THE PHYSICS OF ELECTROMAGNETIC RADIATION

Basic Terminology and Concepts:

Electromagnetic radiation: *http://imagine.gsfc.nasa.gov/docs/introduction/emspectrum.html*

- Ensemble of waves which travle through a vacuum at the speed of light, *c*:

$$c = 2.998 \times 10^{8} \text{ m s}^{-1}$$

- Must be simultaneously regarded as existing in discrete particles, termed **photons** or **quanta of radiant energy**.

Quantity of radiation:

- Energy (J) per unit time (s) is **Radiant flux** (J s^{-1} or W)
- per unit area (m^2) is **Radiant flux density** (W m^{-2})

Quality of radiation:

- Geometry (where it is from and where it goes to)
- Spectral quality (which part of the electromagnetic spectrum it comes from)
- The full assemblage of all possible wavelengths of radiation is termed the **electromagnetic spectrum**

See Electromagnetic Spectrum figure

- Position in the spectrum may be specified by any of the following measures:
  - **Wavelength** (λ): distance between two wave crests (μm)

    See Wavelength figure
  - **Frequency** (ν): number of waves passing a point per unit time (Hz or s^{-1})
  - **wave number** (n): number of waves in a unit (often 1 mm) distance (mm^{-1})

- Relationships (***watch your units carefully!***):

$$\lambda = 1 / n$$

$$c = \lambda \nu$$

Table of significant locations in the electromagnetic spectrum:

Type of Radiation	λ **(μm)**	ν **(Hz)**	**n (mm^{-1})**
Short end of Solar UV	0.1	$3x10^{15}$	$1x10^{4}$
UV / Visible boundary	0.46	$6.5x10^{14}$	$2.2x10^{3}$
Peak emission from Sun	.5	$6x10^{14}$	$2x10^{3}$
Visible / IR boundary	.76	$3.9x10^{14}$	$1.3x10^{3}$
"Near" IR (solar) and "far" IR (terrestrial) boundary	4	$7.5x10^{13}$	$2.5x10^{2}$
Peak emission from Earth (approx.)	10	$3x10^{13}$	100
Long end of terrestrial IR	100	$3x10^{12}$	10