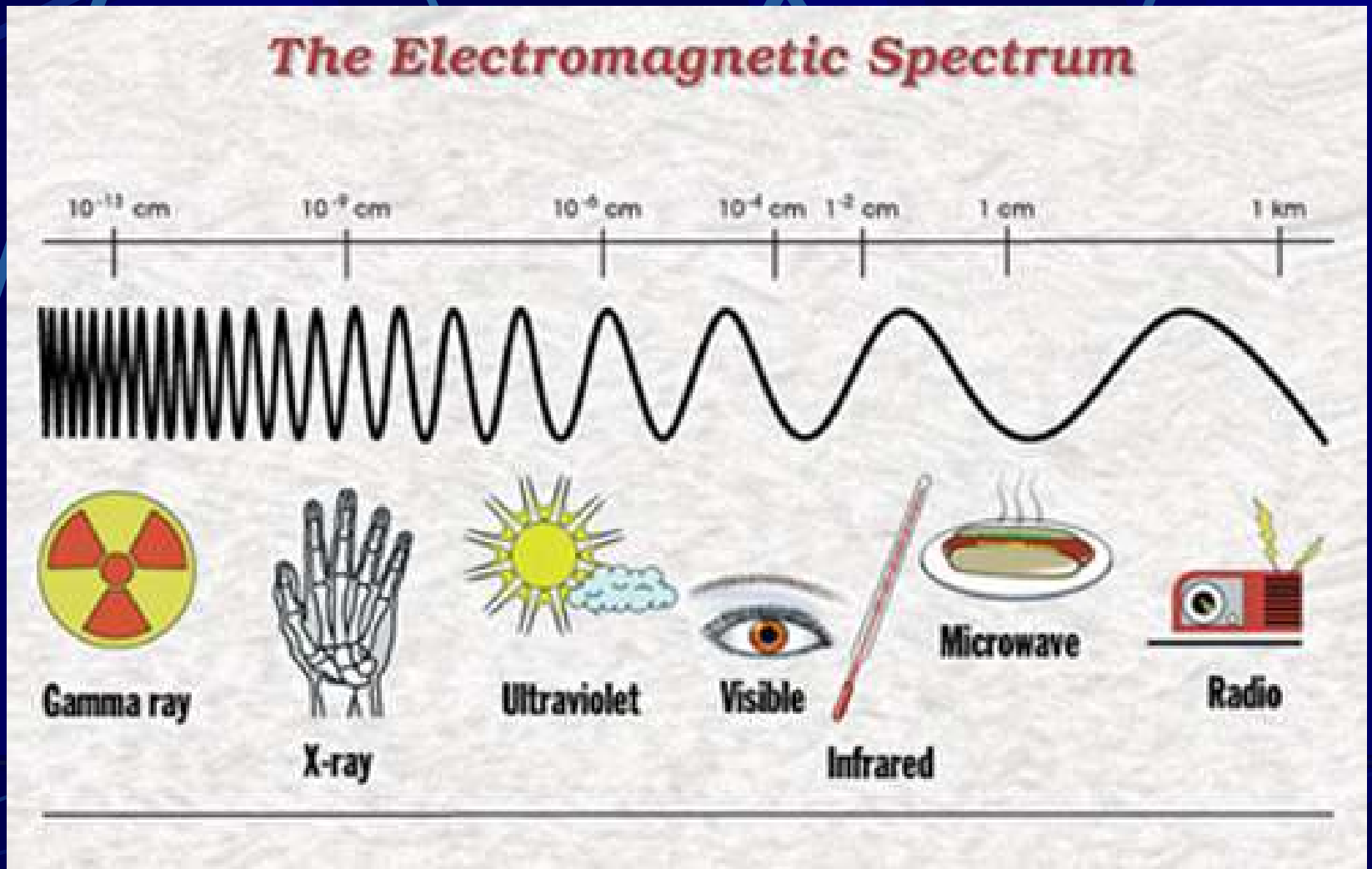
Chapter 13-1

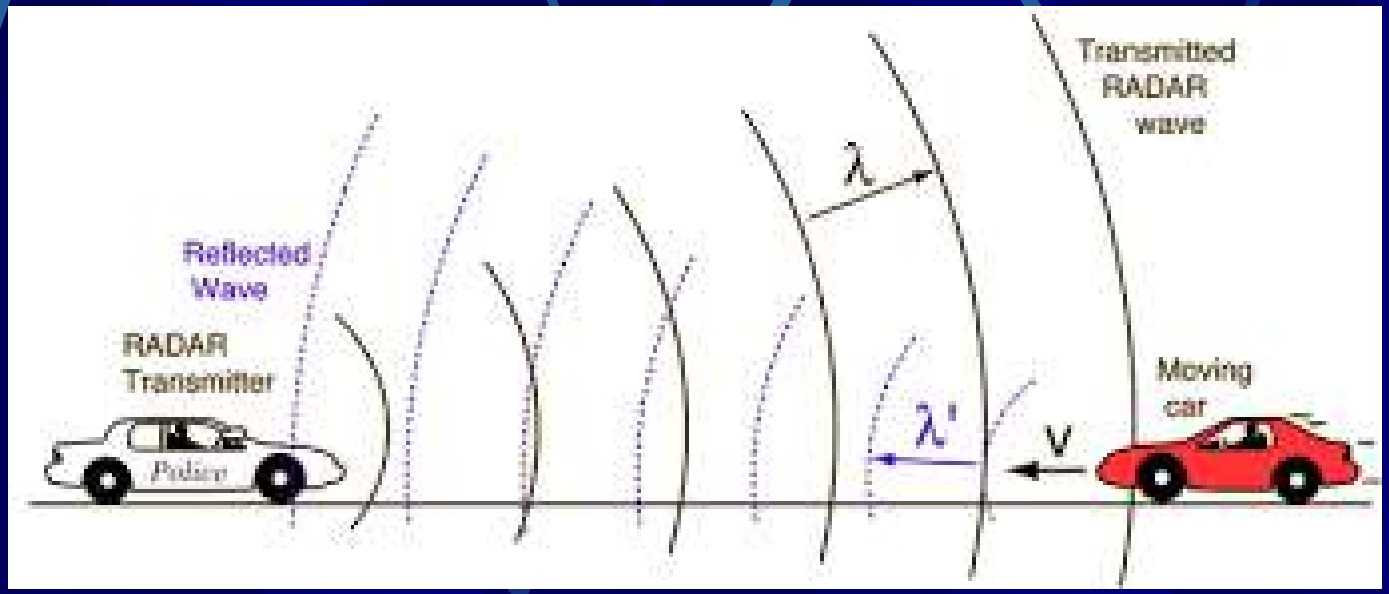
Electromagnetic Waves

- Electromagnetic Wave – A transverse wave consisting of oscillating electric and magnetic fields at right angles to each other.
- The spectrum includes more than visible light – not all light is visible to the human eye.
- Light is a wave and also a particle (photon).

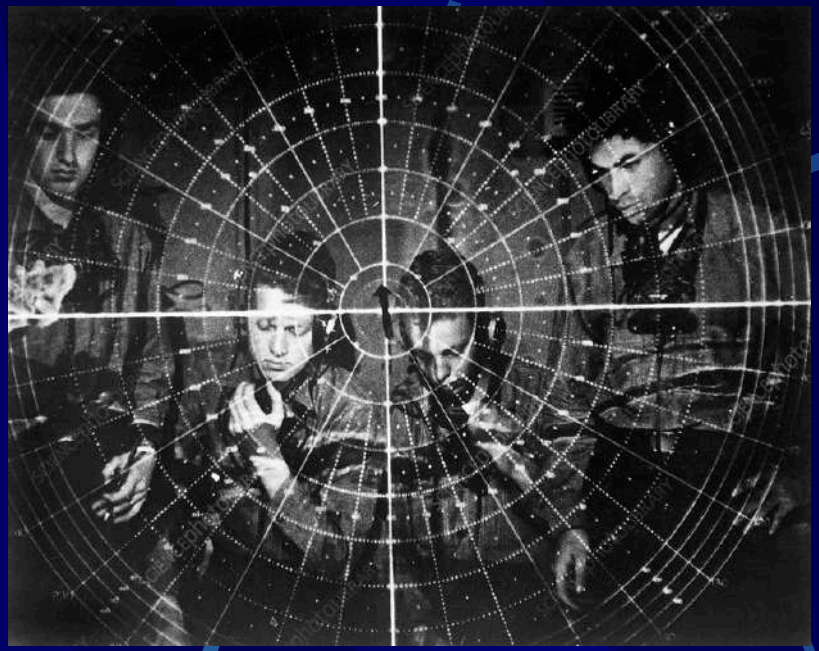
Electromagnetic waves vary depending on frequency and wavelength.

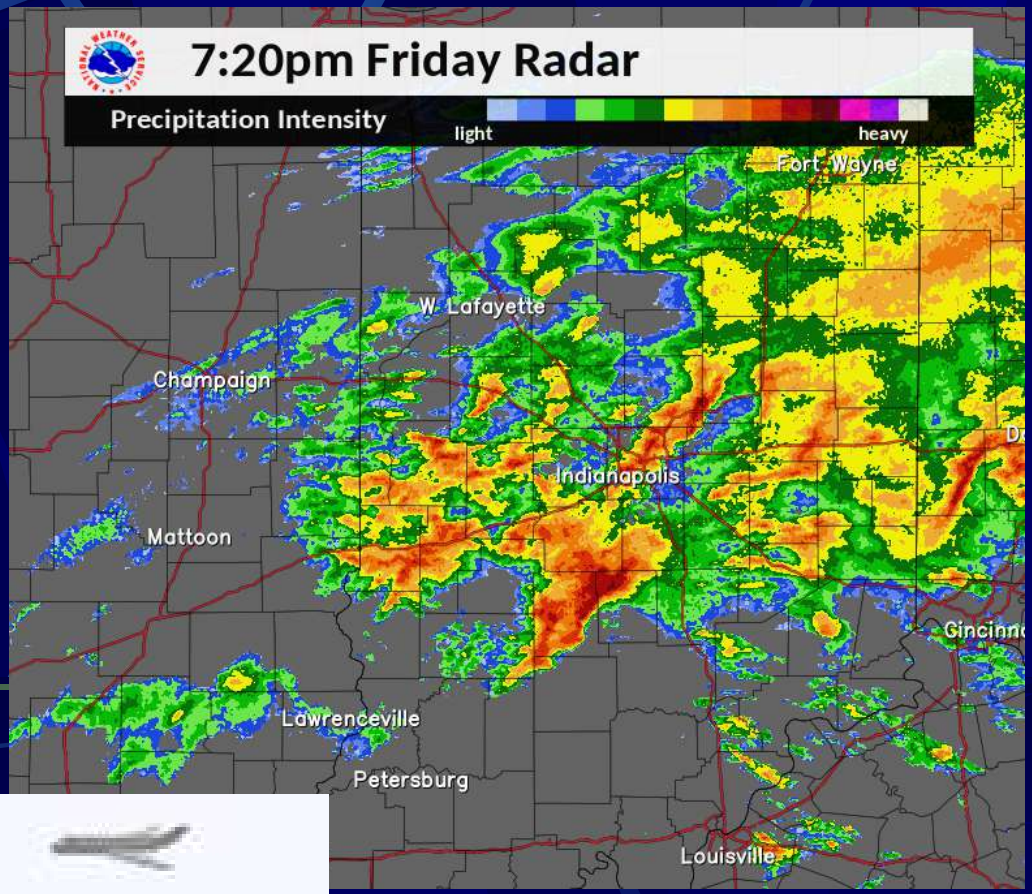


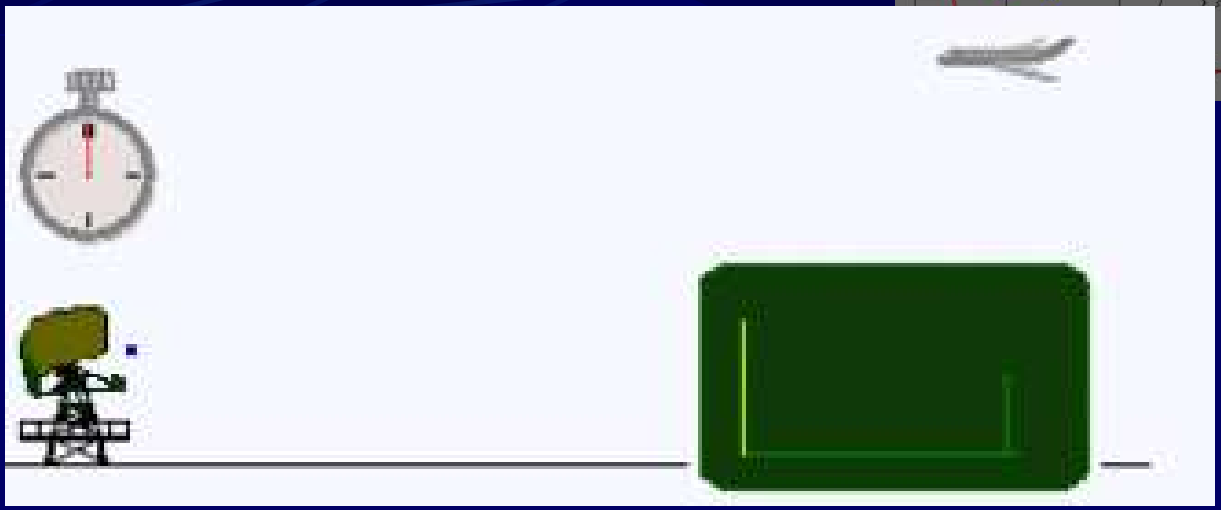
- Radio Waves – Radio (AM and FM), older tv's (not digital or HD), old remote control cars with antenna, and baseball radar guns



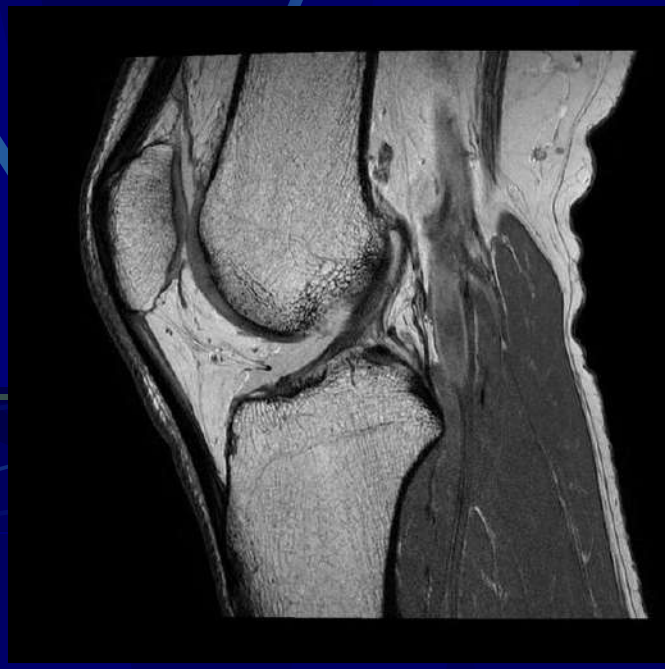
Radio Waves




7:20pm Friday Radar
Precipitation Intensity
light
heavy
Fort Wayne
W Lafayette
Champaign
Indianapolis
Mattoon
Lawrenceville
Petersburg
Louisville



Radio Waves



Magnetic Resonance Imaging - MRI

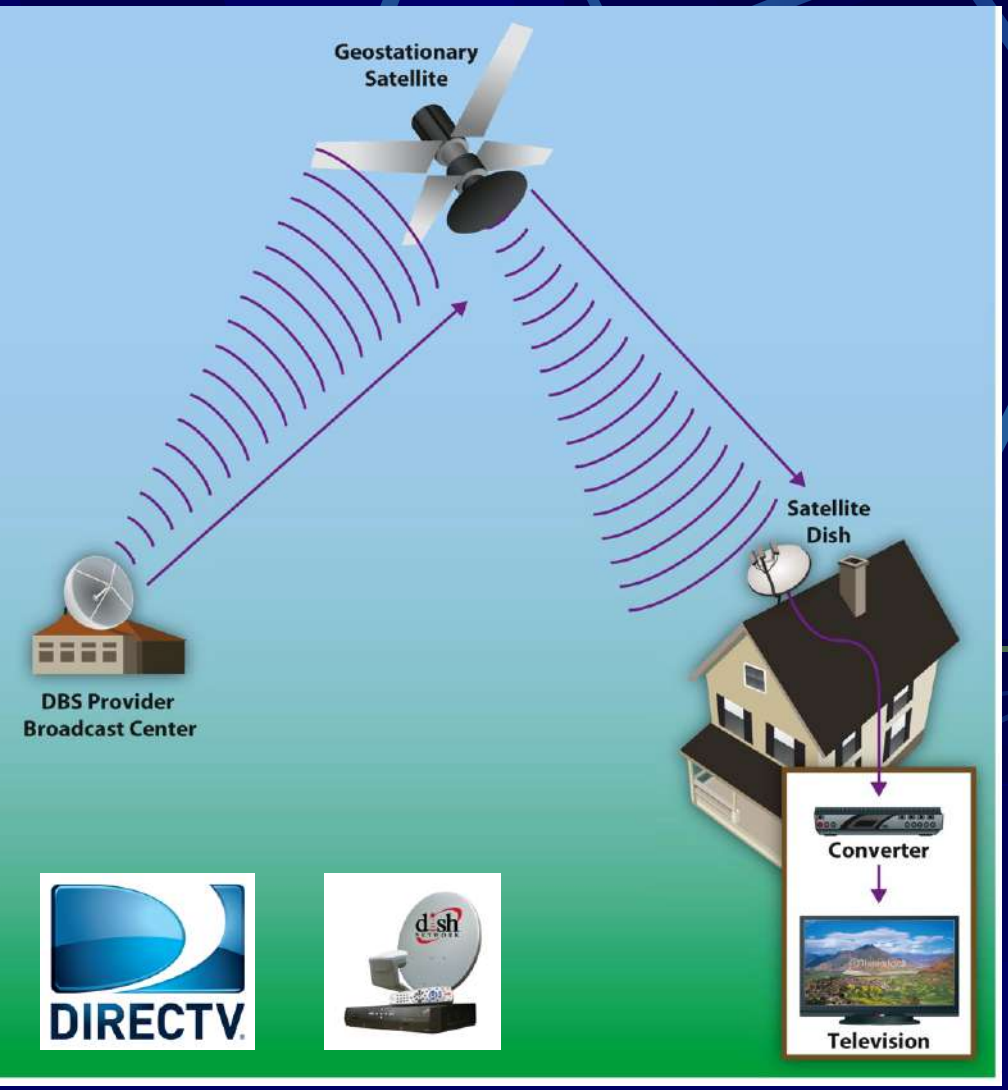
Radio Astronomy

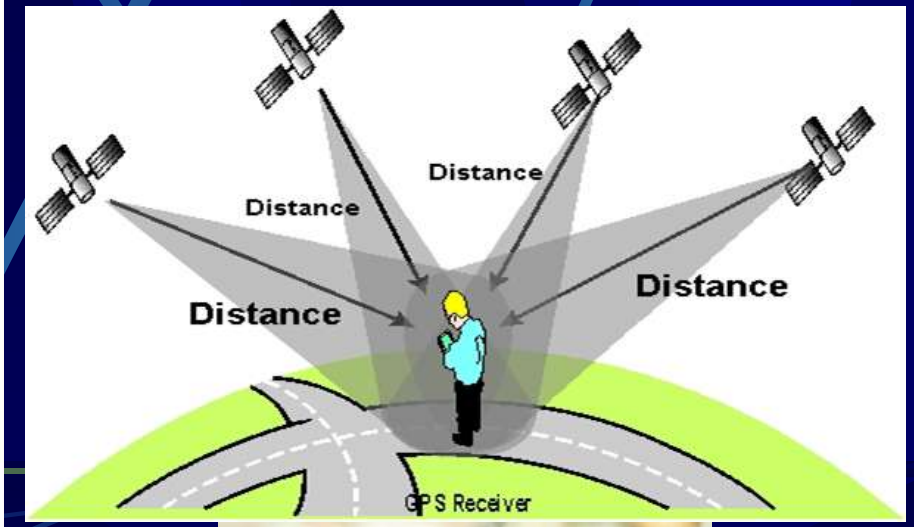
Australia Telescope Compact Array

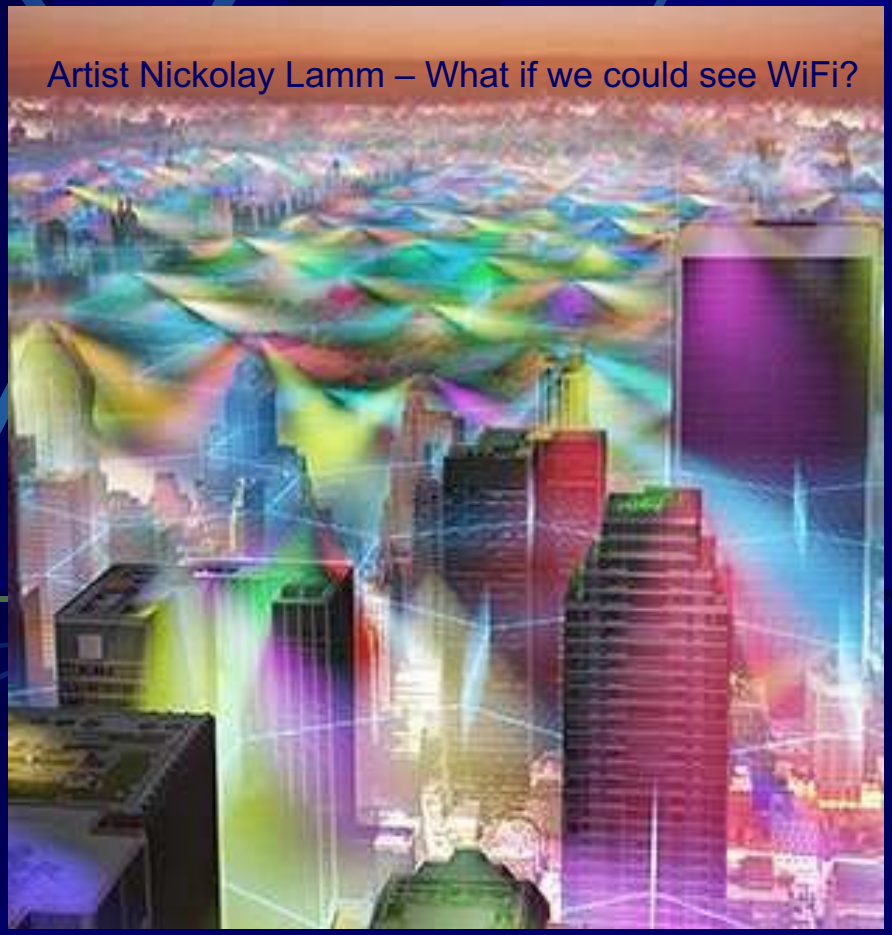
W50 “Manatee” Nebula

- 2. Microwave

Microwaves

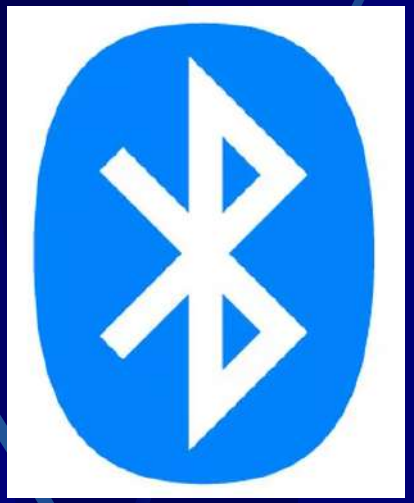

Geostationary Satellite
Satellite Dish
DBS Provider Broadcast Center
Converter
Television
DIRECTV


Distance
Distance
Distance
Distance
Distance
GPS Receiver



Microwaves

Microwaves

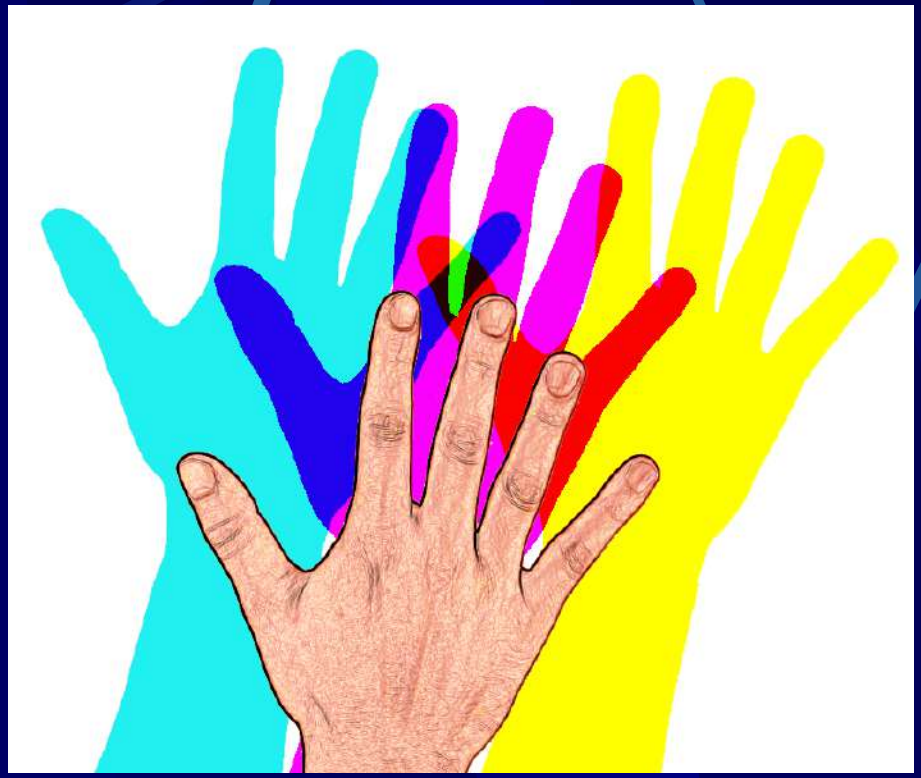


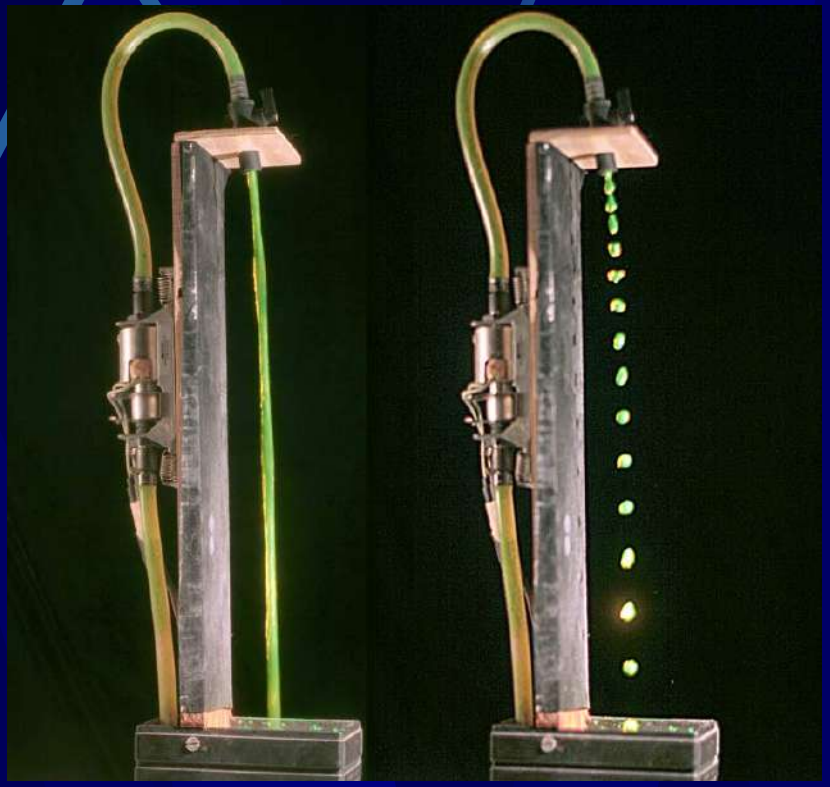
3. Infrared - Night Vision Goggles and Thermal Camera, RC Cars

Video Image Using **Infrared** Light

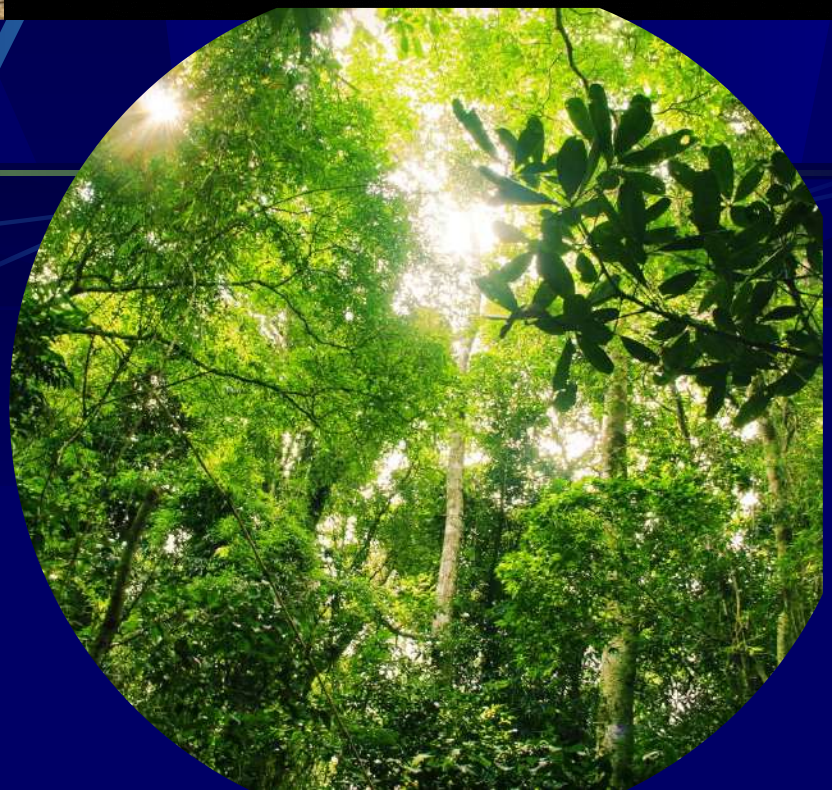
Check out the thermal paw prints …. and the drops of slobber that are evaporating and look cooler.

4. Visible - Color Spotlight, diffraction glasses, bubbles, Oculus, eye dissection, strobe light spinning and desktop strobe fountain





Visible Light & Shadows



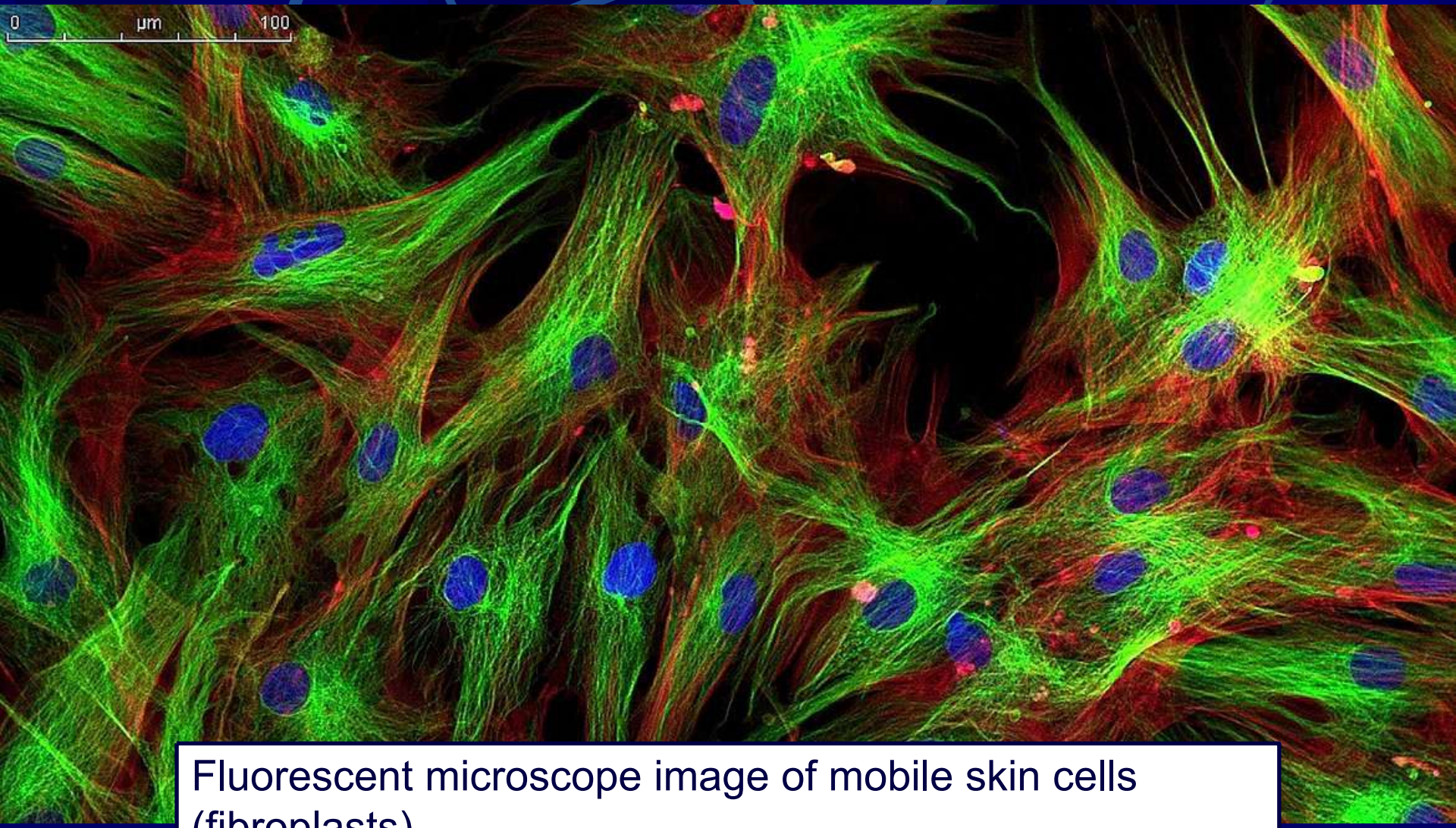
- In visible light, the differences in frequency and wavelength account for different colors.
- The differences in wavelength and frequency also distinguishes visible light from invisible electromagnetic radiation, such as X Rays.

Colors

- Red light has the least amount of energy and longest wavelength
- Violet has the most energy and shortest wavelength

Color	Wavelength (nm)	Frequency (THz)	Photon energy (eV)
violet	380–450	670–790	2.75–3.26
blue	450–485	620–670	2.56–2.75
cyan	485–500	600–620	2.48–2.56
green	500–565	530–600	2.19–2.48
yellow	565–590	510–530	2.10–2.19
orange	590–625	480–510	1.98–2.10
red	625–750	400–480	1.65–1.98

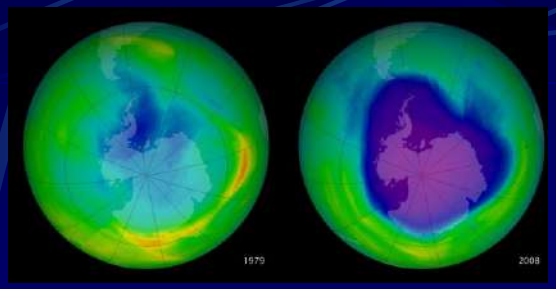
Visible Light



Fluorescent microscope image of mobile skin cells (fibroplasts)

5. Ultraviolet- sterilization, forensics

Ultraviolet Light is Responsible for Sunburn



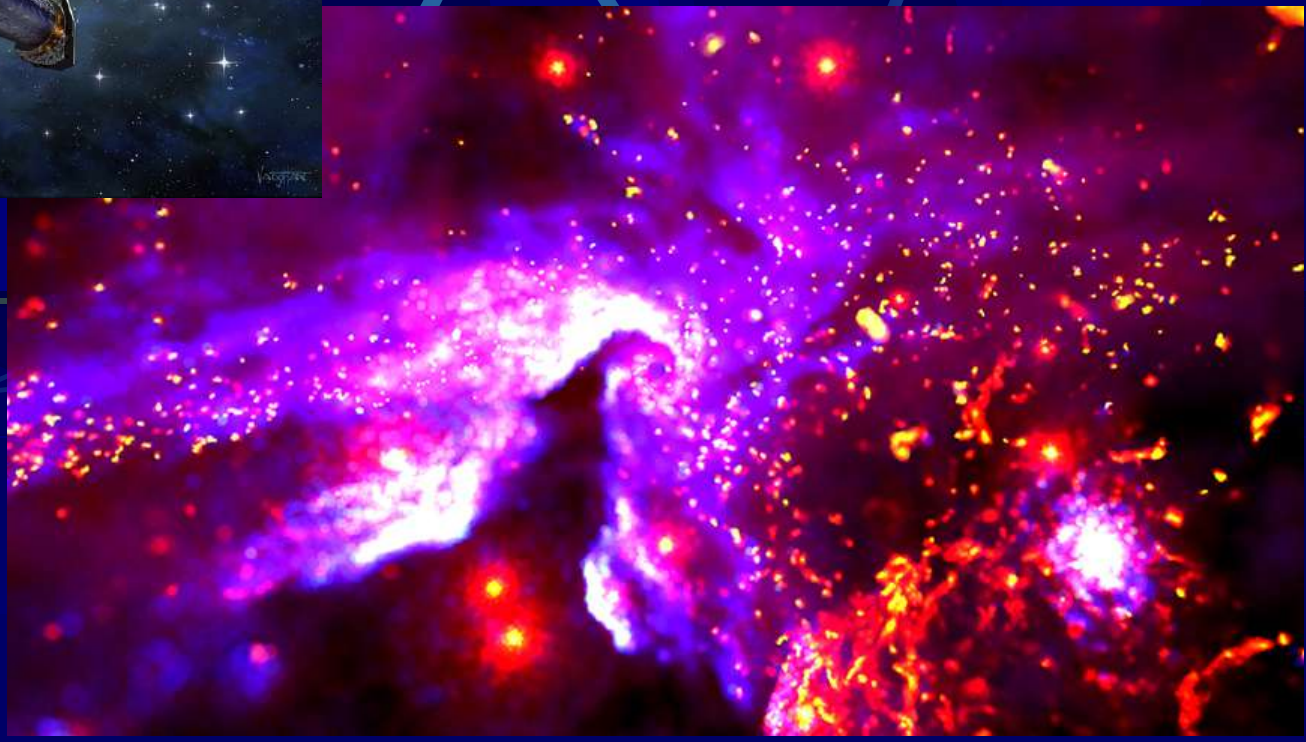
UV Light Initiates Chemical Reactions in the Atmosphere – “Ozone Hole”

Westerlund 2 – 20,000 light-years away

Hubble Space Telescope

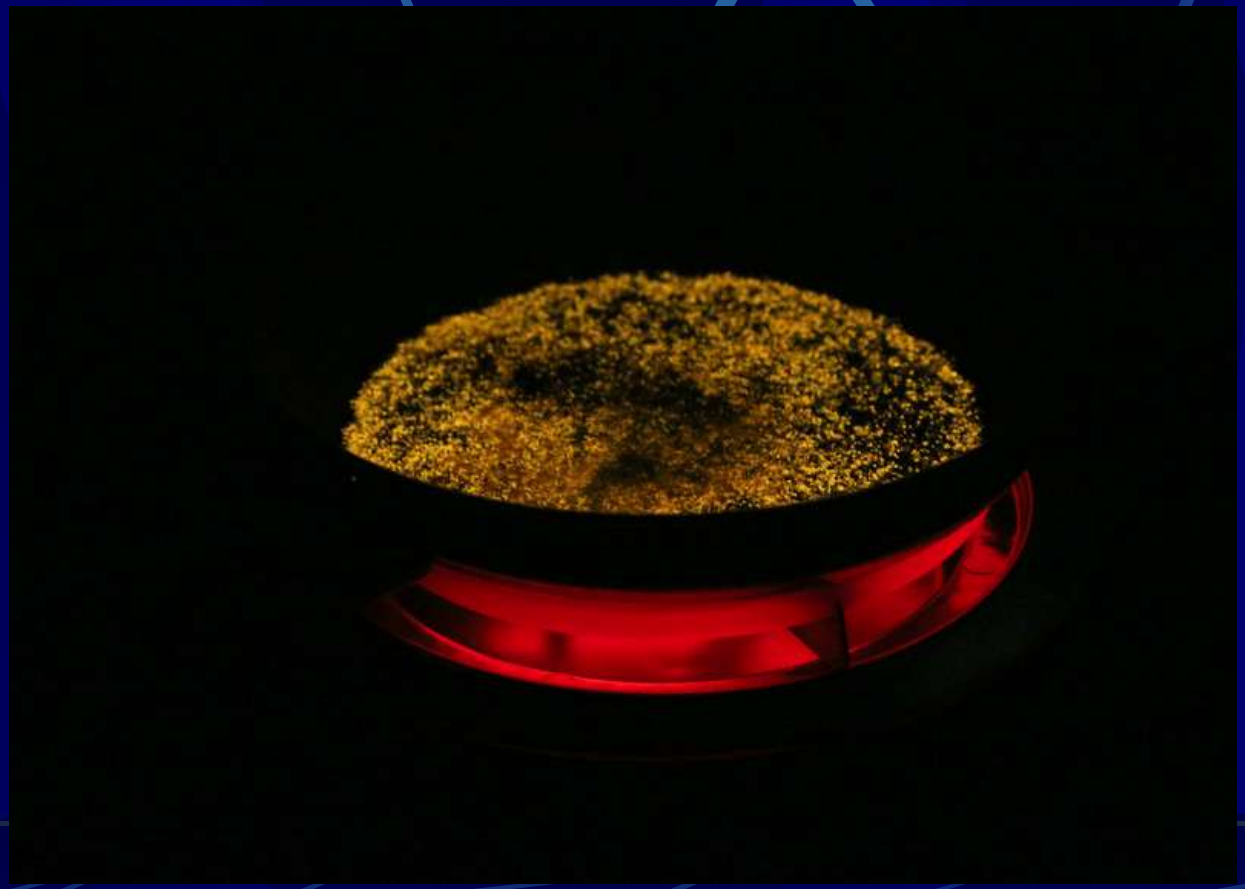
6. X-Rays

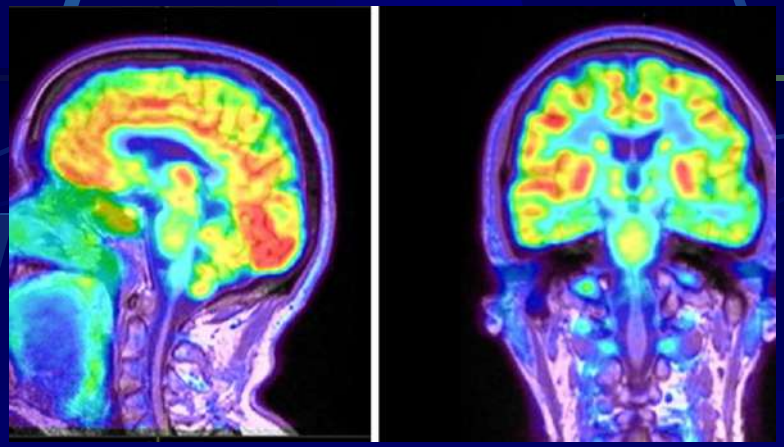
Chandra X-ray Observatory



The center of the Milky Way galaxy located about 26,000 light years from Earth.

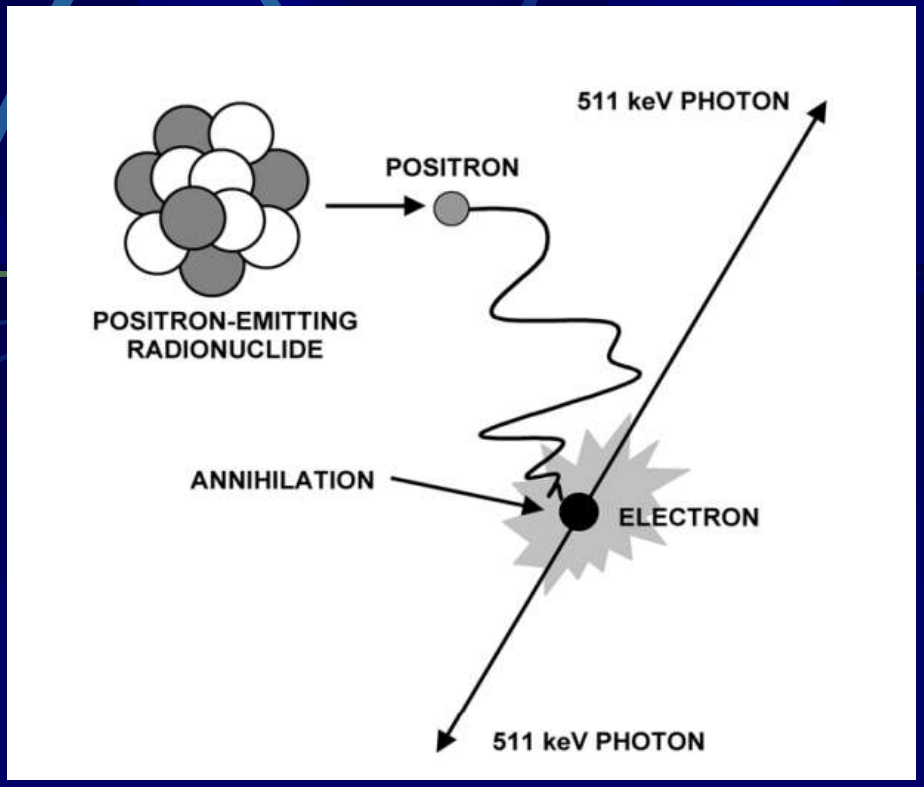
7. Gamma Waves - Nuclear Bombs, Nuclear Energy, Cancer Treatment - Geiger Counter





Gamma Rays

Positron Emission Tomography



- All electromagnetic waves move at the speed of light.
- Speed = wavelength x frequency
- Only the wavelength and frequency change.
- This change decides which type of electromagnetic wave it is, radio, gamma, etc.

- The speed of light in a vacuum =

  2.99792458×10^8
- The speed of light in air = 2.99709×10^8
- We use 3×10^8

- Waves can be approximated as rays.
- Next chapter we'll be drawing out light rays.
- Brightness of light decreases by the square of the distance from the source.