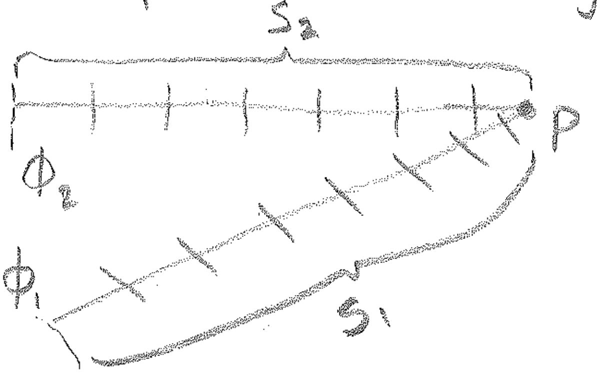
Föreläsning 6 08/04-15

Superpositionsprincipen
- Två vågor kan adderas.

Diffraktion och interferens
Interferens mellan ljudvågor med samma frekvens



$\bar{E}_1 = \bar{E}_{01}\cos(ks_1 - \omega t + \phi_1)$
$\bar{E}_2 = \bar{E}_{02}\cos(ks_2 - \omega t + \phi_2)$

Superpositionsprincipen
$\bar{E}_p = \bar{E}_1 + \bar{E}_2$

Intensitet: $I = \varepsilon_0 c \langle \bar{E}\cdot\bar{E} \rangle$

$\Rightarrow \varepsilon_0 c \langle \bar{E}_p \cdot \bar{E}_p \rangle = \varepsilon_0 c \langle (\bar{E}_1 + \bar{E}_2)\cdot(\bar{E}_1+\bar{E}_2) \rangle =$ ← tidsmedelv

$= \varepsilon_0 c \langle \underbrace{\bar{E}_1 \cdot \bar{E}_1}_{I_1} + \underbrace{\bar{E}_2 \cdot \bar{E}_2}_{I_2} + \underbrace{2\bar{E}_1 \bar{E}_2}_{\text{Interferensterm}} \rangle$

$>0, <0$

$I_p = I_1 + I_2 + I_{12}$ vågegenskap

$I_{12} = 2\varepsilon_0 c \langle \bar{E}_1 \cdot \bar{E}_2 \rangle$

om $\bar{E}_1 \perp \bar{E}_2 \Rightarrow I_{12} = 0$

men om $\bar{E}_1 \parallel \bar{E}_2$

$\bar{E}_1 \cdot \bar{E}_2 = \bar{E}_{01}\cdot\bar{E}_{02}\cos(ks_1 - \omega t + \phi_1)\cos(ks_2 - \omega t + \phi_2)$

$\alpha = ks_1 + \phi_1$

$\beta = ks_2 + \phi_2$

$\Rightarrow 2\bar{E}_1 \cdot \bar{E}_2 = 2\bar{E}_{01}\cdot\bar{E}_{02}\cos(\alpha - \omega t)\cos(\beta - \omega t)$

Samla alla t

trick: $2\cos(A)\cos(B) = \cos(A+B) + \cos(B-A)$

$\Rightarrow 2\langle \bar{E}_1 \cdot \bar{E}_2 \rangle = \bar{E}_{01}\cdot\bar{E}_{02}[\langle\cos(\alpha+\beta-2\omega t)\rangle + \langle\cos(\beta-\alpha)\rangle] =$

$= \bar{E}_{01}\cdot\bar{E}_{02}\langle\cos(\beta-\alpha)\rangle = \bar{E}_{01}\cdot\bar{E}_{02}\langle\cos\delta\rangle$

om $\delta = \beta - \alpha = k(s_2 - s_1) + \phi_2 - \phi_1$

$I_{12} = \varepsilon_0 c\, \bar{E}_{01}\cdot\bar{E}_{02}\langle\cos\delta\rangle$

$I_1 = \varepsilon_0 c\langle \bar{E}_1\cdot\bar{E}_1\rangle = \varepsilon_0 c E_{01}^2 \overbrace{\langle\cos^2(\alpha-\omega t)\rangle}^{1/2} = \frac{1}{2}\varepsilon_0 c E_{01}^2$

$I_2 = \frac{1}{2}\varepsilon_0 c E_{02}^2$

Om $\bar{E}_1 \parallel \bar{E}_2$

$\Longrightarrow I_{12} = 2\sqrt{I_1 I_2}\langle\cos\delta\rangle$

$\Longrightarrow I_p = I_1 + I_2 + 2\sqrt{I_1 I_2}\langle\cos\delta\rangle$

$\langle\cos\delta\rangle = 1$

$I_{max} = I_1 + I_2 + 2\sqrt{I_1 I_2}$, $\delta = 2m\pi$

$\langle\cos\delta\rangle = -1$

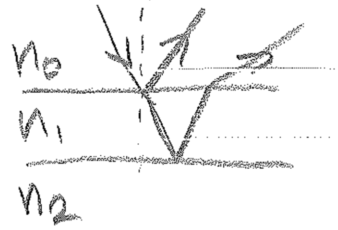
$I_{min} = I_1 + I_2 - 2\sqrt{I_1\cdot I_2}$, $\delta = (2m+1)\pi$

Samma intensitet $I_1 = I_2 = I_0$

$\Longrightarrow I_{max} = I_0 + I_0 + 2I_0 = 4I_0$

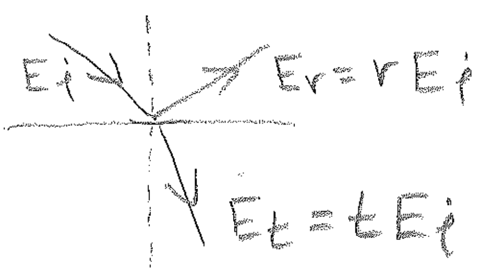
$I_{min} = I_0 + I_0 - 2I_0 = 0$

Interferens i tunna skikt



$r = \frac{1-n}{1+n}$ $\quad r = \frac{E_r}{E_i}$, $t = \frac{E_t}{E_i}$

Stokes relationer



Samma när ljuset går omvänt