

# February 23, 2005

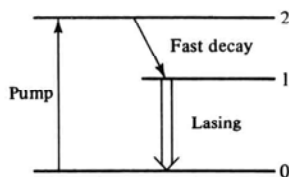
## ■ Exam #1: Results!

- **Range:** 62 - 186
- **Average:** 139.1/200 (70%)
- **Median:** 139/200

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# Population Inversion

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



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

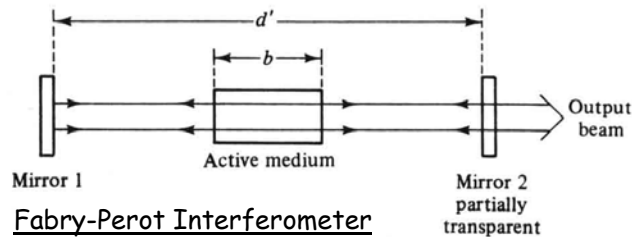
## Pumping Methods:

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

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# Optical Amplification

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

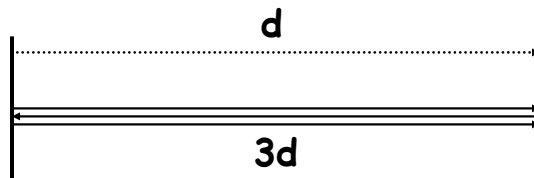


Get constructive interference if:  $d' = n\lambda/2$

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# Constructive Interference

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



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

$$d = n\lambda/2$$

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# 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*