

## Nature and propagation of light

Light as ray: geometrical optics [ reflection, refraction, dispersion]

- Based on rectilinear propagation of light.
- Can explain reflection and refraction of light.

Light as wave: physical optics [reflection, refraction, dispersion, **interference, diffraction, polarization**]

- Based on wave nature of light.
- Can explain reflection, refraction, interference, diffraction and diffraction of light.

Light as particle: Quantum optics [ **photoelectric effect**, Compton effect, Zeeman effect, Raman effect]

- Based on De- Broglie wave particle duality.
- Can explain photoelectric effect, laser etc.

### DIFFERENT THEORIES THAT DESCRIBE NATURE OF LIGHT:

#### 1. **Newton's corpuscular theory:**

Light is composed of streams tiny massless elastic particles- called as corpuscles.

Corpuscles are emitted by luminous body (candle, lamp etc.) which travel in a straight line (rectilinear propagation) with the speed nearly equal to  $3 \times 10^8$  m/s.

- This theory treats light as a particle.
- This theory assumes that the speed of light in denser medium is greater than that in rarer medium. And hence, could not explain the phenomena of refraction clearly.
- The light of different color is due to different size of corpuscles.
- This theory could not explain the phenomena like interference, diffraction, polarization **etc.**

#### 2. **Huygens' wave theory:**

Light travels from source in the form of wave.

From the source of light, periodic disturbances are produced which travels in the form of wave such that the energy is distributed equally in all direction.

- This theory assumes that the light is a **longitudinal wave**.
- Light is a mechanical wave. So, he assumed that all space (including vacuum) is filled with hypothetical medium- **called ether**. [*the existence of ether is not proved yet.*]
- The light of different colors is due to different wavelengths.
- Can explain reflection, refraction, interference, diffraction and diffraction of light. But, could not explain polarization of wave (as polarization is observed in electromagnetic waves).

Huygens' wave theory assumes the **rectilinear propagation** of light wave. [i.e., the wavelength of light wave is so small that its propagation can be treated almost in the form a straight line.]



#### 3. **Maxwell's electromagnetic theory:**

Light is not a mechanical wave, rather it is an electromagnetic wave.

Light propagates via *oscillating electric and magnetic fields*, mutually perpendicular to each other, and hence light is a transverse wave.

- Light propagates through electric and magnetic field oscillations.