Atoms – Light from Matter

Atoms

Smallest unit of an element
Most mass is in the nucleus
Hydrogen: 1830 units in nucleus; 1 unit outside
Most of the volume of an atom is “empty”
Atoms are electrically neutral
Nucleus contains
PROTONS with positive electric charge
NEUTRONS with no electric charge

Atoms, Continued

Chemical identity set by number of protons in the nucleus
1 Hydrogen
2 Helium
6 Carbon
7 Nitrogen
8 Oxygen
As many negative electrons as protons
Atoms, Continued

Electrons orbit the nucleus
Electric attraction between the positive nucleus and the negative electrons provides the force to keep them in orbit
Electrons cannot choose any orbit; they are restricted to very special orbits \((\text{Quantized})\)
Quantized orbits can be numbered: \(n = 1, 2, 3...\)

Light and Energy

- Photon is a packet (quantum) of energy
- Amount of energy \(E\) depends on wavelength \(\lambda\)
  \(E = \frac{hc}{\lambda}\)
- Here \(c\) = speed of light
  \(h = \text{Planck's constant, a constant of Nature}\)
- The shorter its wavelength, the more energy the photon carries
**Temperature and Color**

- Color of light from a hot solid depends on its temperature
- Low temperature $\Rightarrow$ dull red, systematically changing with increasing temperature to:
  - Red
  - Orange
  - Yellow
  - Bluish white

**More on Temperature and Color**

- All hot bodies emit radiation
- All wavelengths are emitted
- Hotter bodies emit more strongly at shorter wavelengths than do cooler ones
- There is one wavelength at which there is more energy emitted than at all others
- The color that we perceive is due to this dominant wavelength and differing sensitivity of our eyes