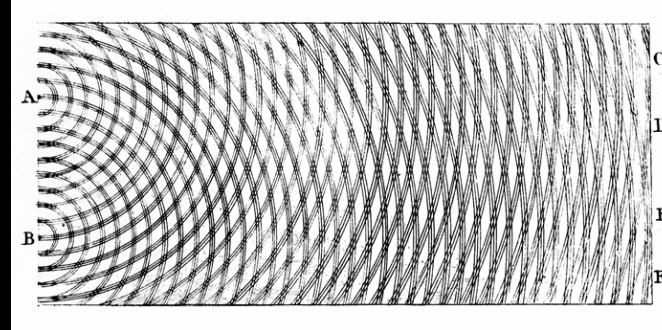
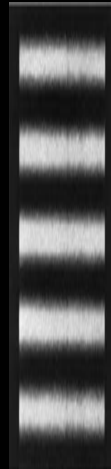
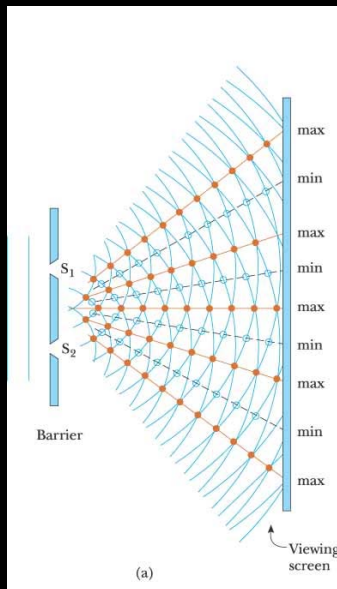
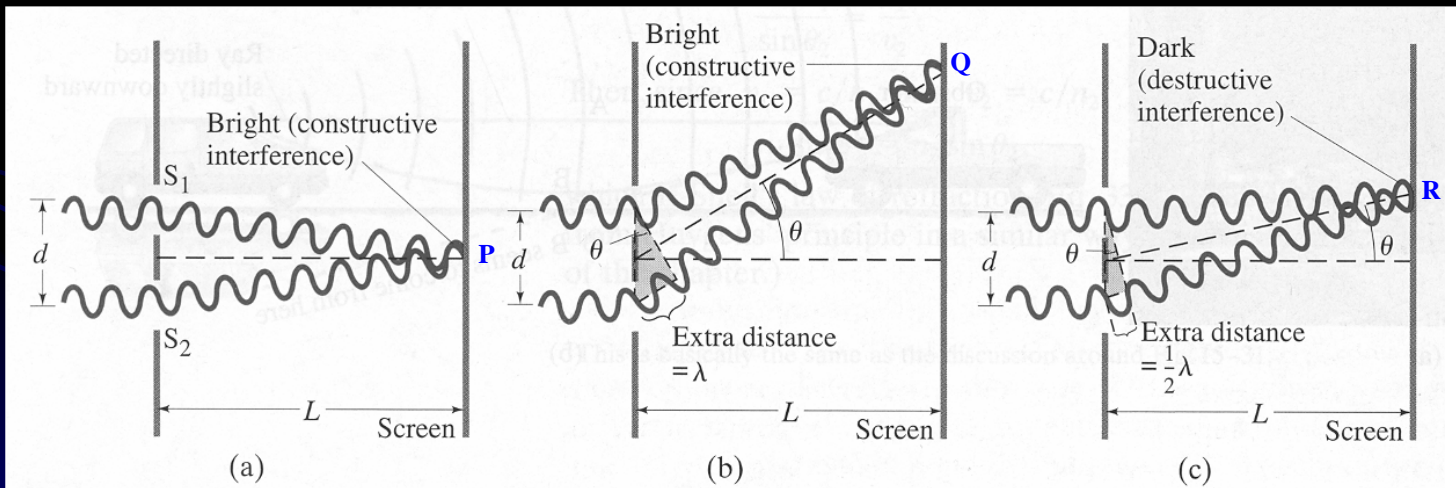


## 37.2 Young's double-slit experiment

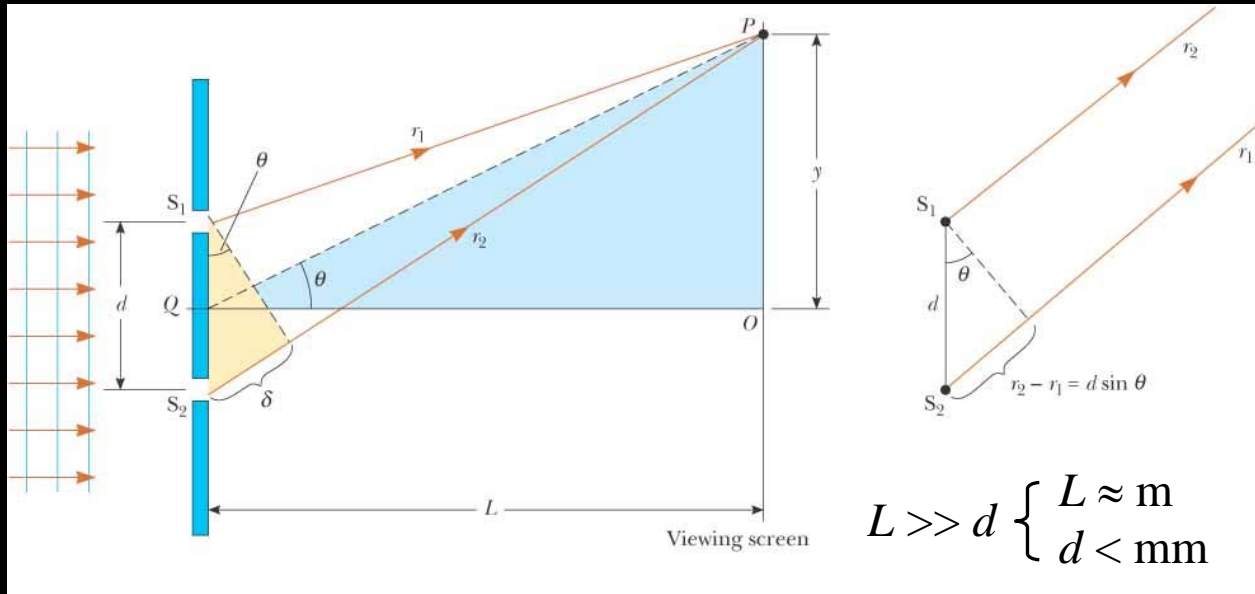


Thomas Young's sketch of double-slit experiment. Young presented the results of this experiment to the Royal Society in 1803.  $\Rightarrow$  Proof of the wave nature of light !



- (a) Constructive interference occurs at point  $P$  when the waves combine.
- (b) Constructive interference also occurs at point  $Q$ .
- (c) Destructive interference occurs at  $R$  when the two waves combine because the upper wave falls half a wavelength behind the lower wave.

- **Young's double-slit experiment (Geometric construction)**



- Young's experiment : Interference in light waves from two sources.

- **Interference (fringe) pattern :**

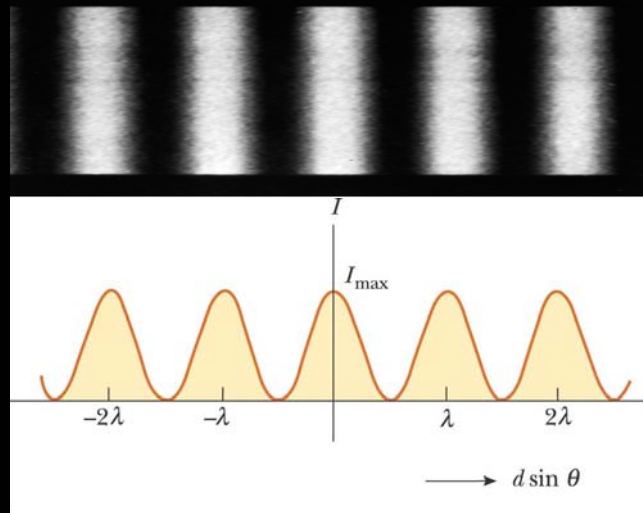
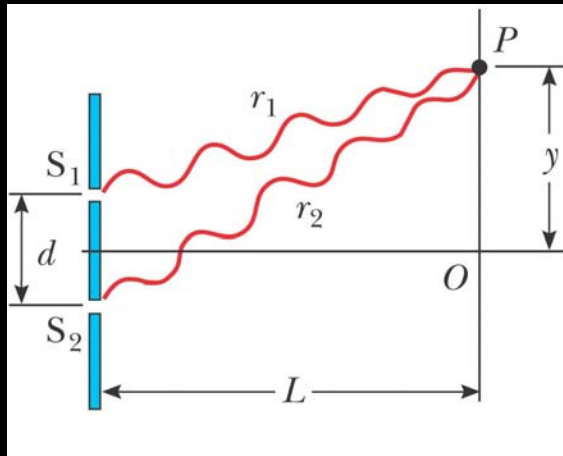
a) Constructive interference: in phase.

→  $y_{max} = m (\lambda L/d)$  for  $m=0, \pm 1, \pm 2 ..$

b) Destructive interference: out of phase.

→  $y_{min} = (m+1/2) (\lambda L/d)$  for  $m=0, \pm 1, \pm 2 ..$

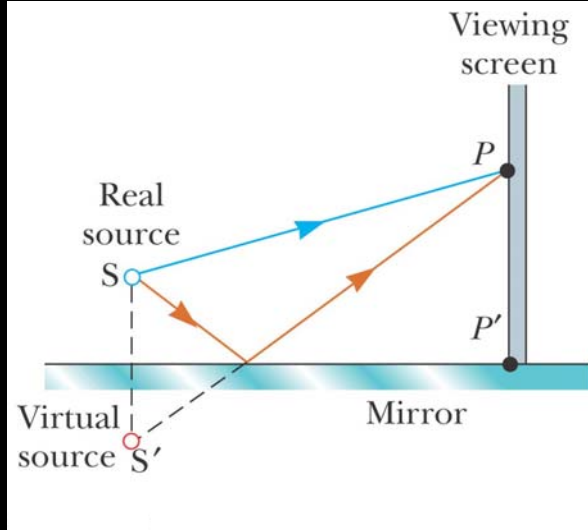
### 37.3 Intensity distribution of the double-slit interference pattern



$$I \propto E_{ro}^2$$

$$I = I_{\max} \cos^2\left(\frac{\pi d}{\lambda L} y\right)$$

## 37.5 Change of phase due to reflection

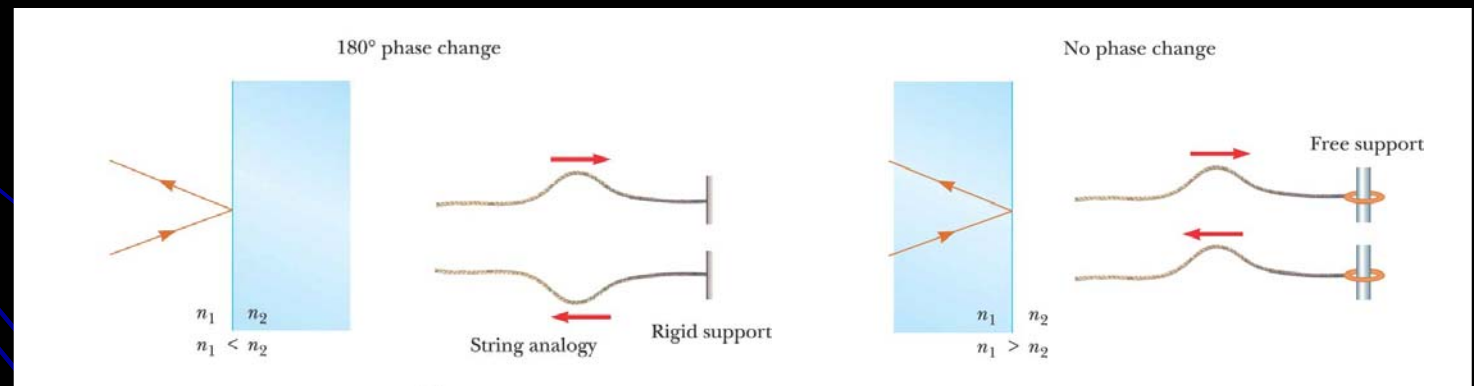


- Lloyd's mirror :

An interference pattern is produced at point  $P$  on the screen as a result of the combination of the direct ray (blue) and the reflected ray (brown).

*The reflected ray undergoes a phase change of  $180^\circ$ .*

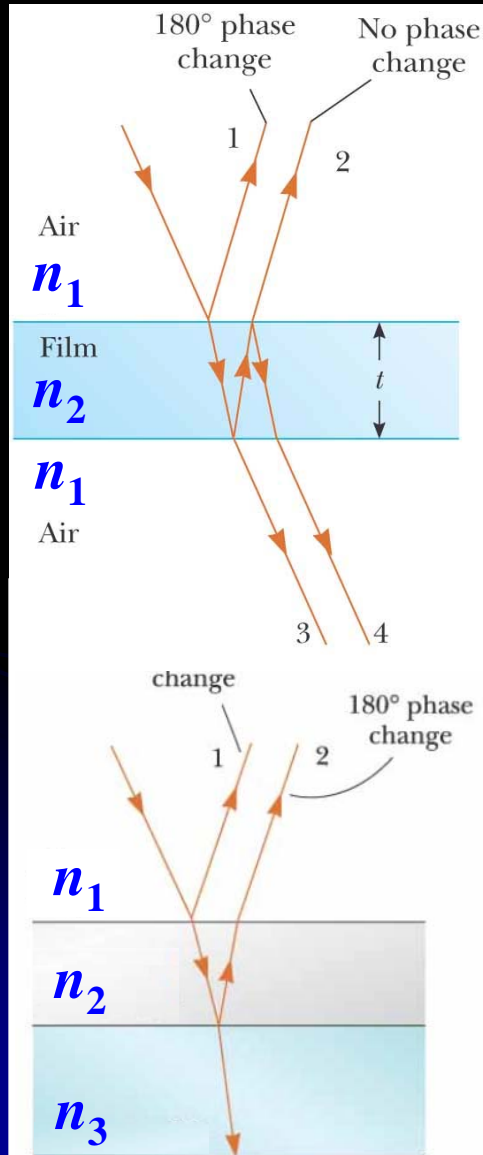
- Analogy between reflected light waves and the reflections of a transverse pulse on a stretched string.



An electromagnetic wave undergoes a phase change of  $180^\circ$  upon reflection from a medium having a higher index of refraction.

## 37.5 Interference in thin films

[1] Uniform films : e.g. interference in soap bubbles.



(a)  $n_1 - n_2 - n_1$  for  $n_2 > n_1$

Constructive interference :  $2nt = (m + \frac{1}{2})\lambda$

Destructive interference :  $2nt = m\lambda$

for  $m = 0, 1, 2 \dots$

(b)  $n_1 - n_2 - n_3$  for  $n_3 > n_2 > n_1$

Constructive interference :  $2nt = m\lambda$

Destructive interference :  $2nt = (m + \frac{1}{2})\lambda$

for  $m = 0, 1, 2 \dots$

An electromagnetic wave undergoes a phase change of  $180^\circ$  upon reflection from a medium having a higher index of refraction.