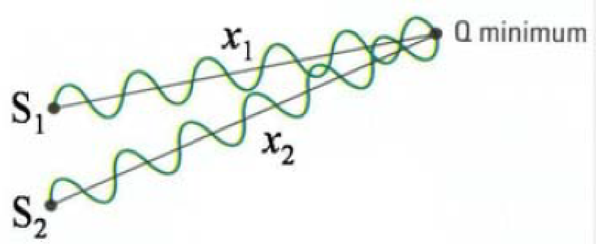
Path difference for destructive interference



- A dark fringe at Q if

$$\Delta\Phi = (2m+1)\pi$$

where $m = 0,1,2,\ldots$

- At Q,

$$E_{1Q} = E_0 \sin(\omega t - kx_1)$$
$$E_{2Q} = E_0 \sin(\omega t - kx_2)$$

then

$$\Delta\Phi = (\omega t - kx_2) - (\omega t - kx_1)$$

$\Delta\Phi = k(x_1 - x_2)$ since $k = \dfrac{2\pi}{\lambda}$ and $(x_1 - x_2) = \Delta L$

$$\Delta\Phi = \frac{2\pi}{\lambda}\Delta L$$

- Therefore

$$(2m+1)\pi = \frac{2\pi}{\lambda}\Delta L$$

$$\boxed{\Delta L = \left(m + \frac{1}{2}\right)\lambda}$$

where $m = 0,1,2,\ldots..$

- Note

When

$m = 0$ ⟹ 1st dark fringe

$m = 1$ ⟹ 2nd dark fringe

$m = 2$ ⟹ 3rd dark fringe

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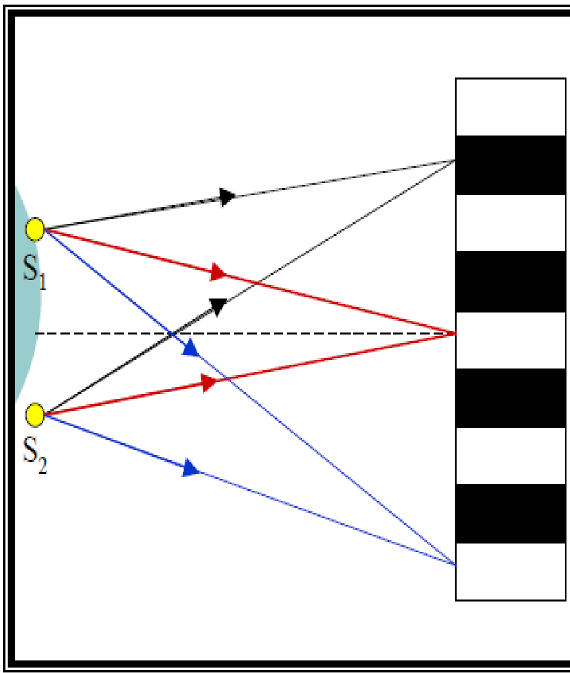
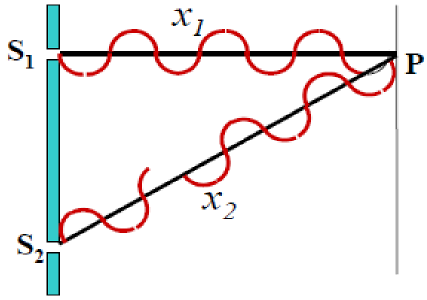


	$\Delta\Phi$	m	ΔL
2nd bright fringe	4π	2	2λ
2nd dark fringe	3π	1	$\frac{3}{2}\lambda$
1st bright fringe	2π	1	λ
1st dark fringe	π	0	$\frac{1}{2}\lambda$
Central bright fringe	0	0	0
1st dark fringe	π	0	$\frac{1}{2}\lambda$
1st bright fringe	2π	1	λ
2nd dark fringe	3π	1	$\frac{3}{2}\lambda$
2nd bright fringe	4π	2	2λ

1.7. Interference of Two Coherent Sources in antiphase

- **Path difference for constructive interference**



- A bright fringe at P if

$\Delta\Phi = 2m\pi$ where $m = 1,2,\ldots$

- At P,

$$E_{1P} = E_0 \sin(\omega t - kx_1)$$
$$E_{2P} = E_0 \sin(\omega t - kx_2 - \pi)$$

then

$$\Delta\Phi = (\omega t - kx_2 - \pi) - (\omega t - kx_1)$$
$$\Delta\Phi = k(x_1 - x_2) - \pi \quad \text{since } k = \frac{2\pi}{\lambda} \text{ and}$$
7 $$\Delta\Phi = \left(\frac{2\pi}{\lambda}\Delta L\right) - \pi \qquad (x_1 - x_2) = \Delta L$$

- Therefore

$$2m\pi = \left(\frac{2\pi}{\lambda}\Delta L\right) - \pi$$
$$\boxed{\Delta L = \left(m + \frac{1}{2}\right)\lambda}$$

where $m = 0,1,2,\ldots..$

- Note

When

$m = 0 \Rightarrow$ 1st bright fringe

$m = 1 \Rightarrow$ 2nd bright fringe

$m = 2 \Rightarrow$ 3rd bright fringe

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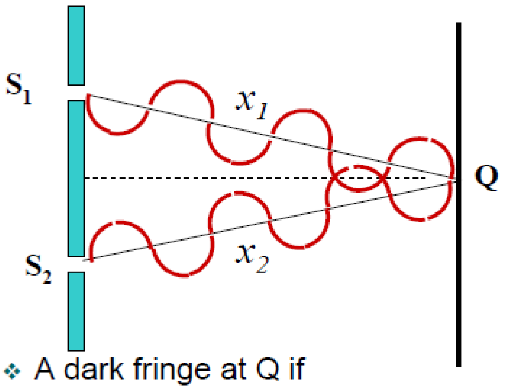
- **Path difference for destructive interference**



- A dark fringe at Q if

$\Delta\Phi = (2m+1)\pi$

where $m = 0,1,2,\ldots$

- At Q, $E_{1Q} = E_0 \sin(\omega t - kx_1)$

$$E_{2Q} = E_0 \sin(\omega t - kx_2 + \pi)$$

then

$$\Delta\Phi = (\omega t - kx_2 + \pi) - (\omega t - kx_1)$$
$$\Delta\Phi = k(x_1 - x_2) + \pi \quad \text{since } k = \frac{2\pi}{\lambda} \text{ and}$$
$$\Delta\Phi = \left(\frac{2\pi}{\lambda}\Delta L\right) + \pi \qquad (x_1 - x_2) = \Delta L$$

- Therefore

$$(2m+1)\pi = \left(\frac{2\pi}{\lambda}\Delta L\right) + \pi$$
$$\boxed{\Delta L = m\lambda}$$

where

$m = 0,1,2,\ldots..$

- Note

When

$m = 0 \Rightarrow$ Central dark fringe

$m = 1 \Rightarrow$ 1st dark fringe

$m = 2 \Rightarrow$ 2nd dark fringe

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