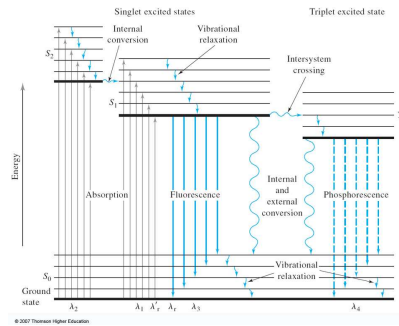
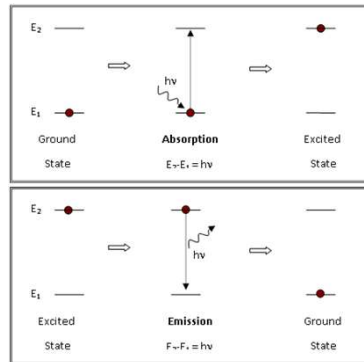


## Analytical Spectroscopy

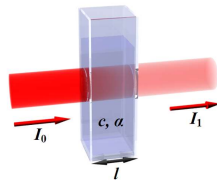
- Interaction of light with matter (atoms/molecules)
- Energy levels in an atom (or molecule) are quantized
  - Transitions between levels can be induced by interaction with light (or release energy as light)
  - Type of transition depends on energy. Could involve anything from ionization (high energy) to vibration and rotation (low energy)



1

## Analytical Spectroscopy Fundamentals

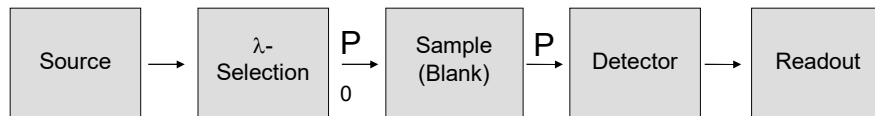
**Absorbance: Beer-Lambert Law**



$$\text{Transmittance} = T = \frac{P}{P_0} = \frac{S}{B}$$

$$\text{Absorbance} = -\log \frac{P}{P_0} = \epsilon bc$$

**Typical instrument requirements**



Same general building blocks for atoms and molecules, absorbance and emission

Specifics depend on application

[http://en.wikipedia.org/wiki/File:Beer\\_lambert.png](http://en.wikipedia.org/wiki/File:Beer_lambert.png)

## Beer-Lambert Law

- Conditions of Beer's Law
  - Monochromatic Radiation
  - Dilute Solution
- Beers law is additive at any wavelength: If two species absorb, A is depends on both

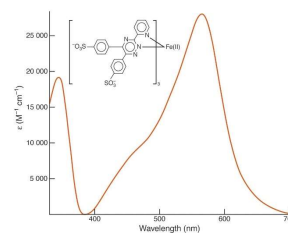
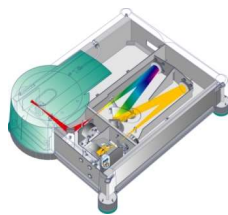
$$A = \epsilon_1 b c_1 + \epsilon_2 b c_2$$

- Considerations of absorption spectroscopy:
  - Keep concentrations low (<~0.01 M)
  - Keep absorbance <1: Higher A introduces uncertainty due to instrumental limitations
  - Don't forget equilibria
  - Understand what "monochromatic" means

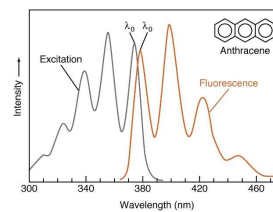
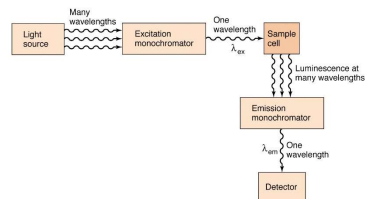
3

## Common Analytical Molecular Spectroscopy Modes

### Molecular UV-Vis Spectroscopy



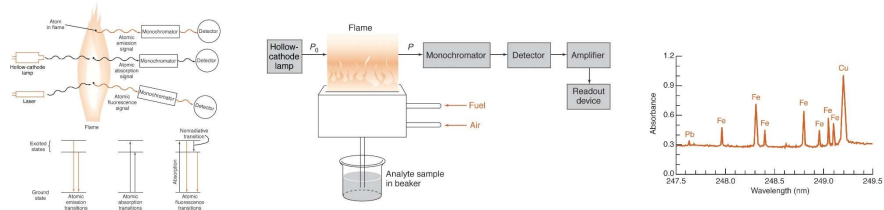
### Molecular Fluorescence Spectroscopy



4

## Atomic Spectroscopy, AAS (or AES)

Generally need to produce gas-phase atoms



- Several sample introduction/atomization options
  - Flame, Furnace, Plasma
  - Goal: Introduce, vaporize, atomize sample
  - May also excite sample
- Need to get sample into flame first: Nebulization
- Considerations of atomic spectroscopy:
  - Looking for atomic lines (narrow)
  - Anything that doesn't lead to atoms (or target species) is BAD
    - Molecules, Oxides, Compounds, Ions