

Chem 507 – Molecular Spectroscopy

Dr. Susan Philips -- Spring 2004

EU #1: Atoms obey the laws of quantum mechanics and have energy levels.

- Electronic energy
- Vibrational energy
- Rotational energy
- Spin States
- Gaussian/WebMO

EU #2: Understanding light and how light affects matter are paramount to understanding spectroscopy.

- Wave & particle properties of light
- Absorption & emission of light as it relates to energy levels of atoms & molecules
- Lasers

EU #3: All areas of chemistry use spectroscopy.

- This will be tied in throughout the course as we discuss each type of spectroscopy
- The course project will also address this EU.
- The lab exercises also relate to this EU.

EU #1: Atoms obey the laws of quantum mechanics and have energy levels.

Content topics:

- Electronic energy
- Vibrational energy
- Rotational energy

EU #2: Understanding light and how light affects matter are paramount to understanding spectroscopy.

Content topics:

- The electromagnetic spectrum
- Wave & particle properties of light
- Absorption & emission of light as it relates to energy levels of atoms & molecules
 - Types of transitions resulting from absorbance of different regions of the electromagnetic spectrum and how this information can be utilized to gain understanding about molecules.
- Boltzmann distribution
- Lasers

EU #3: All areas of chemistry, as well as other fields of science such as biology and astronomy, use spectroscopy.

- This will be tied in throughout the course as we discuss each type of spectroscopy
- The course project will also address this EU.

Labs/PIMS

- “Dissection” of Spec 20; use of Spec-20 to measure absorption spectra (LAB)
 - Components of a spectrometer
 - Relationship between color of light and wavelength
 - Relationship between apparent color of a solution and wavelength(s) of light absorbed

- Beers' Law (electronic energy; absorption of light)
- Laser Diffraction (properties of light; lasers) (LAB)
 - Use of light to measure dimensions of small objects
- IR spectroscopy of organic compounds (vibrational energy; absorption of light)
 - Use of IR spectroscopy to identify functional groups in some organic compounds (LAB)
- IR spectroscopy of gases (vibrational energy; rotational energy; absorption of light) (PIM)
 - Greenhouse effect and IR absorption by atmospheric gases
- Laser PIM. Working in small groups, students research types of lasers and create a presentation to be given to the class
- NMR spectroscopy: mini-lecture and in-class activity on basics of NMR; students identify some compounds from their NMR spectra. (PIM)
- Several activities from Moog "Atoms, Molecules, and Spectroscopy" are utilized
- Raman spectroscopy: mini-lecture, demonstration, and PIM