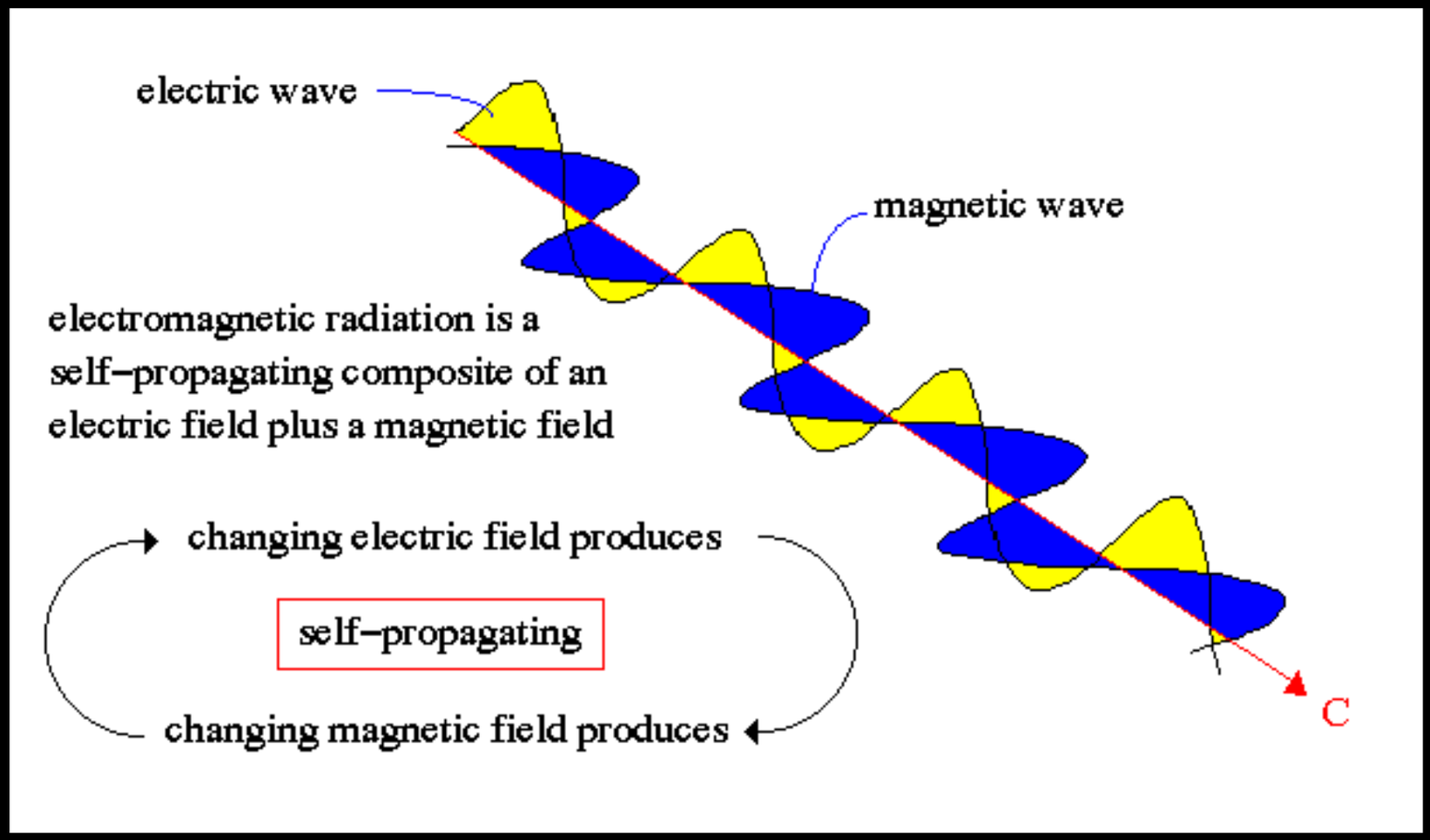
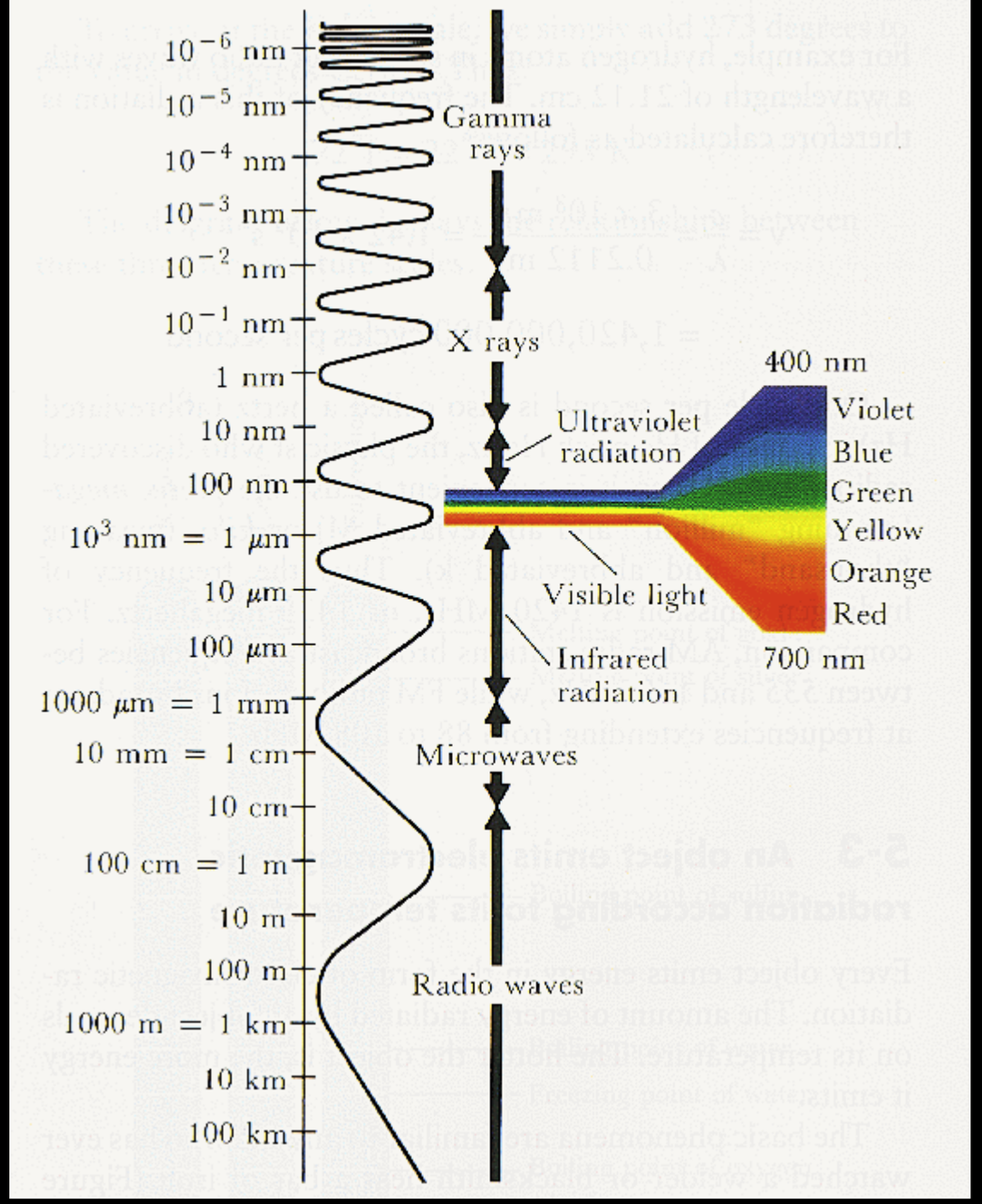
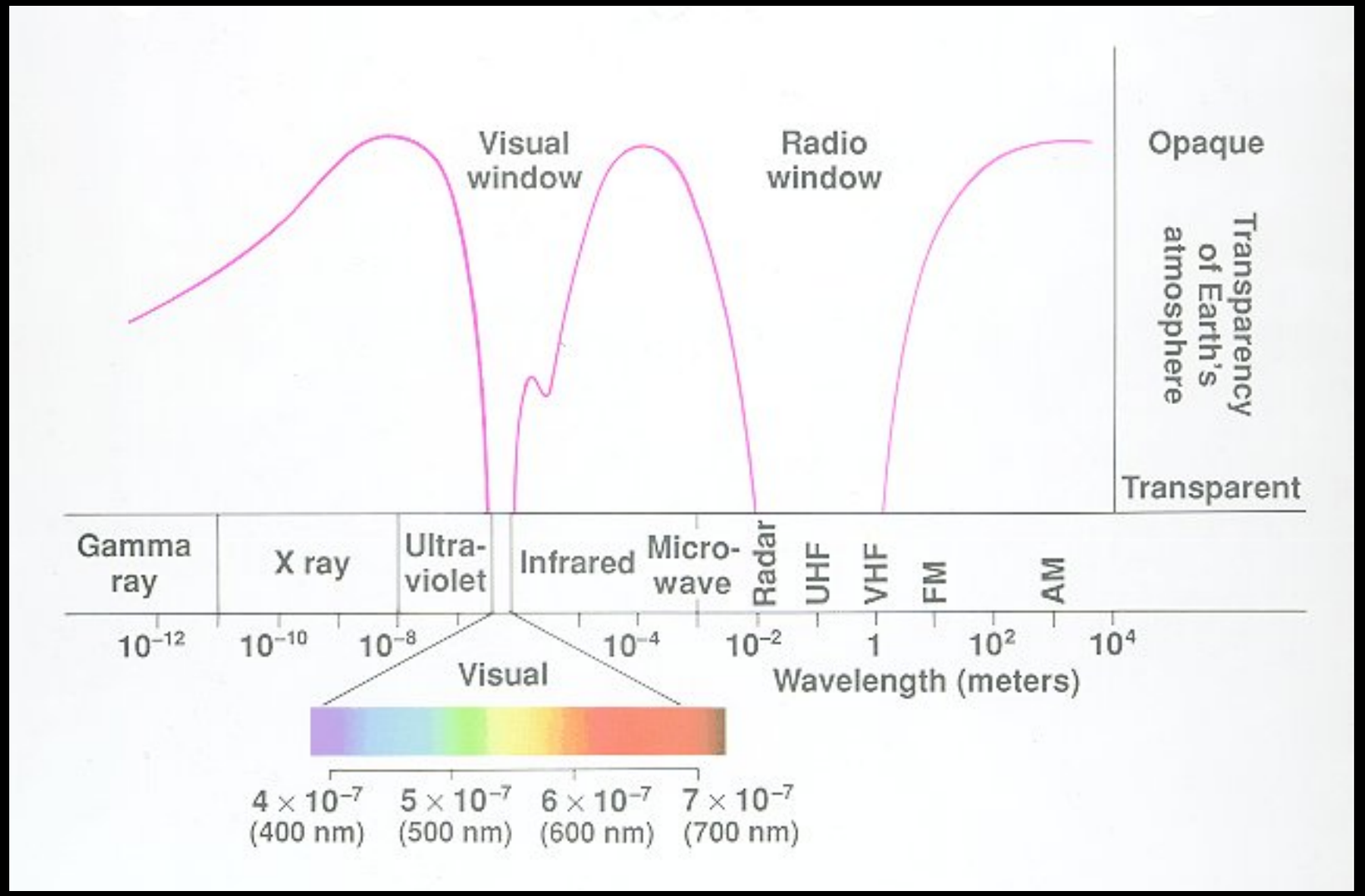


Maxwell (1850's) showed that light is energy carried in the form of opposite but supporting electric and magnetic fields in the shape of waves, i.e. self-propagating electromagnetic waves.



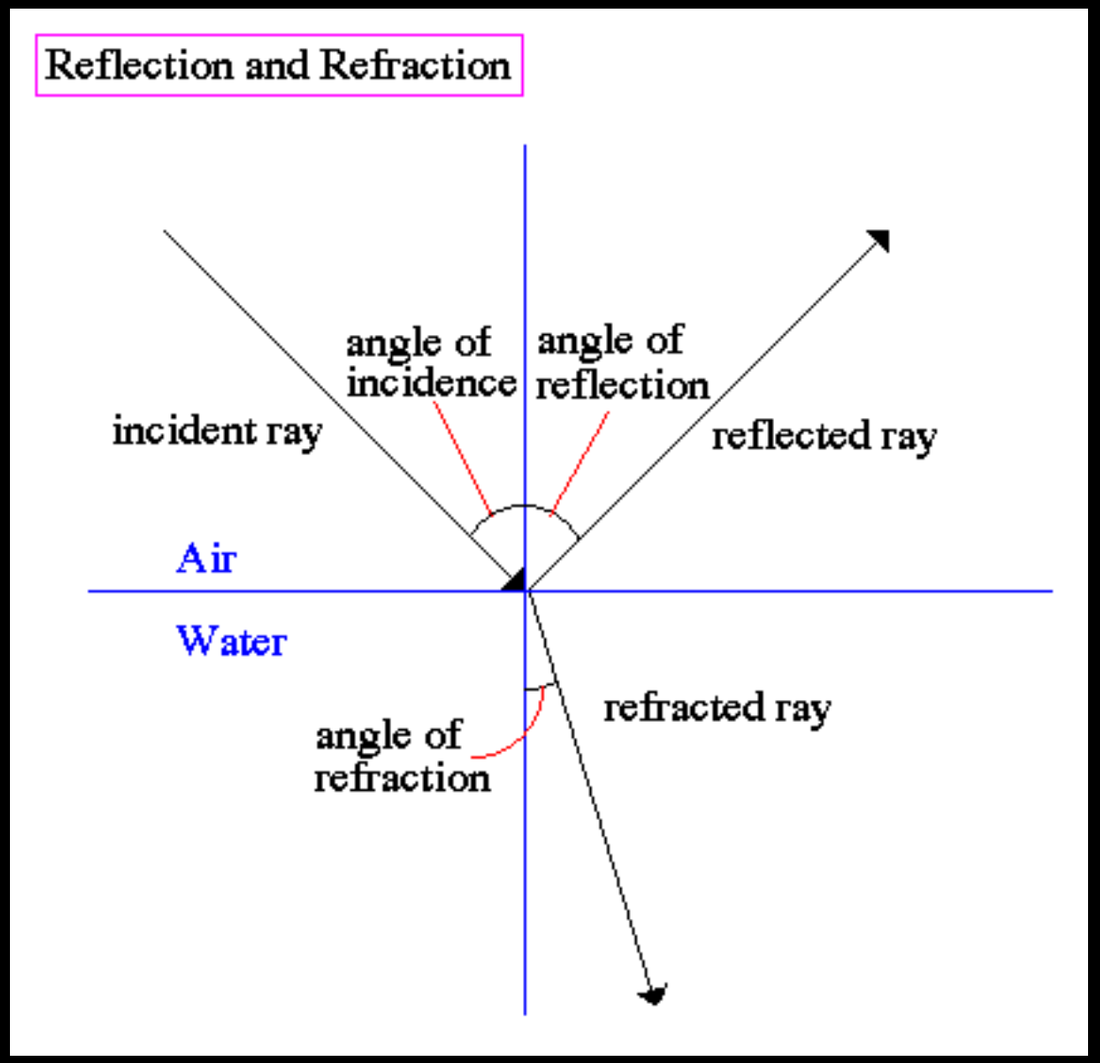
The wavelength of the light determines its characteristics. For example, short wavelengths are high energy gamma-rays and x-rays, long wavelengths are radio waves. The whole range of wavelengths is called the electromagnetic spectrum.

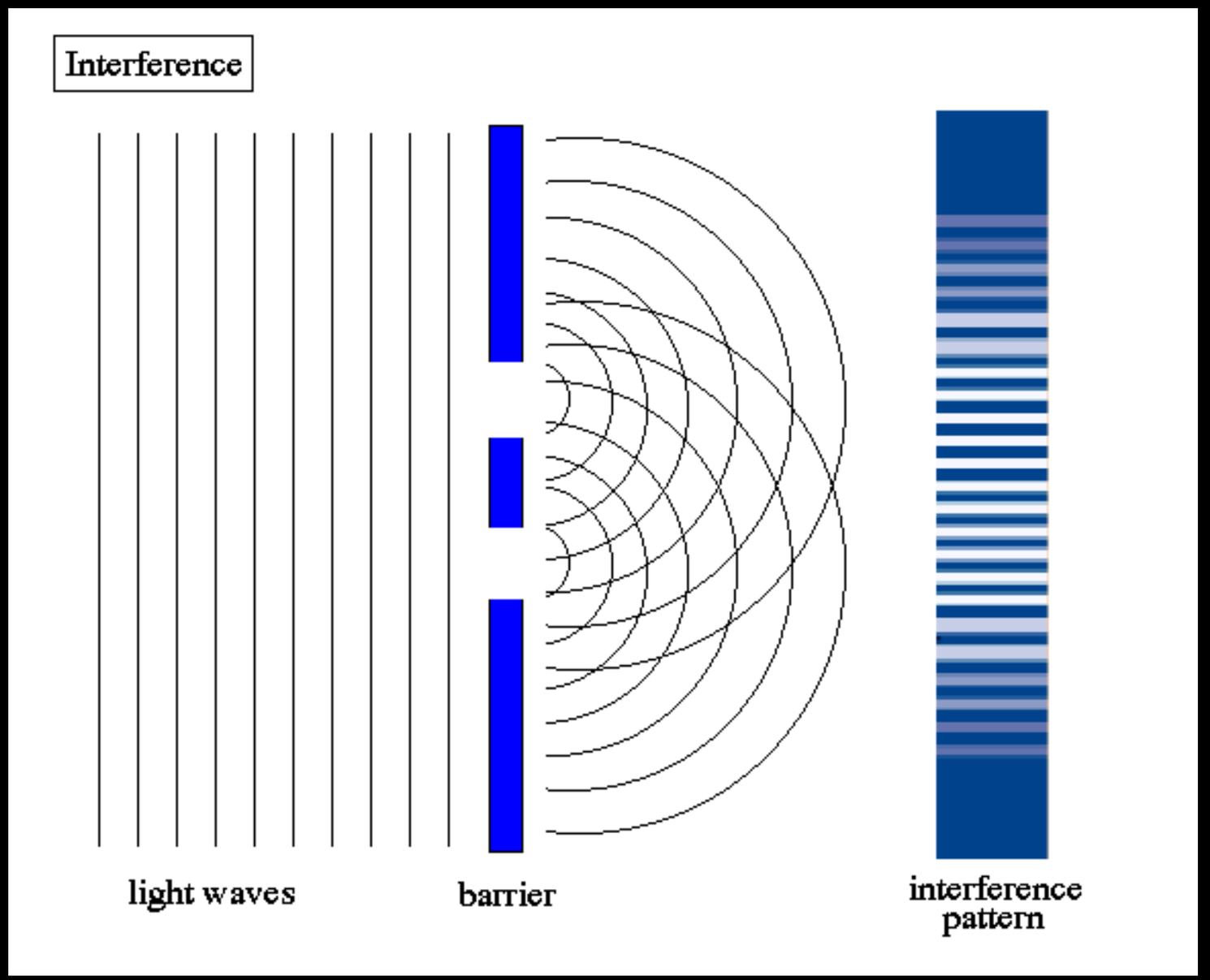


Observing at different wavelengths requires vastly different technology and conditions. In particular, our atmosphere is opaque to certain wavelengths (good for us) meaning that they can only be observed from space (expensive for astronomers).

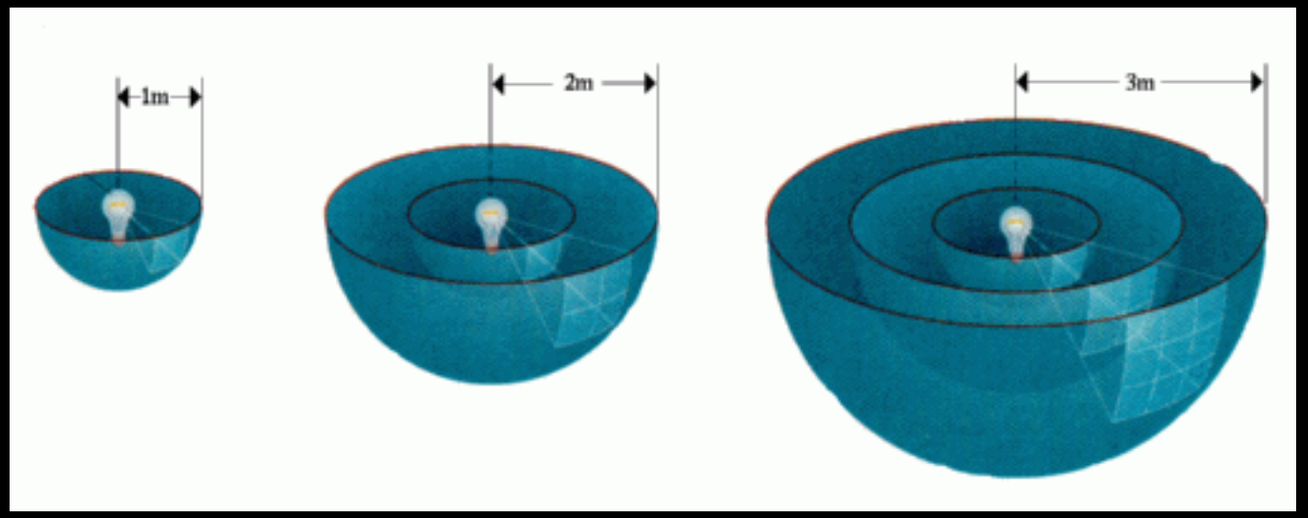
Due to its wave-like nature, light has three properties when encountering a medium:

1) reflection
2) refraction
3) diffraction





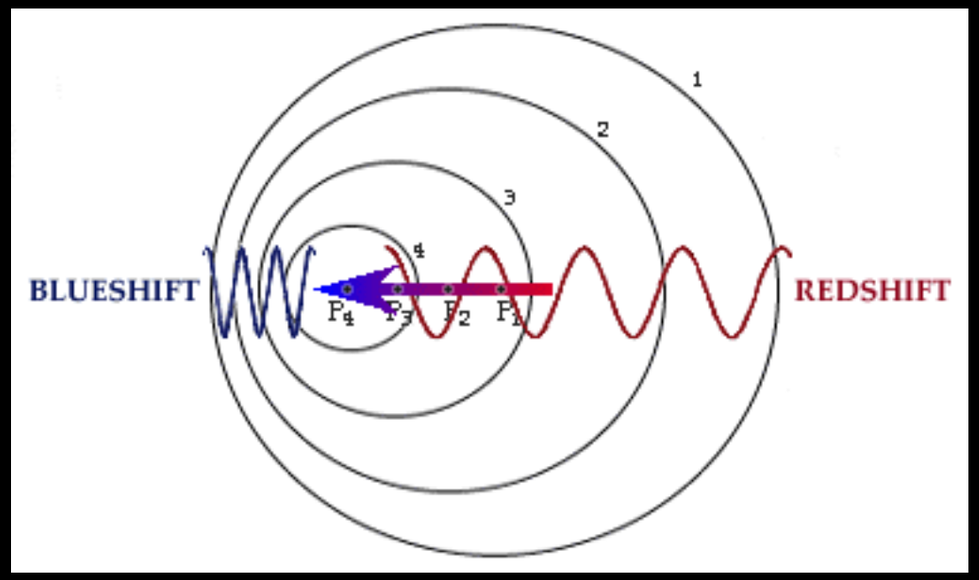
Diffraction is the constructive and destructive interference of two beams of light that results in a wave-like pattern



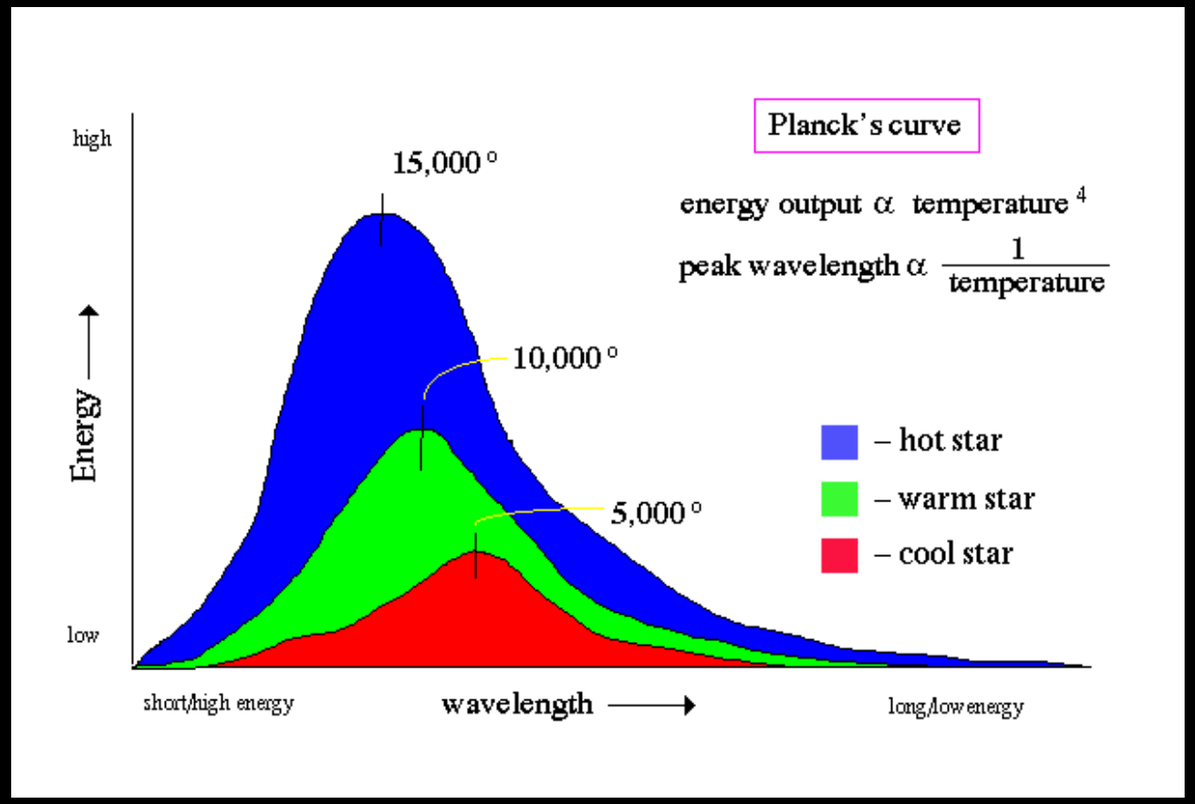
$$\text{brightness} \propto \frac{1}{\text{distance}^2}$$

Example: What is the apparent brightness of the Sun as seen from Jupiter?

$$\frac{b_{Jupiter}}{b_{Earth}} = \frac{D_{Earth}^2}{D_{Jupiter}^2} = \frac{1^2}{5^2} = \frac{1}{25}$$



The Doppler effect occurs when on object that is emitting light is in motion with respect to the observer. The speed of light does not change, only the wavelength. If the object is moving towards the observer the light is ``compressed'' or blueshifted. If the object is moving away from the observer the light is ``expanded'' or redshifted.

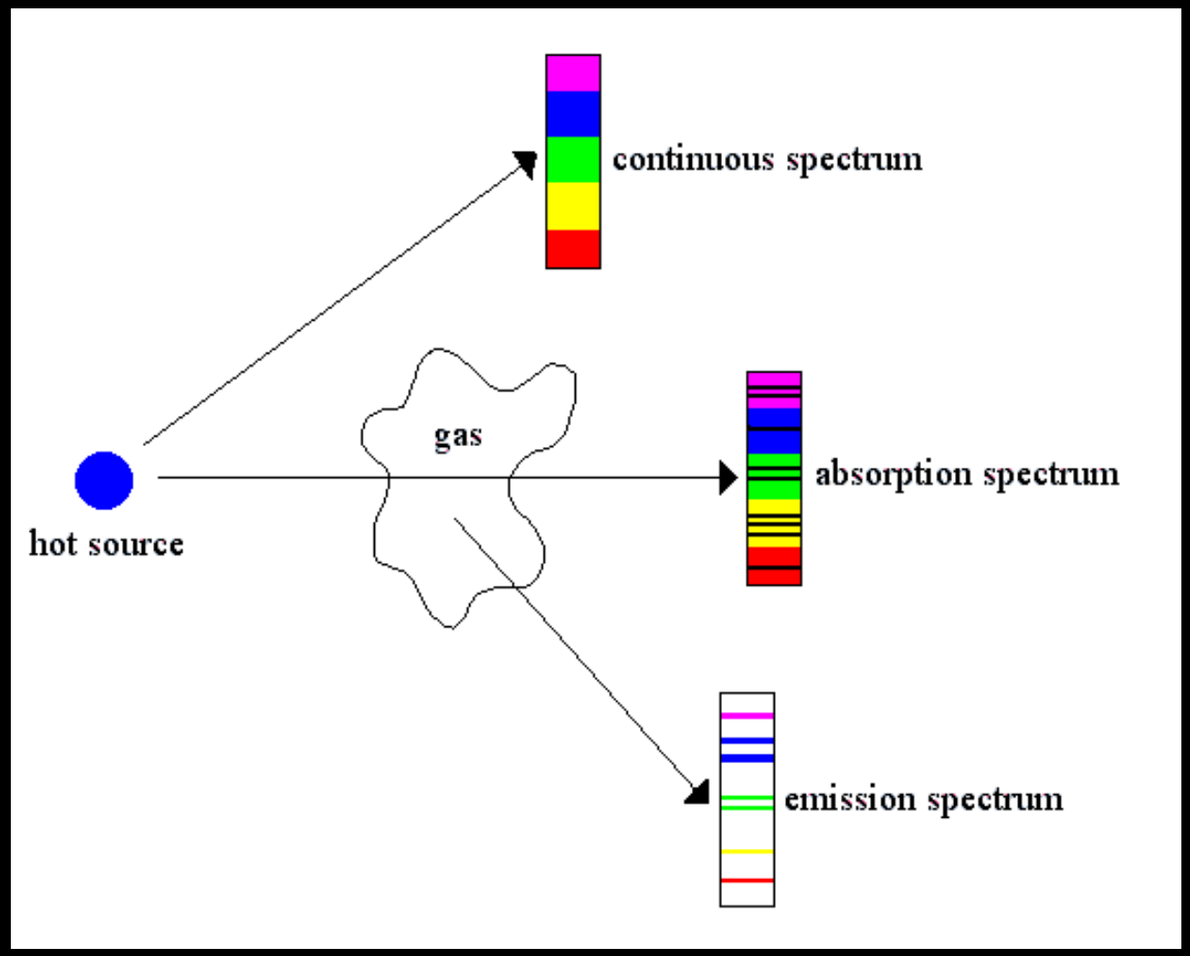


One of the primary results from the field of spectroscopy was the discovery of how the energy outputed by an object (its spectrum) changes with temperature. In particular, was the formulation of the laws of radiation commonly expressed as two laws:

Stefan-Boltzmann law: the amount of energy emitted from a body increases with higher temperature

Wien's law: the peak of emission moves to bluer light as temperature increases

The energy outputted by an object (a star, a piece of metal, a human body) takes on a particular shape called Planck's curve, shown in the following plot of energy versus wavelength.



Kirchhoff's Laws:
There are three types of spectra emitted by objects:

1) Continuous spectrum - a solid or liquid body radiates an uninterrupted, smooth spectrum (Planck curve)

2) Emission spectrum - a radiating gas produces a spectrum of discrete spectral lines

3) Absorption spectrum - a continuous spectrum that passes through a cool gas has specific spectral lines removed (inverse of an emission spectrum)