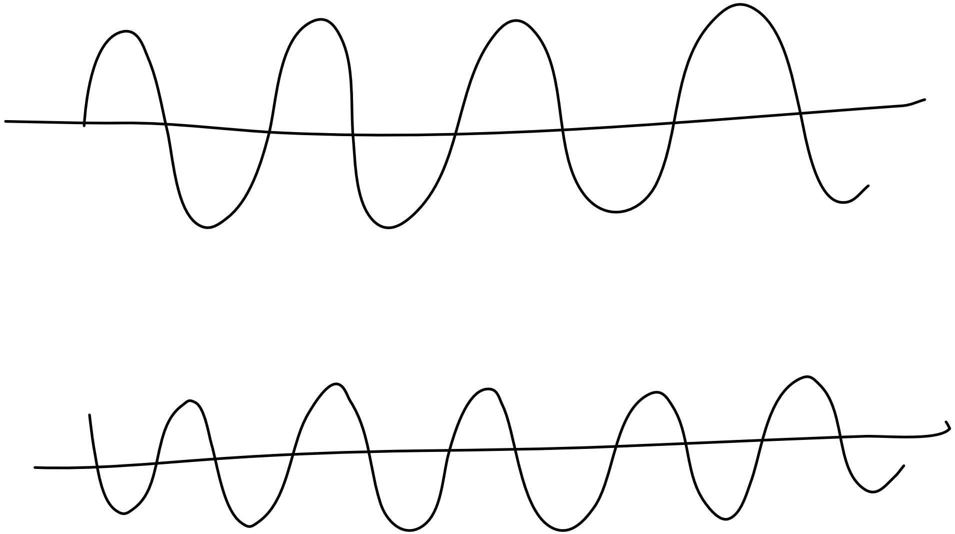
Coherent Sources :

The sources which are emitting light with the same frequency, wavelength, phase and also, they possess a constant phase difference

Example : Laser light, Monochromatic light

↳ which have only 1 type of wavelength

Sound wave .



$y_1 = a_1 \sin \omega t$

Interference

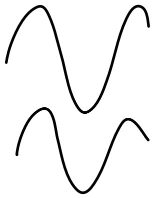
$y_2 = a_2 \sin \omega t$

Incoherent Sources:

The sources which emit light with varying phase, frequency and wavelength

Eg: Tungsten fluorescent lamp.

Sun.



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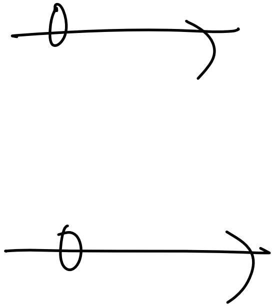
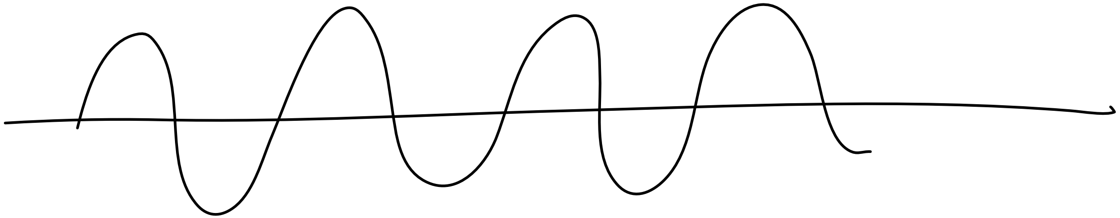
Interference :

Two light waves from various coherent sources, then distribution of energy takes place due to one wave on another.

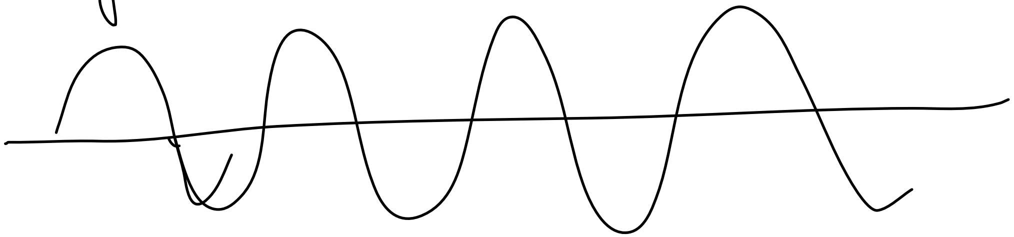
→ Superposition of two waves.



$$y_1 = a\cos\omega t$$



$$y_2 = a\cos\omega t$$



$$y = y_1 + y_2$$

$$= a\cos\omega t + a\cos\omega t$$

$$\Rightarrow 2a\cos\omega t$$

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$y_1 = a \cos \omega t$

$y_2 = a \cos(\omega t + \phi)$

$\left[\cos A + \cos B = 2 \cos\left(\frac{A+B}{2}\right) \cos\left(\frac{A-B}{2}\right) \right.$

$\Rightarrow$

$y_{resultant} = y_1 + y_2$

$\Rightarrow a \cos \omega t + a \cos(\omega t + \phi)$

$\Rightarrow a\left[\cos \omega t + \cos(\omega t + \phi)\right)$

$\Rightarrow a \left[2 \cos\left(\frac{\omega t + \omega t + \phi}{2}\right) \cos\left(\frac{\omega t - \omega t - \phi}{2}\right)\right.$

ABLES KOTA

$$y_{resultant} \Rightarrow 2a\cos\left(\frac{2\omega t+\phi}{2}\right)\cos\left(-\frac{\phi}{2}\right)$$

$$\cos(-\theta) = \cos\theta.$$

$$\Rightarrow 2a\cos\left(\omega t+\frac{\phi}{2}\right)\cos\frac{\phi}{2}.$$

$$\Rightarrow 2a\cos\frac{\phi}{2}\cos\left(\omega t+\frac{\phi}{2}\right)$$

$$I_0 \propto A^2. \qquad I \propto (2A)^2 = 4A^2$$

ABLES KOTA

$$y_1 = a_1 \cos \omega t_1$$

$$y_2 = a_1 \cos \omega t_2$$

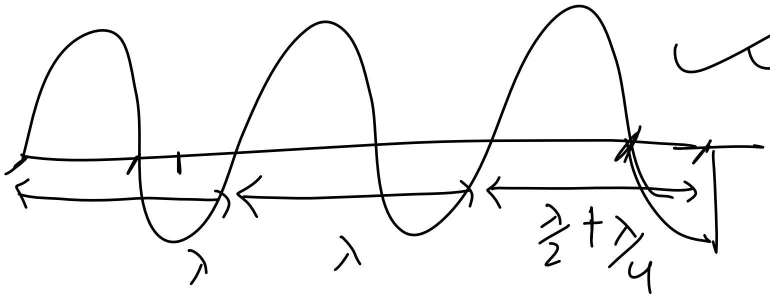
$$\Delta\phi = K\Delta x + \omega\Delta t + \phi_1 - \phi_2$$

Phase difference ($\Delta\phi$); Path diff. (Δx)

$$y_1 + y_2 = a_1 \cos \omega t_1 + a_1 \cos \omega t_2$$

$$\Rightarrow a_1 \left[2\cos\left(\frac{\omega t_1 + \omega t_2}{2}\right) \cos\left(\frac{\omega t_1 - \omega t_2}{2}\right)\right.$$

i)

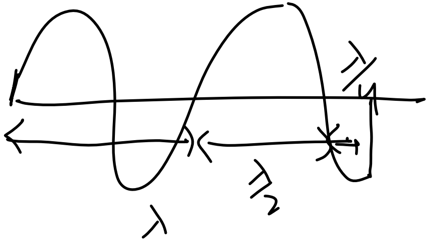


$$x_1 = 2\lambda + \frac{\lambda}{2} + \frac{\lambda}{4}$$

$$\Rightarrow \frac{8\lambda + 2\lambda + \lambda}{4}$$

$$\Rightarrow \frac{11\lambda}{4}$$

ii)



$$x_2 = \lambda + \frac{\lambda}{2} + \frac{\lambda}{4}$$

$$\Rightarrow \frac{4\lambda + 2\lambda + \lambda}{4} = \frac{7\lambda}{4}$$

$$x_1 - x_2 = \frac{11\lambda}{4} - \frac{7\lambda}{4} \Rightarrow \frac{4\lambda}{4} = \lambda$$

$$y = a_1 \sin \omega t + a_2 \cos \omega t$$

$$\Rightarrow a_1 \sin \omega t + a_2 \sin (\omega t + \pi/2)$$

$$y_r \Rightarrow a_1 \sin \omega t + a_2 \sin (\omega t + \pi/2)$$

The resultant displacement produced by a number of waves is the vector sum of the displacement produced by each of the waves.

$A_1 = A_2$

$$y_{resultant} = 2a\cos\frac{\phi}{2}\cos\left(\omega t + \frac{\phi}{2}\right)$$

$$I \propto A^2$$

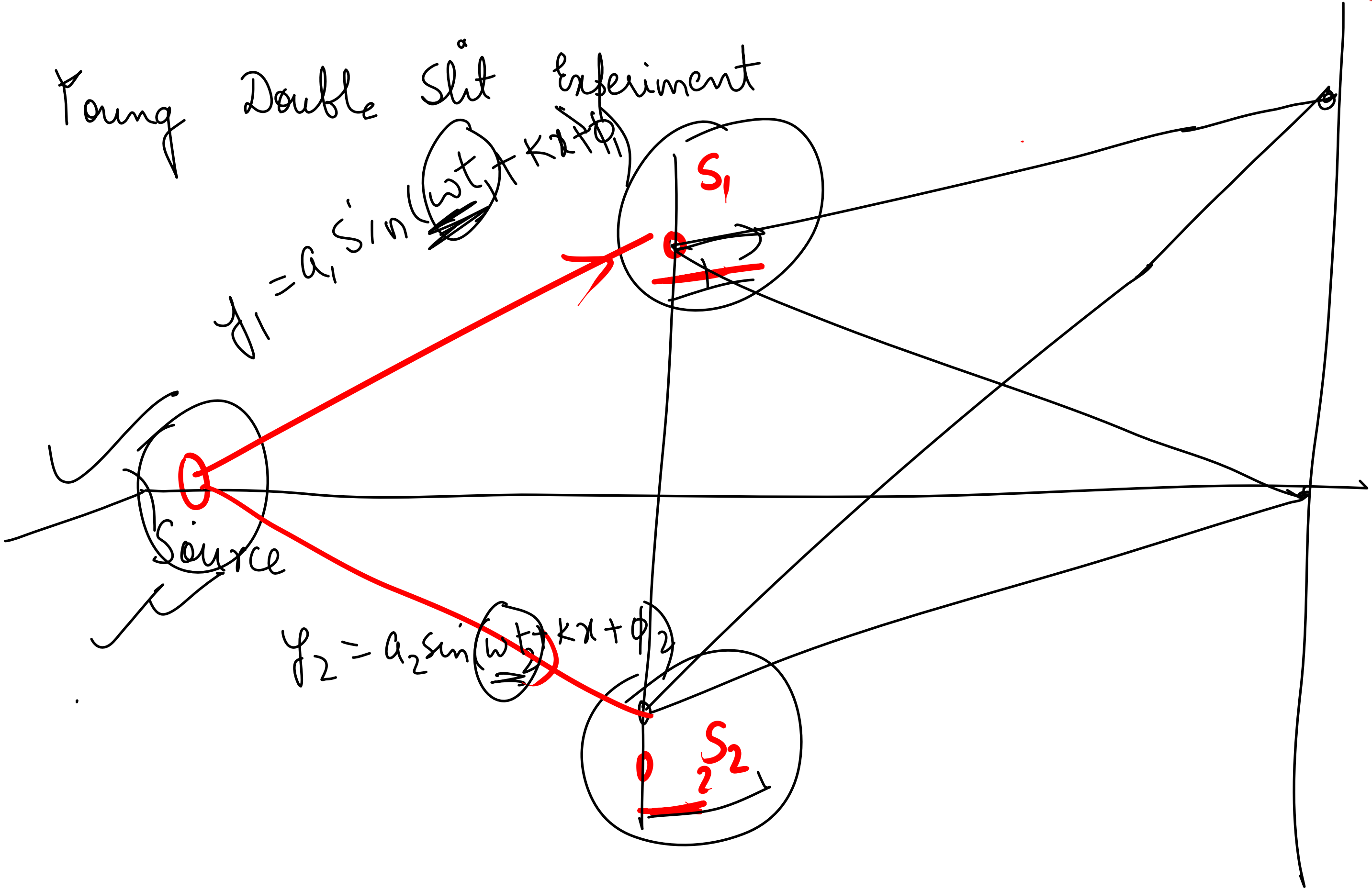
$$y_1 = a\cos\omega t \rightarrow I_0$$

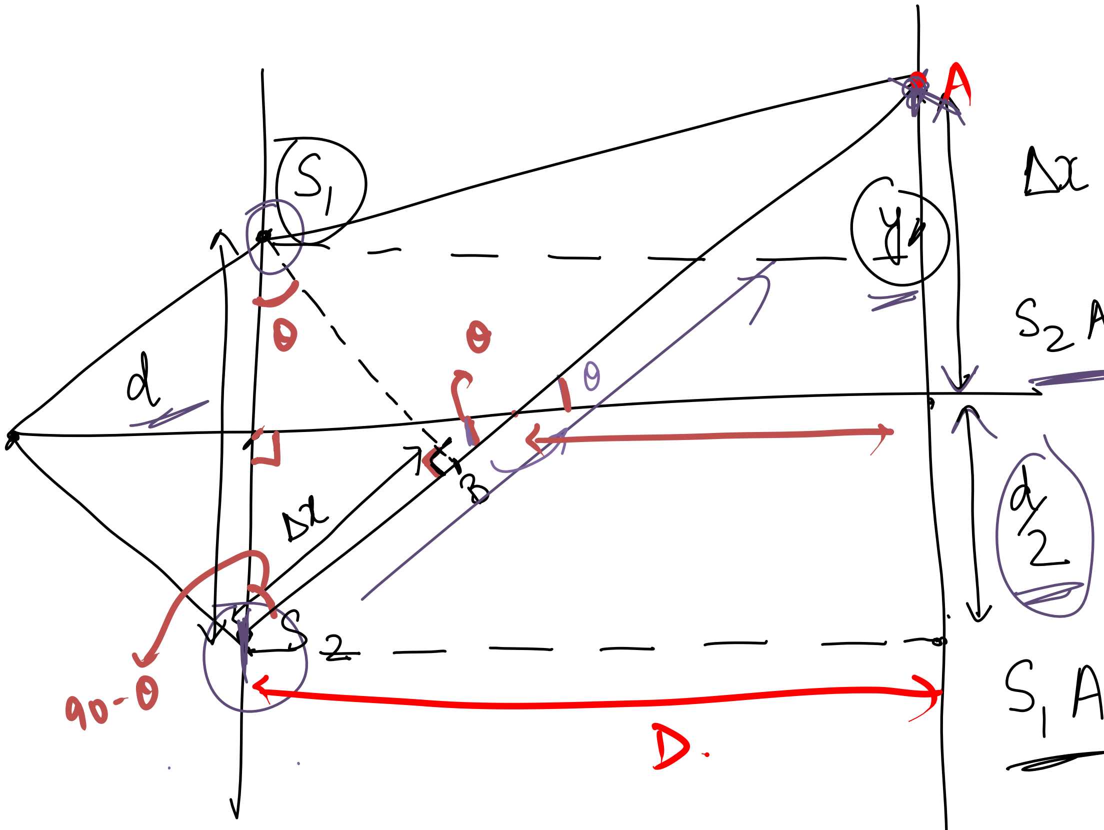
$$\text{Resultant, } I = 4I_0^2\cos^2\frac{\phi}{2}.$$

$\phi = 0°$; $I_{resultant} \rightarrow$ maximum

$\phi = 90°$, $I_r = 0$

Young Double Slit Experiment





$$\Delta x = S_2A - S_1A.$$

$$S_2A = \sqrt{\left(y+\frac{d}{2}\right)^2 + D^2}$$

$$S_1A = \sqrt{\left(y-\frac{d}{2}\right)^2 + D^2}$$

$$(S_2A)^2 - (S_1A)^2$$

$$\Rightarrow \left[\left(y+\frac{d}{2}\right)^2 + D^2\right] - \left[\left(y-\frac{d}{2}\right)^2 + D^2\right]$$

$$\Rightarrow \left(y+\frac{d}{2}\right)^2 + \cancel{D^2} - \left(y-\frac{d}{2}\right)^2 - \cancel{D^2}$$

$$\Rightarrow y^2 + \frac{d^2}{4} + \cancel{2}y\frac{d}{\cancel{2}} - \left(y^2 + \frac{d^2}{4} - \cancel{2}y\frac{d}{\cancel{2}}\right)$$

$$\Rightarrow y^2 + \frac{d^2}{4} + yd - y^2 - \frac{d^2}{4}(-yd)$$

$$\Delta x \Rightarrow 2yd$$

$$D >>>> d$$

$$\tan\theta = \frac{y}{D}$$

[Condition of Maximum & Minima]