$$\lambda = 0.7\,\mu m$$

$$E_g = \frac{1.24}{\lambda\,(\mu m)}\ eV = \frac{1.24}{0.7}$$

$$= 1.77\ eV$$

$$1.77 = 1.424 + 1.266x + 0.266x^2$$

$$0.266x^2 + 1.266x - 0.346 = 0$$

$$x = 0.259$$

$$Ga_{1-x}Al_xAs$$

$$\uparrow$$

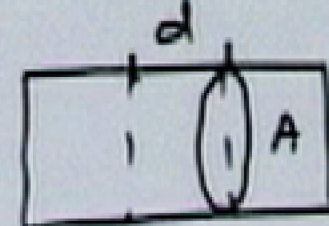
$$\Delta n = \Delta p$$

$$-\frac{\partial \Delta n}{\partial t} = B_r \left\{ (n_0 + \Delta n)(p_0 + \Delta p) \right\} - B_r n_0 p_0$$

$$-\frac{\partial \Delta n}{\partial t} = B_r \left\{ (n_0 + p_0)\Delta n + \Delta n^2 \right\}$$

For high injection $\Delta n >> n_0, p_0$

$$-\frac{\partial \Delta n}{\partial t} = B_r \Delta n^2 = (B_r \Delta n)\Delta n$$



$$\tau_{rr} = \frac{1}{B_r \Delta n}$$

$$\Delta n = \frac{I}{qAd}\tau_{rr}$$

$$\tau_{rr} = \sqrt{\frac{qAd}{B_r I}}$$

$$q = 1.6 \times 10^{-19}\, C$$

$$A = \frac{\pi\ (50 \times 10^{-6})^2}{4}\ m^2$$

$$d = 2 \times 10^{-6}\ m$$

$$B_r = 10^{-10}\ cm^{-3}/s = 10^{-10} \times 10^{6}\ m^{-3}/s$$

τ_{rr} can be calculated.

$$\Delta\omega \approx \frac{1}{\tau_{rr}}$$

$$\frac{\partial(\Delta n)}{\partial t} = \frac{I_p}{qAd} - \frac{\Delta n}{\tau}$$

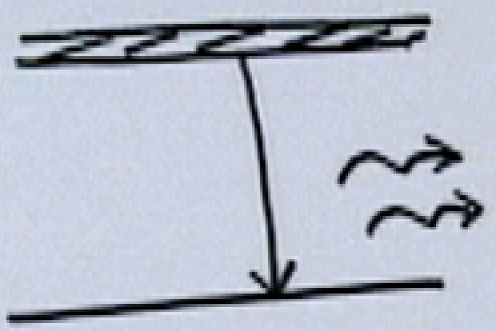
$$\Delta n(t) = \frac{I_p \tau}{qAd}\left(1 - e^{-t/\tau}\right)$$

At $t = t_d$, $I = I_{th}$ $\quad (\Delta n)_{th} = \dfrac{I_{th}\tau}{qAd}$

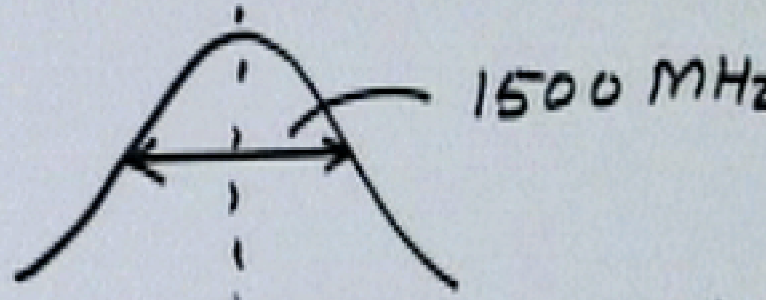
$$\frac{I_{th}\cancel{\tau}}{\cancel{qAd}} = \frac{I_p \cancel{\tau}}{\cancel{qAd}}\left(1 - e^{-t_d/\tau}\right)$$

$$e^{-t_d/\tau} = \frac{I_p - I_{th}}{I_p}$$

$$t_d = \tau \ln\left(\frac{I_p}{I_p - I_{th}}\right)$$



Stimulated emission



632.8 nm (Red)

$$m = \frac{L}{\lambda/2n}$$

Take $n \approx 1$

$$= \frac{2L}{\lambda} = \frac{2L}{c} f$$

$$dm = -\frac{2L}{\lambda^2}\Delta\lambda = \frac{2L}{c} df$$

For adjacent mode $dm = 1$

$$L = \frac{c}{2\,df} = \frac{3 \times 10^8}{2 \times 1500 \times 10^6}\ m$$

$$= 100\ mm$$

$$f = \frac{c\,m}{2L}$$

$$\Delta f = -\frac{c\,m}{2L^2}\,\Delta L$$

$$\frac{\Delta f}{f_0} = \frac{\Delta L}{L}$$

$$f_0 = \frac{3\times10^8}{632.8\times10^{-9}}\ \text{Hz}$$

$$\Delta f = 10^8\ \text{Hz}$$

$$\frac{\Delta L}{L} = \frac{10^8}{f_0} = 0.21\times10^{-6}$$

Temp accuracy $\simeq 0.21\,^{\circ}C$

$$t_d = \tau \ln \left\{ \frac{I_p}{I_p + (I_B - I_{th})} \right\}$$

$g_{th} \rightarrow$ Threshold gain

$$\tau = \frac{1/g_{th}}{c/n} = \frac{n}{c\, g_{th}}$$

$n \leftarrow 4$

$g_{th} \leftarrow 50/\text{cm}$

$$= \frac{4}{3 \times 10^8 \times 50 \times 10^2}$$

$$\tau = 2.66 \text{ psec}$$

$$t_d = 2.66 \ln \left\{ \frac{150}{150 + (50 - 100)} \right\}$$

$$= 2.66 \ln \left\{ 150/100 \right\} = 1.07 \text{ psec}$$

$$\text{Max Pulse rate} \approx \frac{1}{t_d} = \frac{1}{1.07 \times 10^{-12}} = 943 \text{ GHz}$$

$$L = \frac{m\lambda}{2n}$$

$$m = \frac{2nL}{\lambda}$$

$$-dm = 2L\,\frac{\left\{\lambda\frac{dn}{d\lambda} - n\right\}}{\lambda^2}\cdot d\lambda$$

$\downarrow$

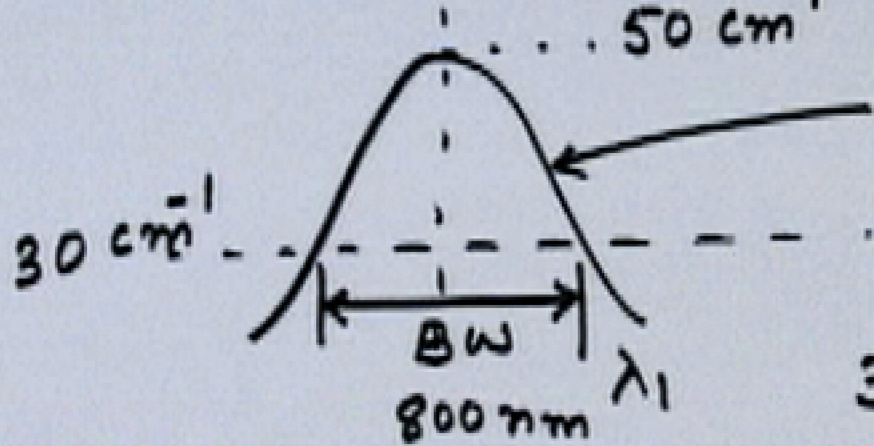
1

$$d\lambda = \frac{\lambda^2}{2L\left\{n - \lambda\frac{dn}{d\lambda}\right\}}$$

$n = 4.5$, $\frac{dn}{d\lambda} = 10^{-3}/nm$, $L = 400\,\mu m$

$$d\lambda = \frac{(1300)^2}{2\times 400\times 10^3\,(4.5 - 1300\times 10^{-3})}$$

$$= 0.66\ nm$$



$$g = 50\, e^{-\frac{(\lambda - 800)^2}{2(2)^2}}$$

$$30 = 50\, e^{-\frac{(\lambda_1 - 800)^2}{2(2)^2}}$$

$$\lambda_1 = 802 \text{ nm}$$

$$BW = 2 \times (802 - 800) = 4 \text{ nm}$$

$$L = \frac{m\lambda}{2n}$$

Line separation $\Delta\lambda = \dfrac{\lambda^2}{2Ln} = \dfrac{(800)^2}{2 \times 400 \times 10^3 \times 3.6}$

$$= 0.22 \text{ nm}$$

No. of lines $= \dfrac{4}{0.22} \approx 18$