

# **EMR** & the Signals

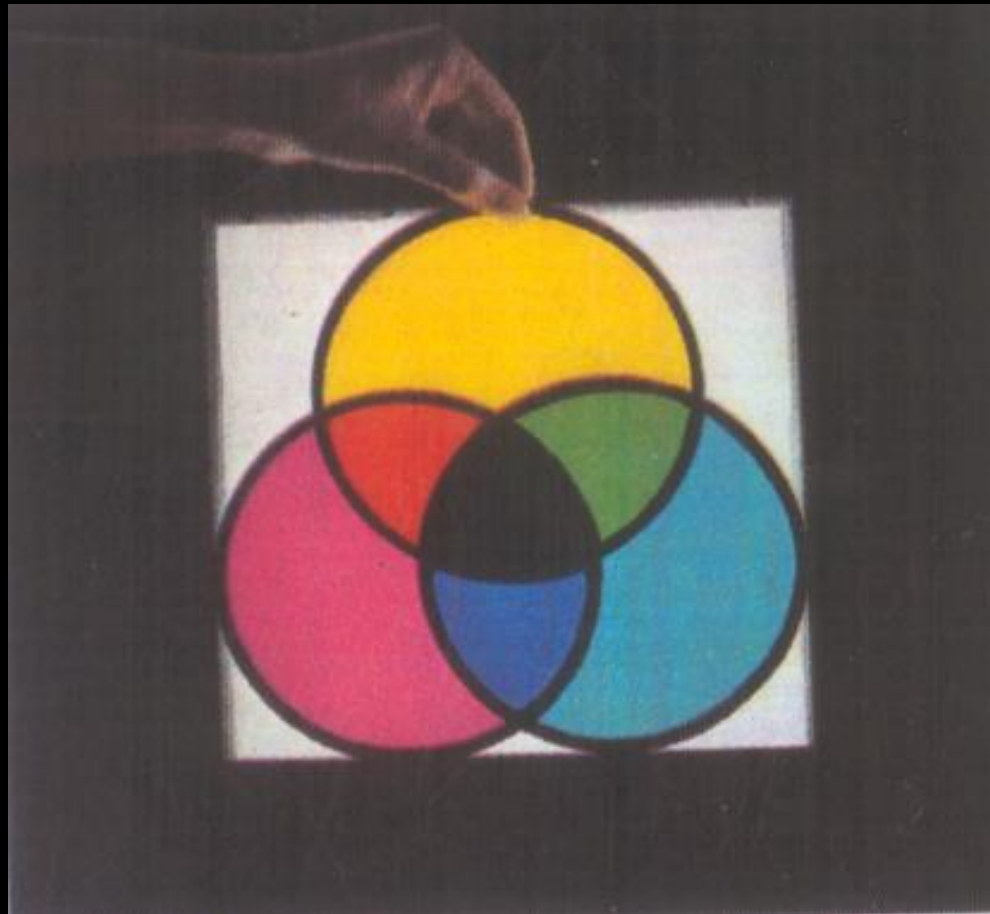
**M.H.M. Rinos**

# Colour Mixing Process



## 1. Colour Additive Process

Operative when lights of different colours are superimposed



## **2. Colour Subtractive Process**

**Operative when dyes of different colours are superimposed**

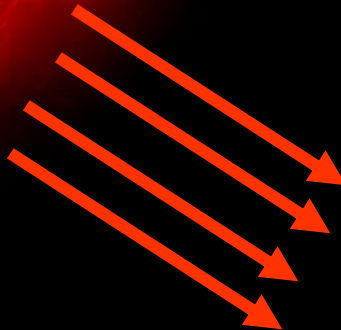
# Sun

Diameter: 1.4 million km

Distance:  $1.5 \times 10^8$  km

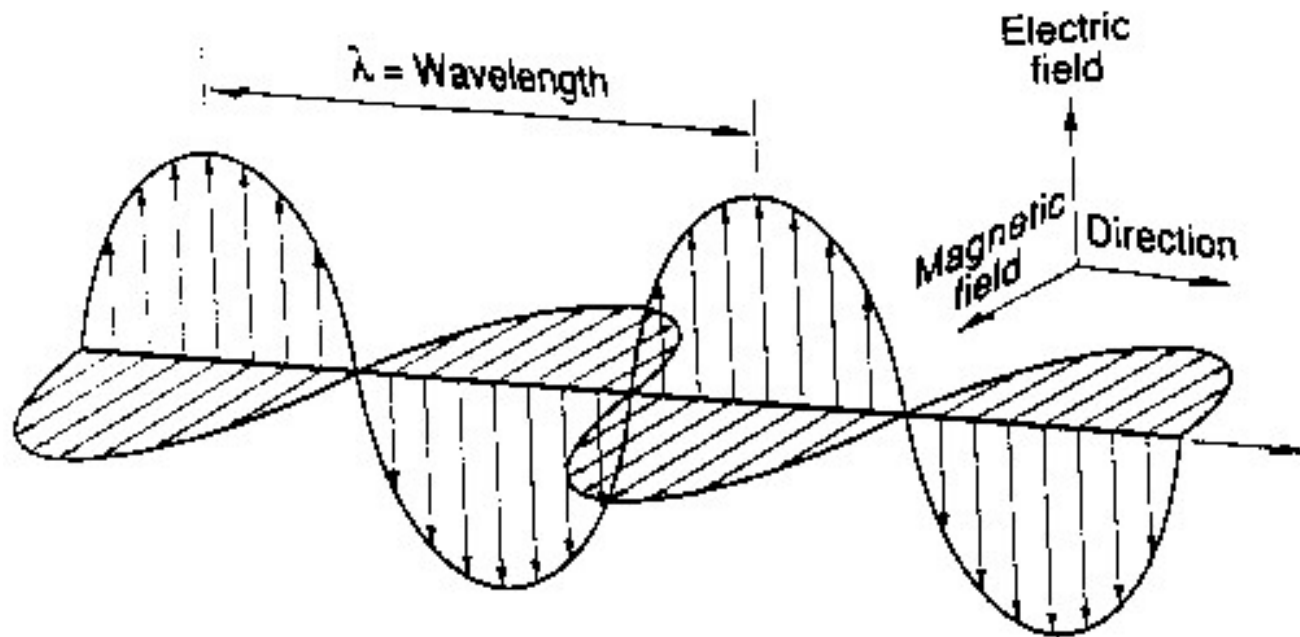
Age: 4.56 billion yrs

Luminosity:  $3.9 \times 10^{26}$  W  
= 1380 W/m<sup>2</sup> at the  
surface of the earth



**EMR**

# Electro Magnetic Radiation

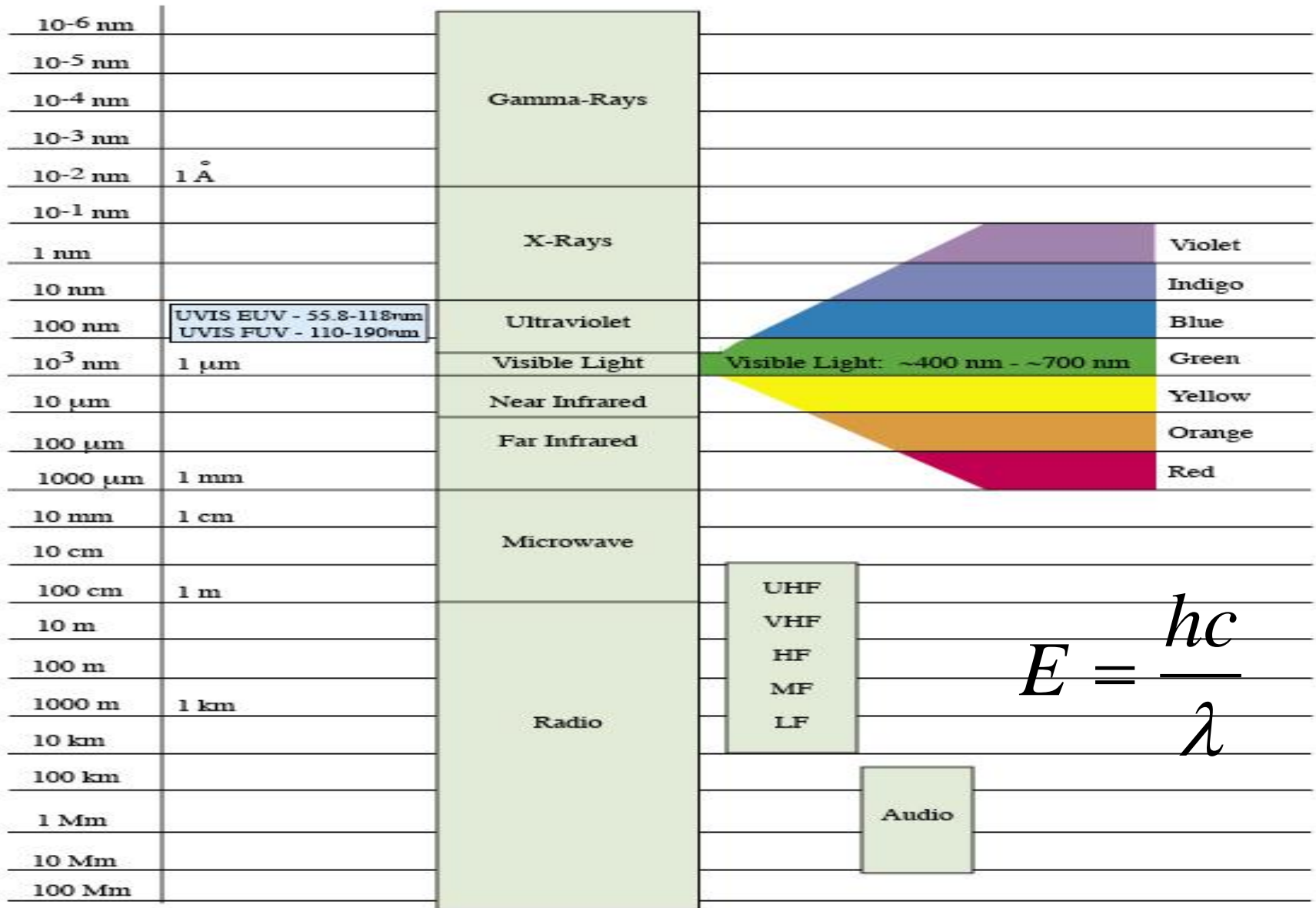


- EMR is a property of wavelength and frequency
- Wavelength is inversely proportional to frequency
- Portion of spectrum that transmits energy is called atmospheric window

Combined effect of various constituent of atmosphere- can cause atm to close down completely in certain regions of the spectrum ( no energy is transmitted)- bad for R S

# The Electromagnetic Spectrum

Chart by LRSP/University of Colorado, Boulder



$$E = \frac{hc}{\lambda}$$

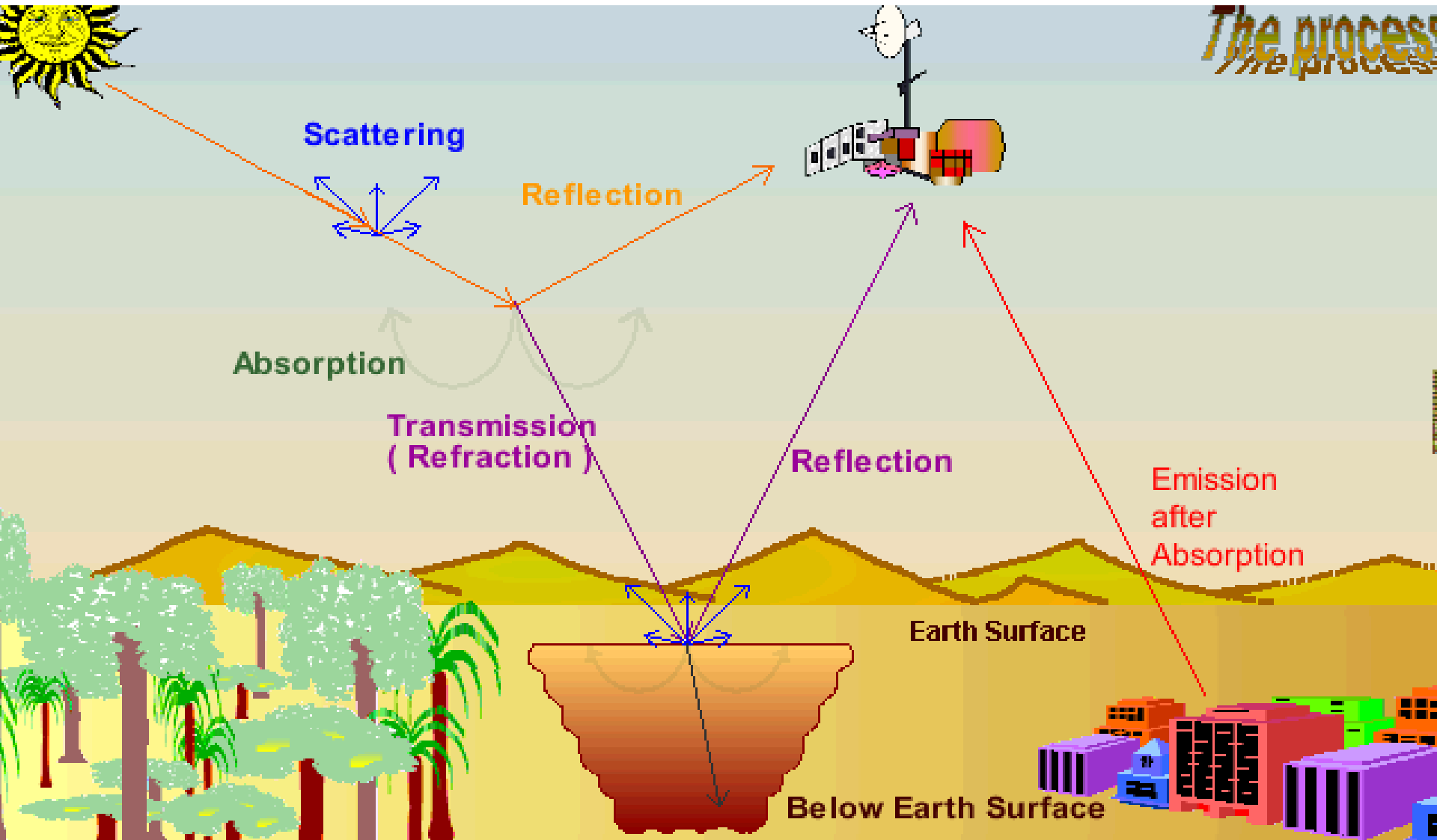
nm=nanometer, Å=angstrom, μm=micrometer, mm=millimeter, cm=centimeter, m=meter, km=kilometer, Mm=Megameter

# Electro Magnetic Radiation

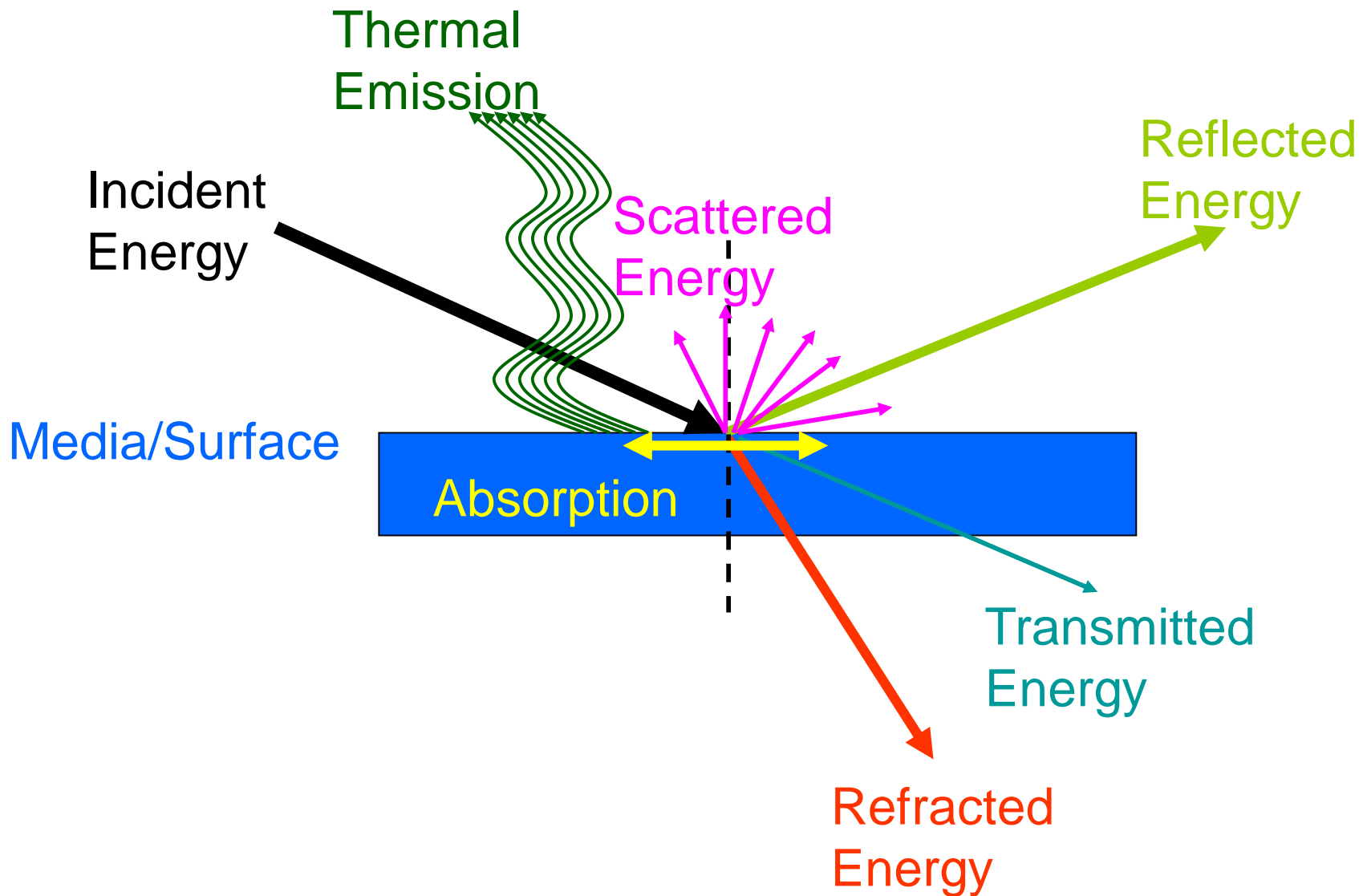
- EMR consists of
  - Electric Field
  - Magnetic Field
- EMR is Characterized by
  - Frequency ( $n$ ) or Wavelength ( $\lambda$ )
  - Intensity ( $i$ )
  - Direction of Travel
  - Plane of Polarization
- Velocity ( $C$ ) of EMR in vacuum is constant
$$C = n \lambda$$



# Interaction of EMR with Earth Object & Atmosphere



# Interaction of EMR with Earth



# INTERACTION PROCESS WITH ATMOSPHERE

- **Transmission**

- **Refraction**

Bending of light as it passes through different medium

- **Scattering**

Diffusion of radiation by particles in the atmosphere

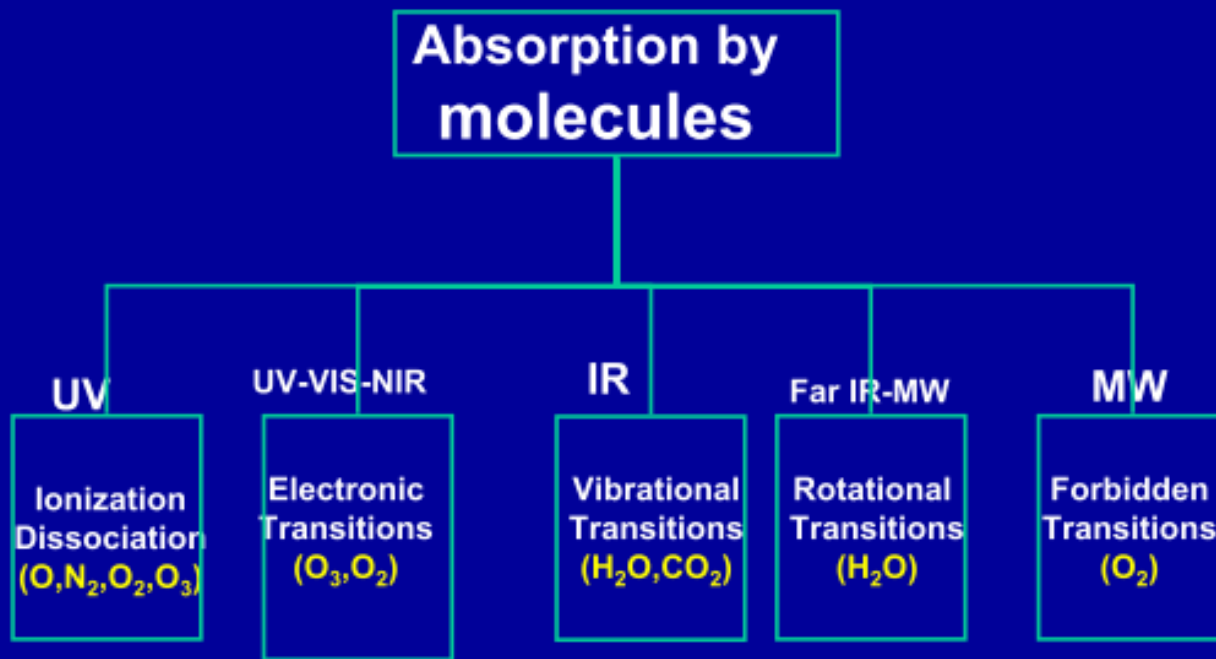
1. **Raleigh scattering: particle size smaller than wavelength**
2. **Mie scattering: particle size = wavelength**
3. **Non selective: particle size more than wavelength**

Absorption : atmosphere and earth surface

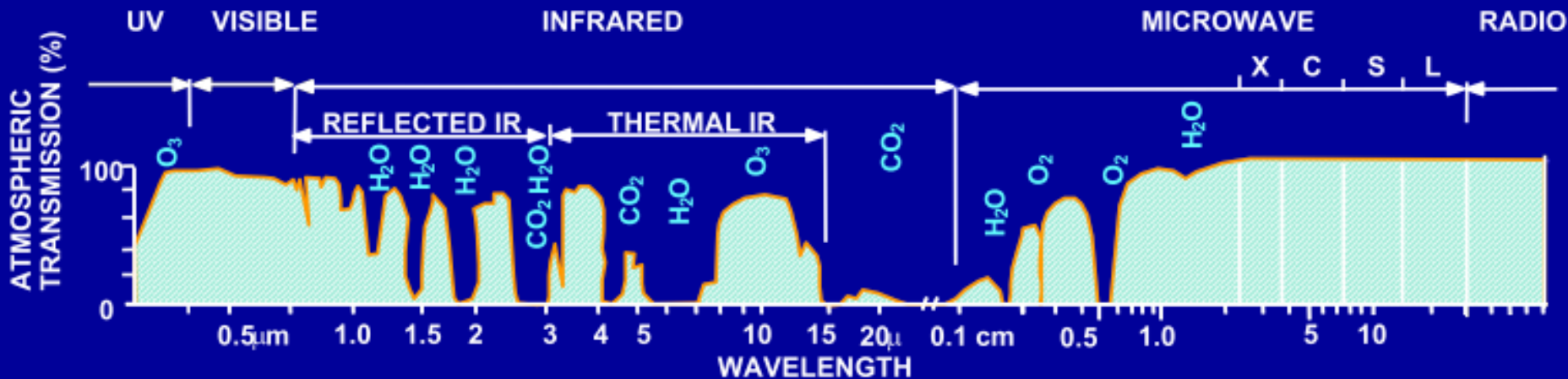
Reflection: radiation bounces off from surface  
atmosphere and earth surface  
specular reflection-  $I_E = R_E$   
diffused/ lambertian reflection- reflects  
in all direction due to sur roughness

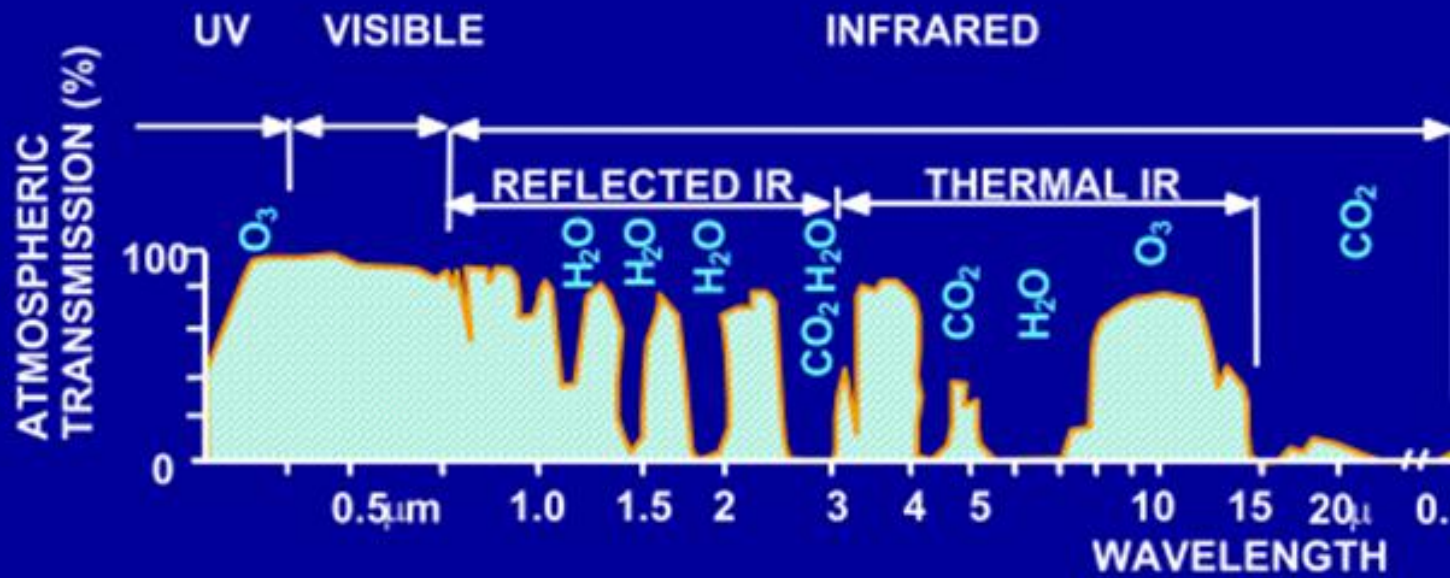
- Reflected
  - Ultra violet: 0.254-0.366  $\mu\text{m}$
  - Visible: 0.4-0.7  $\mu\text{m}$  (B G R or RGB)
  - Near IR: 0.7- 1.3  $\mu\text{m}$
- Thermal (thermal emission recorded)
  - Intermediate IR: 3- 5  $\mu\text{m}$
  - Thermal IR: 8- 14  $\mu\text{m}$
- Microwave (energy from the sensor- reflected from the surface- back to the sensor)
  - 1mm- 1m

# ATMOSPHERIC WINDOWS

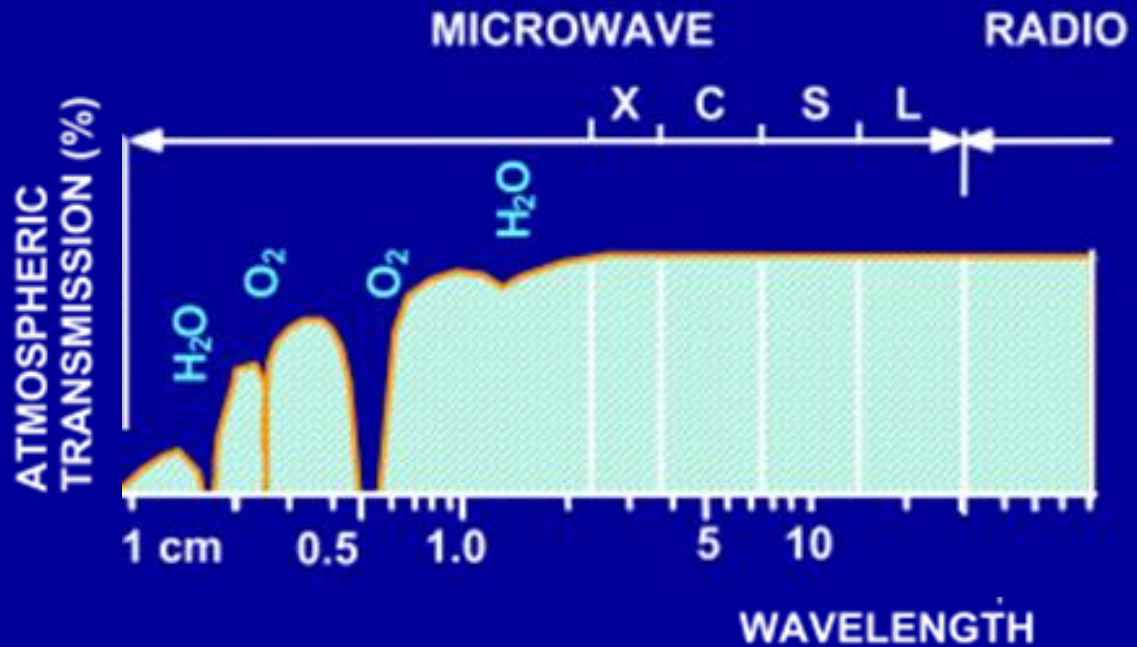


- 0.4-1.3,  
1.5-1.8,  
2.2-2.6,  
3.0-3.6,  
4.2-5.0,  
7-15,  
1cm-30cm
- }  $\mu\text{m}$





# Atmospheric Windows



- REFLECTANCE SPECTRA

