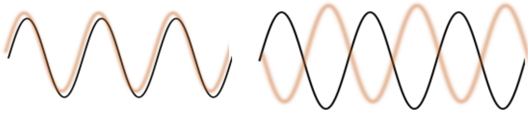
MIND MAP

Wave Optics

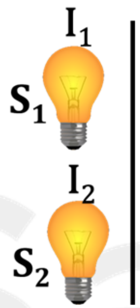


Constructive Interference

Destructive Interference

- Two sources are said to be Coherent if they produce waves having constant (with respect to time) phase difference.
- For Incoherent sources, phase difference varies with time.
- Two independent ordinary sources (like lamps) are incoherent sources.

Incoherent Sources



$I_{res} = I_1 + I_2$

Constructive Interference

$\cos\phi = 1$

$\phi = 2n\pi$

$A_{max} = (A_1 + A_2)$

$I_{max} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2$

$I_{max} = 4I_0$ (If same source of I0)

$\Delta x = 0, \lambda, 2\lambda, 3\lambda\ldots = n\lambda$

Destructive Interference

$\cos\phi = -1$

$\phi = (2n+1)\pi$

$A_{min} = (A_1 - A_2)$

$I_{min} = \left(\sqrt{I_1} - \sqrt{I_2}\right)^2$

$I_{min} = 0$ (If same source of I0)

$\Delta x = 0.5\lambda, 1.5\lambda, 2.5\lambda\ldots = \left(n + \frac{1}{2}\right)\lambda$

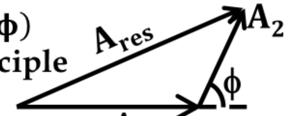
Interference of Waves

$y_1 = A_1 \sin(kx - \omega t)$

$y_2 = A_2 \sin(kx - \omega t + \phi)$

By Superposition Principle

$y_{res} = y_1 + y_2$



$(A_{res})^2 = A_1^2 + A_2^2 + 2A_1A_2 \cos\phi$

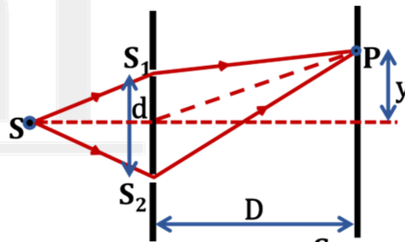
$I \propto A^2$

$I_{res} = I_1 + I_2 + 2\sqrt{I_1}\sqrt{I_2}\cos\phi$

If $I_1 = I_2 = I0$, then

$I_{res} = 4I_0 \cos^2\left(\frac{\phi}{2}\right)$

Young's Double Slit Experiment (YDSE)



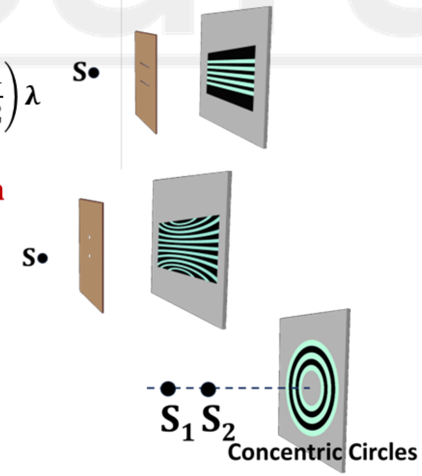
$\Delta x = \frac{yd}{D}$

d is distance between slits S_1 and S_2

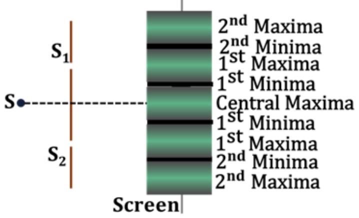
D is distance between slit and screen

y	0	$\frac{\lambda D}{2d}$	$\frac{\lambda D}{d}$	$\frac{3\lambda D}{2d}$	$\frac{2\lambda D}{2d}$
Max /Mina	Central Maxima	1st Minima	1st Maxima	2nd Minima	2nd Maxima

Shape of Fringes



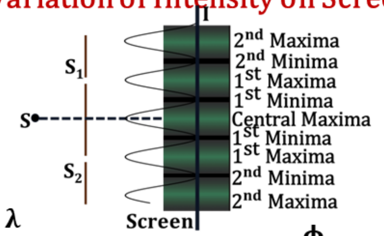
Fringe Width β′



$'\beta' = \frac{\lambda D}{d}$

Angular Fringe Width $\theta = \frac{\beta}{D} = \frac{\lambda}{d}$

Variation of Intensity on Screen



$I_{res} = 4I_0\cos^2\frac{\phi}{2}$

MIND MAP

Wave Optics

Thin Film Interference

a) Interference in Reflection

$\Delta x_{opt} = \left(n+\frac{1}{2}\right)\lambda_{air} \longrightarrow$ Constructive

$2\mu t = \left(n+\frac{1}{2}\right)\lambda_{air} \longrightarrow$ Constructive

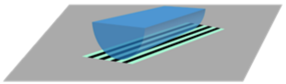
$2\mu t = n\lambda_{air} \longrightarrow$ Dest

b) Interference in Transmission

$(\Delta x)_{opt.} = 2\mu t$

$2\mu t = \left(n+\frac{1}{2}\right)\lambda_{air} \longrightarrow$ Dest

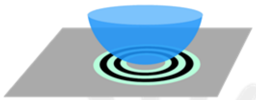
$2\mu t = n\lambda_{air} \longrightarrow$ Constructive



$(\Delta x)_{opt.} = 2\mu t$

$2\mu t = \left(n+\frac{1}{2}\right)\lambda \longrightarrow$ Constructive

$2\mu t = n\lambda \longrightarrow$ Destructive



$(\Delta x)_{opt.} = 2\mu t$

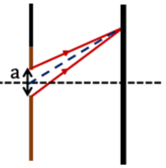
$2\mu t = \left(n+\frac{1}{2}\right)\lambda_{air} \longrightarrow$ Constructive

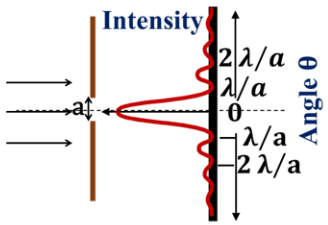
$2\mu t = n\lambda_{air} \longrightarrow$ Dest

Diffraction Through Single Slit

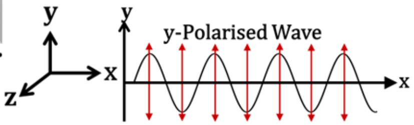
$a\theta = n\lambda$ Minima

$a\theta = \left(n+\frac{1}{2}\right)\lambda$ Maxima



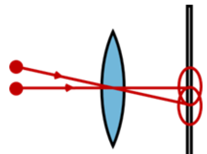


Polarisation



Unpolarised Wave

Resolution of Optical Instruments



(Resolved : seen as separated)

$\Delta\theta_{min} = \frac{1.22\lambda}{D}$

Resolving Power of Telescope

R.P of Telescope $= \frac{1}{\Delta\theta_{min}} = \frac{D}{1.22\lambda}$

D = Diameter of Objective Lens.

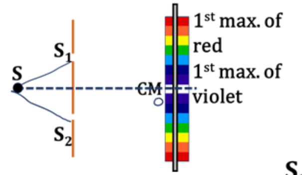
Resolving Power of Microscope

R.P of Microscope $= \frac{1}{d_{min}}$

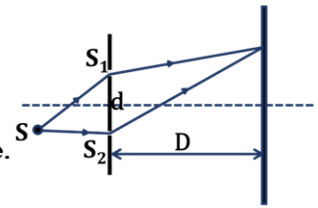
$d_{min} = \frac{1.22\lambda}{2\tan\beta} = \frac{1.22\lambda}{2\sin\beta}$

$d_{min} = \frac{1.22\,\lambda}{2\mu\sin\beta}$ $\quad \tan\beta = \frac{D}{2u}$

YDSE with white light



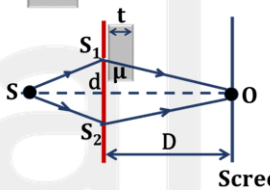
$\beta = \frac{\lambda D}{d}$



Variations in YDSE

In this case CM shifts but fringe width remains same.

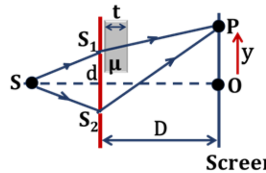
Optical path $= \mu t$



Phase difference at O

$\Delta x = (\mu - 1)t$

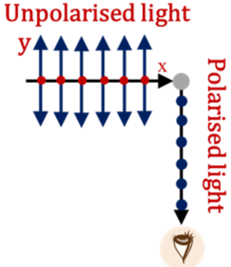
$\beta = \frac{\lambda_{air}D}{d}$ No change



$(\Delta x) = (\mu - 1)t - \left(\frac{yd}{D}\right)$

$\beta = \frac{\lambda_{air}D}{d}$ No change

Polarisation by Scattering



Polarisation by Reflection

$\tan(i_B) = \mu$

Brewster's Law

$i_B = \tan^{-1}\mu$

$i_B + r = 90°$