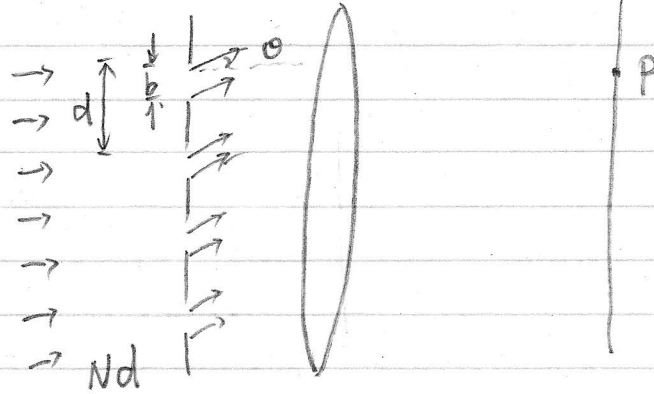


Lect. 20,

①

N-slit Fraunhofer Diffraction Pattern (CH 18-7)



$$E = E_1 + E_2 + \dots + E_N \quad ; \quad N\text{-slit}$$

$$E = A \frac{\sin \beta}{\beta} \cos(\omega t - \beta) \quad \text{first slit}$$

$$+ A \frac{\sin \beta}{\beta} \cos(\omega t - \beta - \Phi_1) \quad \text{2nd slit}$$

$$+ A \frac{\sin \beta}{\beta} \cos(\omega t - \beta - (N-1)\Phi_1) \quad \dots \text{Nth slit}$$

$$\Phi_1 = \frac{2\pi}{\lambda} d \sin \theta$$

Use complex representation and partial sum of series (in single-slit)

$$E = \frac{A \sin \beta}{\beta} \cdot \frac{\sin N\gamma}{\sin \gamma} \cos \left[\omega t - \beta - \frac{1}{2}(N-1)\Phi_1 \right]$$

$$\beta = \frac{\pi b \sin \theta}{\lambda}$$

$$\gamma = \frac{\Phi_1}{2} = \frac{\pi}{\lambda} d \sin \theta$$

$$\Rightarrow I = I_0 \left(\frac{\sin^2 \beta}{\beta^2} \right) \left(\frac{\sin^2 N\gamma}{\sin^2 \gamma} \right)$$

↳ diffraction by a single slit
↳ Interference pattern by N point sources

$N=1$, $I = I_0 \frac{\sin^2 \beta}{\beta^2}$ → single slit

$N=2$, $I = I_0 \frac{\sin^2 \beta}{\beta^2} (4 \cos^2 \gamma)$ → double-slit

