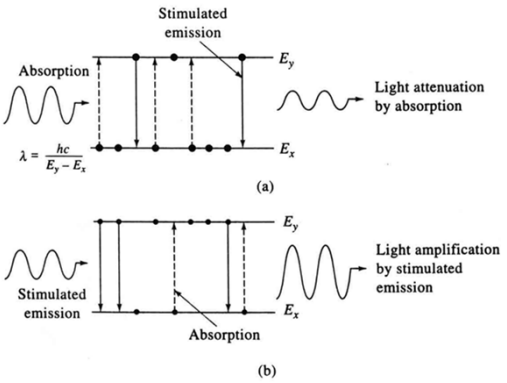
February 17, 2012

- **Exam #1 Solutions will be posted by Monday**
- **Exams will be graded and returned by Wednesday**

Absorption versus Stimulated Emission

- Two processes can occur when a system is presented with EMR:



Since:

B_{pq} (Abs) = B_{qp} (St. Em.)

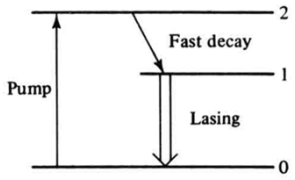
-rates of absorption and of stimulated emission depend on the *populations* of the *ground* (N_p) and *excited* (N_q) states, respectively

Need: $N_q > N_p$ (population inversion) . .

Impossible! (with just 2 states)

Population Inversion

- Requires at least a ***3-state system:***



- ***PUMP*** so that $N_1 > N_0$ (population inversion)

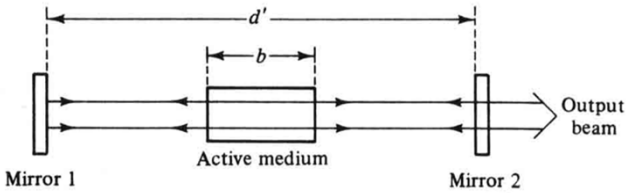
Pumping Methods:

- ***Optical*** - flashlamp, laser
- ***Electrical*** - capacitive electrical discharge
- ***Chemical*** - reaction leaving product in excited state

3

Optical Amplification

- We can enhance the ***intensity*** of the emission by using an *optically resonant cavity:*



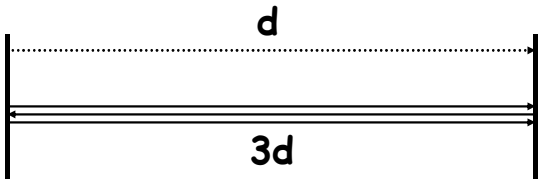
Fabry-Perot Interferometer

Get *constructive interference* if: $d' = n\lambda/2$

4

Constructive Interference

- Waves are *perfectly in-phase* if the difference in the distance they travel is an **integer multiple of the wavelength:**



$$3d - d = 2d = n\lambda$$

$$\boxed{d = n\lambda/2}$$

5

EMR from a Laser is *Unusual*

- **Spatial Coherence**
  -all photons are *in-phase*
  -can attain very high *power density*
  -very low *beam divergence*
- **Spectral Coherence**
  -highly monochromatic
- **High-Intensity**
  -very high power over very small $\Delta\lambda$

Very rarely used for *absorption spectrophotometry,* but important sources for *fluorescence and Raman spectroscopies*

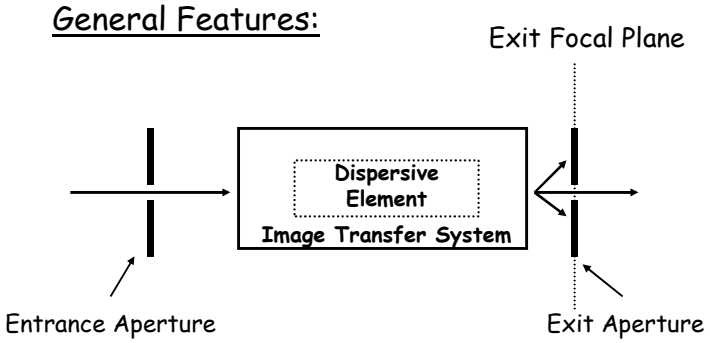
6

Wavelength Selectors

- Dispersive Devices

  -separates EMR into individual λ-components

  General Features:



7