\frac{B_{21}}{B_{12}} = 1 \Rightarrow B_{12} = B_{21}$$

Light Amplification: -

LASER

$\downarrow$ Light Amp

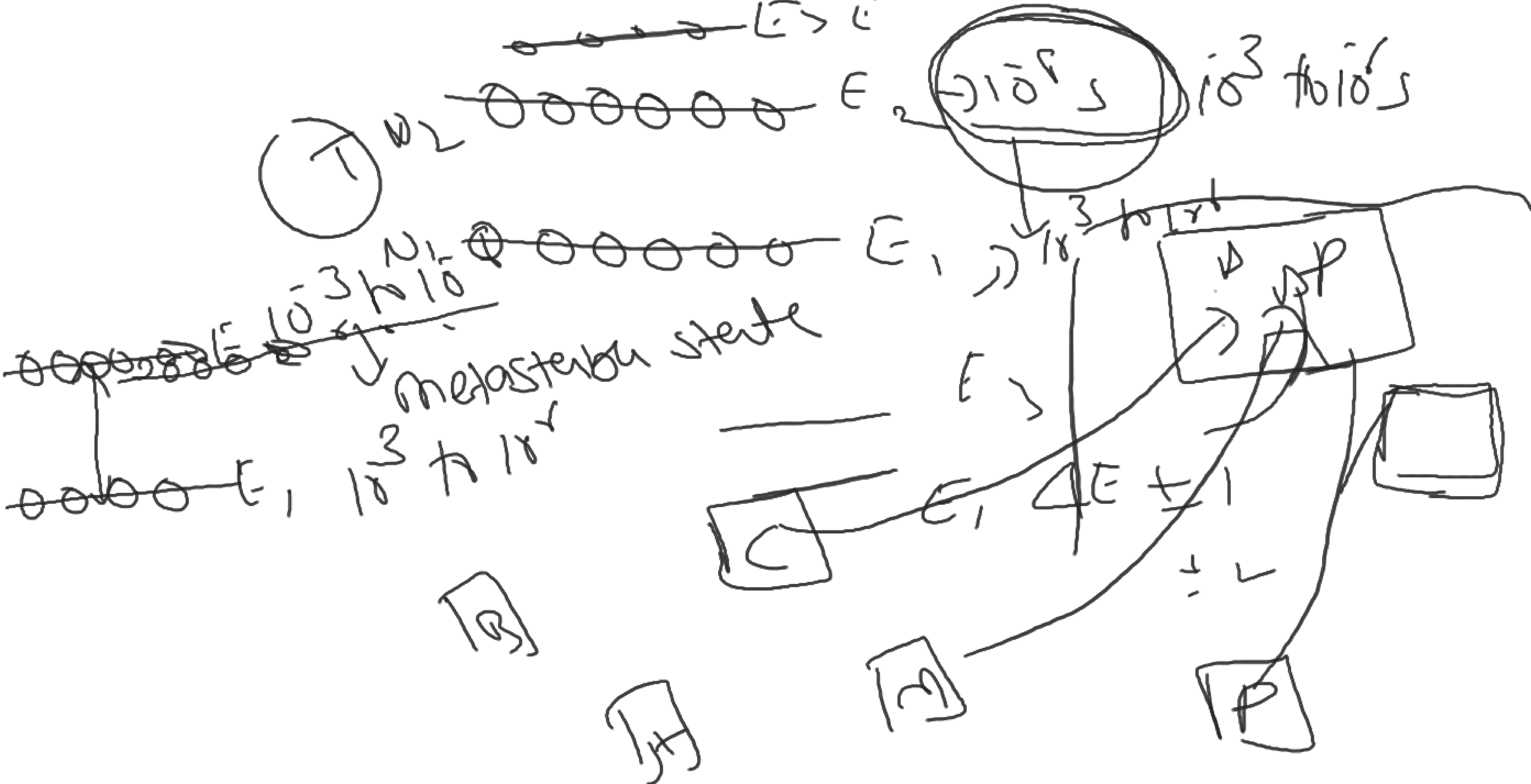
$$A_{21} = \frac{8\pi h\nu^3}{c^3} B_{21}$$

① Condition for St. Emission to Dominate sp. Emission

$$\frac{\text{St. Emission}}{\text{SP. Emission}} = \frac{B_{21}\cancel{N_2}\rho(\nu)}{A_{21}\cancel{N_2}} = \frac{B_{21}}{A_{21}}\rho(\nu)$$

$\propto \rho(\nu)$

2. Requirement of states of larger lifetime



3 Condition for Sti Emission to Dominate induced absorption

Population inversion

$$\frac{\text{St tran}}{\text{in tran}} = \frac{B_{21} N_2 \rho(\nu)}{B_{12} N_1 \rho(\nu)} = \frac{B_{21}}{B_{12}} \cdot \frac{N_2}{N_1} = \frac{N_2}{N_1}$$

10^{2}

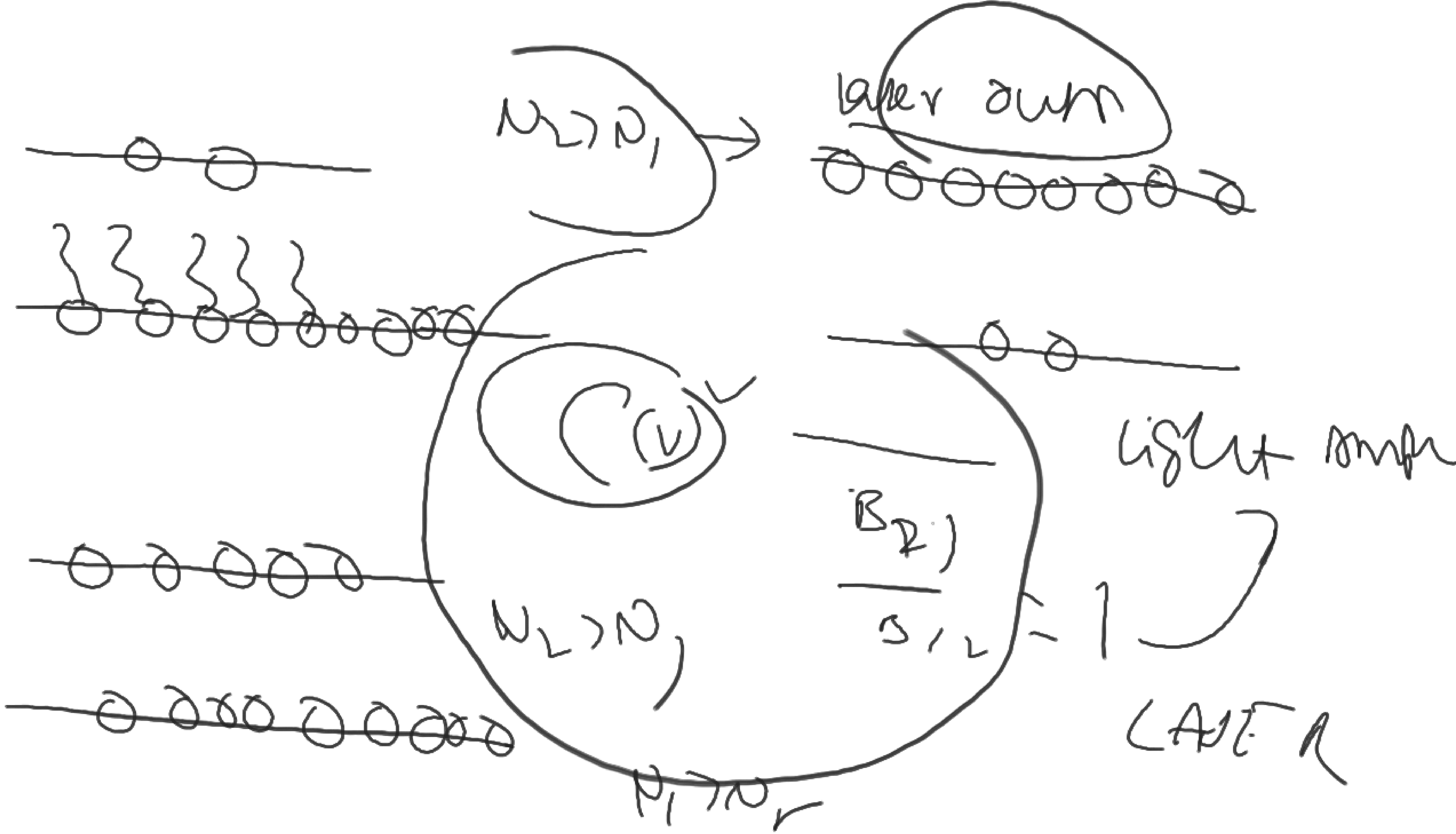
N_2 ———— E_2 at thermal equi.

10^{30}

N_1 ———— E_1 G.S

N_1 (10^{30}) $> N_2$

$N_2 > N_1 \rightarrow$



N2>N1
laser own
N2>N1
light ampr
LASER

① find the ratio of populations of the two states in a He-Ne laser that produces light of W.L 6328 Å at 27 °C

$$\frac{N_2}{N_1} = $$