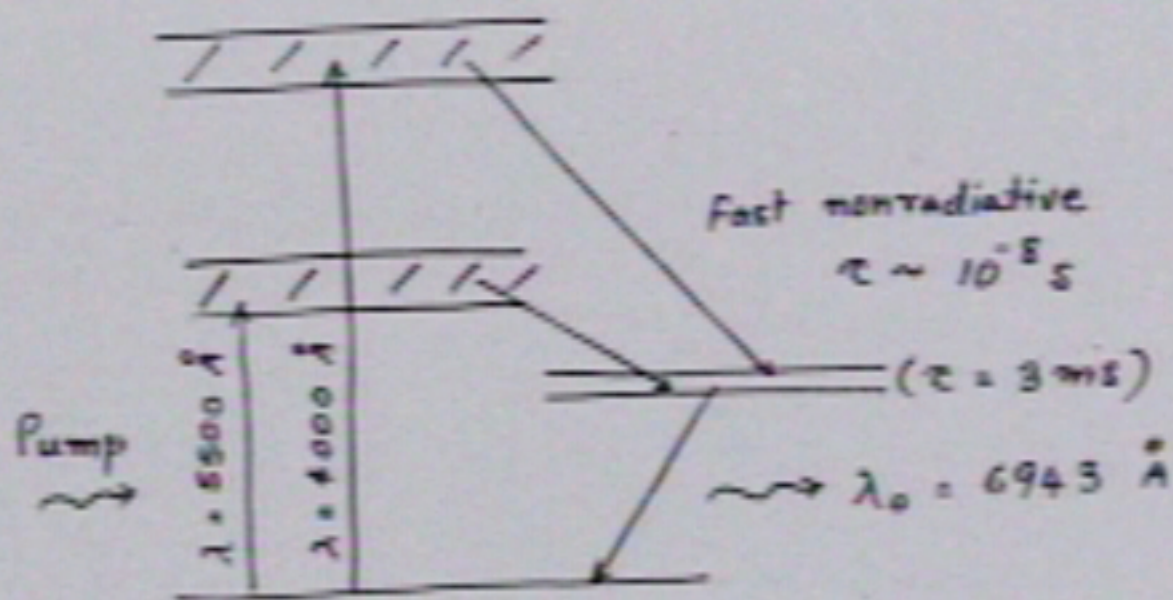
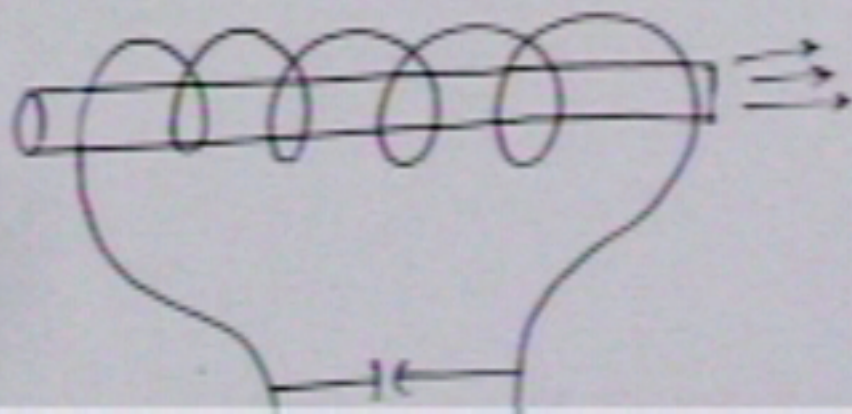


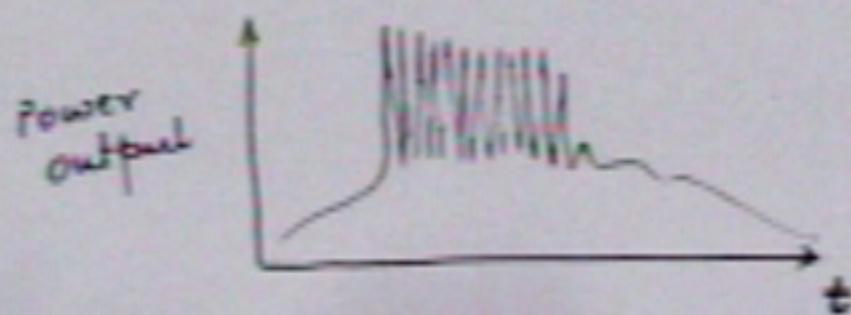
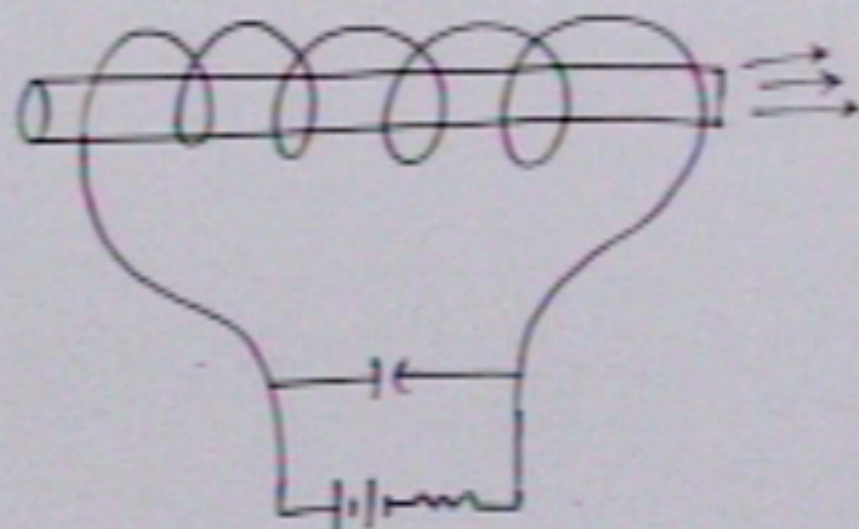
Ruby Laser :



Pump is a flashing lamp

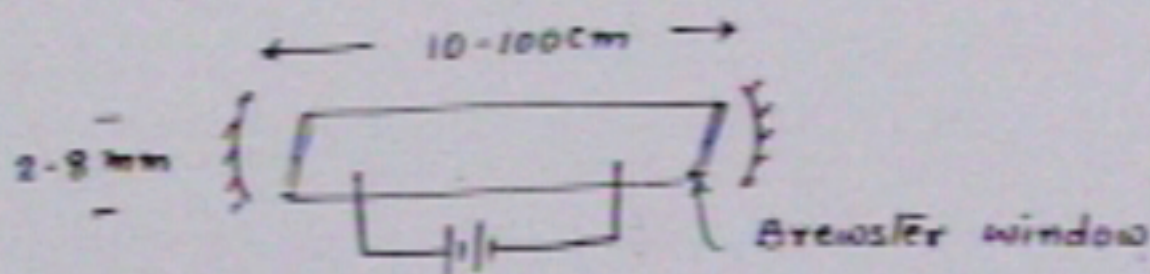


Pump is a flashing lamp



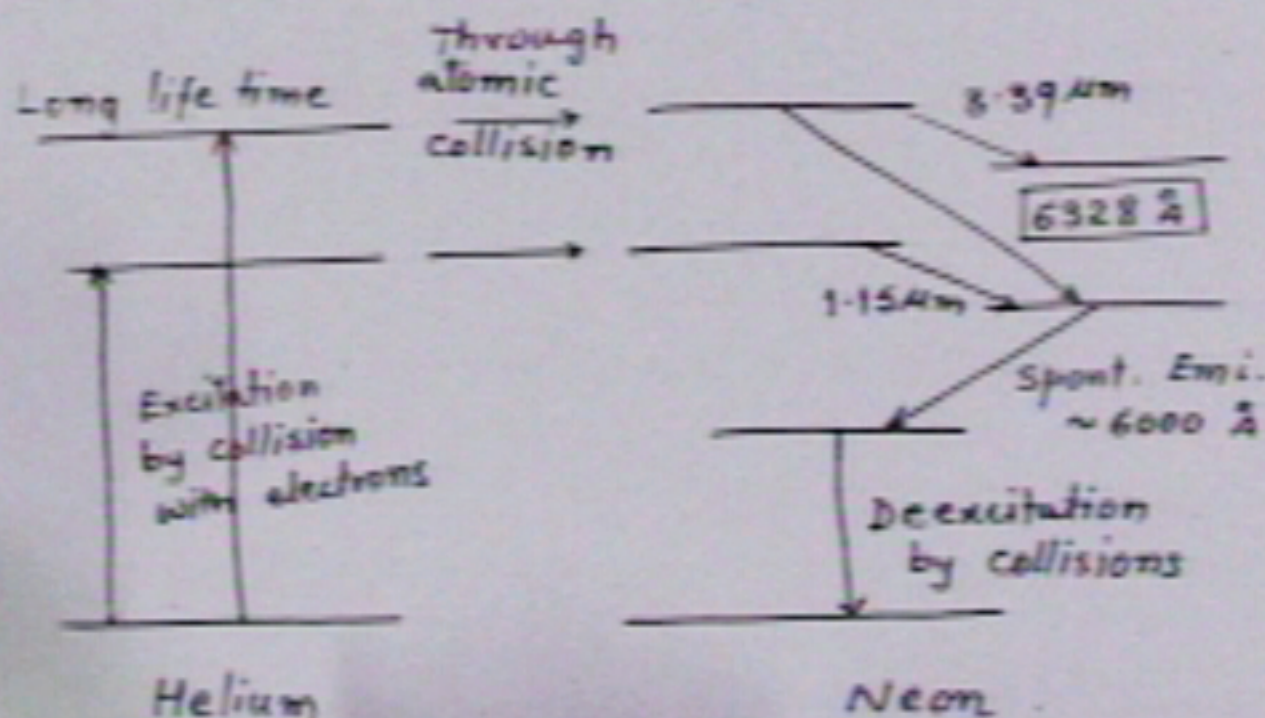
He-Ne Laser:

Pump is through electric discharge



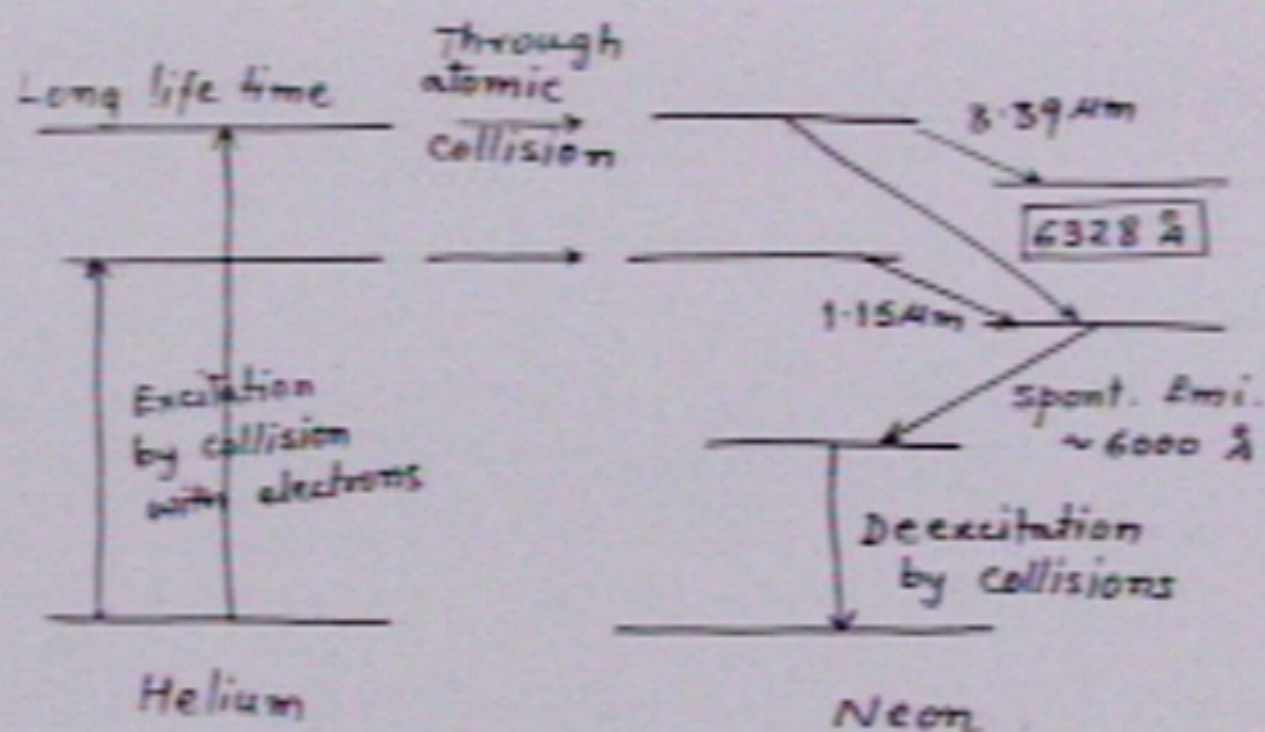
He - pressure 1 torr (1 mm Hg)

Ne - pressure 0.1 torr



He - pressure 1 torr (1 mm Hg)

Ne - pressure 0.1 torr

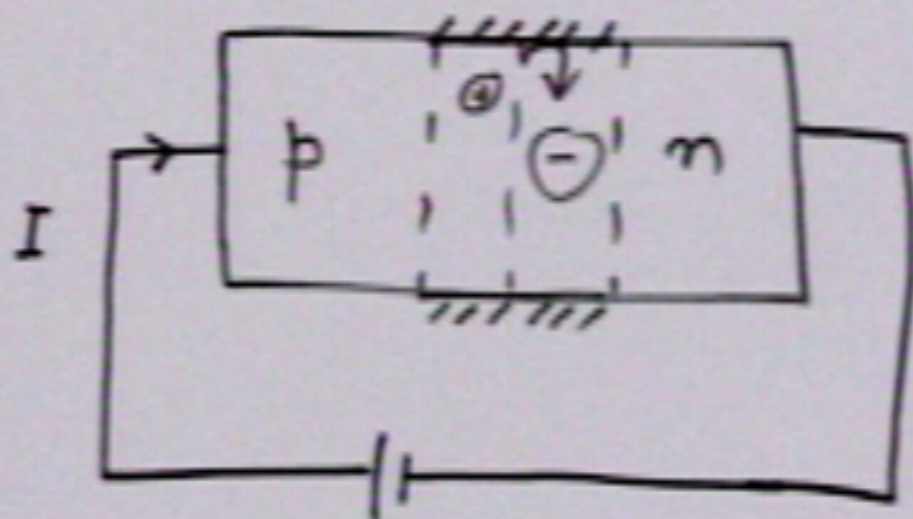


Oscillation normally tend to occur at 8.39 μm .

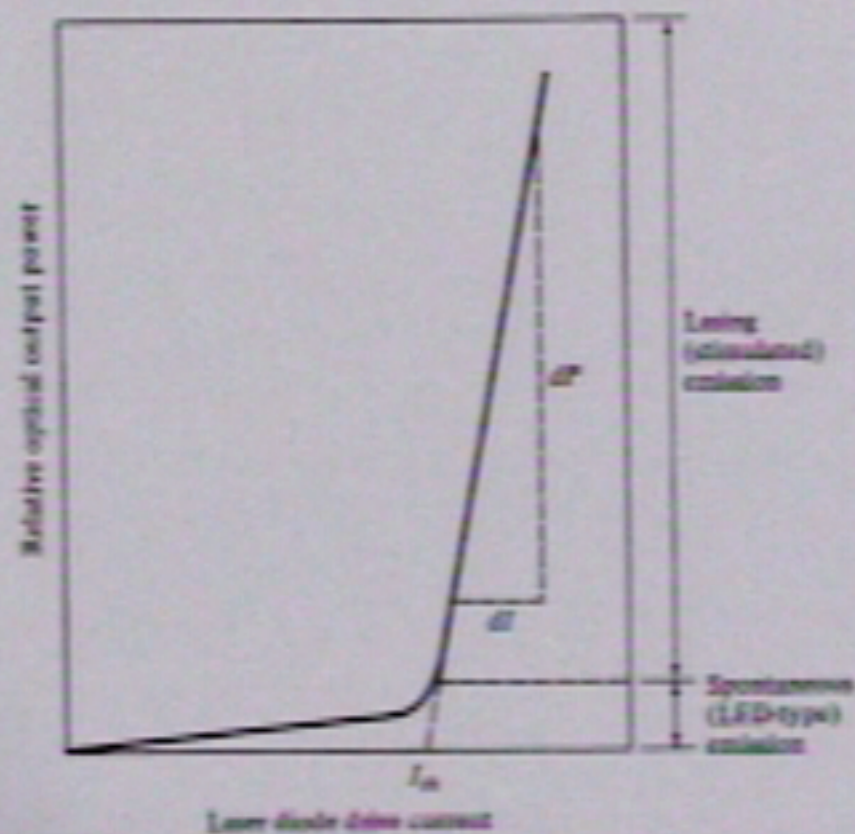
To suppress 8.39 μm \rightarrow

1. Absorbing element
2. Line broadening due to Zeeman effect

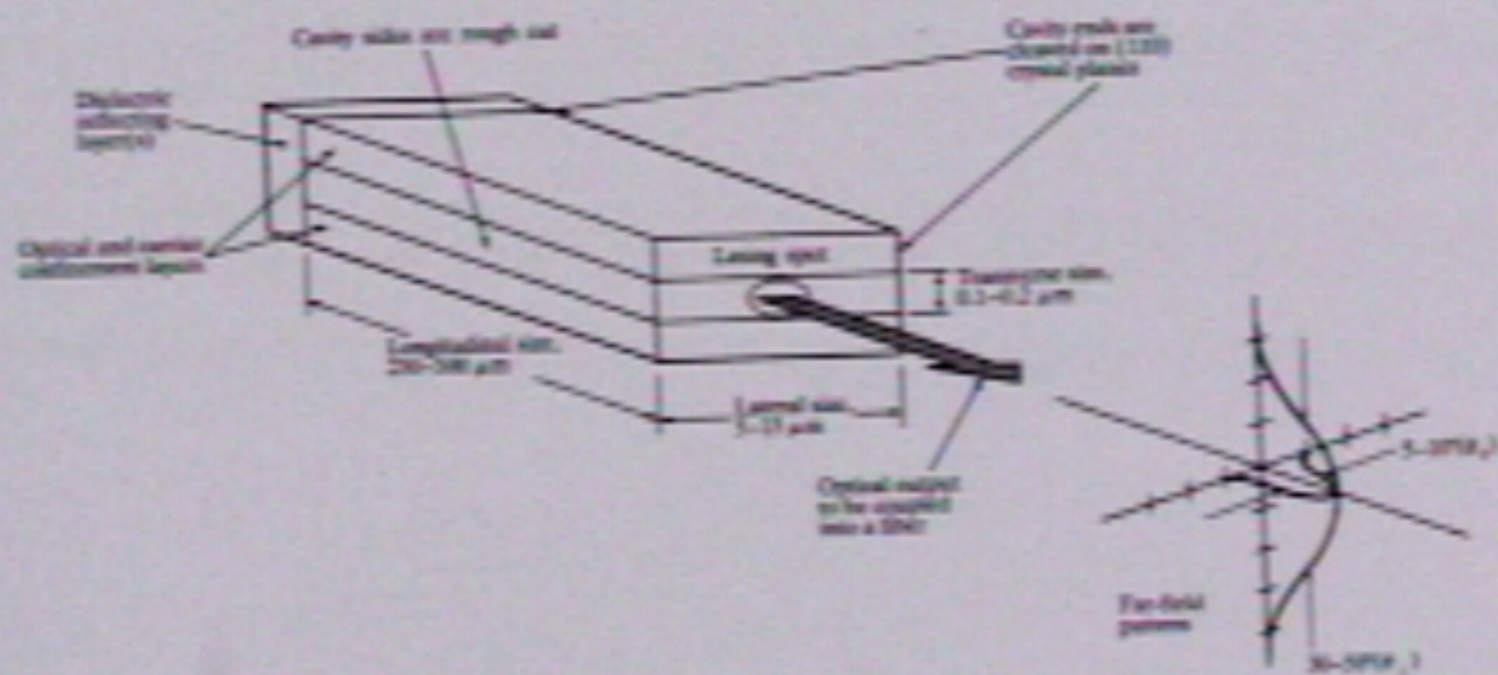
Laser Diode

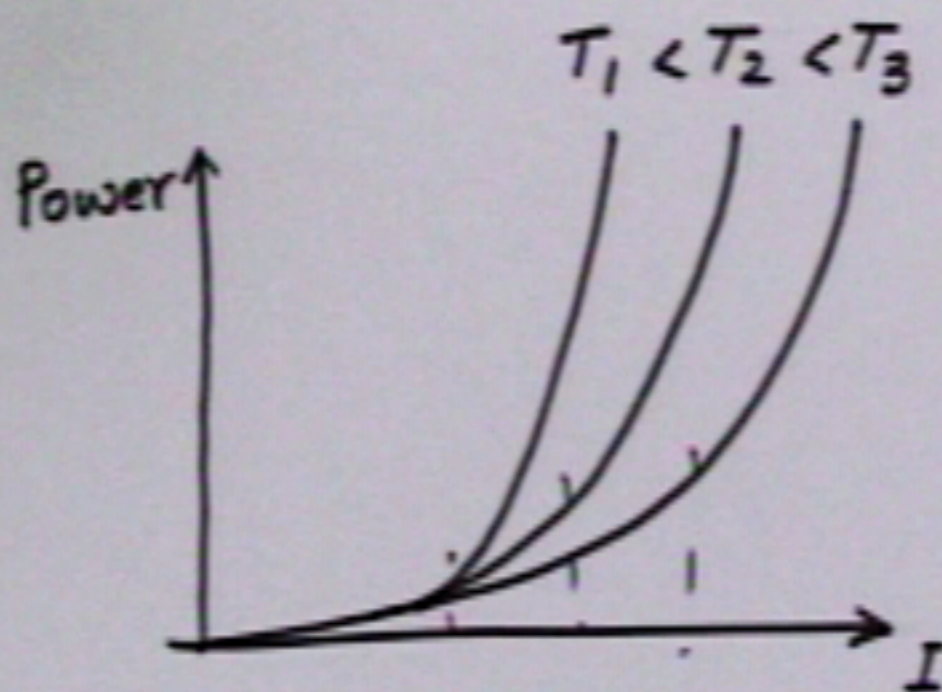


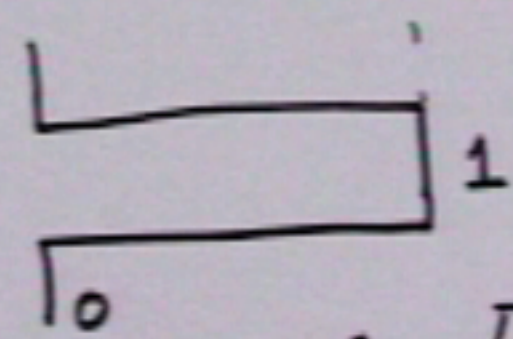
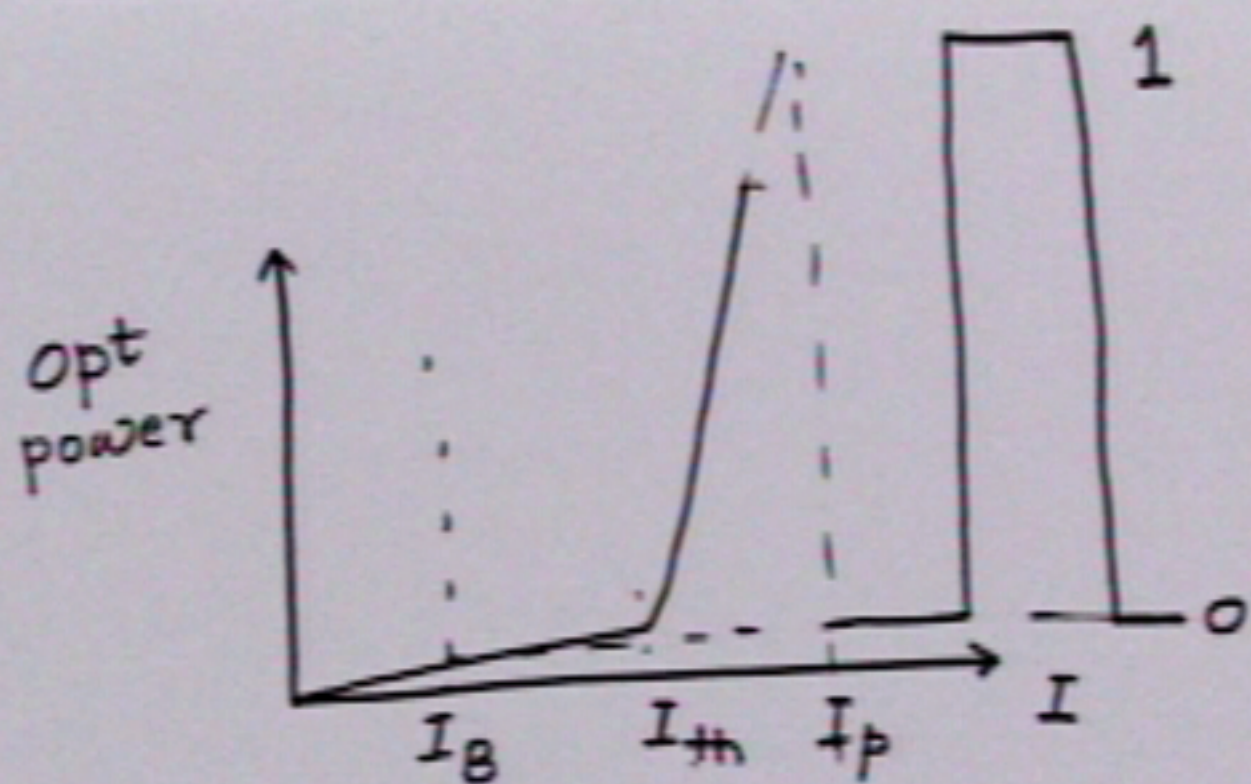
Optical output vs. drive current



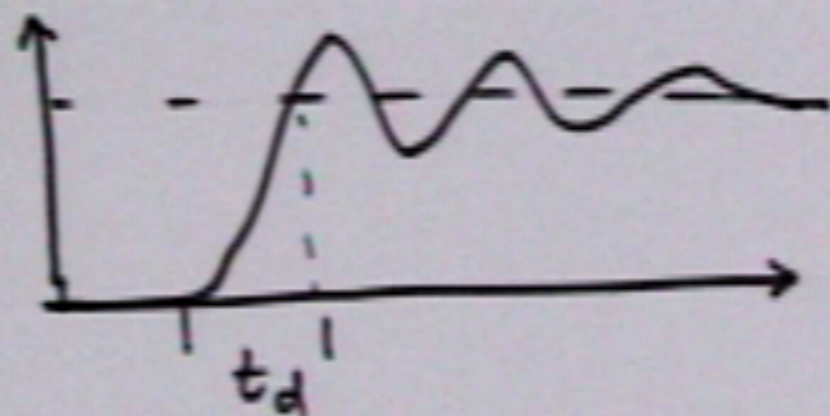
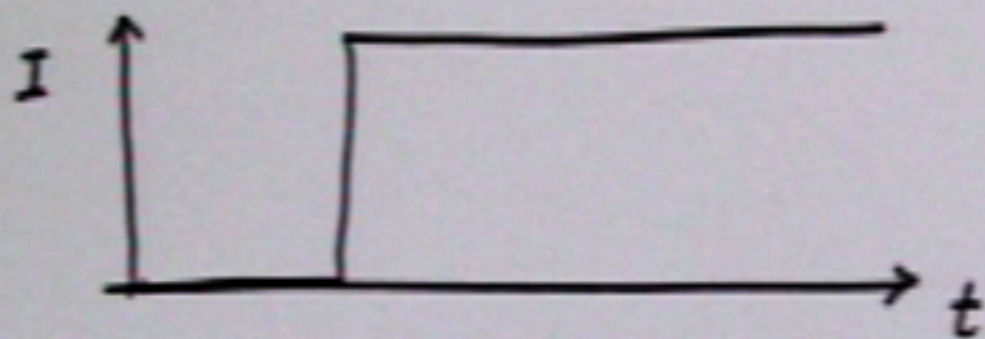
Fabry-Perot resonator cavity







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



Relaxation oscillation

$$f = \frac{1}{2\pi} \frac{1}{\sqrt{\tau_{ph} \tau_{sp}}} \left(\frac{I}{I_{th}} - 1 \right)^{1/2}$$

• Spontaneous Life time $\tau_{sp} \sim 10^{-9}$

• Stimulated Life time $\tau_{st} \approx$ Tens of ps.

• Photon Life time $\tau_{ph} \sim 2-3$ ps.

$$\tau_{ph} = \frac{c}{\pi} G_{th} = \frac{c}{\pi} \left(\alpha + \frac{1}{2L} \ln(R_1 R_2) \right)^{-1}$$