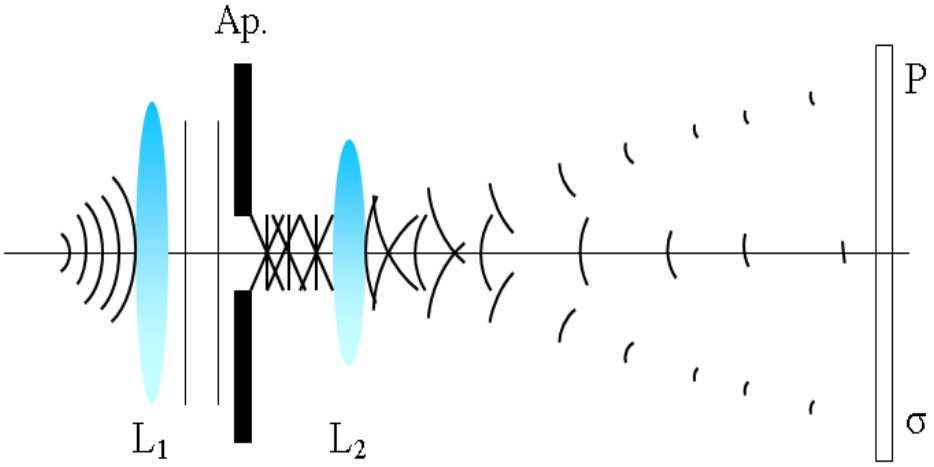
• Fraunhofer diffraction



Intensity $I(\theta) = v\sqrt{\mu_E + \mu_B} = (\frac{\epsilon}{\nu})^{\frac{1}{2}} \frac{1}{2} |E^2|$

$E_i = \frac{A_0}{K_i} \sin(\omega t - k x_i)$ --- spherical wave

at $\theta = 0$ $\quad I(0) = \frac{1}{2} (\frac{\epsilon}{\mu})^{\frac{1}{2}} \frac{A_0}{x_0^2} = \frac{I_{slit}}{x_0^2}$

let $\beta = \frac{\Delta}{2}$ $\quad \frac{d}{d\beta} ¿ (\frac{\sin\beta}{\beta})^2_{\beta=\beta_0} = 0$

⇨ $\tan\beta = \beta$

- Phasor

$$E_i(x_i,t)=\frac{A_0}{N-x_i}\mathrm{e}^{i(\omega t-k x_i)}$$

$$tilt\,E(\theta)=\sum_i^N{}' E_i(x_i,t)$$

$$=\frac{A_0}{N-x_0}e^{i(\omega t-kx)}(1+e^{-i\frac{\Delta}{N}}+\ldots+e^{-i\frac{N-1}{N}\Delta})$$

- Interference of N-slit diffraction

$$I(\theta)=\frac{A_0^2}{2x_0^2N^2}(\frac{\sin\frac{\Delta}{2}}{\sin\frac{\Delta}{2N}})^2=I(0)(\frac{\sin\beta}{\beta})^2$$

from s to s+Δs

$$dE_s=\frac{A_0}{b}\times\frac{dS}{x_s}\sin(\omega t-k x_s)=\frac{A_0}{b x_s}dS\ \sin(\omega t-k x_0-k s\sin\theta)$$

$$dE(s)=dE_{-s}+dE_{+s}=\frac{A_0}{k x_0}ds\times 2\cos(k s\sin\theta)$$

$$E(\theta)=\int_0^{\frac{b}{2}}dE(s)=\frac{A_0}{k}\frac{\sin(\frac{1}{2}k b\sin\theta)}{\frac{1}{2}k b\sin\theta}$$

$$I(\theta)=(\frac{\epsilon}{\mu})^{\frac{1}{2}}\frac{1}{2}\left|E(\theta)^2\right|$$

- Interference of square aperture with diffraction

dydz $\Rightarrow$ $dE(\theta,\phi) = \frac{A_0}{bl} dy\, dz \sin(\omega t - k l_{yz})$, $l_{yz} = l_{00} + \Delta l(y,z)$

$E(\theta,\phi) = \iint dE(y,z)$

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

$\beta = \frac{1}{2} k b \sin\theta$, $\gamma = \frac{1}{2} k d \sin\theta$

- Interference of Double slit with diffraction

from s to s+Δs

$dE_s = \frac{A_0}{b} \times \frac{dS}{x_s} \sin(\omega t - k x_s)$

$dE(s) = dE_{-s} + dE_{+s} = \frac{A_0}{k x_0} ds \times 2\cos(k s \sin\theta)$

$E(\theta) = \frac{2A_0}{b x_0} \left[\frac{\sin(k s \cdot \sin\theta)}{k \sin\theta}\right]_{\frac{d}{2}-\frac{b}{2}}^{\frac{d}{2}+\frac{b}{2}} \times \sin(\omega t - k x_0)$

$= \frac{2A_0}{x_0} \times \frac{\sin\beta}{\beta} \cos x \, \sin(\omega t - k x_0)$

$\beta = \frac{1}{2} k b \sin\theta$, $\gamma = \frac{1}{2} k d \sin\theta$

$I(\theta) = \left(\frac{\epsilon}{\mu}\right)^{\frac{1}{2}} \frac{1}{2} \left|E(\theta)^2\right| = I(0) \left(\frac{\sin\beta}{\beta}\right)^2 \cos^2\gamma$