3.4 Electromagnetic Spectrum

PRE-LECTURE READING 3.4

- *Astronomy Today*, 8th Edition (Chaisson & McMillan)
- *Astronomy Today*, 7th Edition (Chaisson & McMillan)
- *Astronomy Today*, 6th Edition (Chaisson & McMillan)

VIDEO LECTURE

- Electromagnetic Spectrum[1] (5:14)

SUPPLEMENTARY NOTES

Types of Light

- See Types of Light[2].
- Visible light—the light that we can see with our eyes—is only a tiny sliver of the entire electromagnetic spectrum, with wavelengths between ≈700 nm (red) and ≈400 nm (violet).

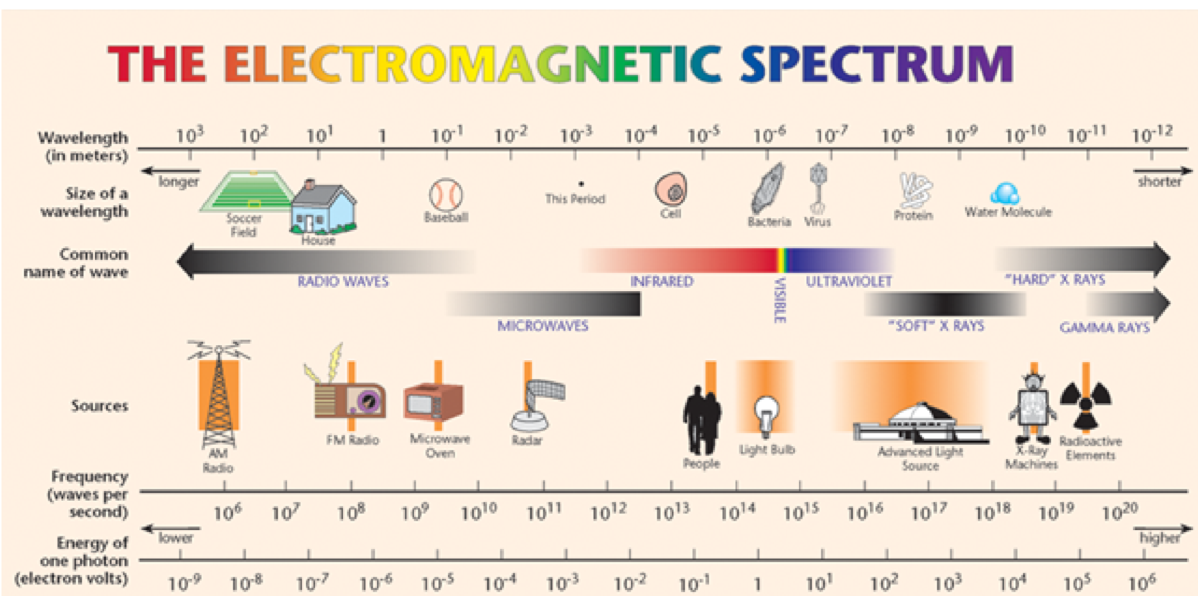

Figure 1: Image Credit: Advanced Light Source, Lawrence Berkeley National Laboratory

[1] http://youtu.be/6ylZgURxlmc
[2] http://en.wikipedia.org/wiki/Electromagnetic_spectrum

Light Wave Properties

Waves in general

- See Particle vs. Wave Motion[3].

$$E \propto \nu$$

$$\lambda \times \nu = v$$

Light waves

$$E = h\nu \tag{6}$$

- h = Planck's constant

EXAMPLE:

If you double a light wave's frequency, you double its energy.

$$\lambda \times \nu = c \tag{7}$$

- c = speed of light

- Solving for λ and ν yields:

$$\lambda = \frac{c}{\nu} \tag{8}$$

$$\nu = \frac{c}{\lambda} \tag{9}$$

[3] ../lab_3_2/manual.html

EXAMPLE:

Consider a 1-m radio wave. Hence, $\lambda = 1$ m and $\nu = \frac{(3\times10^8 \text{ m/s})}{(1 \text{ m})} = 3\times10^8 \text{ s}^{-1} = 3\times10^8$ Hz.

EXAMPLE:

Consider a 10^8-Hz radio wave. Hence, $\nu = 10^8$ Hz and $\lambda = \frac{(3\times10^8 \text{ m/s})}{(10^8 \text{ Hz})} = 3$ m.

For λ measured in nm, µm, mm, cm, m, and km, the following values of c, respectively, can be used to simplify calculations:

- $c = 3.00 \times 10^{17}$ nm/s
- $c = 3.00 \times 10^{14}$ µm/s
- $c = 3.00 \times 10^{11}$ mm/s
- $c = 3.00 \times 10^{10}$ cm/s
- $c = 3.00 \times 10^{8}$ m/s
- $c = 3.00 \times 10^{5}$ km/s

ASSIGNMENT 2

- Do Question 2.