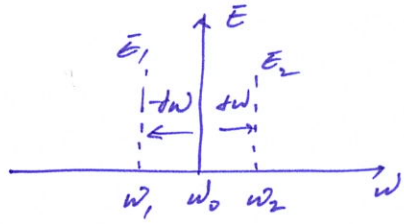
3/17/'21

⟨Beating⟩

- $E_1(x,t) = E_0 e^{i(k_1x - \omega_1 t)}$; $E_2(x,t) = E_0 e^{i(k_2x - \omega_2 t)}$

Q. $E = E_1 + E_2$?



Sol. $E_1(x,t) = E_0 e^{i(k_0x - \omega_0 t)} e^{-i(\delta k x - \delta\omega t)}$

$E_2(x,t) = E_0 e^{i(k_0x - \omega_0 t)} e^{i(\delta k x - \delta\omega t)}$

$\rightarrow E = E_0 e^{i(k_0x - \omega_0 t)} \left[e^{i(\delta k x - \delta\omega t)} + e^{-i(\delta k x - \delta\omega t)} \right]$

let $\delta\varphi = \delta k x - \delta\omega t$.

then, $E = E_0 e^{i(k_0x - \omega_0 t)} (e^{i\delta\varphi} + e^{-i\delta\varphi})$ ①

$= \underline{2E_0 e^{i(k_0x - \omega_0 t)} \underline{\cos\delta\varphi}}$ ②.

Beat signal at diference freq.

Original wave at average of E_1 & E_2.

- Measurement (측정)

$I = EE^* = I_0 (e^{i\delta\varphi} + e^{-i\delta\varphi})(e^{-i\delta\varphi} + e^{i\delta\varphi})$

$= I_0 (1 + 1 + e^{2i\delta\varphi} + e^{-2i\delta\varphi})$

$= \underline{2 I_0 (1 + \cos 2\delta\varphi)}$ ①

$= \underline{4 I_0 \cos^2 \delta\varphi}$ ②

$\cos 2\delta\varphi = \cos^2\delta\varphi - \sin^2\delta\varphi$
$= \cos^2\delta\varphi - 1 + \cos^2\delta\varphi$
$\therefore 1 + \cos 2\delta\varphi = 2\cos^2\delta\varphi$

- Compare it with Young's double-slit exp.