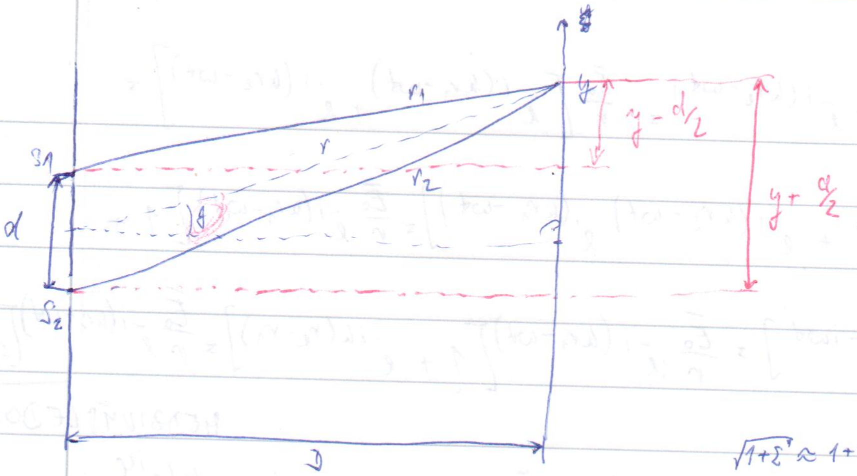
(27)




$\Delta r = r_2 - r_1$

$\sqrt{1+\varepsilon} \approx 1 + \frac{1}{2}\varepsilon$

$$r_1 = \sqrt{D^2 + \left(y - \frac{d}{2}\right)^2} = D\sqrt{1 + \left(\frac{y - \frac{d}{2}}{D}\right)^2} \approx D\left(1 + \frac{1}{2}\left(\frac{y-\frac{d}{2}}{D}\right)^2\right)$$

$$r_2 = \sqrt{D^2 + \left(y + \frac{d}{2}\right)^2} = D\sqrt{1 + \left(\frac{y + \frac{d}{2}}{D}\right)^2} \approx D\left(1 + \frac{1}{2}\left(\frac{y+\frac{d}{2}}{D}\right)^2\right)$$

$$\Delta r = r_2 - r_1 = D\left[1 + \frac{1}{2}\left(\frac{y+\frac{d}{2}}{D}\right)^2 - 1 - \frac{1}{2}\frac{\left(y-\frac{d}{2}\right)^2}{D^2}\right] = \frac{D}{2D^2}\left[y^2 + dy + \frac{d^2}{4} - y^2 + dy - \frac{d^2}{4}\right]$$

$$= \boxed{\frac{dy}{D} = \Delta r}$$

a) $y_{m1} = ?$ ; $\vartheta_{m1} = ?$ $\rightarrow$ $\vartheta_{m1} = \frac{y_{m1}}{D}$

podmienka interf. minima: $\boxed{\Delta r = \left(m - \frac{1}{2}\right)\lambda}$

$$\frac{dy_{m1}}{D} = \left(m - \frac{1}{2}\right)\lambda = \frac{1}{2}\lambda$$

$$\underline{y_{m1} = \frac{D\lambda}{2d}} \qquad \underline{\vartheta_{m1} = \frac{\frac{D\lambda}{2d}}{D} = \frac{\lambda}{2d}}$$

b) $y_{M10} = ?$ ; $\vartheta_{M10} = ?$ $\rightarrow$ $\vartheta_{M10} = \frac{y_{M10}}{D}$

podmienka interf. maxima: $\boxed{\Delta r = M\lambda}$

$$\frac{dy_{M10}}{D} = M\lambda = 10\lambda$$

$$\underline{y_{M10} = \frac{10\lambda D}{d}} \qquad \underline{\vartheta_{M10} = \frac{\frac{10\lambda D}{d}}{D} = \frac{10\lambda}{d}}$$

c) $S_1: \bar{E}_1 = \bar{E}_0 \cdot \frac{1}{r_1} e^{-i(kr_1 - \omega t)}$ ; $S_2: \bar{E}_2 = \frac{\bar{E}_0}{r_2} e^{-i(kr_2 - \omega t)}$

$\bar{E}_1 \approx \frac{\bar{E}_0}{r} e^{-i(kr_1 - \omega t)}$ $\qquad$ $\bar{E}_2 \approx \frac{\bar{E}_0}{r} e^{-i(kr_2 - \omega t)}$

$$\underline{\bar{E}_c = \bar{E}_1 + \bar{E}_2}$$

čo potrebujeme vedieť: $x^2 \cdot x^5 = x^{2+5}$

$x^{-2} \cdot x^2 = x^{-2+2} = x^0 = 1$

$x^{-1} = \frac{1}{x}$

• $E_c \approx \frac{E_0}{r} e^{-i(kr_1-\omega t)} + \frac{E_0}{r} e^{-i(kr_2-\omega t)} = \frac{E_0}{r}\left[e^{-i(kr_1-\omega t)} + e^{-i(kr_2-\omega t)}\right] =$

$= \frac{E_0}{r} e^{-i(kr_1-\omega t)}\left[1 + e^{-i(kr_2-\omega t)}\, e^{i(kr_1-\omega t)}\right] = \frac{E_0}{r} e^{-i(kr_1-\omega t)}\left[1 + e^{-ikr_2+i\omega t+ikr_1-i\omega t}\right] = \frac{E_0}{r}e^{-i(kr_1-\omega t)}\left[1+e^{-ik(r_2-r_1)}\right] = \frac{E_0}{r}e^{-i(kr_1-\omega t)}\left[1+e^{-ik\Delta r}\right]$

MEDZIVÝSLEDOK

$I = E_c E_c^*$ ; $*$ ... komplexné združenie → $z = x+iy = |z|e^{i\varphi}$

$z^* = x-iy = |z|e^{-i\varphi}$

• $I = \frac{E_0}{r}e^{-i(kr_1-\omega t)}\left[1+e^{-ik\Delta r}\right]\cdot \frac{E_0}{r}e^{+i(kr_1-\omega t)}\left[1+e^{+ik\Delta r}\right]$

$= \left(\frac{E_0}{r}\right)^2\left[1+e^{-ik\Delta r}\right]\left[1+e^{ik\Delta r}\right] = \left(\frac{E_0}{r}\right)^2\left[1+e^{-ik\Delta r}+e^{ik\Delta r}+1\right] = \left(\frac{E_0}{r}\right)^2\left[2+e^{ik\Delta r}+e^{-ik\Delta r}\right]$

$= \left(\frac{E_0}{r}\right)^2\left(2+2\cos(k\Delta r)\right) = 2\left(\frac{E_0}{r}\right)^2\left(1+\cos(k\Delta r)\right) = 4\left(\frac{E_0}{r}\right)^2\cos^2\left(\frac{k\Delta r}{2}\right)$

$\boxed{\cos x = \frac{e^{ix}+e^{-ix}}{2}}$   $\boxed{1+\cos(2x) = 2\cos^2\left(\frac{x}{2}\right)}$

ABY BOL VÝSLEDOK KONZISTENTNÝ S HRW OZNAČÍME $\frac{E_0^2}{r^2} \equiv I_0$

$I = 4I_0\cos^2\left(\frac{k\Delta r}{2}\right) = 4I_0\cos^2\left(\frac{2\pi\Delta r}{2\lambda}\right) = 4I_0\cos^2\left(\frac{\pi\Delta r}{\lambda}\right)$

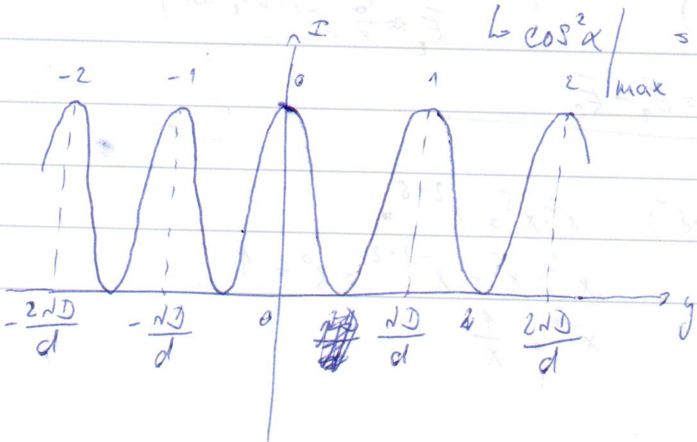
$\boxed{k = \frac{2\pi}{\lambda}}$ veľkosť vlnového vektoru

• použijeme $\Delta r = \frac{yd}{D}$ → $I = 4I_0\cos^2\left(\frac{\pi y d}{\lambda D}\right)$

kreslenie $I(y)$

$\cos^2(\alpha)$ má maximum vo všetkých násobkoch (celočíselných) $\pi$

↳ $\cos^2\alpha\big|_{max} = 1$ ... dosaďte si




$\cos^2\alpha = 1 \Leftrightarrow \alpha = M\pi$

$\frac{\pi y d}{\lambda D} = M\pi$   $M = 0, \pm 1, \pm 2, \dots$

$\boxed{y_M = \frac{M\lambda D}{d}}$