

Light Propagation.

Light is a form of energy which generally gives the sensation of sight.

(1) Different theories

Newton's corpuscular theory	Huygens's wave theory	Maxwell's EM wave theory	Einstein's quantum theory	de-Broglie's dual theory of light
(i) Based on Rectilinear propagation of light	(i) Light travels in a hypothetical medium ether (high elasticity very low density) as waves	(i) Light travels in the form of EM waves with speed in free space $c = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$	(i) Light is produced, absorbed and propagated as packets of energy called photons	(i) Light propagates both as particles as well as waves
(ii) Light propagates in the form of tiny particles called Corpuscles. Color of light is due to different size of corpuscles	(ii) He proposed that light waves are of longitudinal nature. Later on it was found that they are transverse	(ii) EM waves consists of electric and magnetic field oscillation and they do not require material medium to travel	(ii) Energy associated with each photon $E = h \nu = \frac{hc}{\lambda}$ h = planks constant $= 6.6 \times 10^{-34} \text{ J - sec}$ ν = frequency λ = wavelength	(ii) Wave nature of light dominates when light interacts with light. The particle nature of light dominates when the light interacts with matter (microscopic particles)

(2) Optical phenomena explained (√) or not explained (×) by the different theories of light

S. No.	Phenomena	Theory				
		Corpuscular	Wave	E.M. wave	Quantum	Dual
(i)	Rectilinear Propagation	√	√	√	√	√
(ii)	Reflection	√	√	√	√	√
(iii)	Refraction	√	√	√	√	√
(iv)	Dispersion	×	√	√	×	√
(v)	Interference	×	√	√	×	√
(vi)	Diffraction	×	√	√	×	√
(vii)	Polarization	×	√	√	×	√
(viii)	Double refraction	×	√	√	×	√
(ix)	Doppler's effect	×	√	√	×	√
(x)	Photoelectric effect	×	×	×	√	√

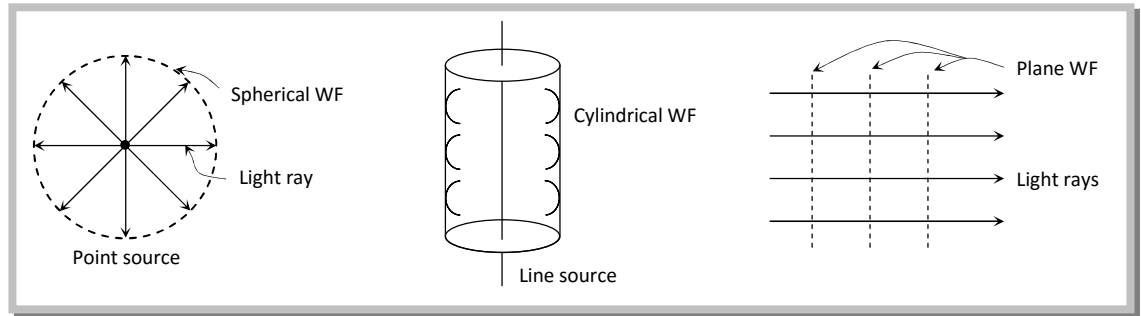
(3) Wave front

(i) Suggested by Huygens

(ii) The locus of all particles in a medium, vibrating in the same phase is called Wave Front (WF)

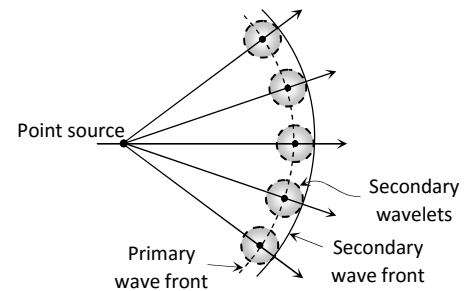
(iii) The direction of propagation of light (ray of light) is perpendicular to the WF.

(iv) Types of wave front



(v) Every point on the given wave front acts as a source of new disturbance called secondary wavelets. Which travel in all directions with the velocity of light in the medium.

A surface touching these secondary wavelets tangentially in the forward direction at any instant gives the new wave front at that instant. This is called secondary wave front



Note: Wave front always travels in the forward direction of the medium.

Light rays is always normal to the wave front.

The phase difference between various particles on the wave front is zero.