$p = \alpha E$

$P = Np = \underbrace{N\alpha E = \epsilon_0 \chi E}$

$1+\chi = \epsilon = n^2$

$n^2 = 1 + \frac{N\alpha}{\epsilon_0}$

$E_0 e^{ik_0 \tilde{n} z - i\omega t} = E_0 e^{ik_0 n - i\omega t} \cdot \underbrace{e^{-k_0 \kappa z}}$

$\tilde{n} = n + i\kappa$

$e^{-k_0 \kappa z}$

$\bar{E}_1(\bar{r}, t) = \bar{E}_{01} \cos(\bar{k}_1 \cdot \bar{r} - \omega t + \epsilon_1)$

$\bar{E}_2(r, t) = E_{02} \cos(\bar{k}_2 \cdot \bar{r} - \omega t + \epsilon_2)$

Intensity $\langle S \rangle_t = \frac{n}{Z_0} \langle \bar{E}^2 \rangle_t \hat{s}$

$Z_0 = \sqrt{\frac{\mu_0}{\epsilon_0}}$

$\bar{E}^2 = (E_1 + E_2)^2 = E_1^2 + E_2^2 + 2E_1 \cdot E_2$

$I = \cancel{(}(I_1 + I_2 + I_{12})$

$(\ ) \langle E_1^2 \rangle \quad \cancel{+} \quad \langle E_2^2 \rangle \qquad \underbrace{2\langle \bar{E}_1 \cdot \bar{E}_2 \rangle_t}$

$$\langle \bar{E}_1 \cdot \bar{E}_2 \rangle_t = \bar{E}_{01} \cdot \bar{E}_{02} \langle \cos(k_1 \cdot r - \omega t + \epsilon_1) \cdot \cos(k_2 \cdot r - \omega t + \epsilon_2) \rangle_t$$

$$= \frac{\bar{E}_{01} \cdot \bar{E}_{02}}{2} \cos\Big[\underbrace{(\bar{k}_1 - \bar{k}_2) \cdot r + (\epsilon_1 - \epsilon_2)}_{\delta}\Big]$$

$$I_{tot} = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos \delta$$

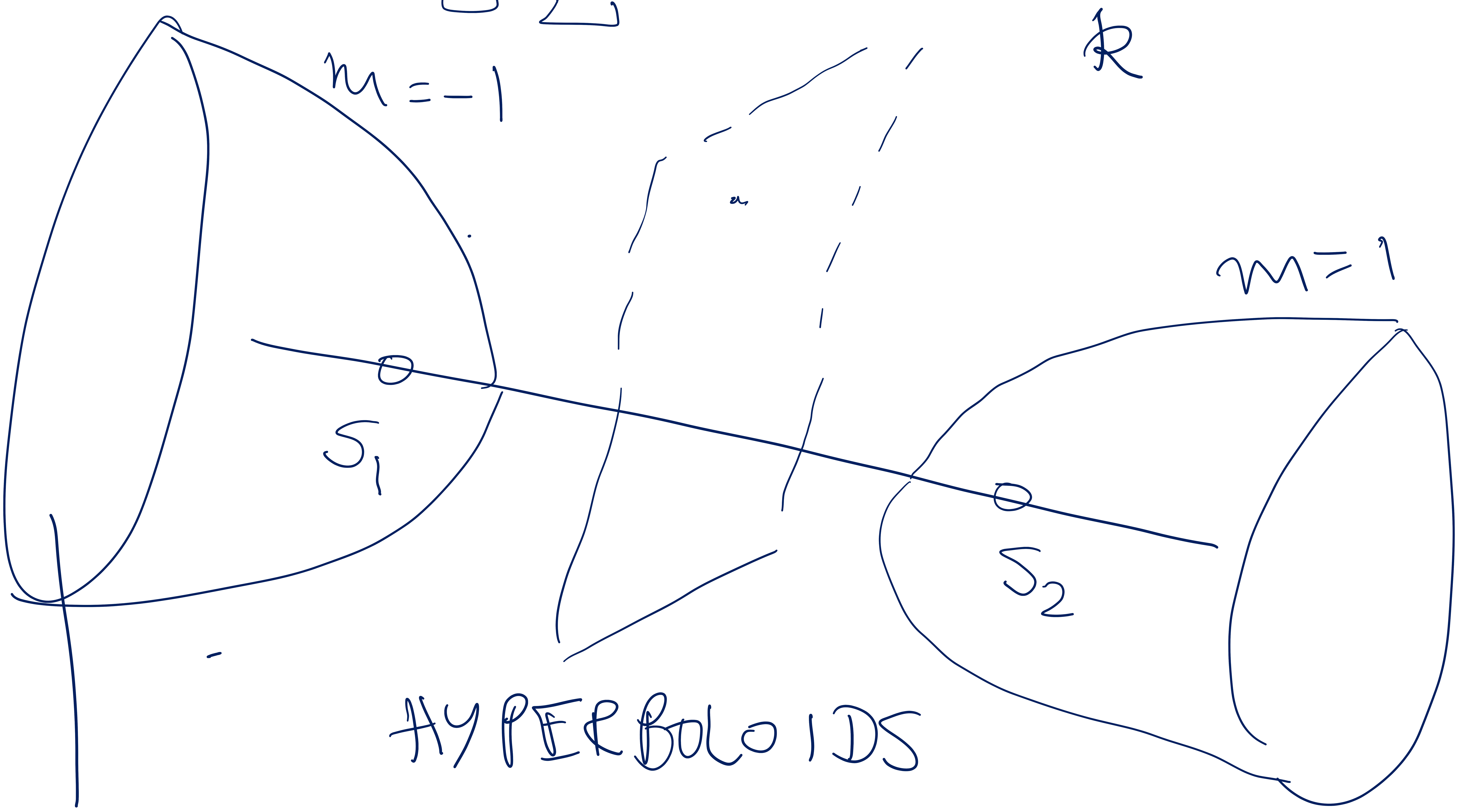
Spherical waves

$$I = 4 I_0 \cos^2\left[\frac{1}{2}\left(k(r_1 - r_2) + \epsilon_1 - \epsilon_2\right)\right]$$

$$\delta = m\pi$$

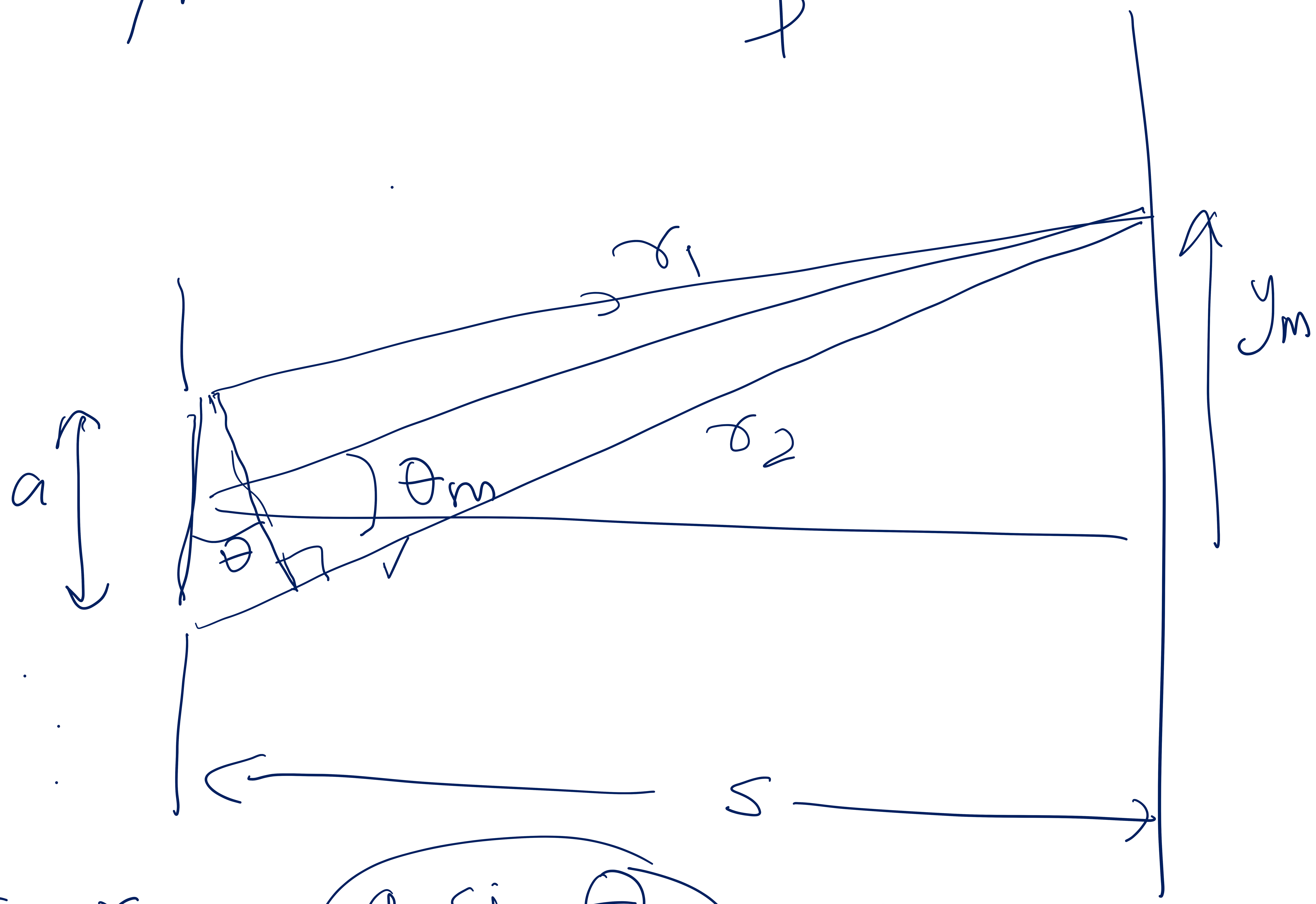
$$k(r_1 - r_2) + \epsilon_1 - \epsilon_2 = 2m\pi$$

$$r_1 - r_2 = \frac{2m\pi + (\epsilon_2 - \epsilon_1)}{k}$$



HYPERBOLOIDS

Wavefront splitting interferometers

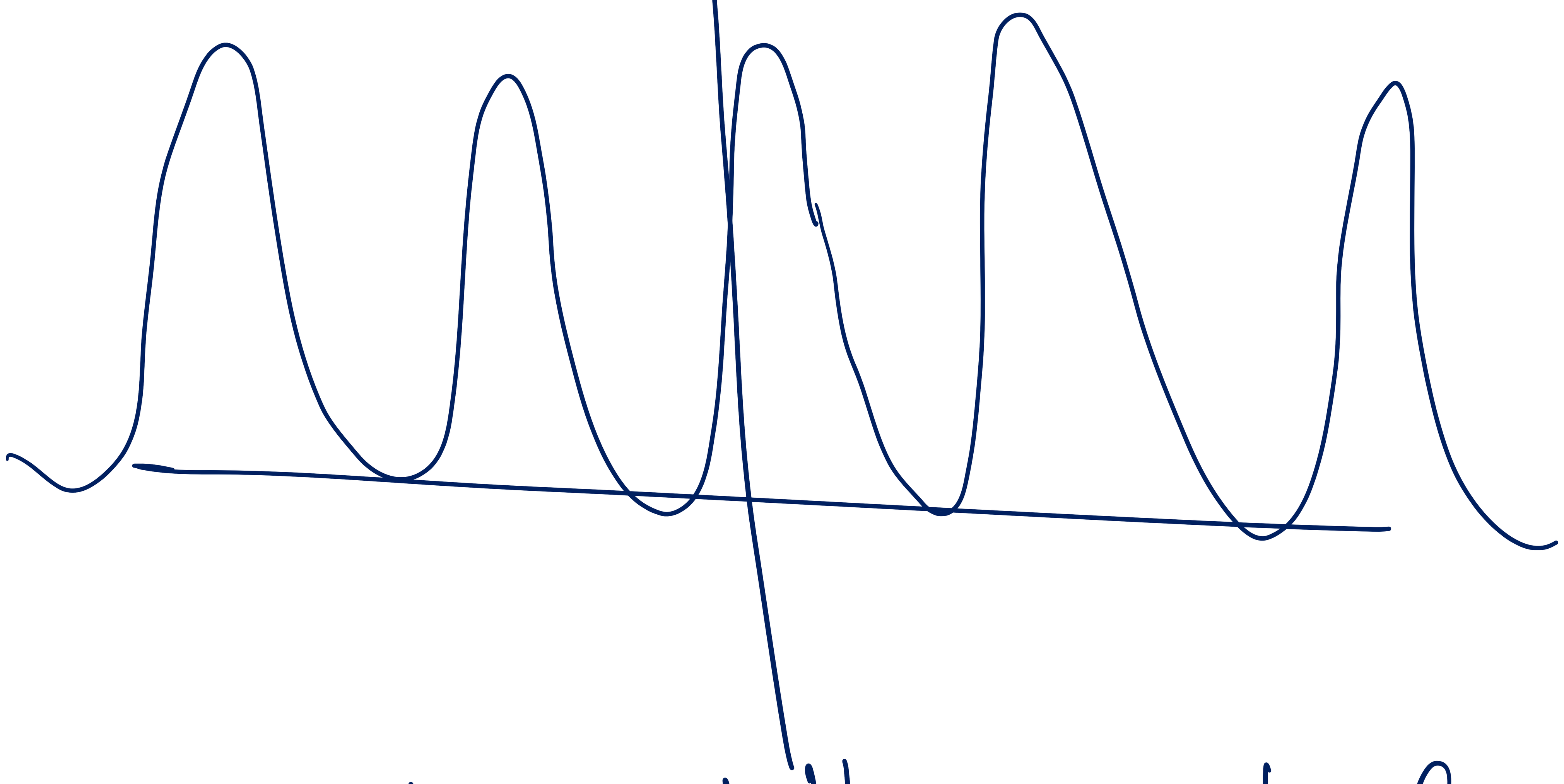


$$\underline{r_1 - r_2} = \underline{a \sin \theta_m} = \underbrace{\frac{ay}{s} = m\lambda}$$

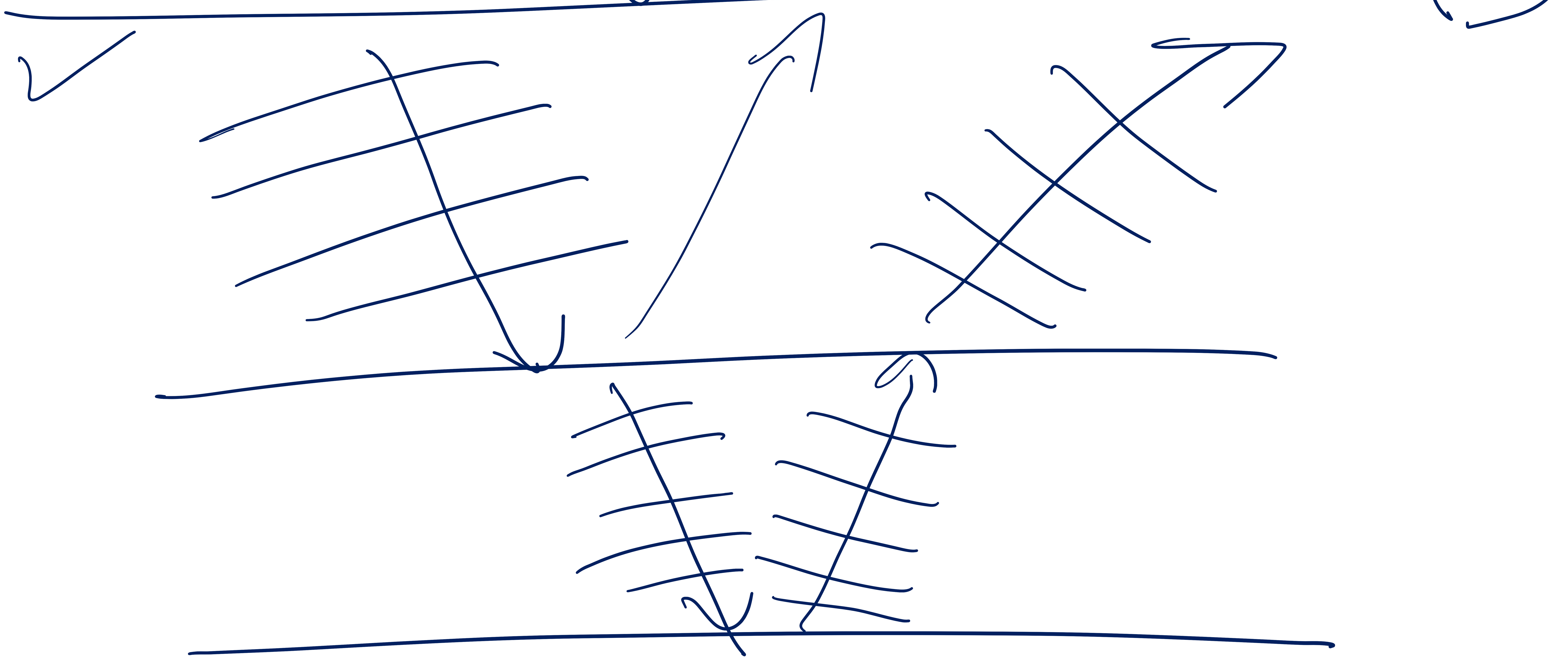
$$y_m = \frac{s}{a} \cdot m\lambda \,, \quad \theta_m = \frac{m\lambda}{a}$$

$$I = 4 I_0 \cos^2\left(\frac{k(r_1 - r_2)}{2}\right)$$

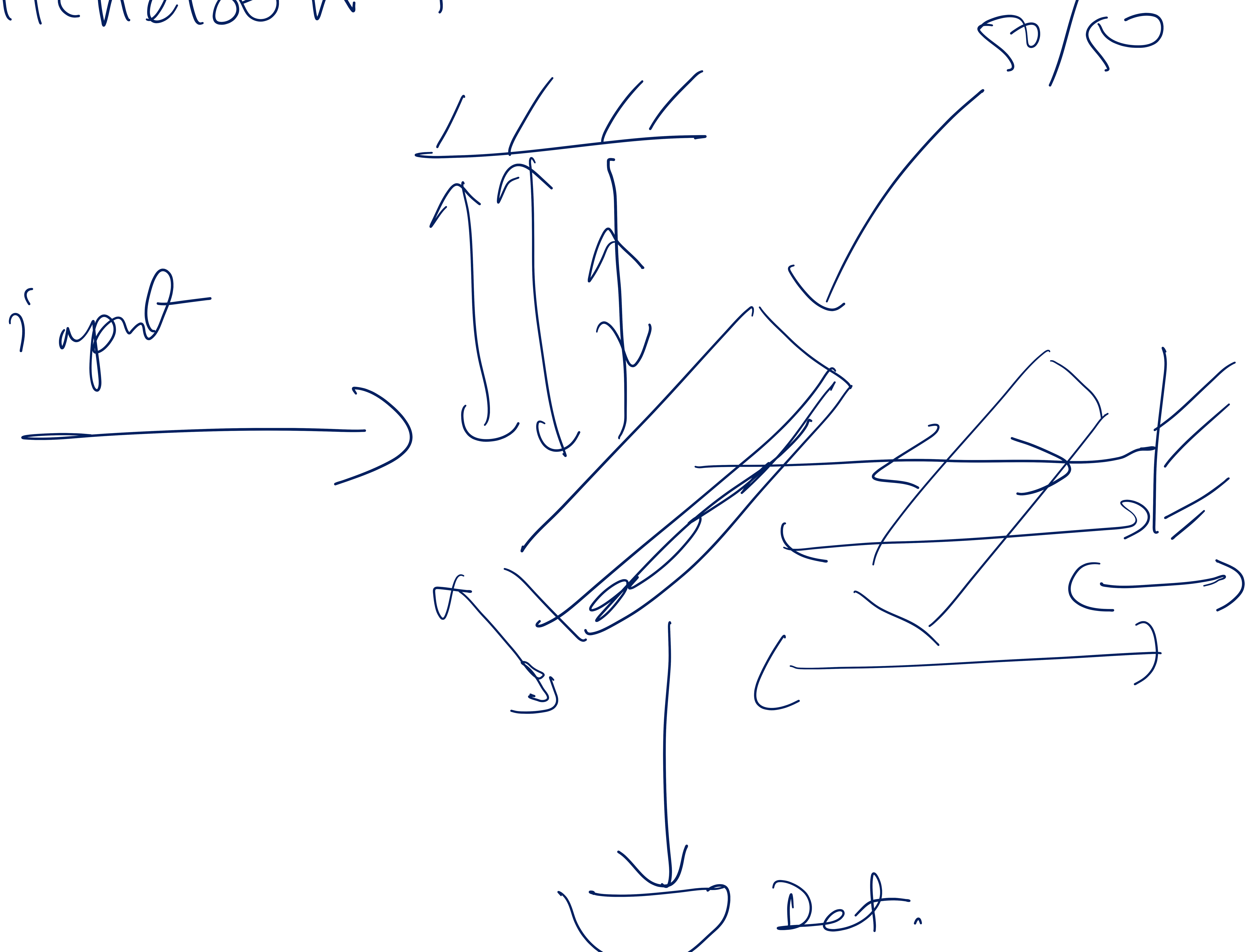
$$= 4 I_0 \cos^2\left[\frac{\pi}{\lambda}\frac{ay}{s}\right]$$



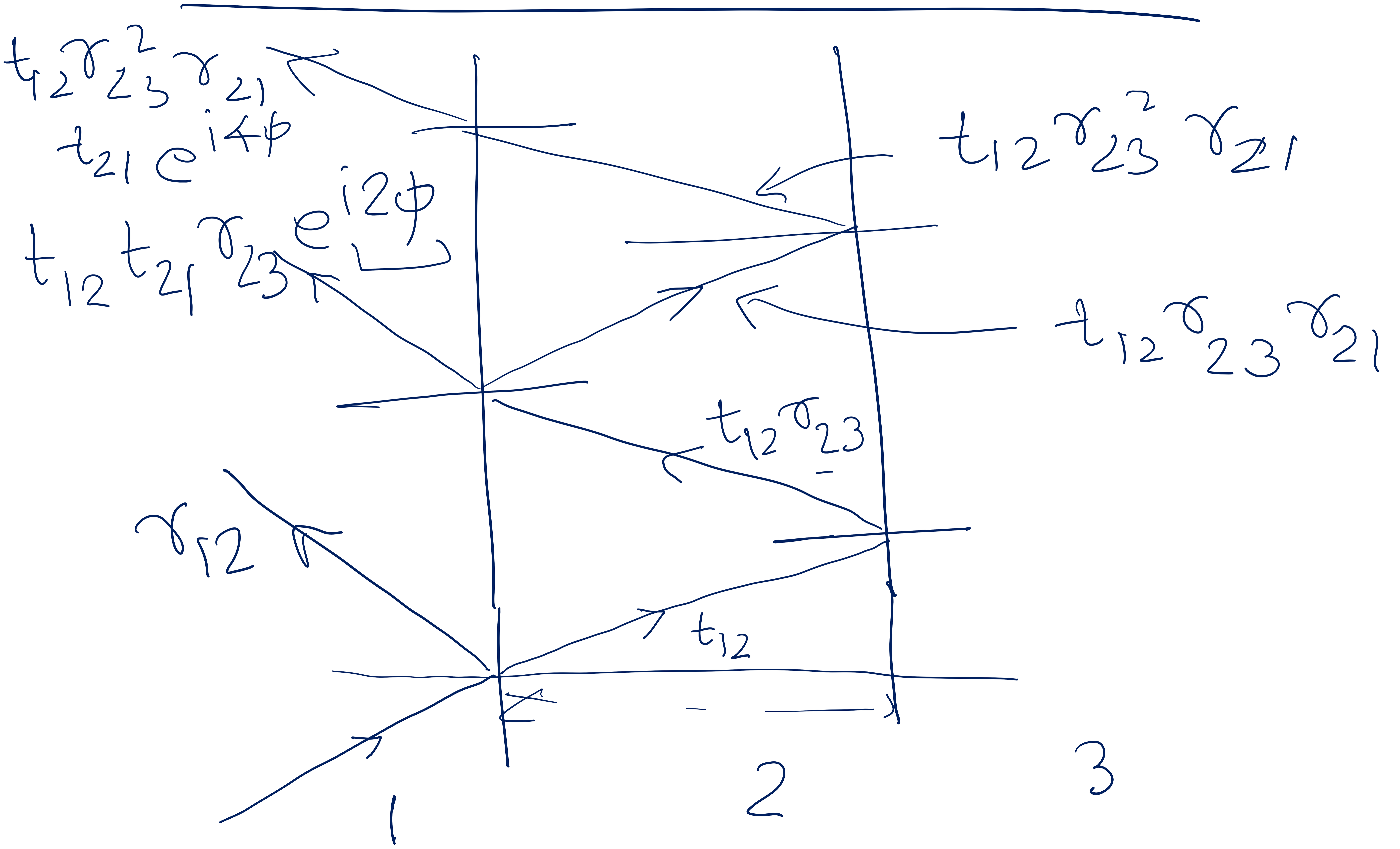
Amplitude splitting interferometers



Michelson inter



Multiple beam interference (AIRY)



Total refl.

$$r = r_{12} + t_{12} t_{21} r_{23} e^{2i\phi} + t_{12} t_{21} r_{23}^2 r_{21} e^{i4\phi} + \dots$$

$$= r_{12} + t_{12} t_{21} r_{23} e^{2i\phi} \left(1 + r_{21} r_{23} e^{2i\phi} + \dots\right)$$

$$= r_{12} + \frac{t_{12} t_{21} r_{23} e^{2i\phi}}{1 - r_{21} r_{23} e^{2i\phi}}$$

Exercise

$$t_{12} t_{21} - r_{12} r_{21} = 1$$

$$r_{21} = - r_{12}$$

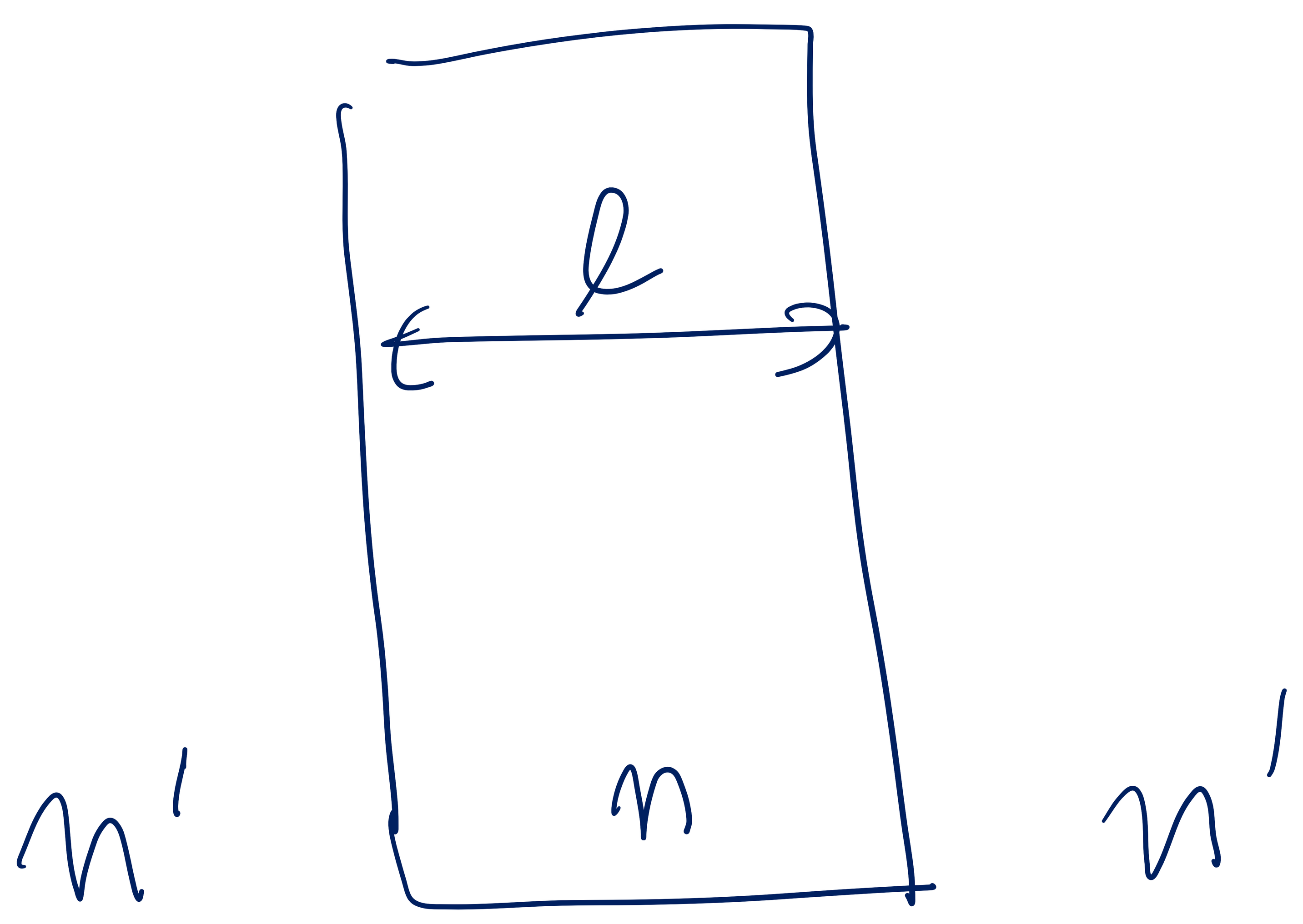
$$\boxed{r = \frac{r_{12} + r_{23} e^{2i\phi}}{1 + r_{12} r_{23} e^{2i\phi}}}$$

$$\boxed{t = \frac{t_{12} t_{23} e^{i\phi}}{1 + r_{12} r_{23} e^{2i\phi}}}$$

$$\phi = k_0 n_2 d \cos\theta_2 \qquad \square$$

AIRY FORMULAS

FABRY - PEROT INTERFEROMETER
(FPI) "etalon"



SIMPLE
FPI

Ex

$$\boxed{\underline{r} = \frac{(1-e^{2i\phi})\sqrt{R}}{1-Re^{2i\phi}}}$$

$$R = r_{12}^2 = r_{23}^2$$

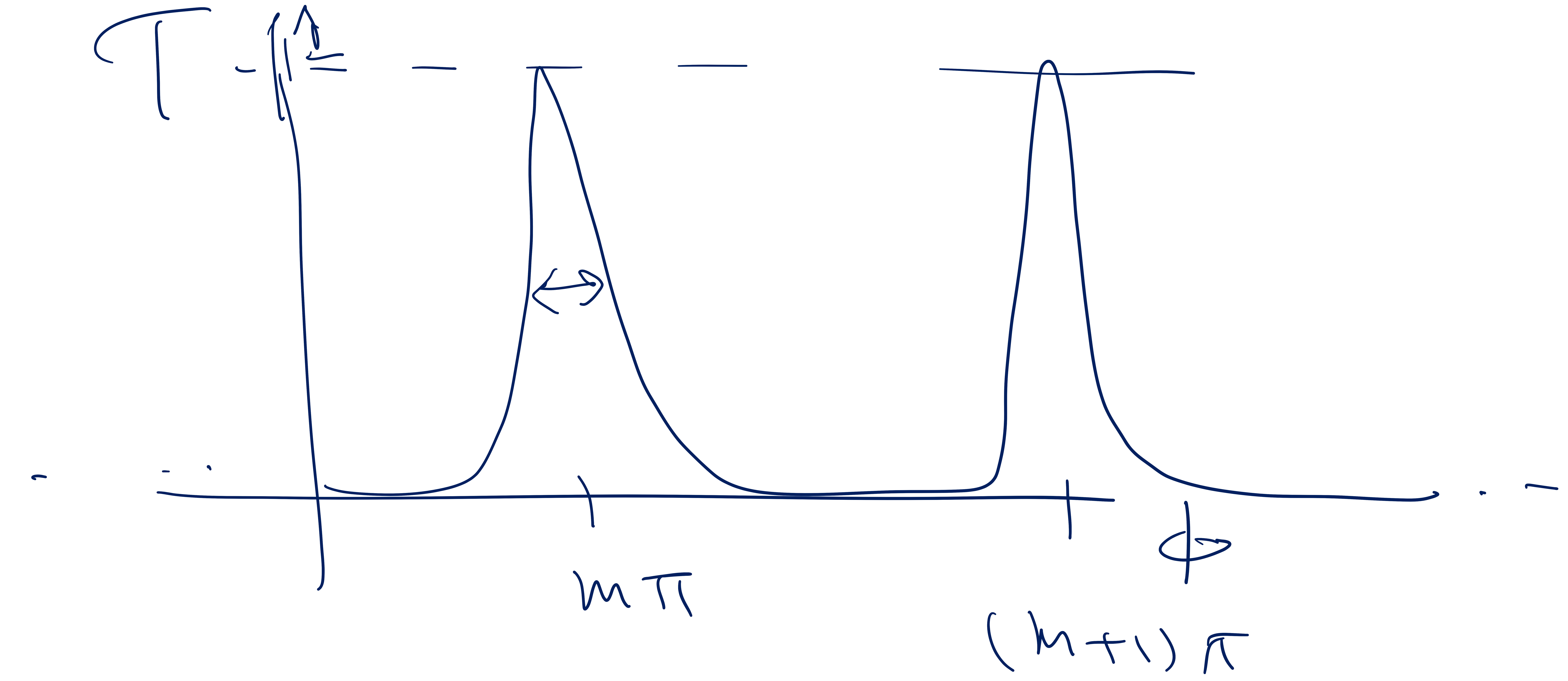
$$\boxed{t = \frac{Te^{i\phi}}{1-Re^{2i\phi}}}$$

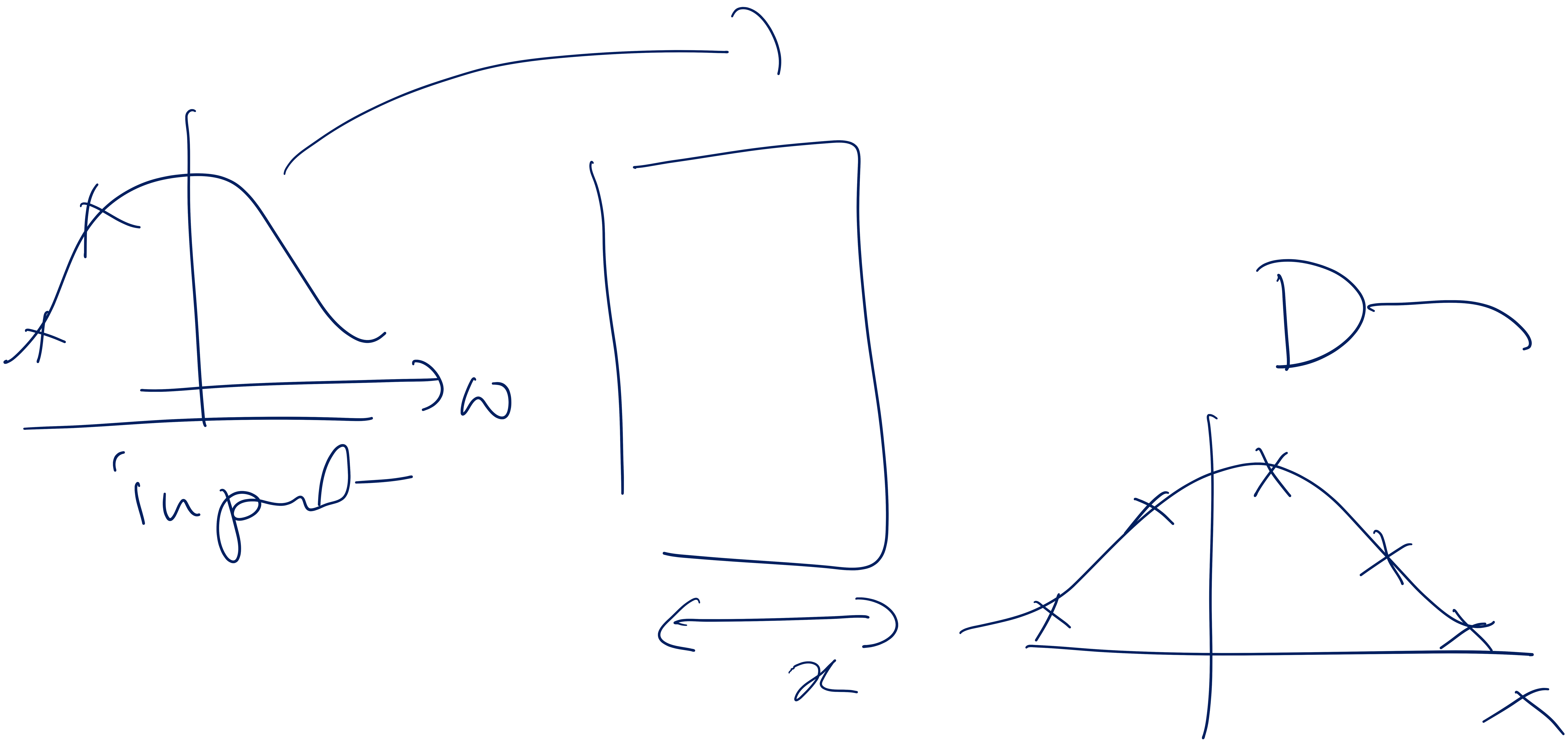
$$T = t_{12}t_{23}$$

$$\underline{R} = |r|^2 = \frac{4R\sin^2\phi}{(1-R)^2+4R\sin^2\phi}$$

$$T = (1-)|t|^2 = \frac{(1-R)^2}{(1-R)^2+4R\sin^2\phi}$$

$$\phi = k_0 n l\cos\theta = m\pi$$


T
1
mπ
(m+1)π
φ


ω
input
x
D