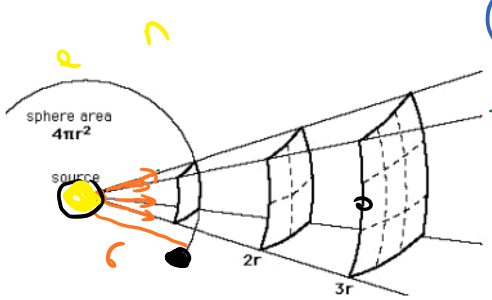
L:1

as distance from a wave source increases the Intensity decreases

The Wave Nature of Light

Electro-magnetic waves (including light) has been known to exhibit wave properties for centuries, in order to fully show how these properties relate to light we must look through some important wave properties that apply to all waves, not just EM waves.

Waves spread out in a spherical form from their source, this may seem circular in the case of water waves on a surface but this is because very little of the wave's energy transmits from the water into air.
As the wave travels farther from its source it travels a radial distance r = v t where v is the wave's speed and t is the elapsed time from the source emitting a particular pulse. d
The intensity of waves at any radius from a source of light waves (or volume of sound) is found as I = Io / 4πr². Where Io is the intensity (brightness) of the source.



Io

$I_1 = \frac{Io}{4\pi r_1^2}$

At t_1 the wave front is at r, at t_2 it is at 2r, at t_3 at 3r. Then the intensity I at t_2 must be:
$I_1 = \frac{Io}{4\pi r_1^2}$ and $I_2 = \frac{Io}{4\pi r_2^2}$ at t_2 $r_2 = 2r_1$ so: $I_2 = \frac{Io}{4\pi (2r_1)2}$ or $I_2 = \frac{Io}{4\pi 4r_1^2}$

But substitution for $I_1 = Io / 4\pi r_1^2$ gives us:

$I_2 = I_1 / 4$

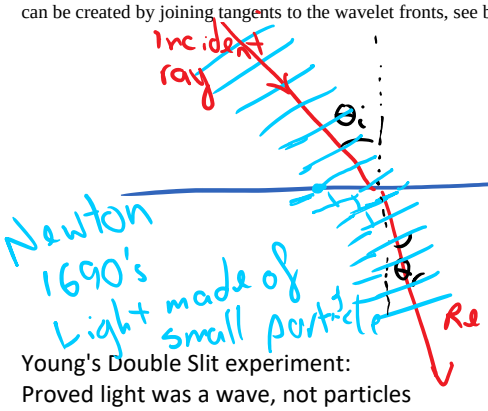
The relation above illustrates that the intensity of a light wave (or any wave) obeys the inverse square law, as the wave Energy is spread over a surface area increasing as a function of r².

Determine the ratio of intensities of light at a distance 1.0 m from its source to a distance 3.0 m from its source.

Luminous objects glow, they are sources of light. Things which are illuminated reflect light from light sources.

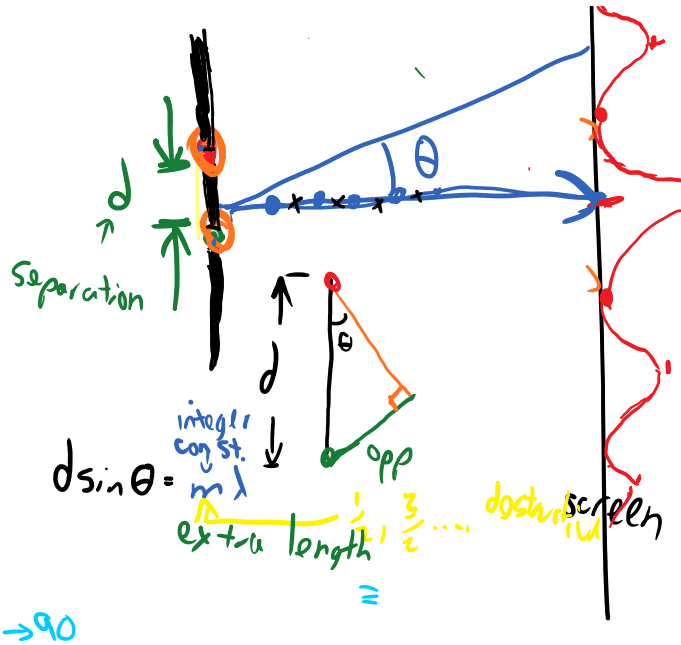
Huygen's Principle

Each point along a wave front can be considered a point source of a future wave which he called a "wavelet", then each wavelet has a front which travels distance d = vΔt and the full wave front can be created by joining tangents to the wavelet fronts, see below:

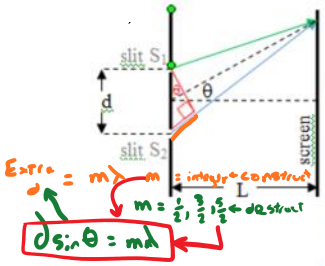


Newton 1690's Light made of small particles

Young's Double Slit experiment:
Proved light was a wave, not particles
Shot down Newton's theory of light as particles.



O → 90



1st order maxima occurs when blue ray has traveled an extra distance of one wavelength greater than the green ray

Angle θ is drawn from the central maxima to the mid-point between slits S1 & S2 to the 1st (or higher) order maxima

In the red triangle the red angle at S1 corresponds to θ and is therefore θ

The extra distance travelled by the blue ray then becomes the opposite to θ which is d sin θ for small angles. So d sin q = 1 for the first order maxima. The next maxima (2nd order) occurs when d sin θ = 2 λ or generally:

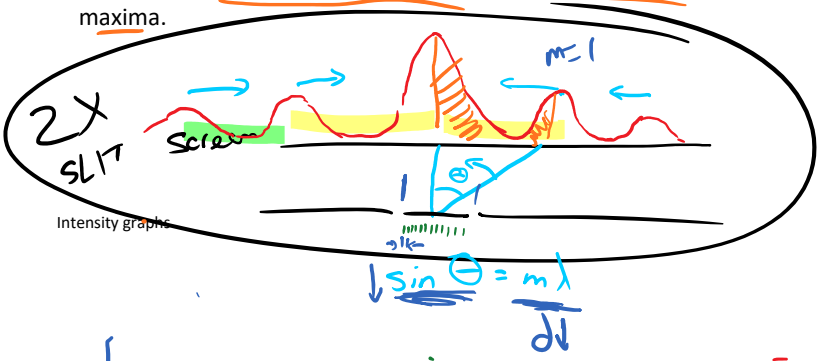
d sin θ = m λ where m is the order of the maxima

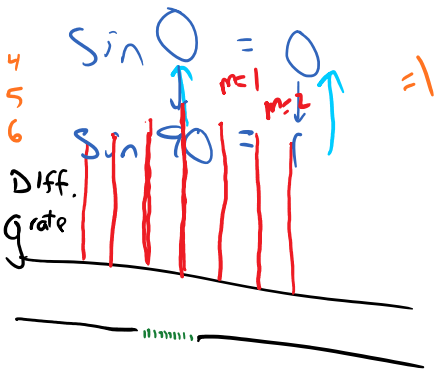
tructive ← Black if m = 1/2, 1, 3/2, 5/2

λ

16) 14. Illum

A diffraction grating is a series of lines usually several hundred lines per millimeter. Many sources, better constructive interference at high m AND better destructive between maxima. Also changes spacing of maxima.





maximum

m = 1 (-1)

m = 2