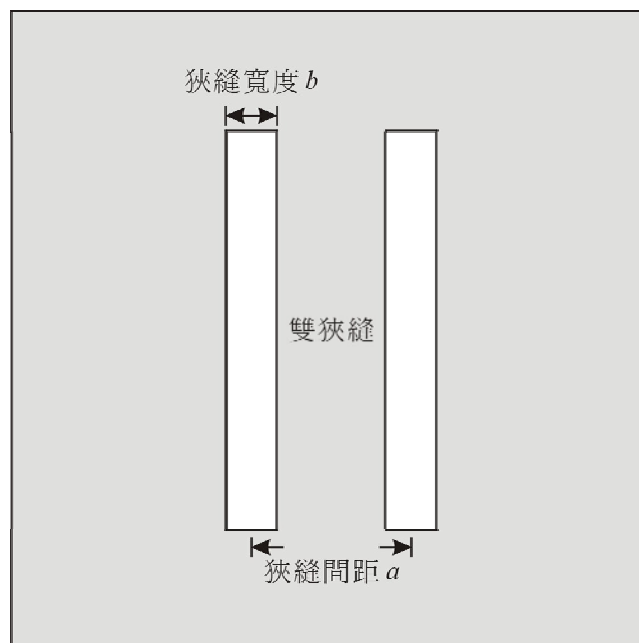


實驗六：干涉

狹縫寬度與狹縫間距：



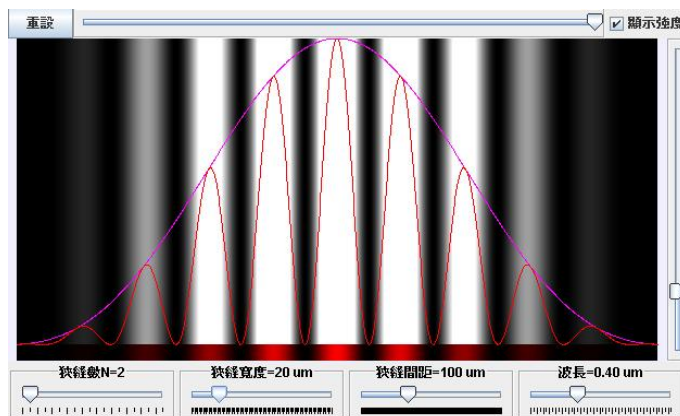
以下 8 張狹縫繞射圖來自師大物理教學示範實驗室

<http://www.phy.ntnu.edu.tw/moodle/mod/resource/view.php?id=478>

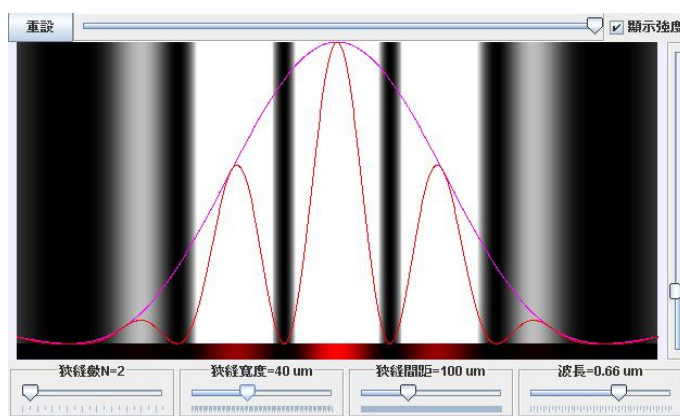
同學可以比較不同狹縫數目，相同狹縫寬度，其繞射圖的差異。這些和你實驗時看到的又有何差異？

東海大學物理系
改變狹縫寬度：

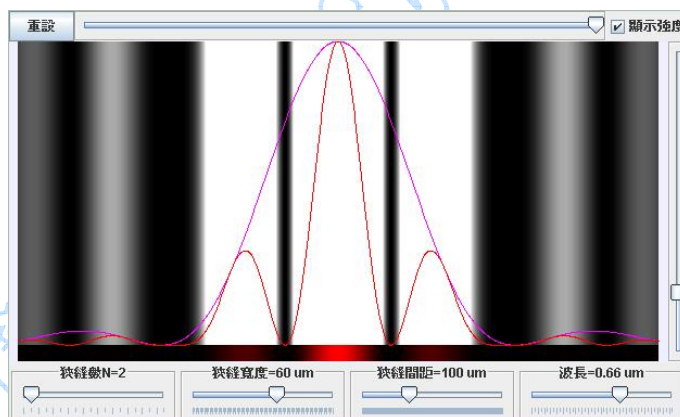
狹縫寬度為 $20\mu\text{m}$



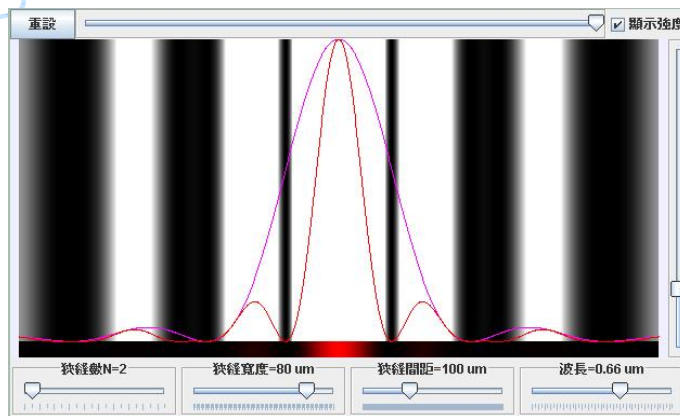
狹縫寬度為 $40\mu\text{m}$



狹縫寬度為 $60\mu\text{m}$

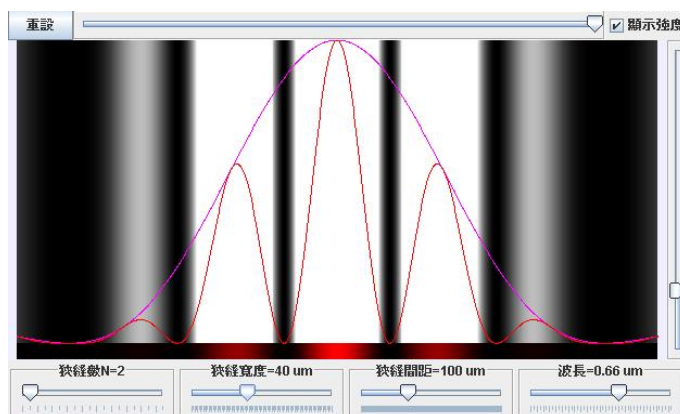


狹縫寬度為 $80\mu\text{m}$

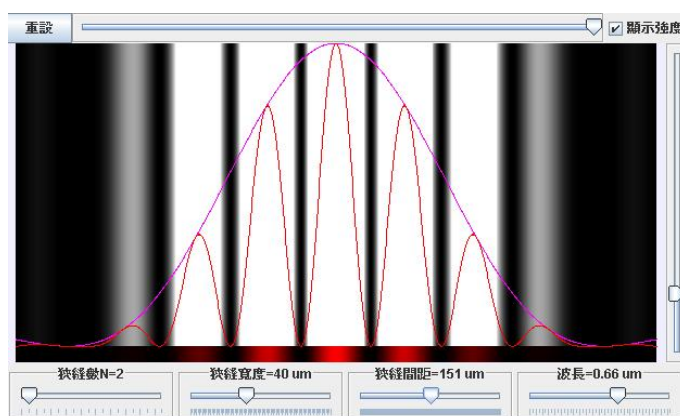


改變狹縫間距：

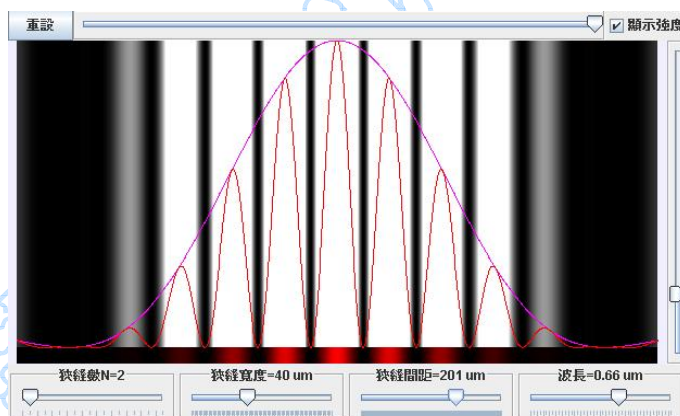
狹縫間距為 $100\mu\text{m}$



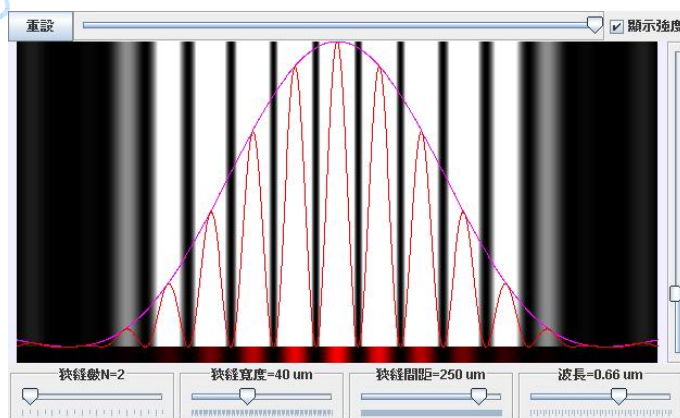
狹縫間距為 $150\mu\text{m}$



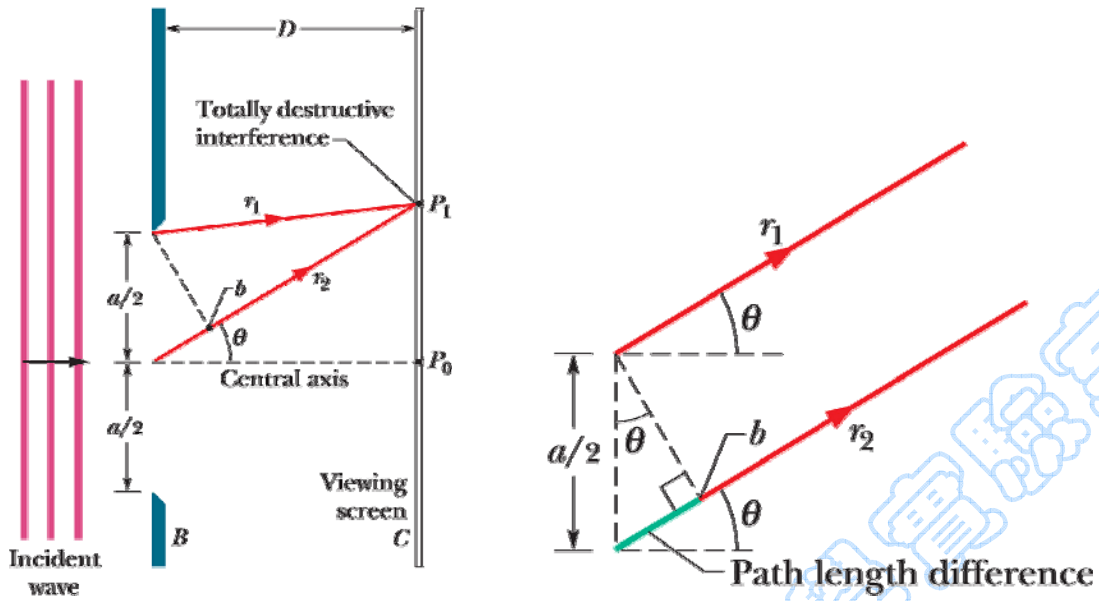
狹縫間距為 $200\mu\text{m}$



狹縫間距為 $250\mu\text{m}$

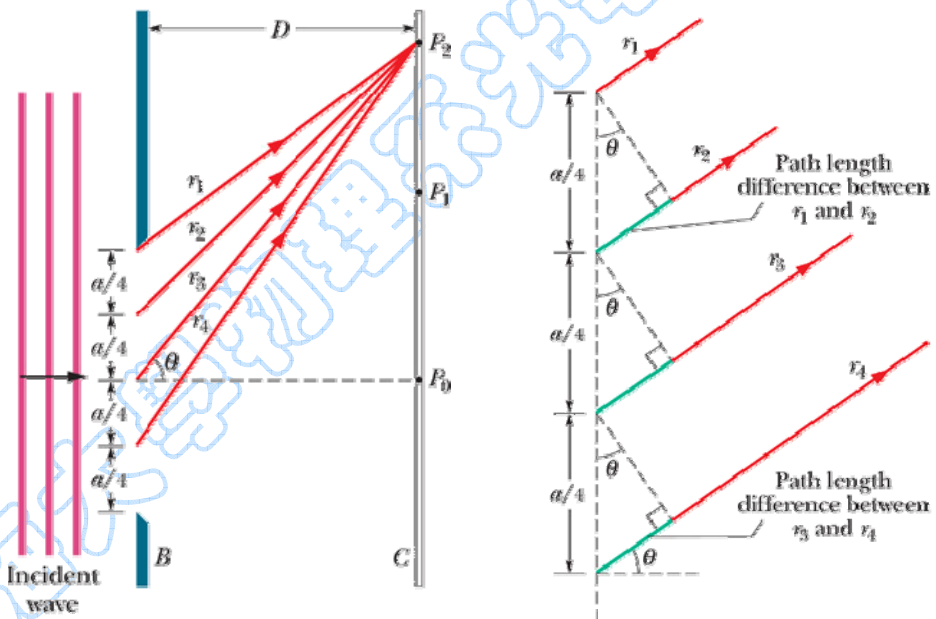


【單狹縫】：單狹縫繞射



$$\frac{a}{2} \sin \theta = \frac{\lambda}{2}$$

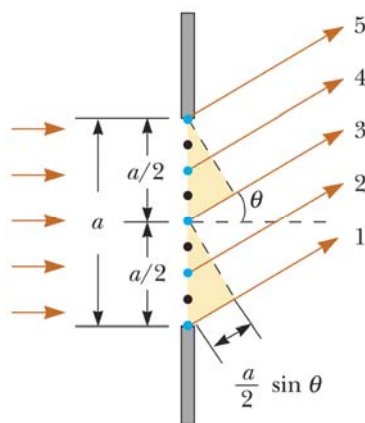
$$a \sin \theta = \lambda \quad (\text{first minimum})$$



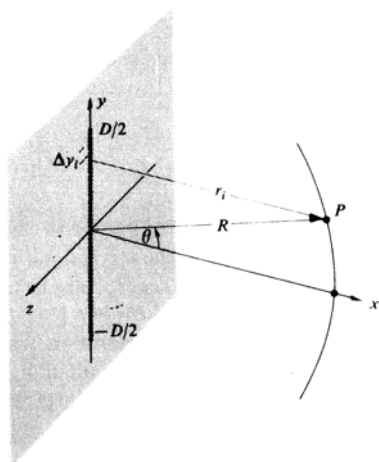
$$\frac{a}{4} \sin \theta = \frac{\lambda}{2}$$

$$a \sin \theta = 2\lambda \quad (\text{second minimum})$$

$$\Rightarrow a \sin \theta = m\lambda \quad , \quad m = 1, 2, 3, \dots$$



單狹縫寬度 D ，距離屏幕 R



$$R \gg D$$

$$dE = \frac{\varepsilon_L}{R} \sin(\omega t - kr) dy$$

$$\varepsilon_L \equiv \frac{1}{D} \lim_{N \rightarrow \infty} (\varepsilon_0 N) \dots \text{source strength per unit length}$$

$\varepsilon_0 \dots$ source strength

$$r = R - y \sin \theta + \frac{y^2}{2R} \cos^2 \theta + \dots$$

$$E = \frac{\varepsilon_L}{R} \int_{-\frac{D}{2}}^{\frac{D}{2}} \sin[\omega t - k(R - y \sin \theta)] dy = \frac{\varepsilon_L D}{R} \frac{\sin\left[\frac{kD}{2} \sin \theta\right]}{\frac{kD}{2} \sin \theta} \sin(\omega t - kR)$$

$$= \frac{\varepsilon_L D}{R} \frac{\sin \beta}{\beta} \sin(\omega t - kR)$$

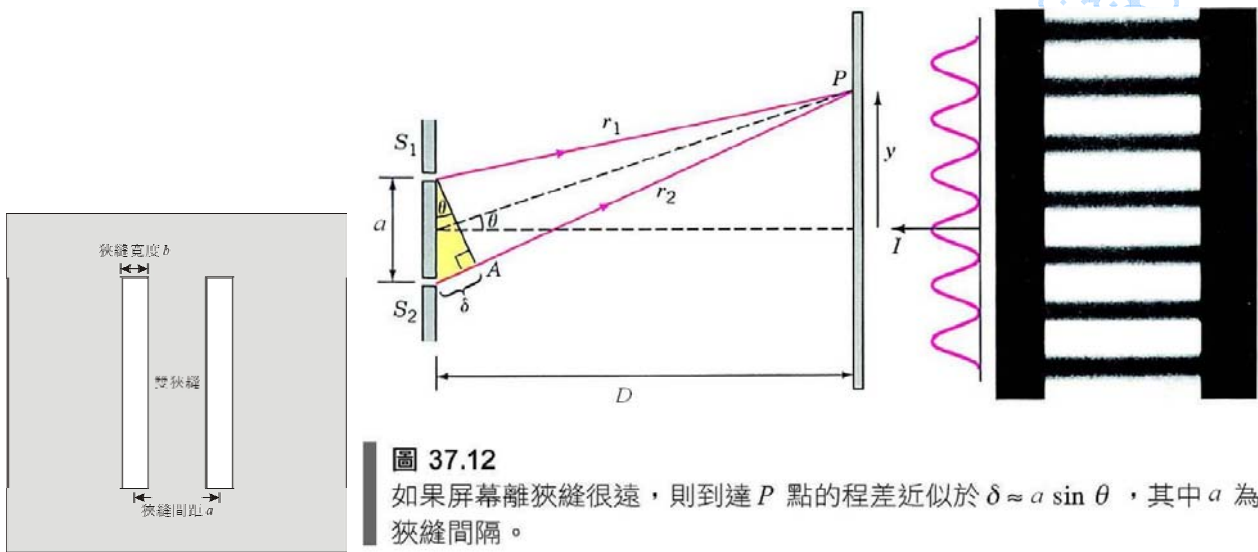
$$I(\theta) = \frac{1}{2} \left(\frac{\varepsilon_L D}{R} \right)^2 \left(\frac{\sin \beta}{\beta} \right)^2$$

當 $\theta = 0$ 時， $I(\theta) = I(0) \Rightarrow I(\theta) = I(0) \left(\frac{\sin \beta}{\beta} \right)^2$

$\beta = \frac{kb}{2} \sin \theta = \frac{1}{2} \frac{2\pi}{\lambda} b \frac{y_m}{L} = m\pi$ (高 y ，距離 L)

$y_m = m \frac{\lambda L}{b} \Rightarrow \Delta y = \frac{\lambda L}{b}$

【雙狹縫】：



$\delta = r_2 - r_1 \approx a \sin \theta$

maxima : $a \sin \theta = m\lambda$ ， m 是整數

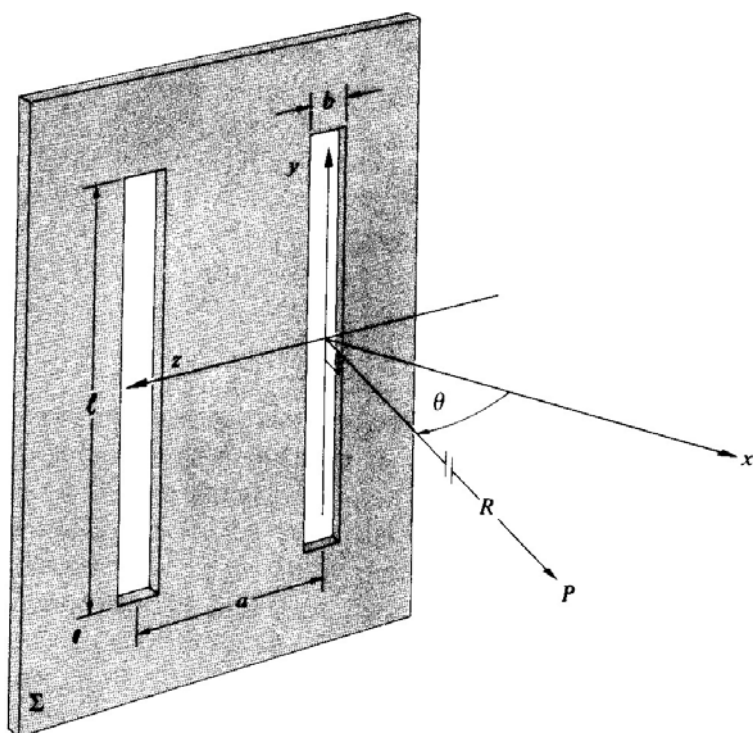
minimum : $a \sin \theta = (m + \frac{1}{2})\lambda$

$\tan \theta = \frac{y_m}{L}$

當 θ 很小時 ($D \gg a$)， $\tan \theta \approx \sin \theta$

$\tan \theta = \frac{y_m}{D} = \sin \theta = \frac{m\lambda}{a}$

$y_m = \frac{m\lambda L}{a} \Rightarrow \Delta y = \frac{\lambda L}{a}$



$$I(\theta) = 4I(0) \left(\frac{\sin \beta}{\beta} \right)^2 \cos^2 \alpha$$

$$\alpha = \frac{ka}{2} \sin \theta, \quad \beta = \frac{kb}{2} \sin \theta$$