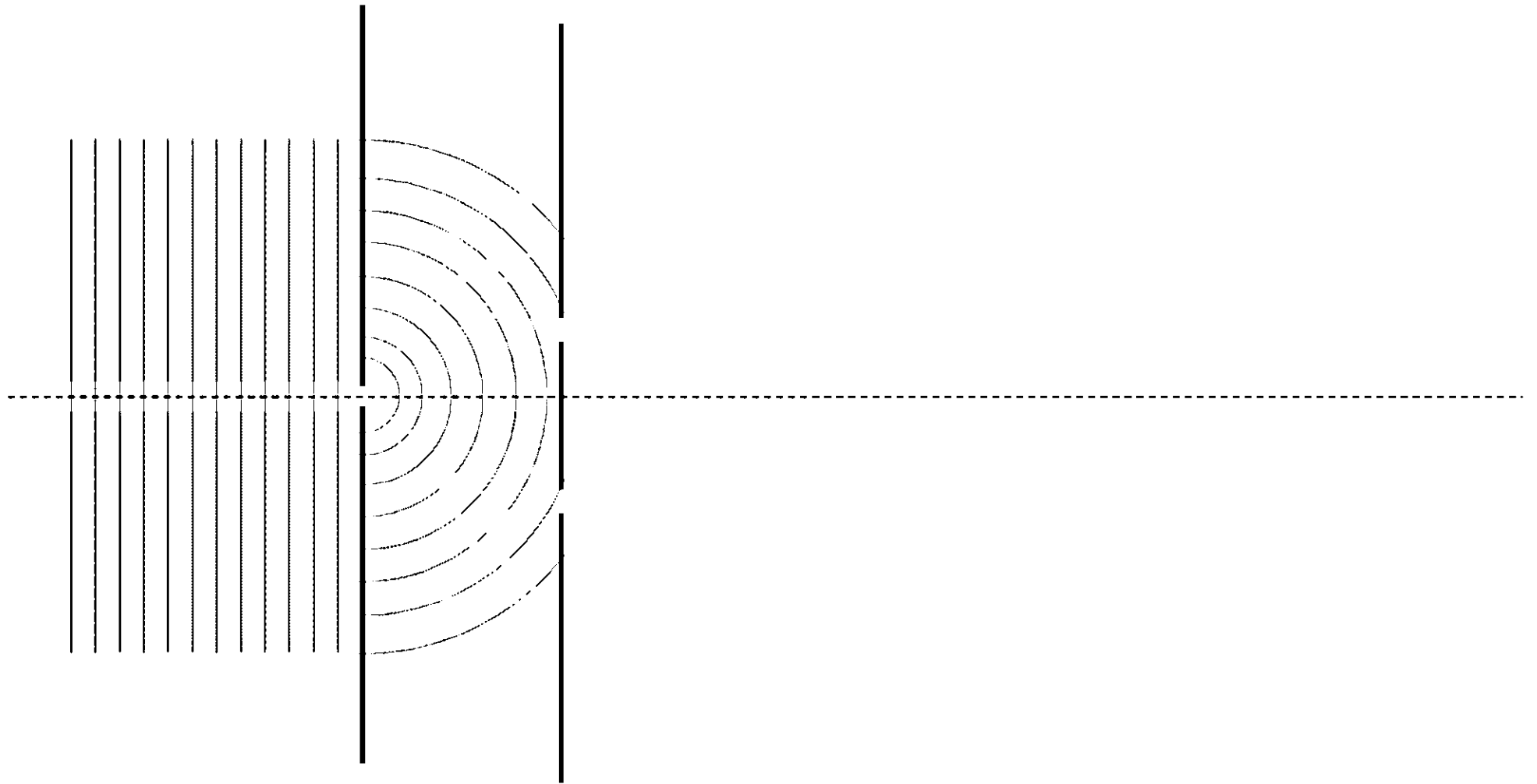
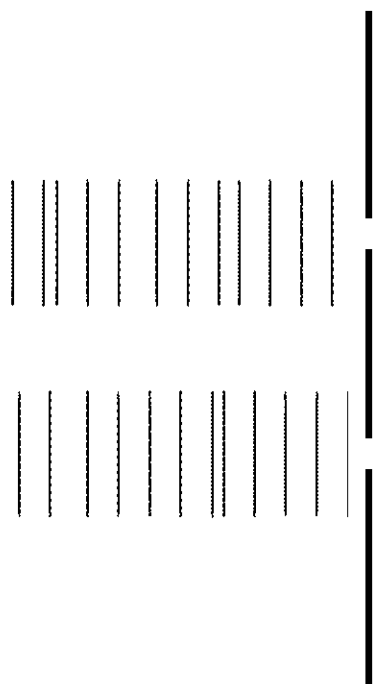
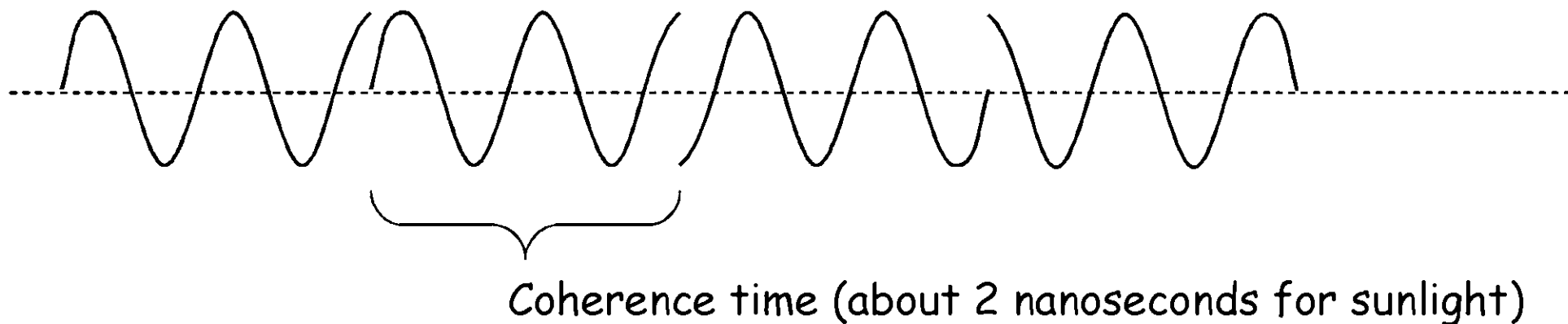


Visualizing Interference: Young's Double Slit



Why three slits? Coherence!

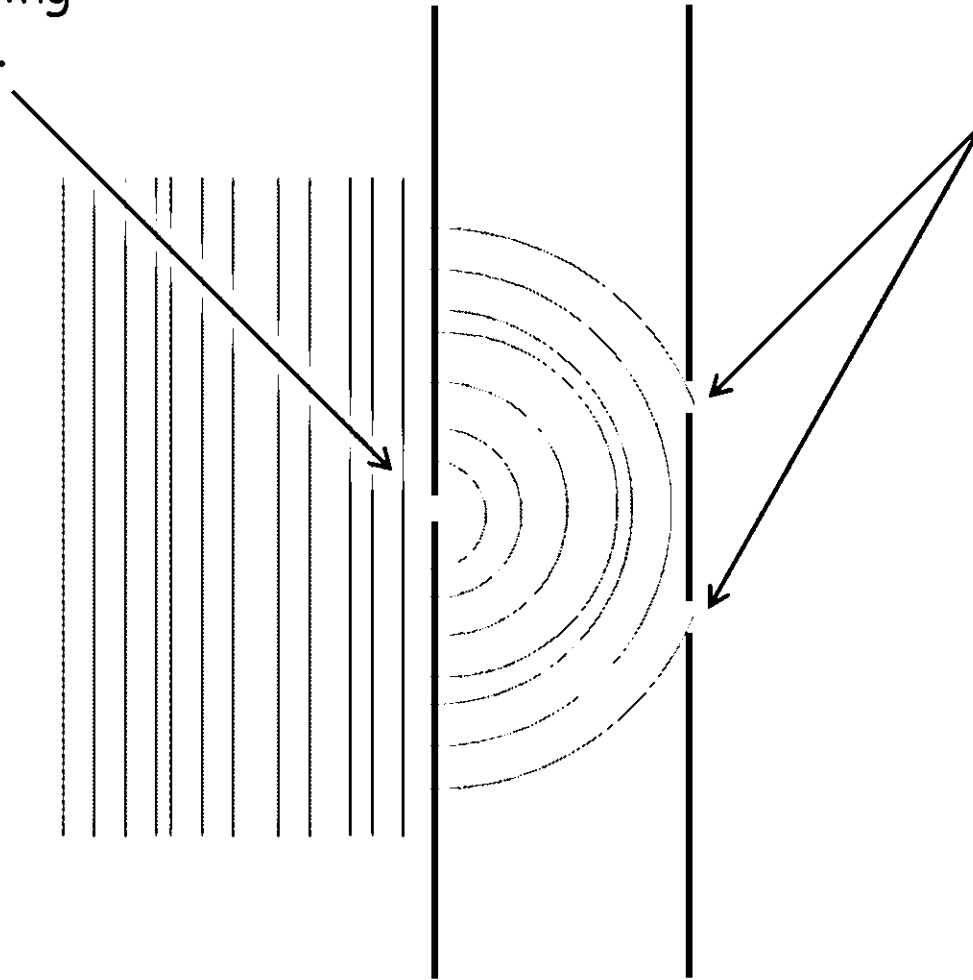
Natural light randomly skips in phase at a characteristic time scale:



Since interference depends on phase differences, random jumps in phase will move the interference pattern. If it occurs every 2 nanoseconds the interference pattern will be "washed out".

Three slits because light has *spatial coherence* : over small region of the wavefront it randomly skips in phase together.

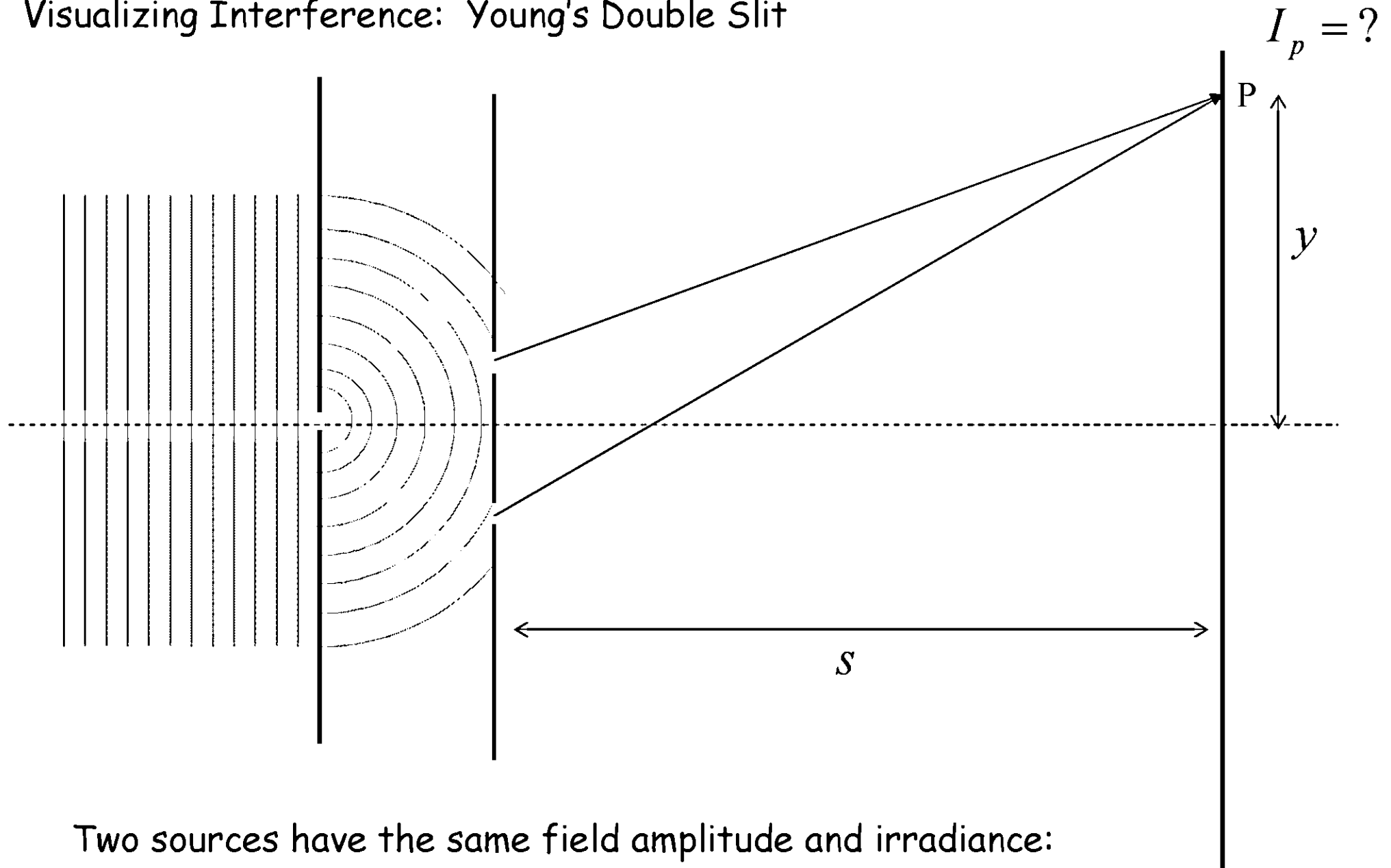
Randomly skipping
in phase here....



...results in *same*
random skips in
phase at these two
slits.

The spatial coherence of sunlight is about 0.1 mm

Visualizing Interference: Young's Double Slit



Two sources have the same field amplitude and irradiance:

$$I_1 = I_2 = I_o$$

Irradiance at P is described by interference of the light from each slit:

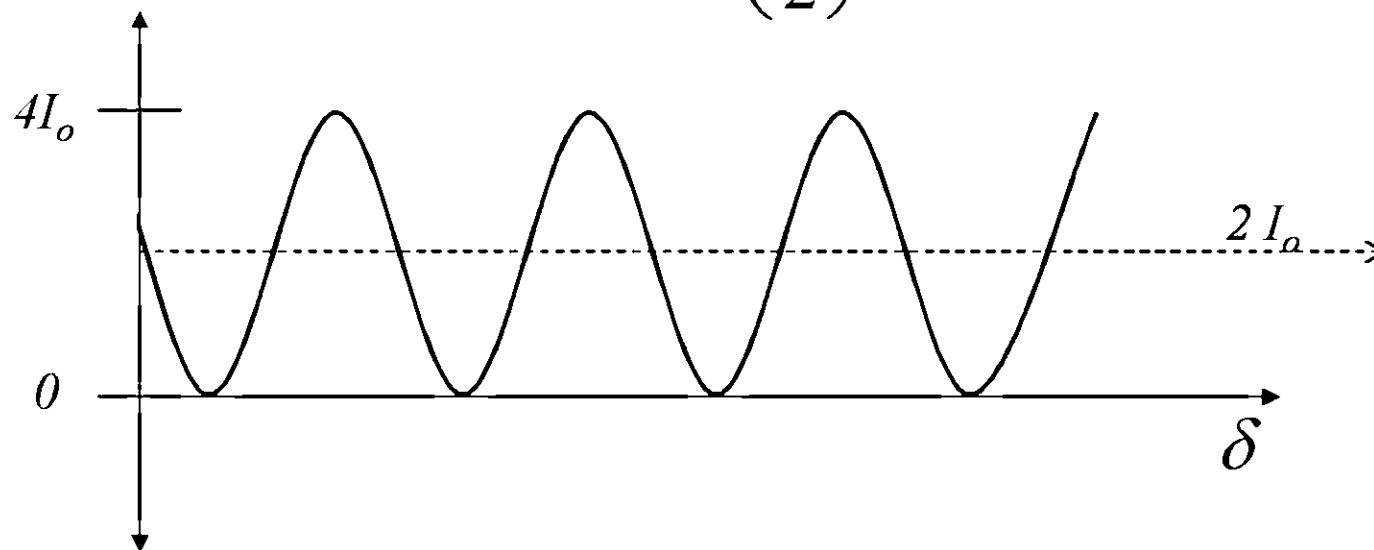
$$I_p = 2I_o + \varepsilon_o c \vec{E}_o^2 \cos(\delta)$$

$$I_p = 2I_o + 2I_o \cos(\delta)$$

It is usually written in a more compact form:

$$\text{Use: } 1 + \cos(\delta) = 2 \cos^2\left(\frac{\delta}{2}\right)$$

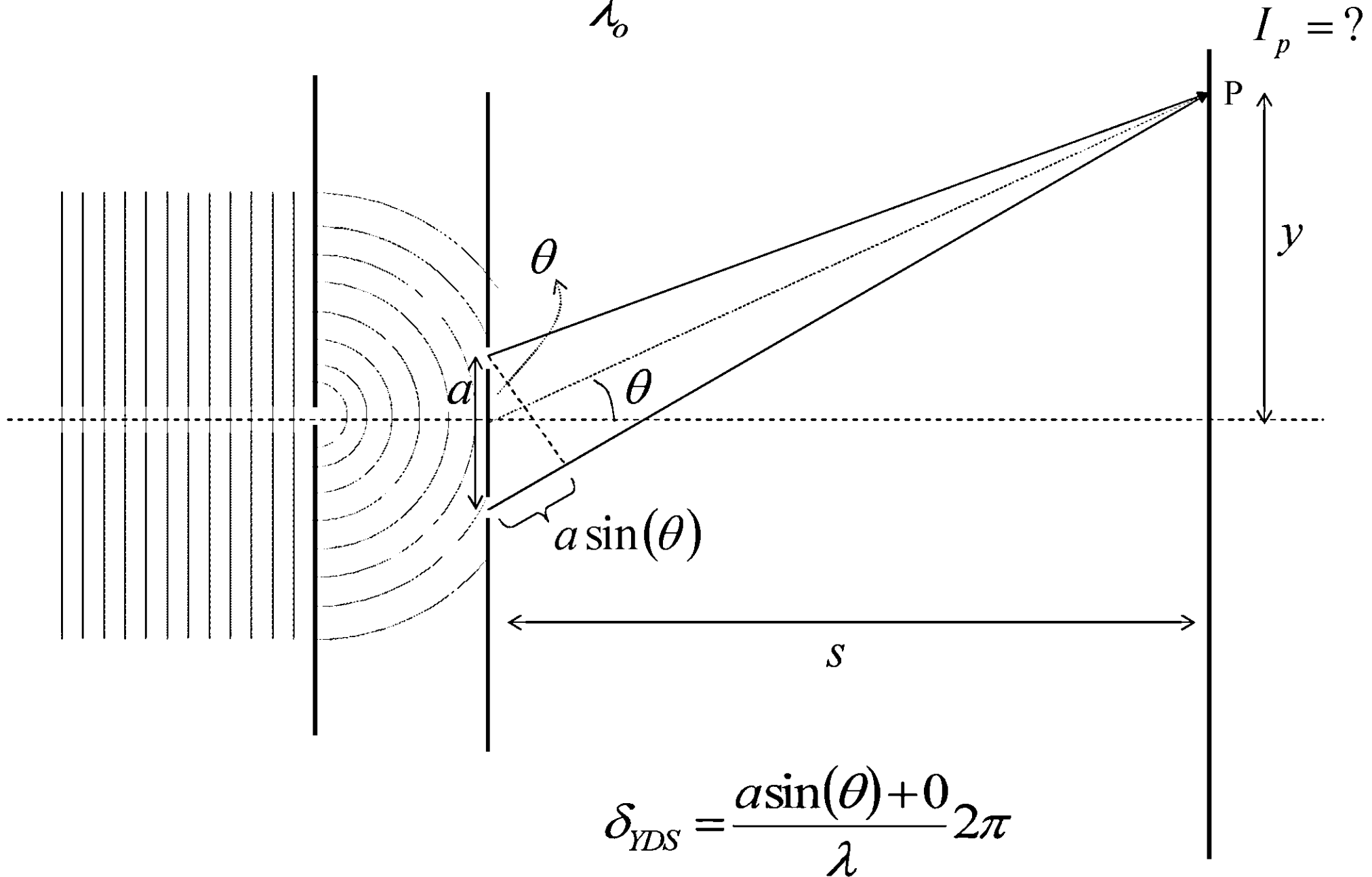
$$I_p = 4I_o \cos^2\left(\frac{\delta}{2}\right)$$



The average value is what you get if you ignore interference.

What is δ ?

$$\delta = \frac{\Delta_{path} + \Delta_{phase}}{\lambda_o} 2\pi$$



$$\delta_{YDS} = \frac{a \sin(\theta) + 0}{\lambda} 2\pi$$

$$I_p = 4I_0 \cos^2\left(\frac{\pi a \sin(\theta)}{\lambda}\right)$$

if $y \ll s$, $\sin(\theta) = y/s$

$$I_p = 4I_0 \cos^2\left(\frac{\pi a}{s\lambda} y\right)$$

