Lecture Notes C: Electromagnetic Spectrum and Spectroscopy

1) The electromagnetic spectrum

![Electromagnetic Spectrum Diagram]

- Radio
- Microwave
- Infrared
- Visible
- Ultraviolet
- X-rays
- Gamma Rays

- Wavelength in centimeters

- About the size of...
- Buildings
- Humans
- Honey Bee
- Firehead
- Protons
- Molecules
- Atoms
- Atoms: Nuclei

- ROY G. B V

- Red
- Orange
- Yellow
- Green
- Blue
- Violet

- Altitude - 400 km
- Sea Level
<table>
<thead>
<tr>
<th>Region</th>
<th>Wavelength (Angstroms)</th>
<th>Wavelength (centimeters)</th>
<th>Frequency (Hz)</th>
<th>Energy (eV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio</td>
<td>&gt; 10^9</td>
<td>&gt; 10</td>
<td>&lt; 3 x 10^9</td>
<td>&lt; 10^-5</td>
</tr>
<tr>
<td>Microwave</td>
<td>10^9 - 10^6</td>
<td>10 - 0.01</td>
<td>3 x 10^9 - 3 x 10^12</td>
<td>10^-5 - 0.01</td>
</tr>
<tr>
<td>Infrared</td>
<td>10^6 - 7000</td>
<td>0.01 - 7 x 10^-3</td>
<td>3 x 10^12 - 4.3 x 10^14</td>
<td>0.01 - 2</td>
</tr>
<tr>
<td>Visible</td>
<td>7000 - 4000</td>
<td>7 x 10^-5 - 4 x 10^-3</td>
<td>4.3 x 10^14 - 7.5 x 10^14</td>
<td>2 - 3</td>
</tr>
<tr>
<td>Ultraviolet</td>
<td>4000 - 10</td>
<td>4 x 10^-2 - 10^-1</td>
<td>7.5 x 10^14 - 3 x 10^17</td>
<td>3 - 10^5</td>
</tr>
<tr>
<td>X-Rays</td>
<td>10 - 0.1</td>
<td>10^-7 - 10^-9</td>
<td>3 x 10^17 - 3 x 10^19</td>
<td>10^3 - 10^5</td>
</tr>
<tr>
<td>Gamma Rays</td>
<td>&lt; 0.1</td>
<td>&lt; 10^-9</td>
<td>&gt; 3 x 10^19</td>
<td>&gt; 10^5</td>
</tr>
</tbody>
</table>

2) **Wavelength vs. frequency**

Consider light with a wavelength of 2.83m. What is it’s frequency?
3) What do you “see” when you look at a molecule? (semi-classical interpretation)

radio / microwave

infrared

visible/ultraviolet
4) **What do you “see” when you look at a molecule? (quantum mechanical interpretation)**
5) **Particles have wavelengths**