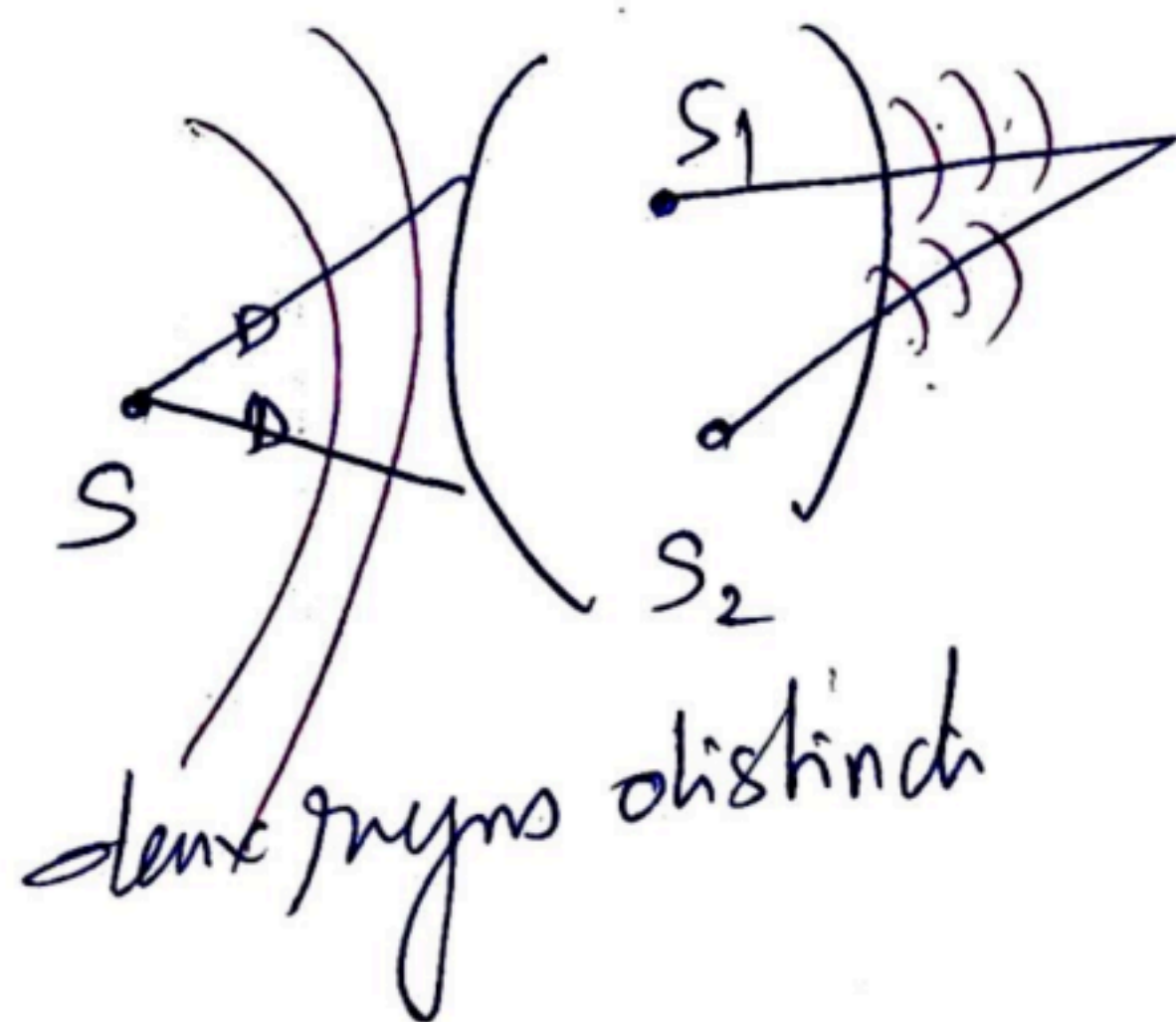
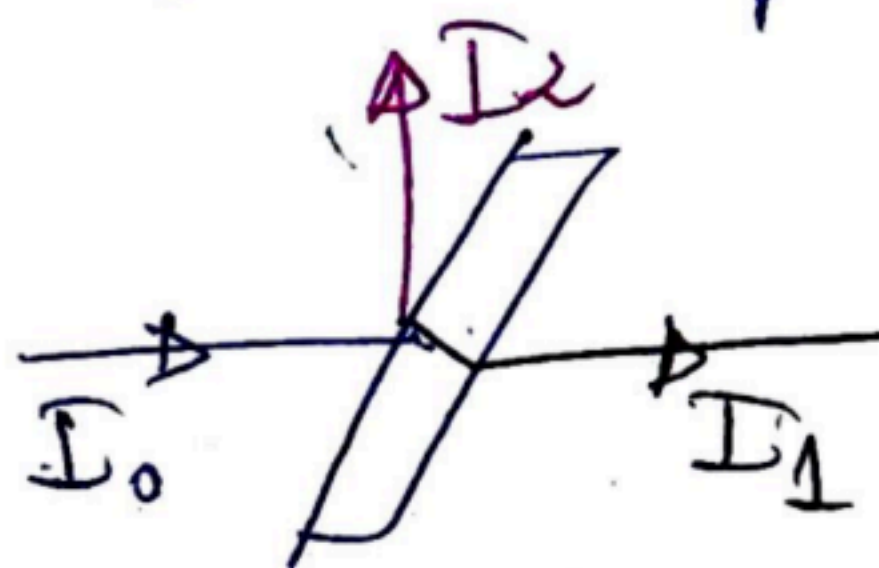


front d'onde

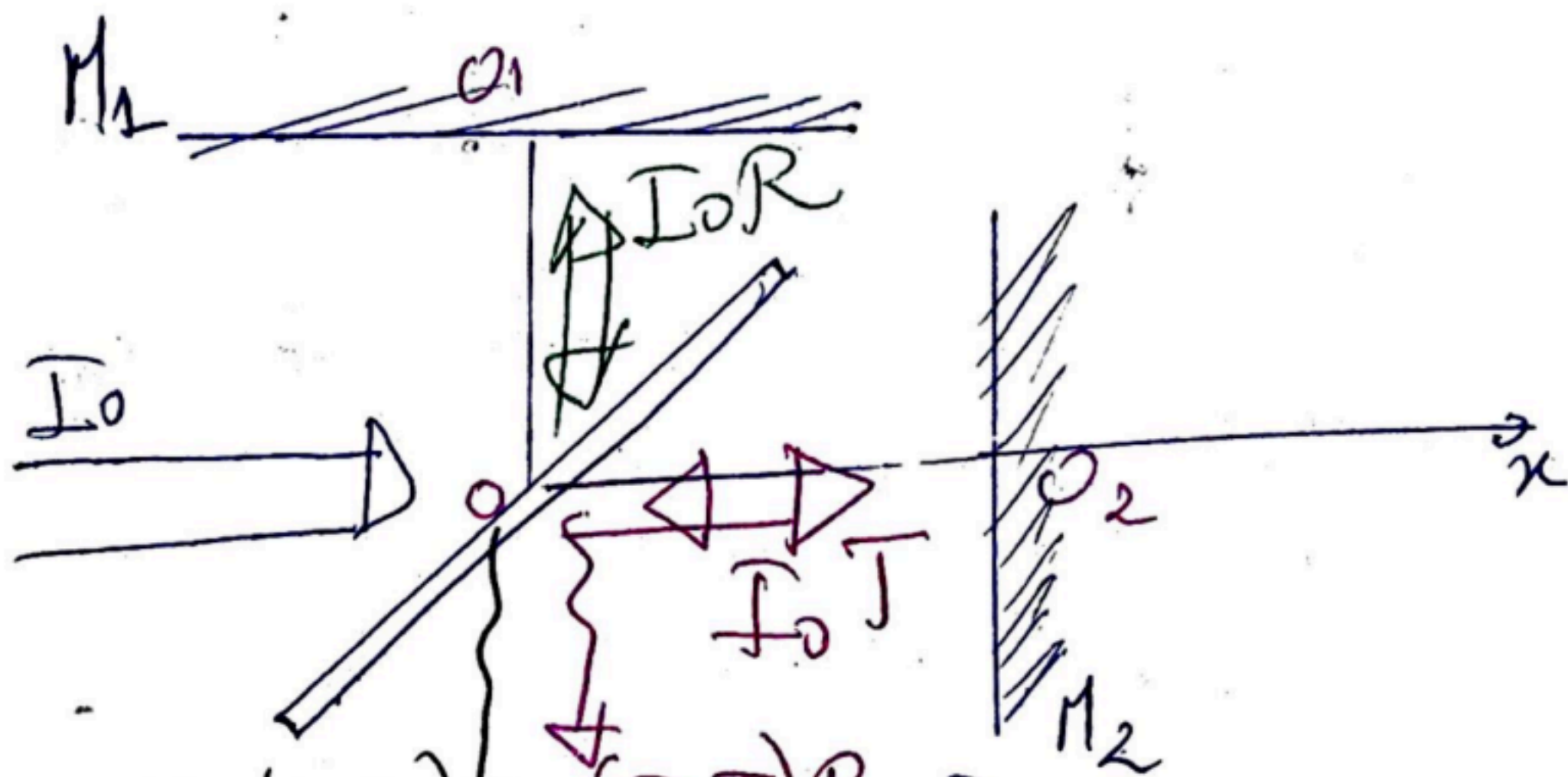


division d'amplitude



~~Saut~~ $I_0 \neq I_1 = I_2$
un seul rayon

	front d'onde	Division d'amplitude
Source ponctuelle	$C=1$ la luminosité ✗ Non localisée	$C=1$ luminosité ✗ Non localisée
Source étendue	$C \searrow$ <u>brouillage</u>	$C=1$ luminosité ↗ <u>localisées</u>



$$I_1 = T(R I_0) \quad (I_0 T) R = I_2$$

$$OO_1 = d_1; \quad OO_2 = d_2$$

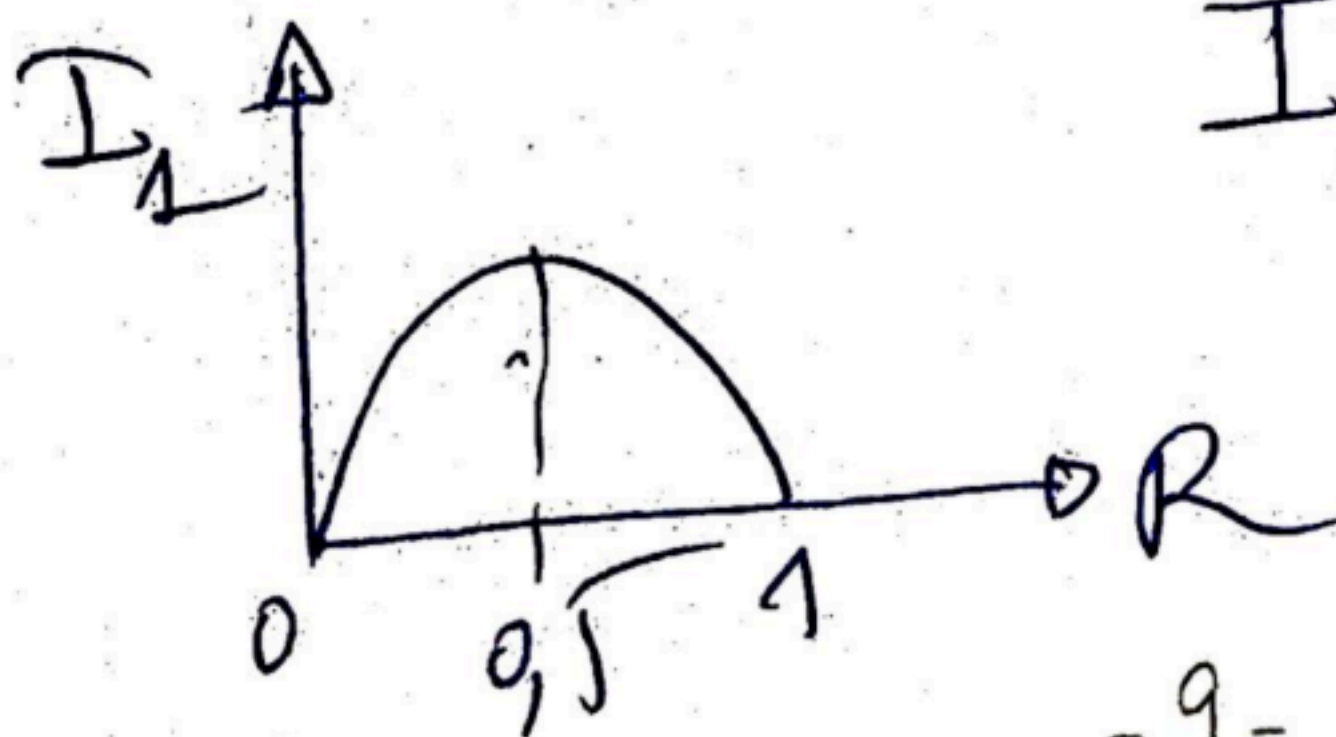
So $d_1 = d_2$: contact optique

Les deux bras de Michelson.

L_s = lame demi-réfléchissante; $R = 0,5$

$$I_1 = I_2 = I_0 R (1 - R) \quad \underline{\underline{\forall R}}$$

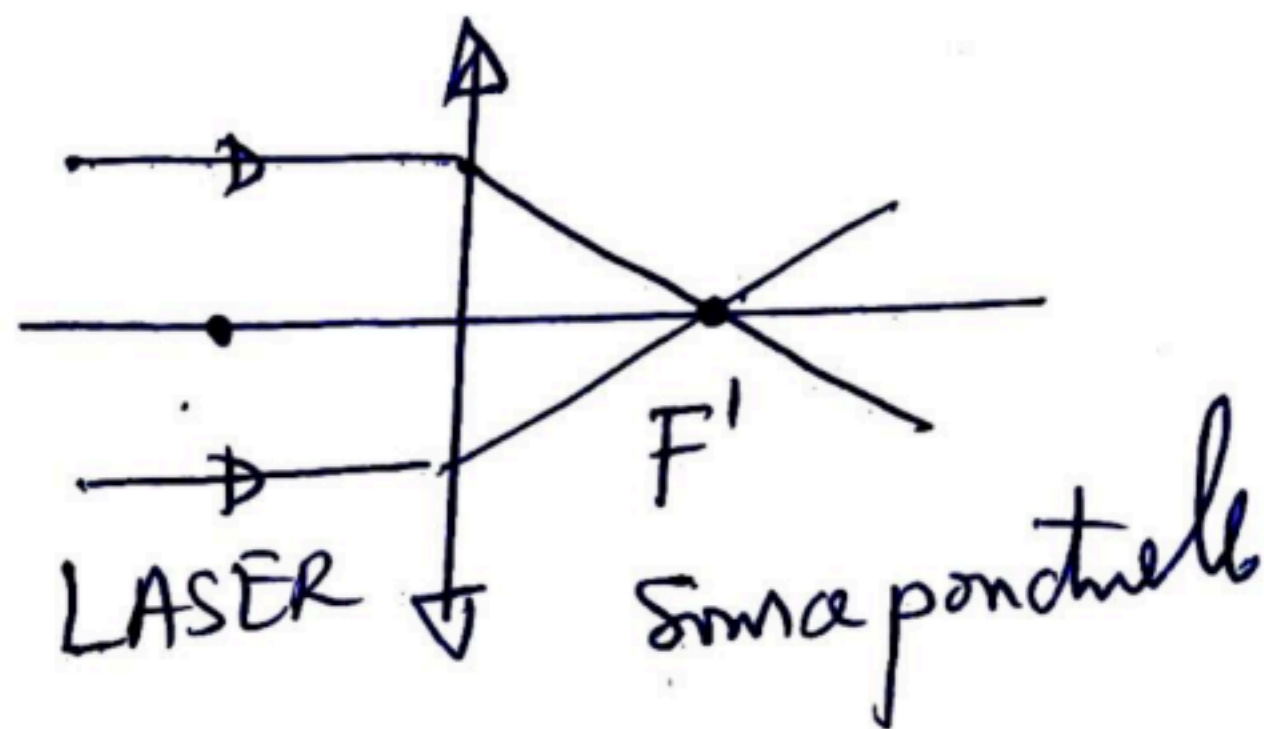
$$C = \frac{2\sqrt{I_1 I_2}}{I_1 + I_2} = 1 \quad \forall R$$



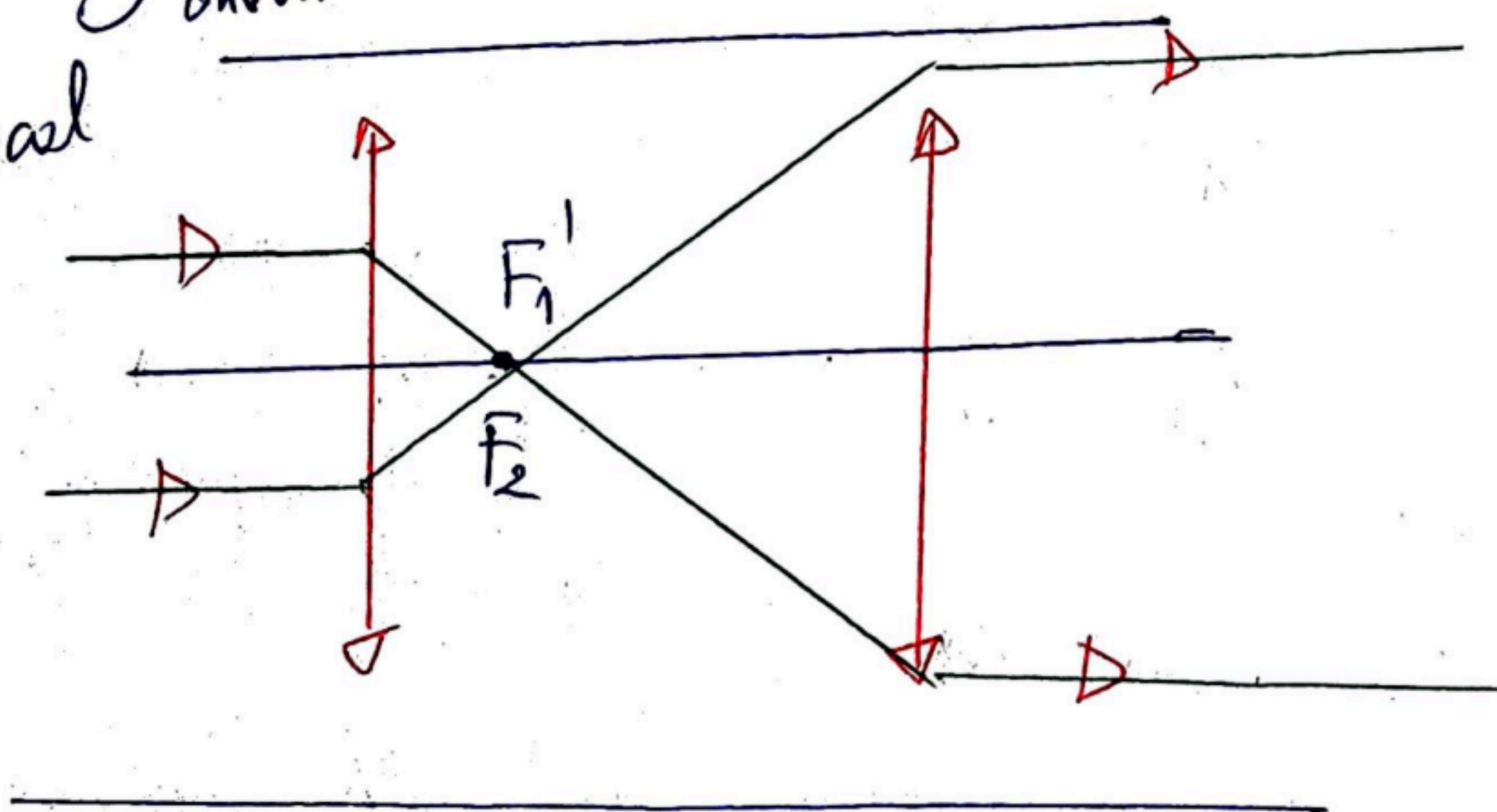
$$I_1 = \frac{I_0}{4} = I_2$$

$$I = \frac{I_0}{2} (1 + \cos 4\theta)$$

① Source ponctuelle

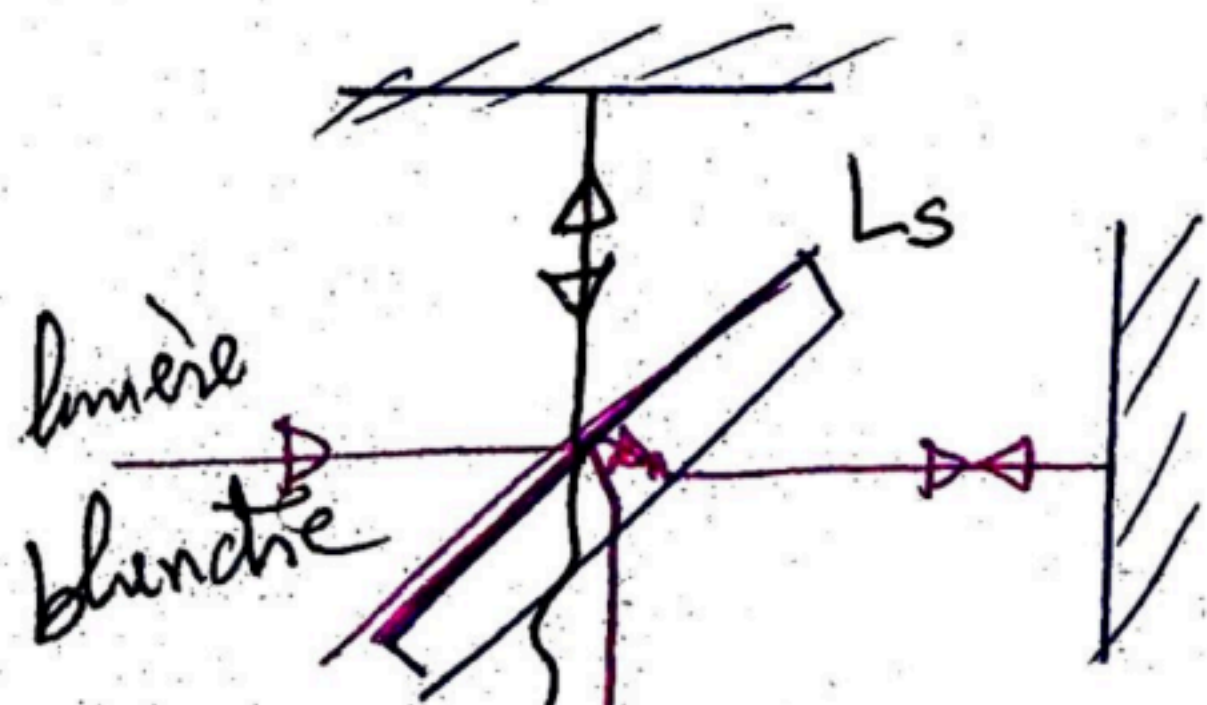


diaphragme
de faible
ouverture
à focal



$n(\lambda)$: dispersion

Spurious = dépend
de $n(\lambda)$.

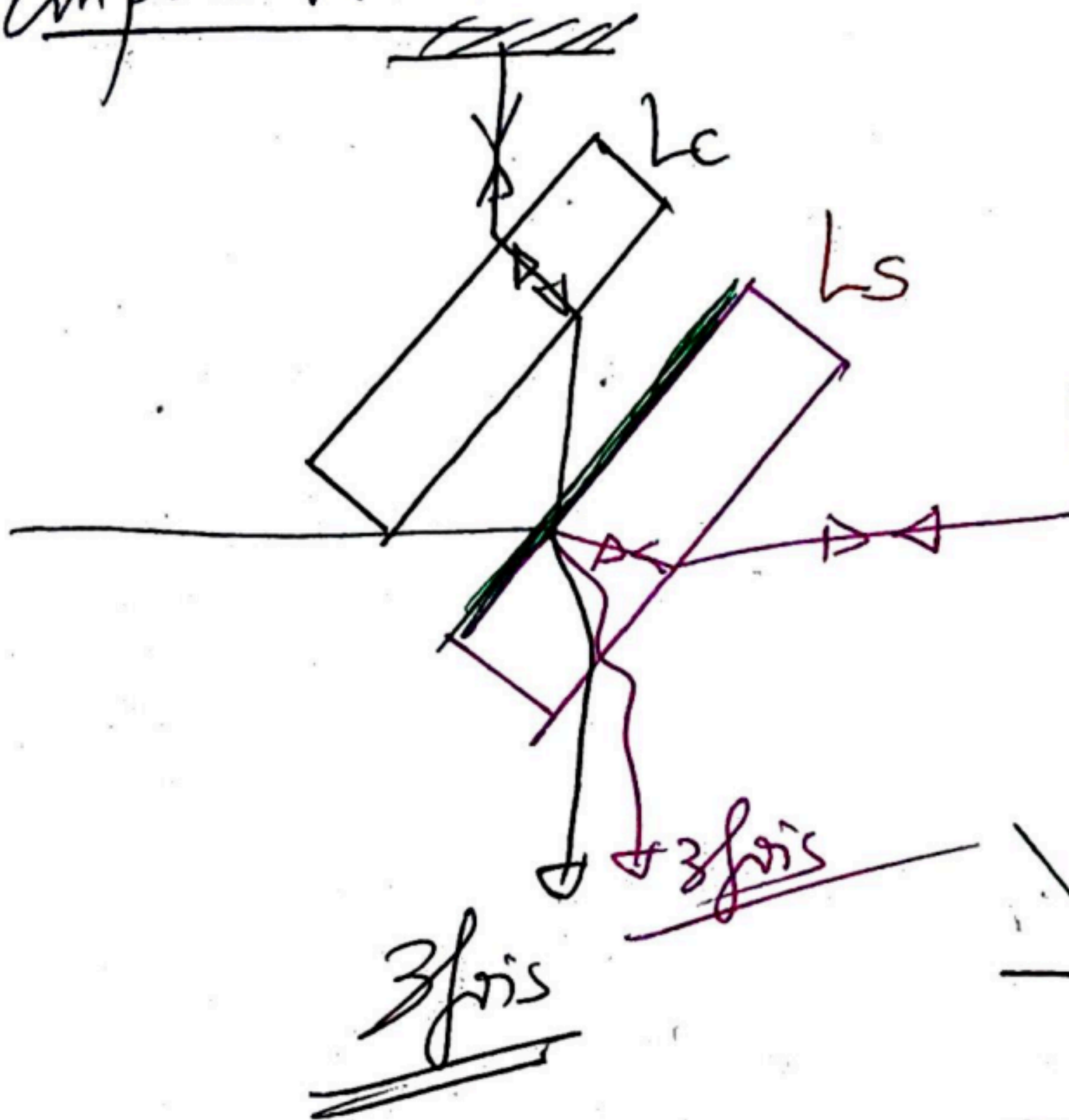


1 fois 3 fois

$$\Delta = 3ne - ne$$

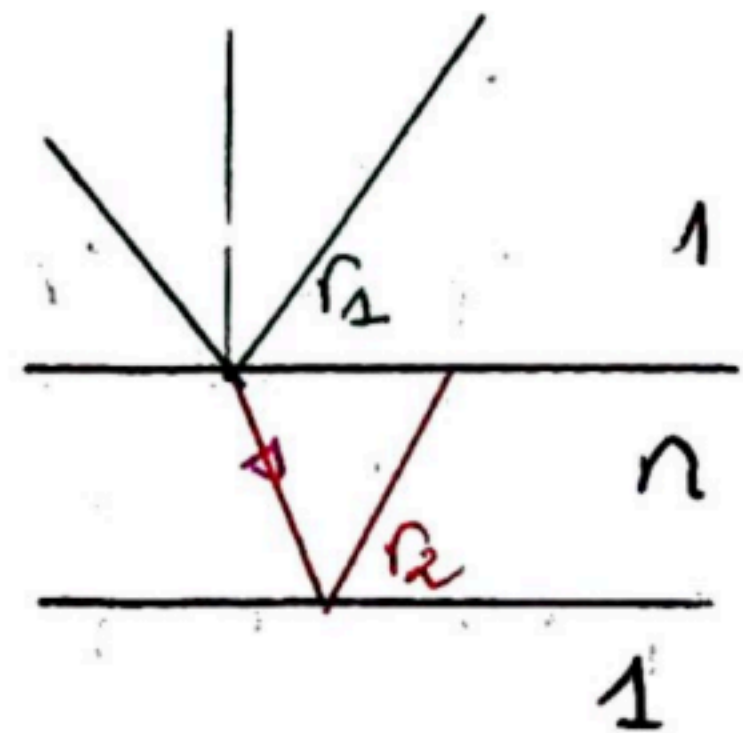
parasite

Compensatrice



$$\delta_{tot} = \delta_g + \frac{\lambda}{2}$$

بفعل 3 مراتب



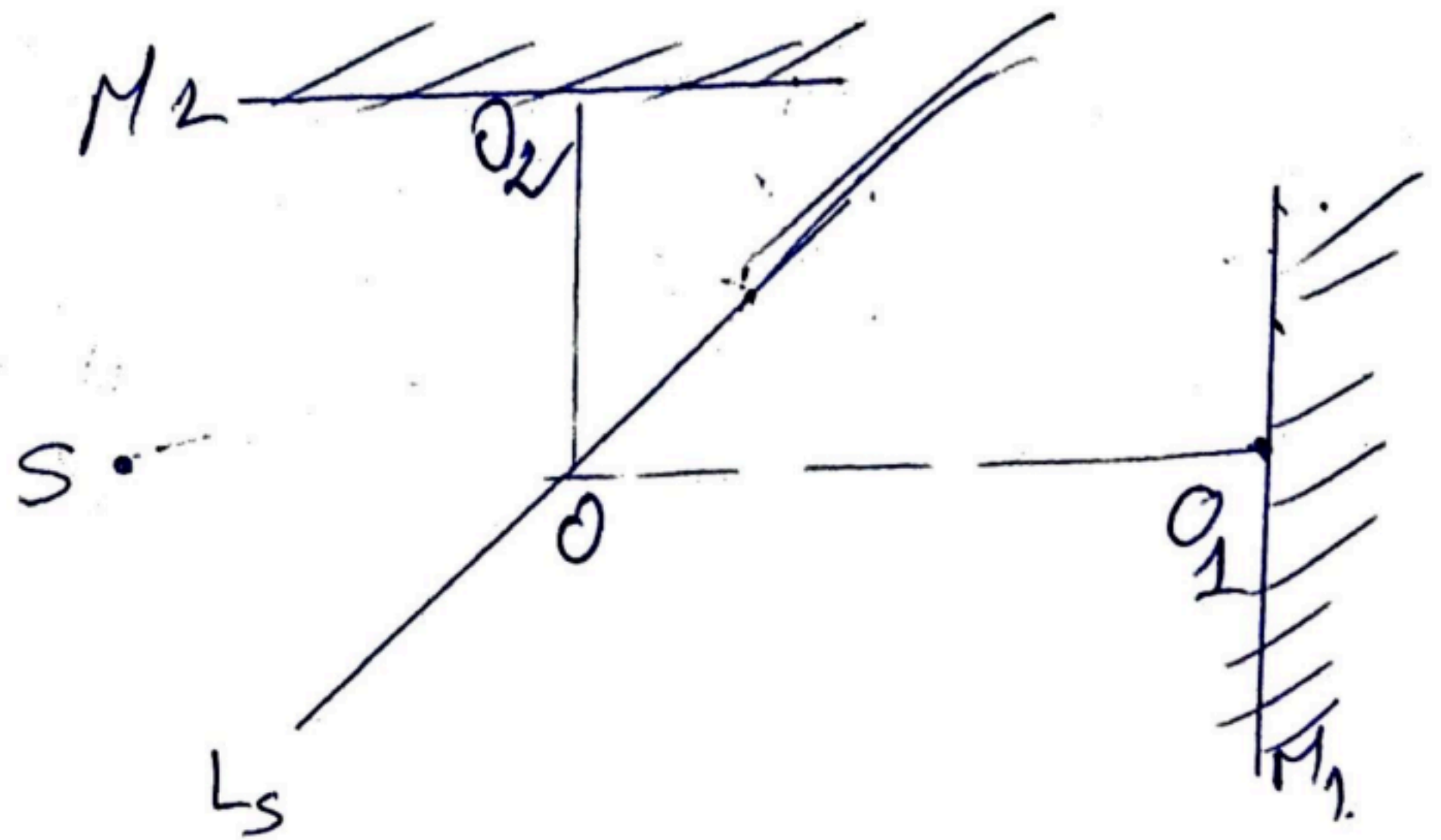
$r =$ coefficient de reflexion
en amplitude :

$$r_{12} = \frac{n_1 - n_2}{n_1 + n_2}$$

$$\frac{1}{n} ; r_1 = \frac{1 - n}{1 + n} < 0 \quad \hookrightarrow \varphi = \pi$$

$$\delta_{sup} = \frac{\lambda}{2}$$

$$\frac{n}{1} \quad r_2 = \frac{n - 1}{n + 1} > 0$$



$$\begin{array}{ccc}
 S \xrightarrow{M_1} S'_1 & \xrightarrow{L_s} & S_1 \\
 O_1 S = O_1 S'_1 & & O S'_1 = O S_1
 \end{array}$$

$$\begin{array}{ccc}
 S \xrightarrow{L_s} S'_2 & \longrightarrow & S_2 \\
 O S = O S'_2 & & O_2 S'_2 = O_2 S_2
 \end{array}$$

$$\begin{aligned} S &= (S_2' I_1' M_\infty) - (S_2' J_2 M_\infty) \\ &= (S_2 I_1' M_\infty) - (S_2 J_2 M_\infty) \end{aligned}$$

$$S_g = S_1 \uparrow \infty - S_2 \uparrow \infty$$

$$= S_1 H = S_1 S_2 \cos \theta$$

$$S_g = 2e \cos \theta$$

$$S_{\text{tot}} = 2e \cos \theta + \frac{\lambda}{2}$$

$$* S_1 S_2 = 2e = ??$$

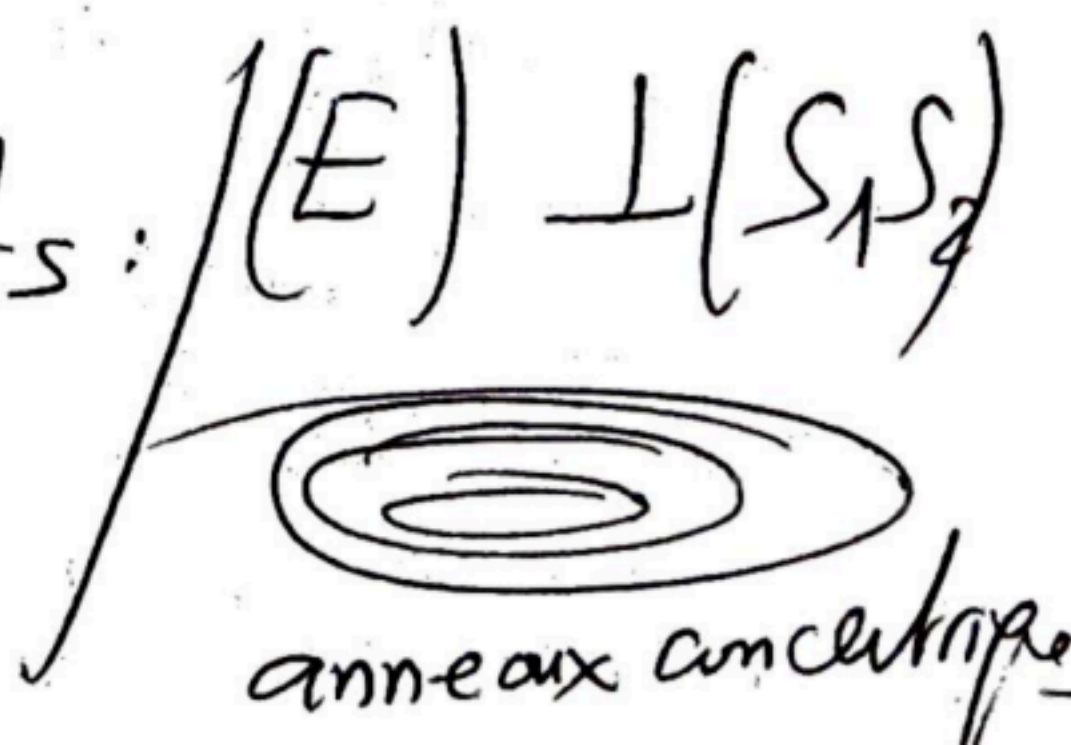
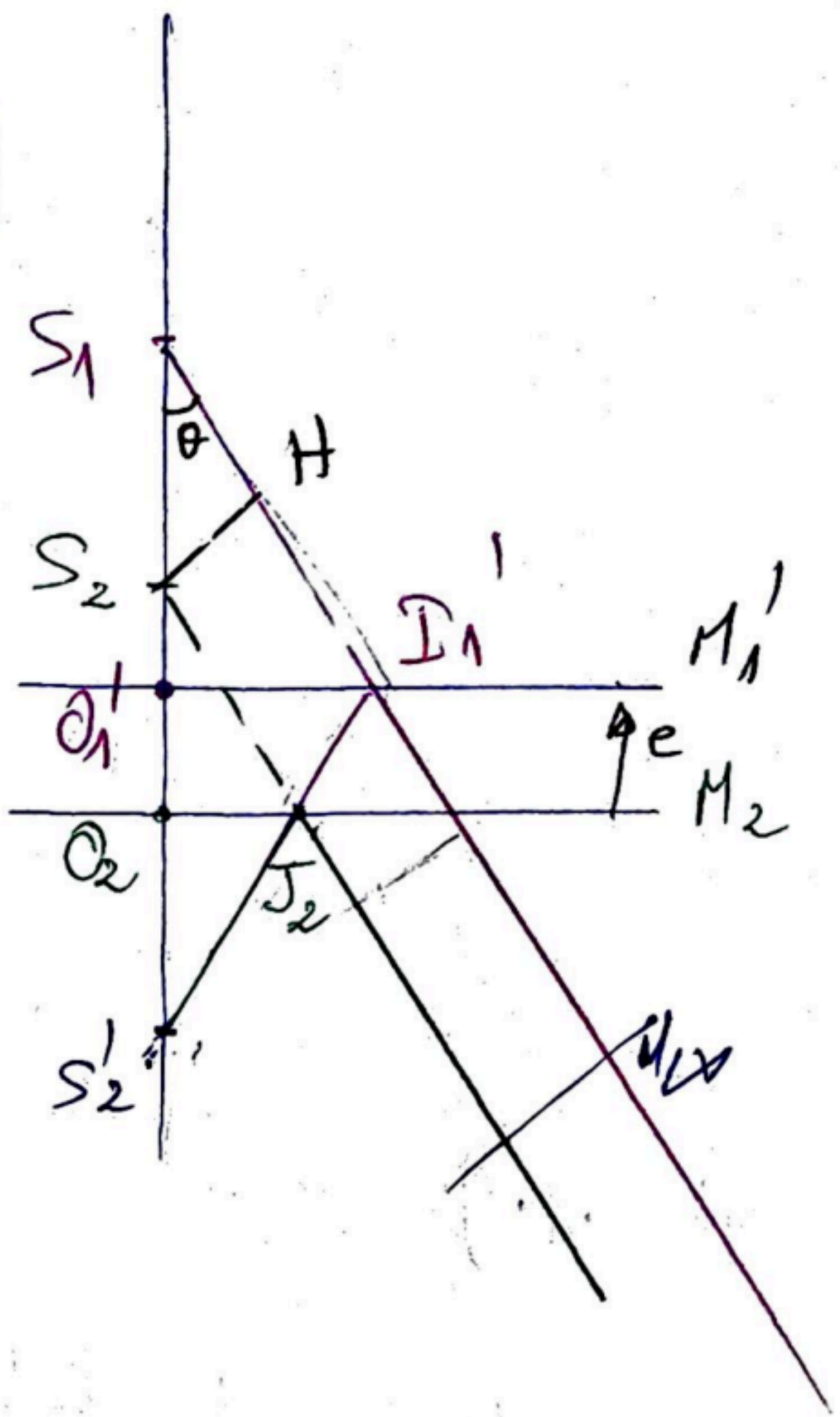
$$\overline{OS_1} = \overline{OS_2} + \overline{S_2S_1} = -d + [(2d) + e] \times 2$$

$$\overline{OS}_2 = -d + 2d \times 2 = 3d$$

4) c) $\delta = S_1 \eta - S_2 \eta =$ Hyperboloides

ct s: $\sqrt{(E)} \perp (S_1, S_2)$

anneaux concentriques



$$S = 2e \cos \theta + \frac{\lambda}{2}$$

6) Ecran plan focal image L_{cv}

$$\tan \theta = \frac{r_{aym}}{f'} \Rightarrow r_{aym} = f' \tan \theta$$

pour même inclinaison θ''

$\therefore f' \nearrow ; r_{ayms} \nearrow$

$$7) p(r) = \frac{S(r)}{\lambda} = \frac{2e \cos \theta}{\lambda} + \frac{1}{2}$$

au centre $M \equiv F' \Rightarrow \theta = 0$

$$p_0 = \frac{2e}{\lambda} + \frac{1}{2} = \frac{2 \times 10^{-3}}{546 \times 10^{-9}} + \frac{1}{2}$$

$$p_0 = 3663,5$$

une tache noire 

$$8) I(r) = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos \varphi$$

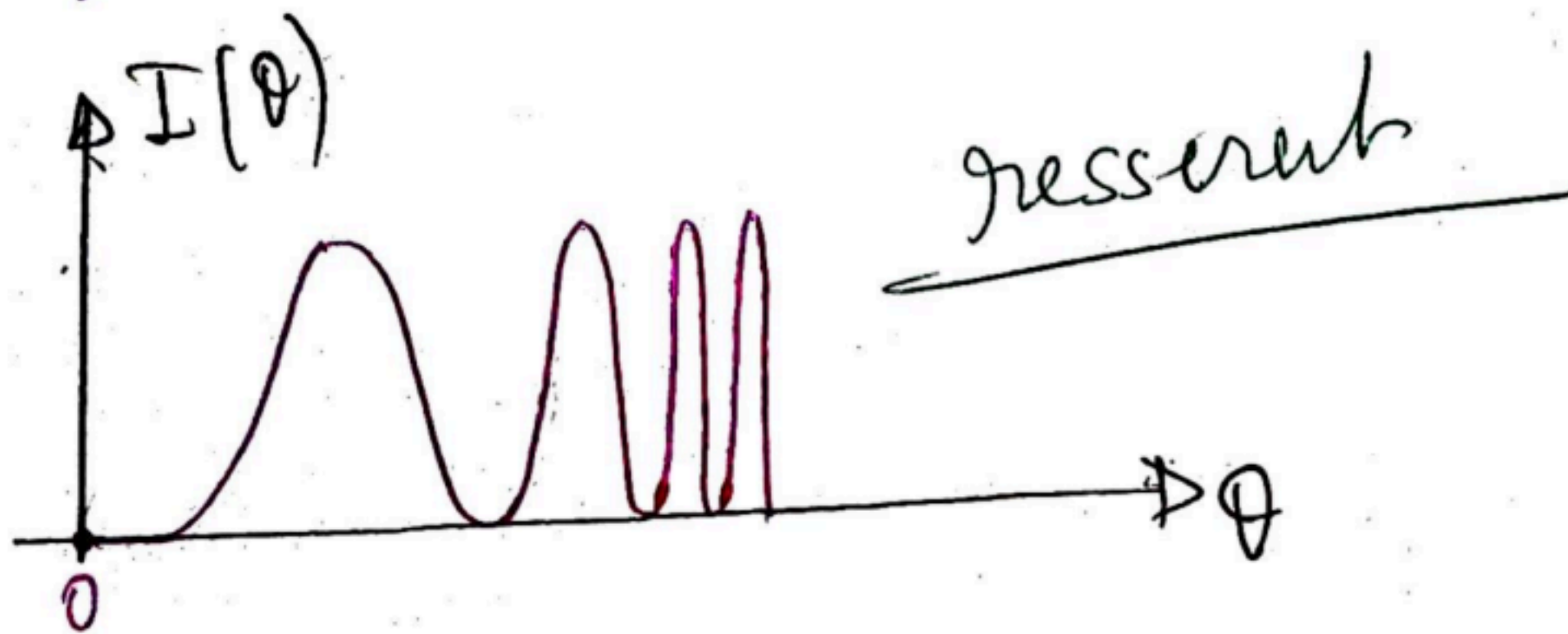
$$= \frac{I_0}{4} + \frac{I_0}{4} + 2 \frac{I_0}{4} \cos \varphi$$

$$I = \frac{I_0}{2} (1 + \cos \varphi)$$

$$I = \frac{I_0}{2} \left(1 + \cos \left[\frac{2\pi}{\lambda} \left(\frac{2e \cos \theta}{2} + \frac{1}{2} \right) \right] \right)$$

$$= \frac{I_0}{2} \left(1 - \cos \left(\frac{4\pi e \cos \theta}{\lambda} \right) \right)$$

$$= \frac{I_0}{2} \left(1 - \cos \left(\frac{4\pi e}{\lambda} \left(1 - \frac{\theta^2}{2} \right) \right) \right)$$



g)a) $p = \frac{2e}{\lambda} \cos \theta + \frac{1}{2}$

$$p = \frac{2e}{\lambda} \left(1 - \frac{\theta^2}{2} \right) + \frac{1}{2}$$

$$p = \left(\frac{2e}{\lambda} + \frac{1}{2} \right) - \frac{e}{\lambda} \theta^2$$

$$p = p_0 - \frac{e}{\lambda} \theta^2$$

$$\frac{e}{\lambda} \theta^2 = (p_0 - p)$$

$$\theta = \sqrt{\frac{(p_0 - p) \lambda}{e}} = \frac{r}{f'}$$

$$r = f' \sqrt{\frac{\lambda}{e} (p_0 - p)}$$

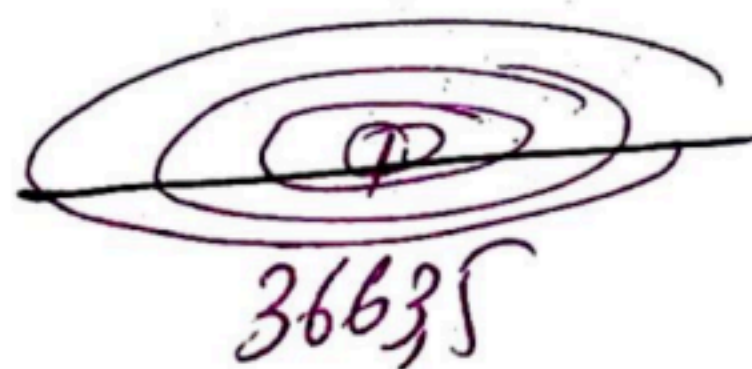
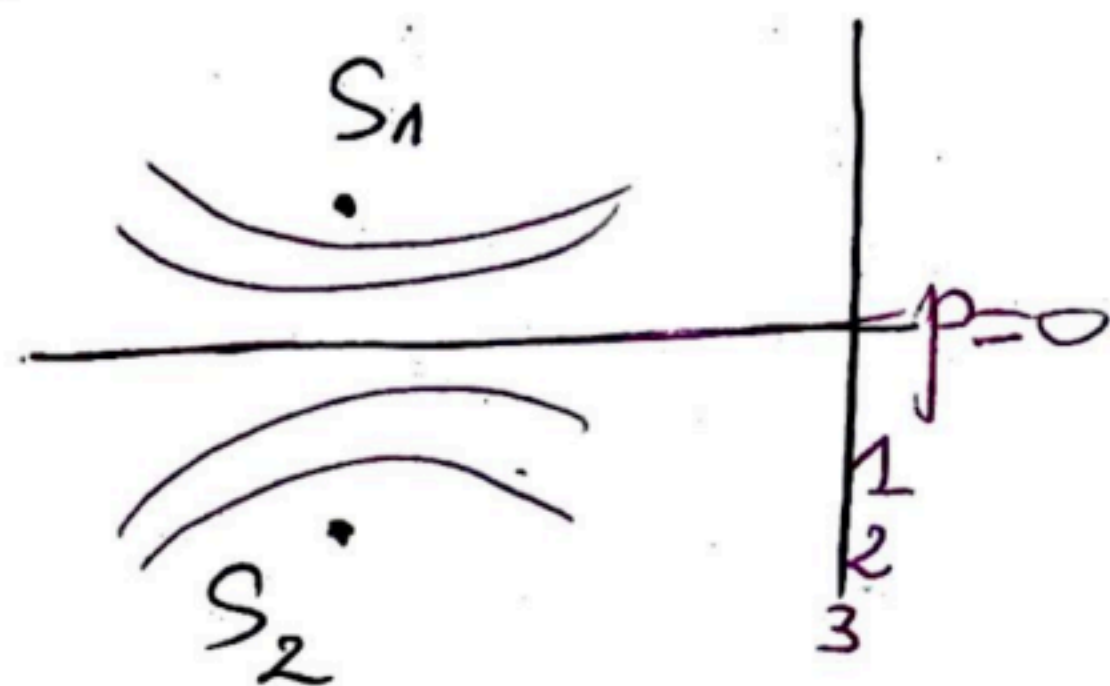
$p_0 = 3663,5$: la distance

$$p_{1S} = p_0 - 1$$

$$p_{2S} = p_0 - 2$$

$$p_{KS} = p_0 - K$$

$$r_{KS} = f' \sqrt{\frac{\lambda K}{e}}$$



$$b) r_{(K+1)} - r_K = f' \sqrt{\frac{\lambda}{e}} \left[\sqrt{K+1} - \sqrt{K} \right]$$

$$K \rightarrow \left(r_{K+1}^S - r_K^S \right) \rightarrow$$

$$(r_{K+1} - r_K)(r_{K+1} + r_K) = f'^2 \frac{\lambda}{e} [(K+1) - K]$$

$$= \left(\frac{\lambda f'^2}{e} \right) = B$$

$$c) \theta_1 = d + e$$

$e \rightarrow$

$$\theta_2 = d$$

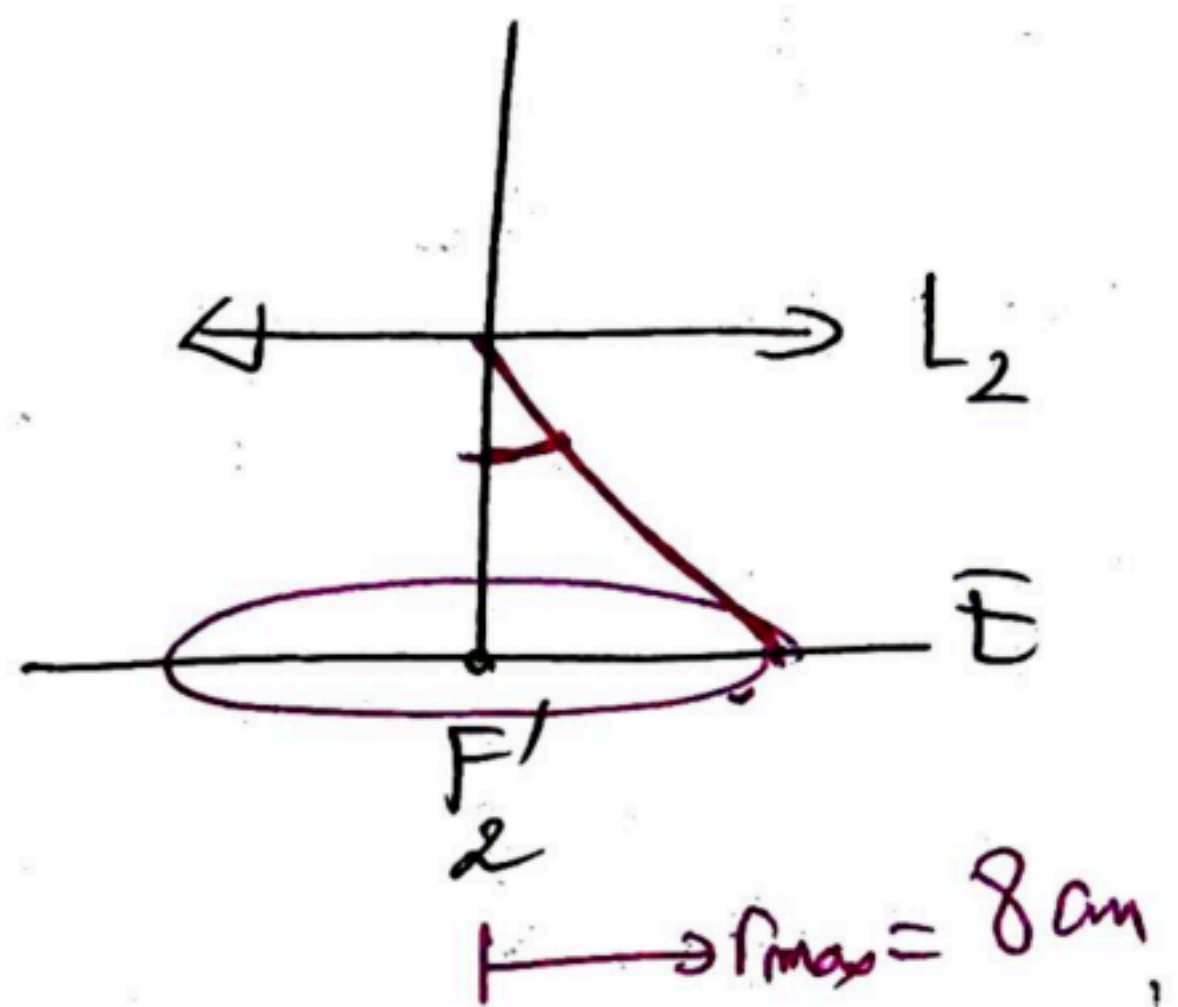
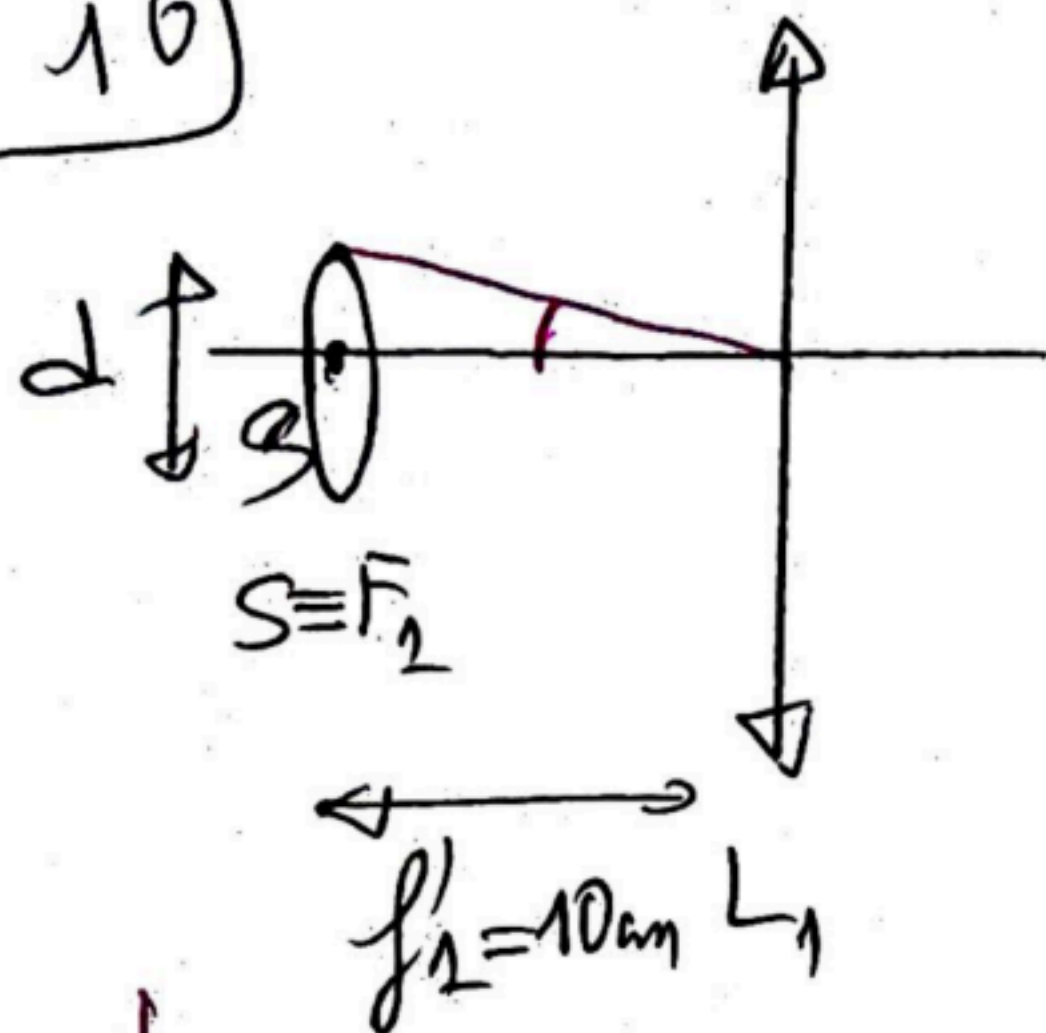
$$* \text{ pour } S(M) = 2e \cos \theta = d \sin \theta$$

$$e \rightarrow (\cos \theta) \rightarrow$$

$$\theta \rightarrow$$

on observe un défilent des anneaux vers le centre
: une fente noire $OO_1 = OO_2$

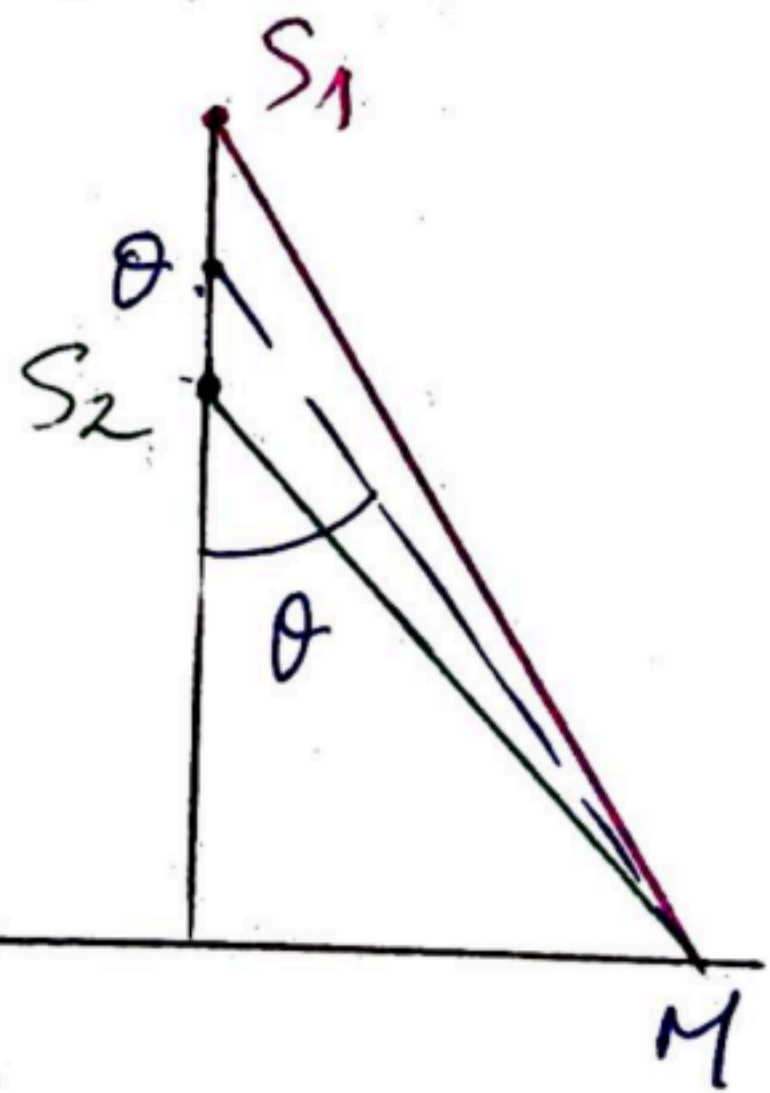
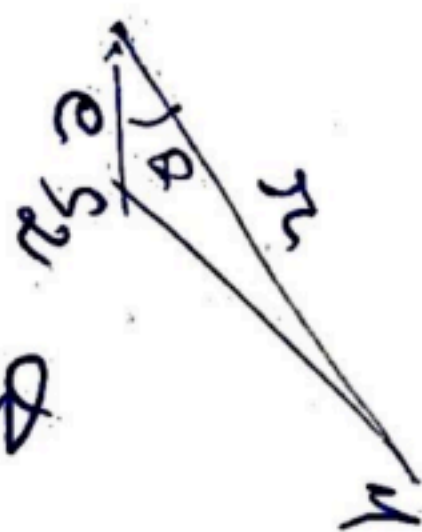
1b)



$$\frac{d}{2f'_1} = \frac{r_{\max}}{f'_2} \Rightarrow d =$$

$$S_1 S_2 = 2e$$

$$(S_2 M)^2 = e^2 + r^2 - 2er \cos \theta$$



$$= r^2 \left[1 + \frac{e^2}{r^2} - \frac{2e}{r} \cos \theta \right]$$

$$S_2 M = \left[1 + \left(-\frac{2e}{2r} \right) \cos \theta \right] r = r \left(1 - \frac{e}{r} \cos \theta \right)$$

$$S_1 M = r \left(1 + \frac{e}{r} \cos \theta \right); \quad \delta = 2e \cos \theta$$

$$p_0 = k + \varepsilon \quad 0 < \varepsilon < 1$$

$$p_{1B} = k = p_0 - \varepsilon$$

$$p_{2B} = (p_0 - \varepsilon) - 1$$

$$p_{3B} = (p_0 - \varepsilon) - 2$$

$$p_{kB} = (p_0 - \varepsilon) - (k - 1)$$

$$p_0 = 3663$$

$$p_{1S} = p_0 - \frac{1}{2}$$

$$p_{1B} = (p_0 - 1)$$

$$p_0 = 3663,2$$

$$\varepsilon = 0,2$$

$$p_{1B} = 3663$$

$$p_{1S} = p_{1B} - \frac{1}{2}$$

$$p_0 = 3663,8$$

$$p_{1S} = 3663,5; \quad p_{1B} = 3663$$

c) Mesure $\Delta\lambda_{Na}$.

$\delta = 2e + \frac{\lambda}{2}$: au centre de l'Écran

$$I(m) = I_{\lambda_1}(m) + I_{\lambda_2}(m)$$

$$= \frac{I_0}{2} \left(1 - \cos\left(\frac{2\pi 2e}{\lambda_1}\right) + 1 - \cos\left(\frac{2\pi 2e}{\lambda_2}\right) \right)$$

$$= I_0 \left[1 - \cos\left(\frac{\pi (2e) \Delta\lambda}{\lambda_0^2}\right) \cos\left(\frac{2\pi (2e)}{\lambda_0}\right) \right]$$

$$C=0 \Rightarrow \frac{\pi (2e) \Delta\lambda}{\lambda_0^2} = \left(m + \frac{1}{2}\right) \pi$$

$$e_m = \frac{\lambda_0^2}{2\Delta\lambda} \left(m + \frac{1}{2}\right)$$

$$e_{m+1} - e_m = \Delta e = \frac{\lambda_0^2}{2\Delta\lambda}$$

$$\Delta\lambda = \frac{\lambda_0^2}{2\Delta e} \simeq 6 \text{ \AA}$$

Coin Fair

$$OO_1 = OO_2 = d$$

$$\underline{OO_1 = OO_2 = d}$$

entourne miroir d'un angle α .

$$\delta = 2e(n)$$

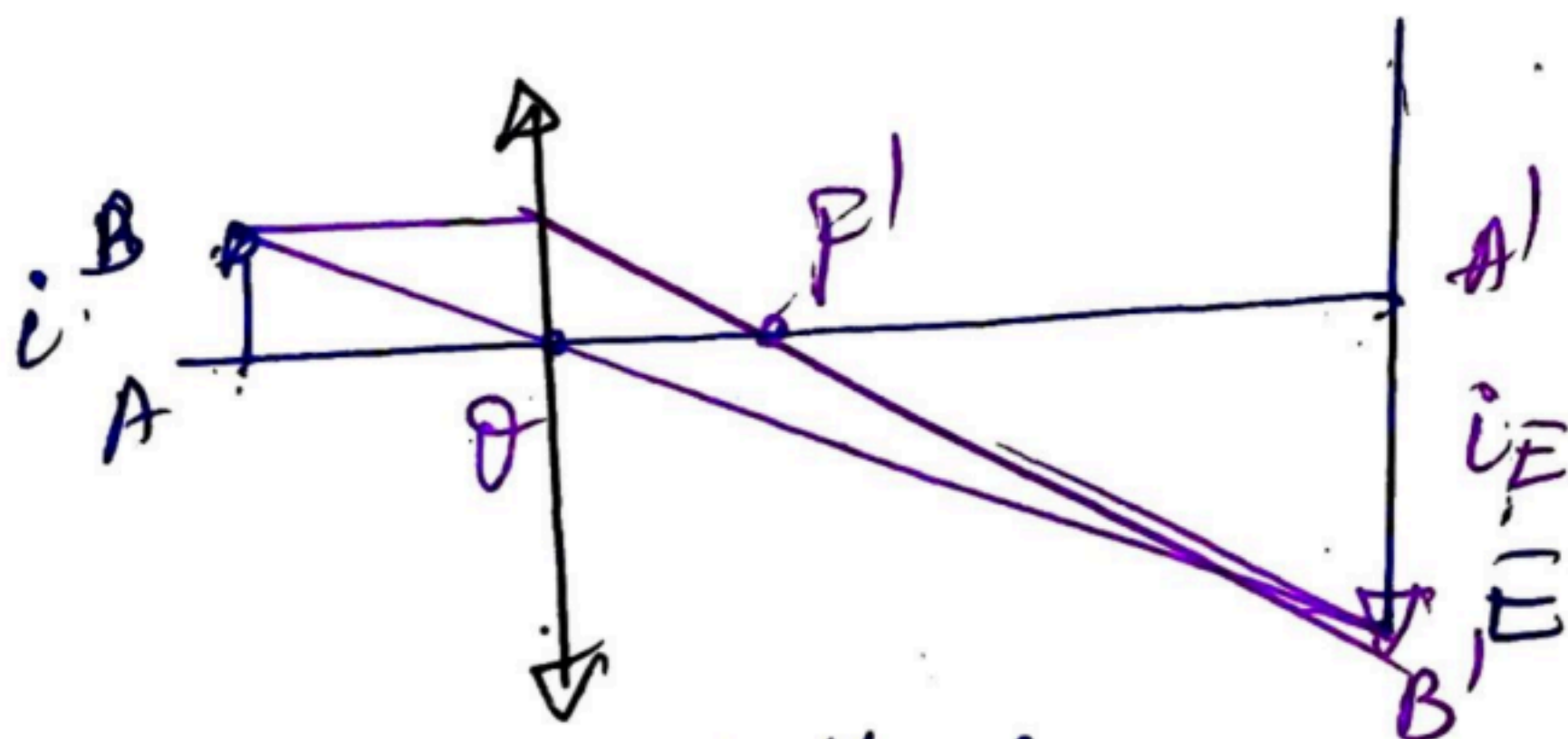
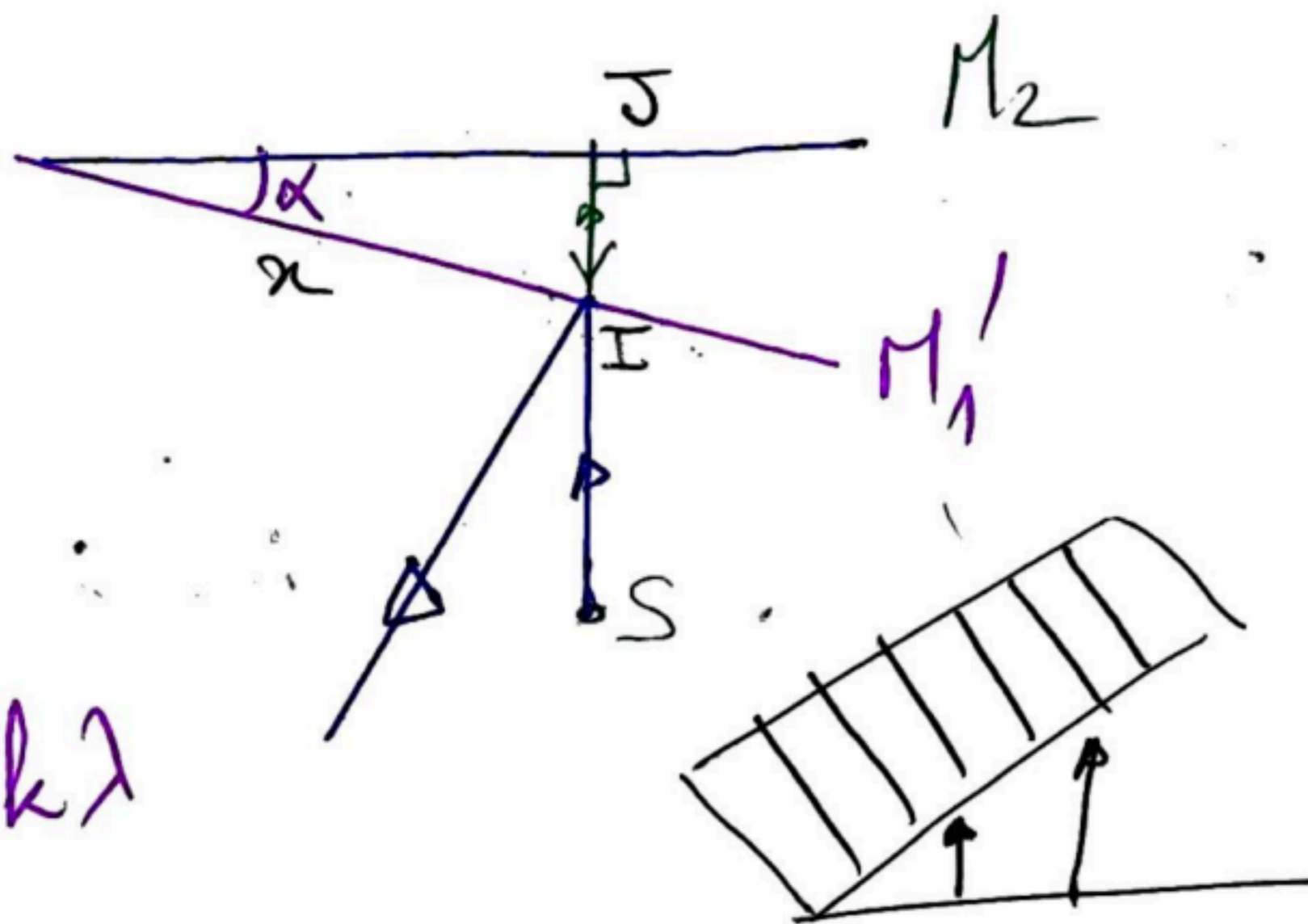
$$\delta = 2\pi \sin \alpha$$

$$\oint = 2\pi\alpha = k\lambda$$

$$x_h = \frac{h\lambda}{2\alpha};$$

$$i = x_{k+1} - x_k = \frac{\lambda}{2\alpha}$$

localisés
au voisinage
Miroir



$$\frac{1}{OA'} - \frac{1}{OA} = \frac{1}{OF}, \quad |\gamma| = -\frac{iE}{c} \quad \text{phần liên hợp}$$

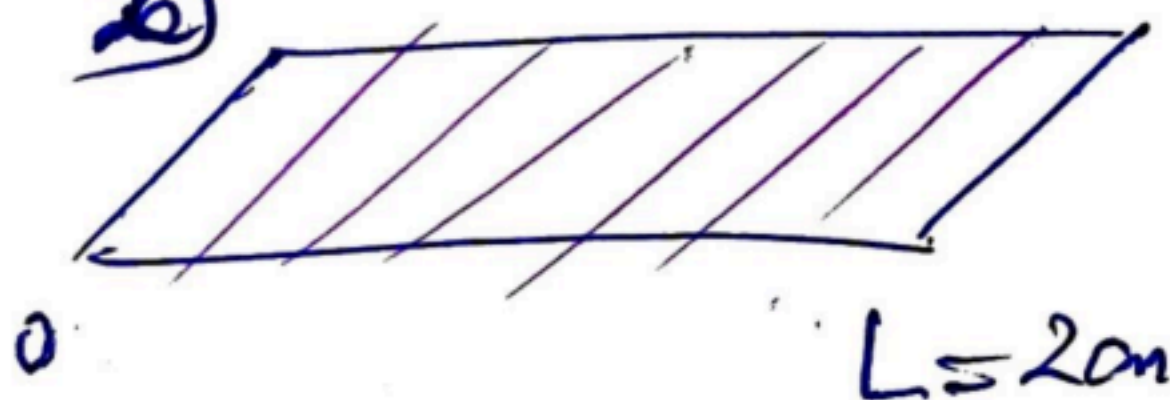
phen conjugate

$$i_E = 1 \text{ mm}$$

$$\Rightarrow i = 1 \text{ mm}$$

$$|\gamma| = 4$$

2)



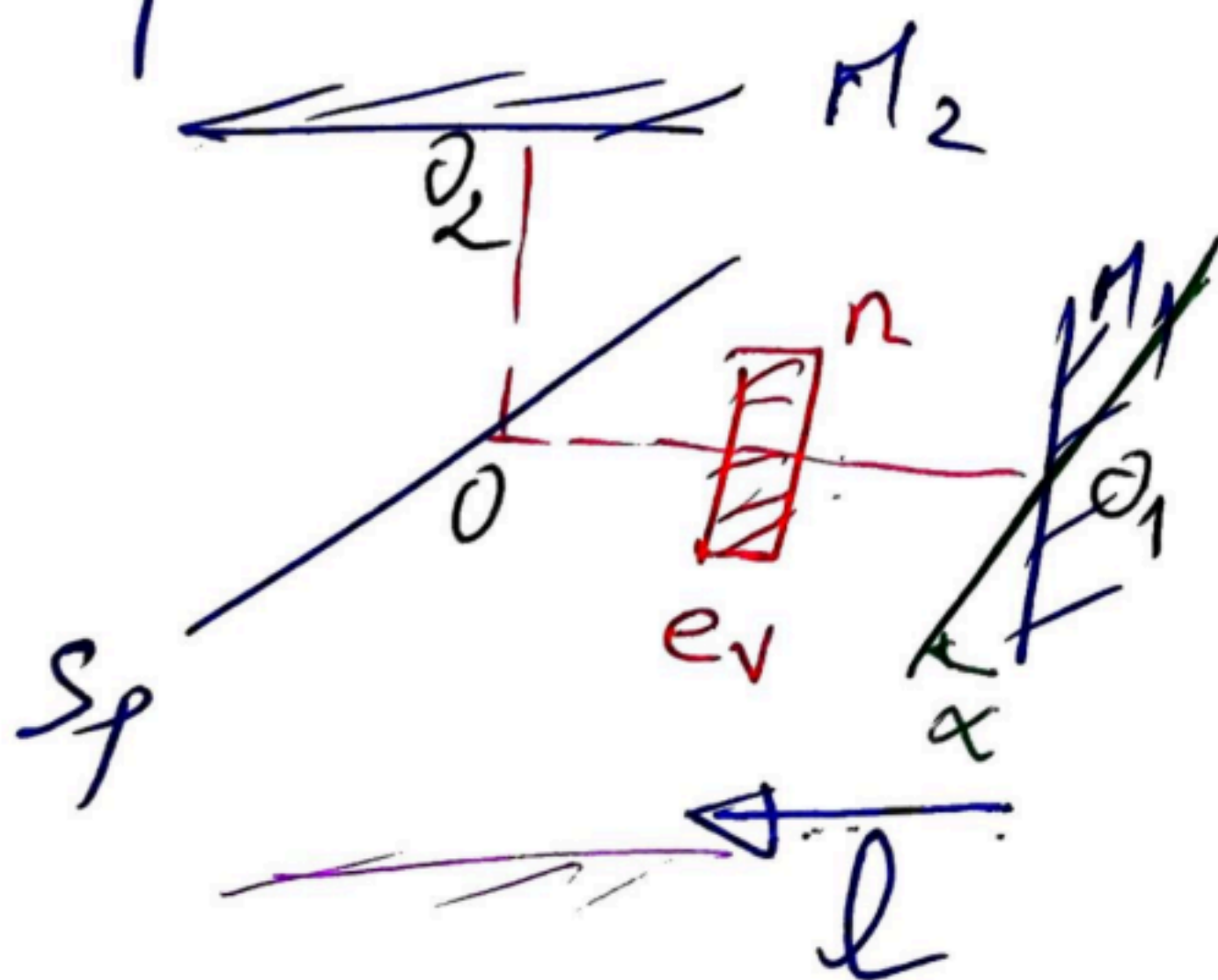
$$0 \leq x \leq L \Rightarrow 0 \leq p \leq \frac{L}{i} =$$

- 3) a) frange centrale blanche - -
 • deux franges noires.
 • 99 franges irisées.
 • blanc d'ordre supérieur.

$$b) OO_2 = OO_1 = d$$

$$[OO_1] = (d - e) + ne$$

$$[OO_2] = d$$



$$\delta_{\text{hène}} = 2(n-1)e$$

$$\delta_{\text{tot}} = 2n\alpha + 2(n-1)e$$

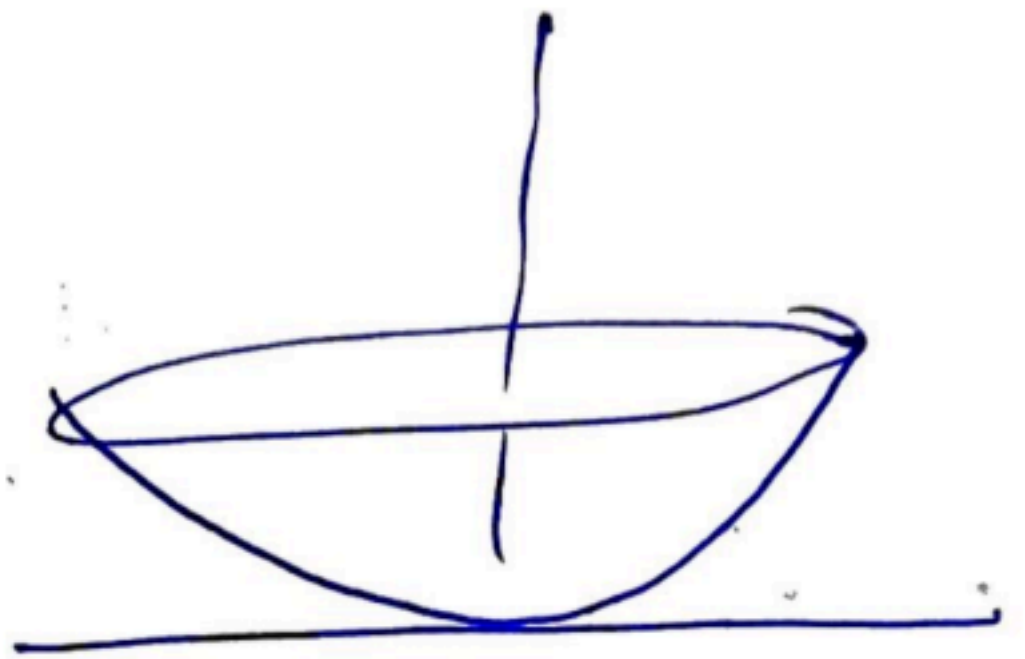
$$\underline{\underline{\alpha \approx 0}} \quad \delta_{\text{tot}} \gg L_c = 1 \mu\text{m}.$$

on observe le blanc d'ordre supérieur

$$2l = 2(n-1)e$$

$$l = (n-1)e$$

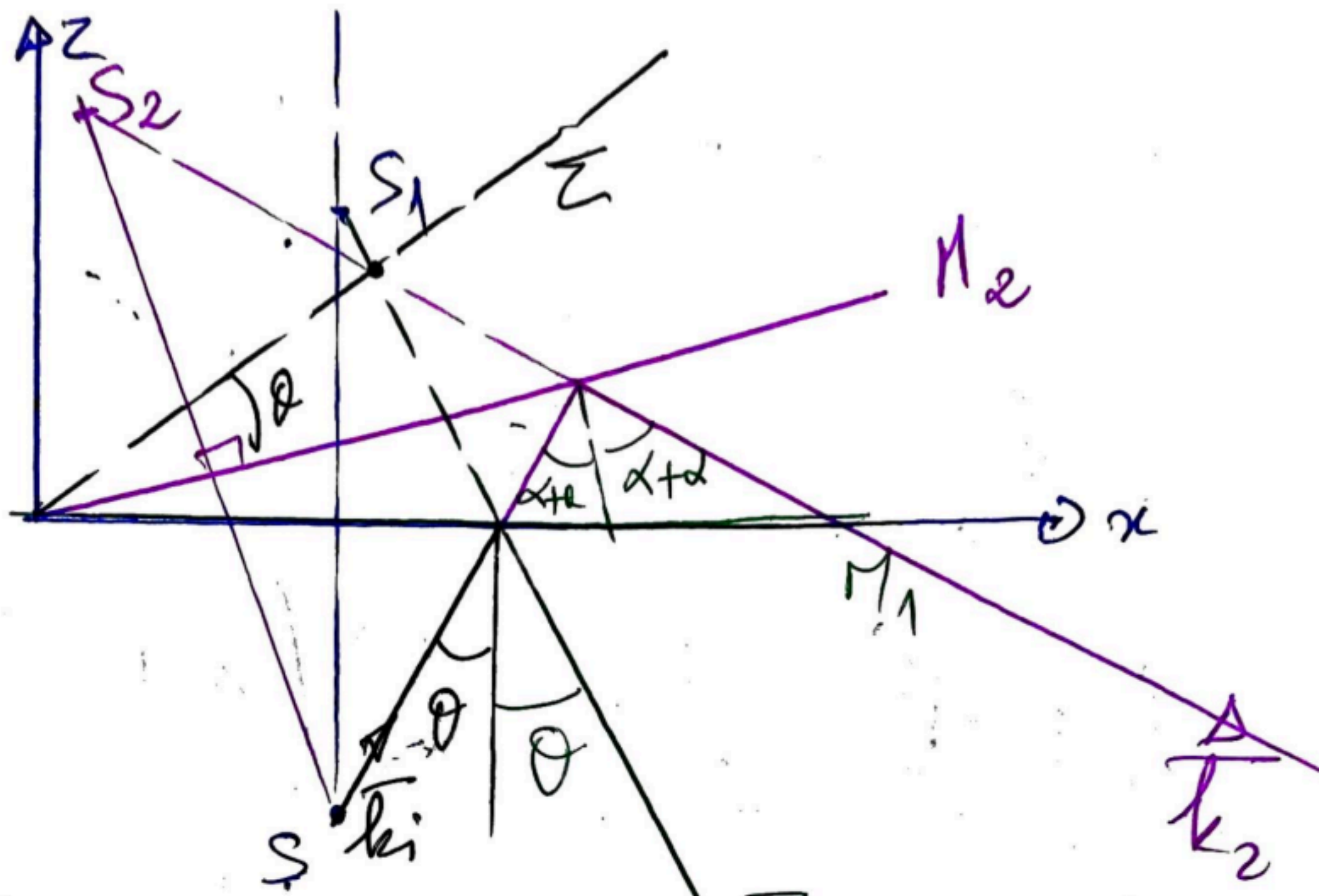
d) 1182 2015



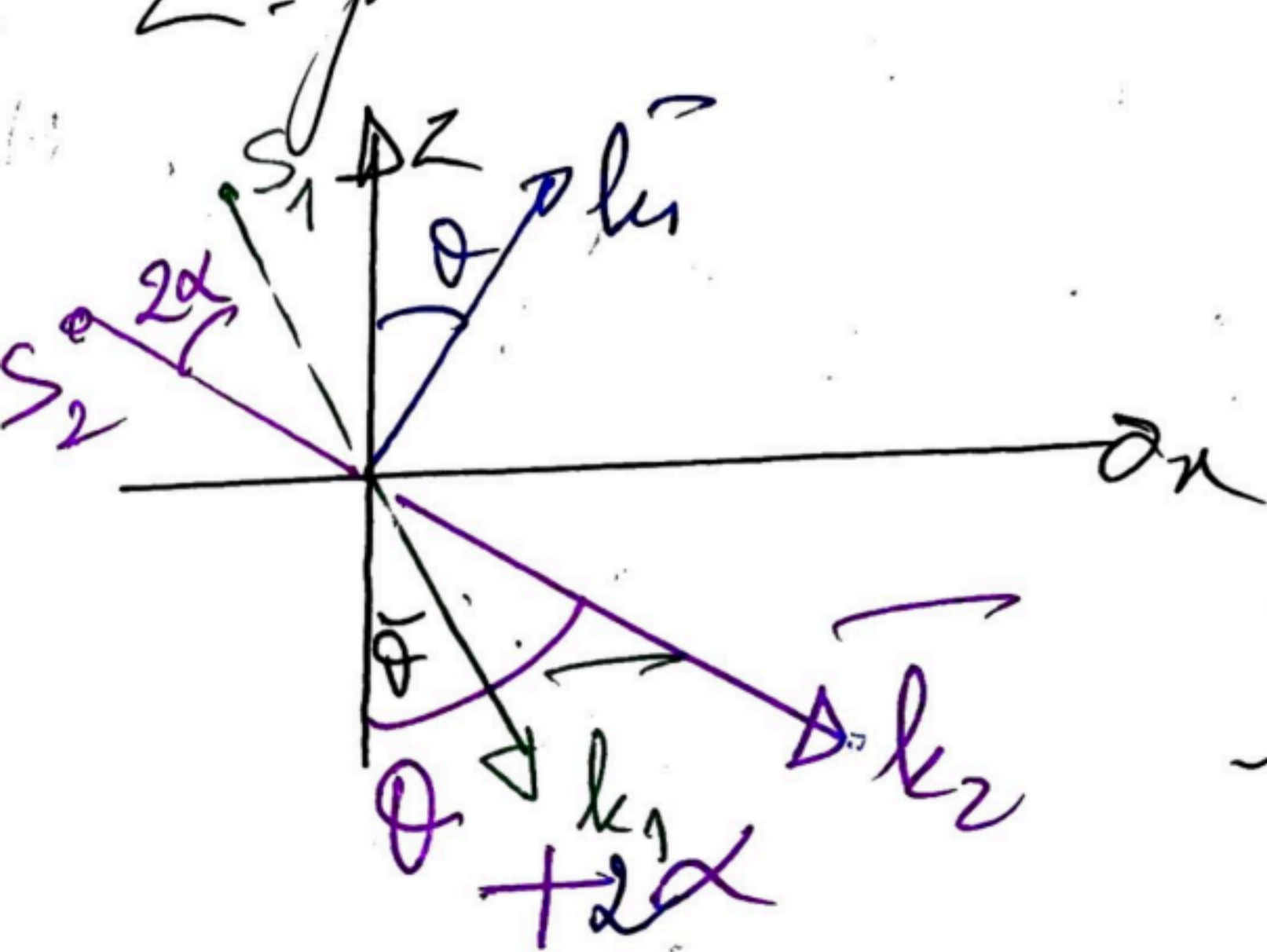
coin d'air



anneaux de Newton



$\Sigma =$ plan de localisation des franges



$$\vec{k}_1 = \frac{2\pi}{\lambda} \begin{pmatrix} \sin \theta \\ 0 \\ -\cos \theta \end{pmatrix}$$

$$\vec{k}_2 = \frac{2\pi}{\lambda} \begin{pmatrix} \sin(\theta + 2\alpha) \\ 0 \\ -\cos(\theta + 2\alpha) \end{pmatrix}$$

$$\phi = (\vec{k}_2 - \vec{k}_1) \cdot \vec{r}$$

$$= \frac{2\pi}{\lambda} \left[x (\sin(\theta + 2\alpha) - \sin \theta) + z (\cos \theta - \cos(\theta + 2\alpha)) \right]$$

$$\phi = \frac{2\pi}{\lambda} (2\sin\alpha) [x \cos(\alpha + \theta) + z \sin(\alpha + \theta)]$$

$$= \frac{2\pi}{\lambda} 2\alpha [x + z(\alpha + \theta)]$$

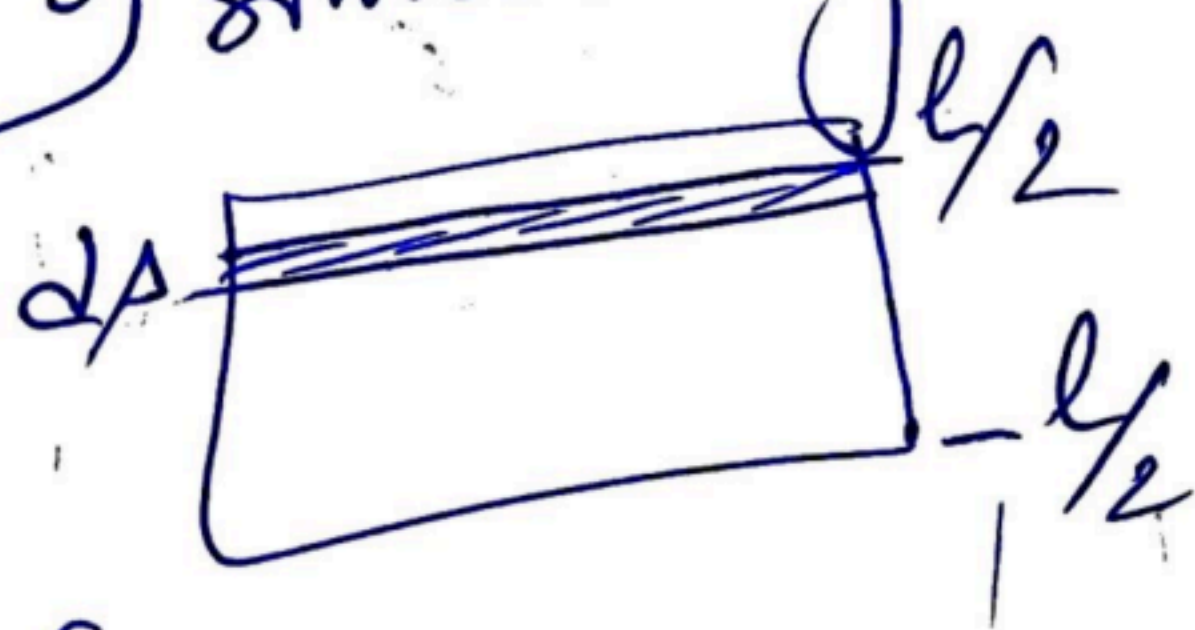
$$2) p(r) = \frac{\phi}{2\pi} = \frac{2\alpha}{\lambda} (x + z(\alpha + \theta))$$

$$b) I(r) = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos\phi$$

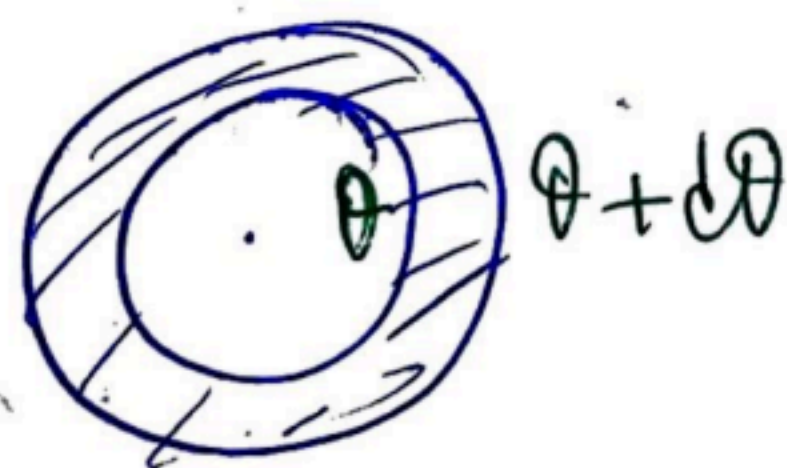
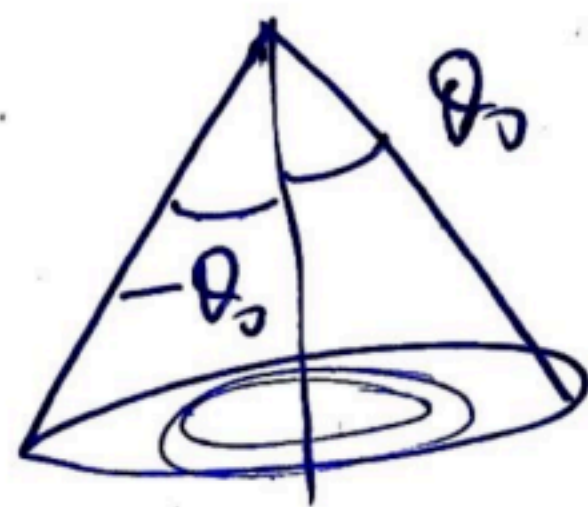
$$I = I_0 + I_0 + 2I_0 \cos\phi$$

$$I = 2I_0 \left(1 + \cos \frac{2\pi}{\lambda} 2\alpha (x + z(\alpha + \theta)) \right)$$

3) $\sin\alpha$ large



$$\int dI = I$$



$$dI = 2I_0 \left[1 + \cos \left(\frac{4\pi d}{\lambda} (n + z(\alpha + \theta)) \right) \right] d\theta$$

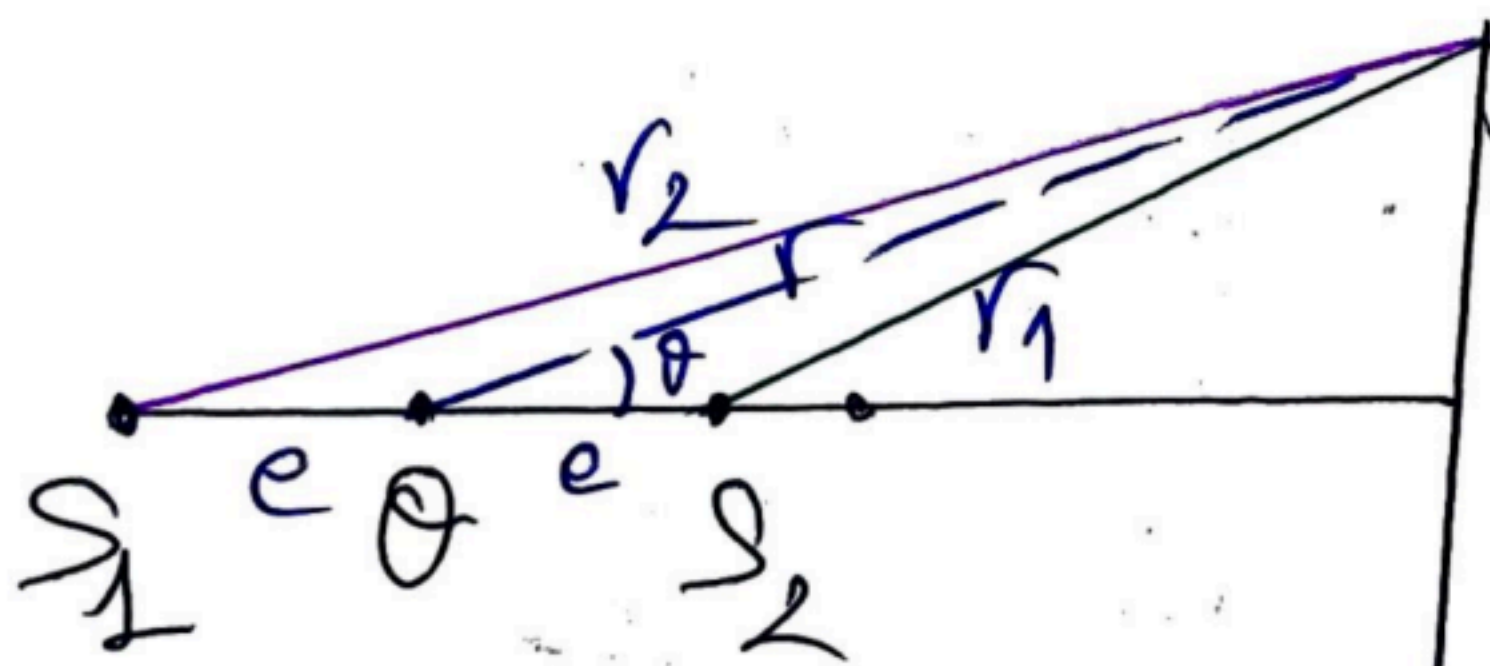
$$I = \frac{2I_0}{2\theta_0} \int \left(1 + \cos \frac{4\pi d}{\lambda} (n + z(\alpha + \theta)) \right) d\theta$$

$$= 2I_0 \left[1 + \operatorname{sinc} \left(\frac{4\pi d}{\lambda} z\theta_0 \right) \cos \frac{4\pi d}{\lambda} (n + \alpha) \right]$$

$z=0$ $\forall \theta$ $V(0, \theta) = 1$

$$I = 2I_0 \left(1 + \cos \left(\frac{4\pi d}{\lambda} n \right) \right)$$

$i = \frac{\lambda}{2d}$ $PT2$ 2007

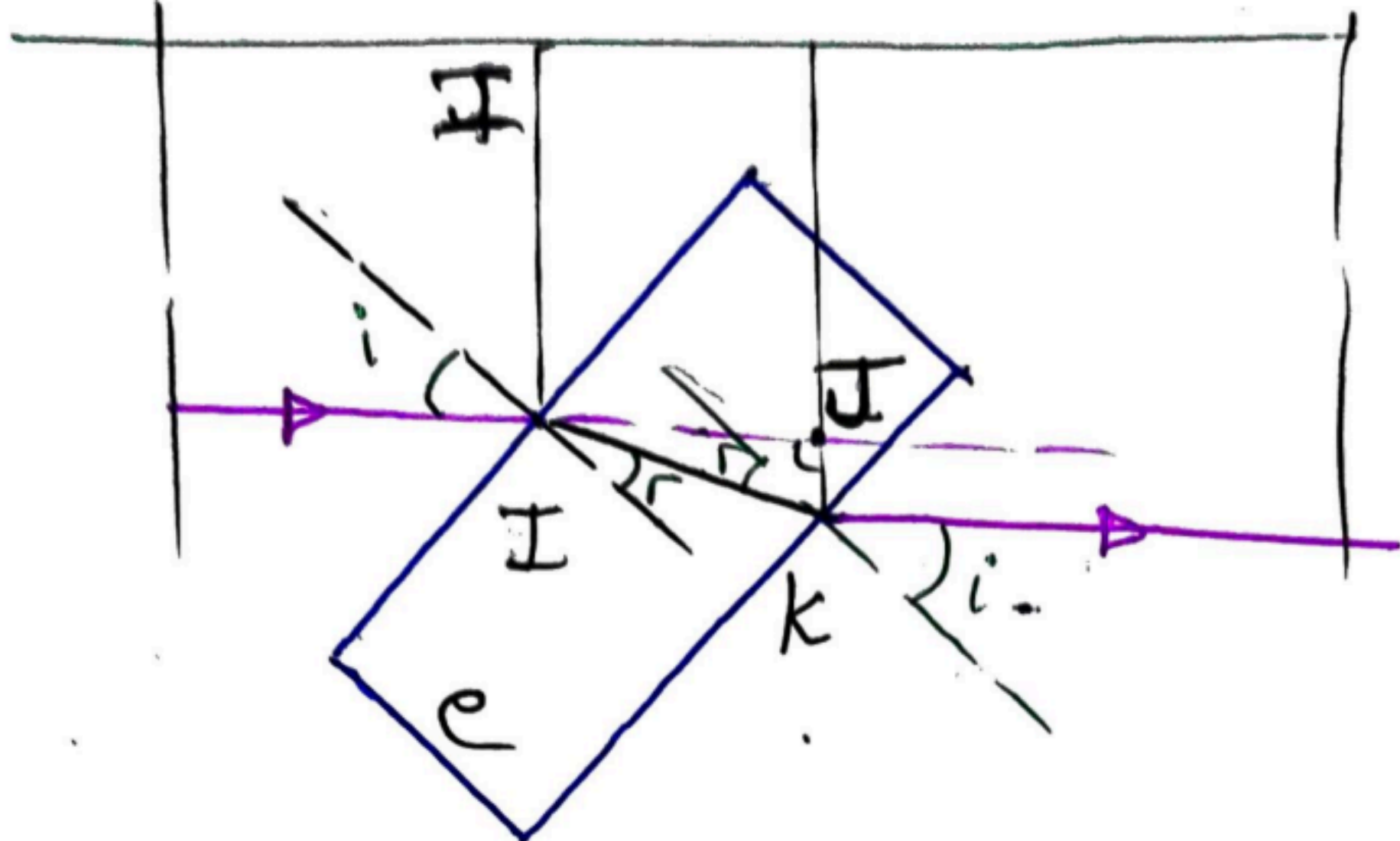
$$S = S_1 \cdot \eta - S_2 \Pi$$


$$r_1^2 = e^2 + r^2 - 2er \cos \theta$$

$$\frac{202}{2003}$$

$$f = 2e \cos \theta$$

$$p = \frac{2e \cos \theta}{\lambda}$$



$$\delta = (IK)n - (IJ)$$

$$\cos r = \frac{e}{IK} \Rightarrow IK = \frac{e}{\cos r}$$

$$\cos(i - r) = \frac{IJ}{IK} \Rightarrow IJ = \frac{e}{\cos r} \cos(i - r)$$

$$\delta = \frac{e}{\cos r} (n - \cos i \cos r - \sin i \sin r)$$

$$= \frac{e}{\cos r} (n - n \sin^2 r - \cos i \cos r)$$

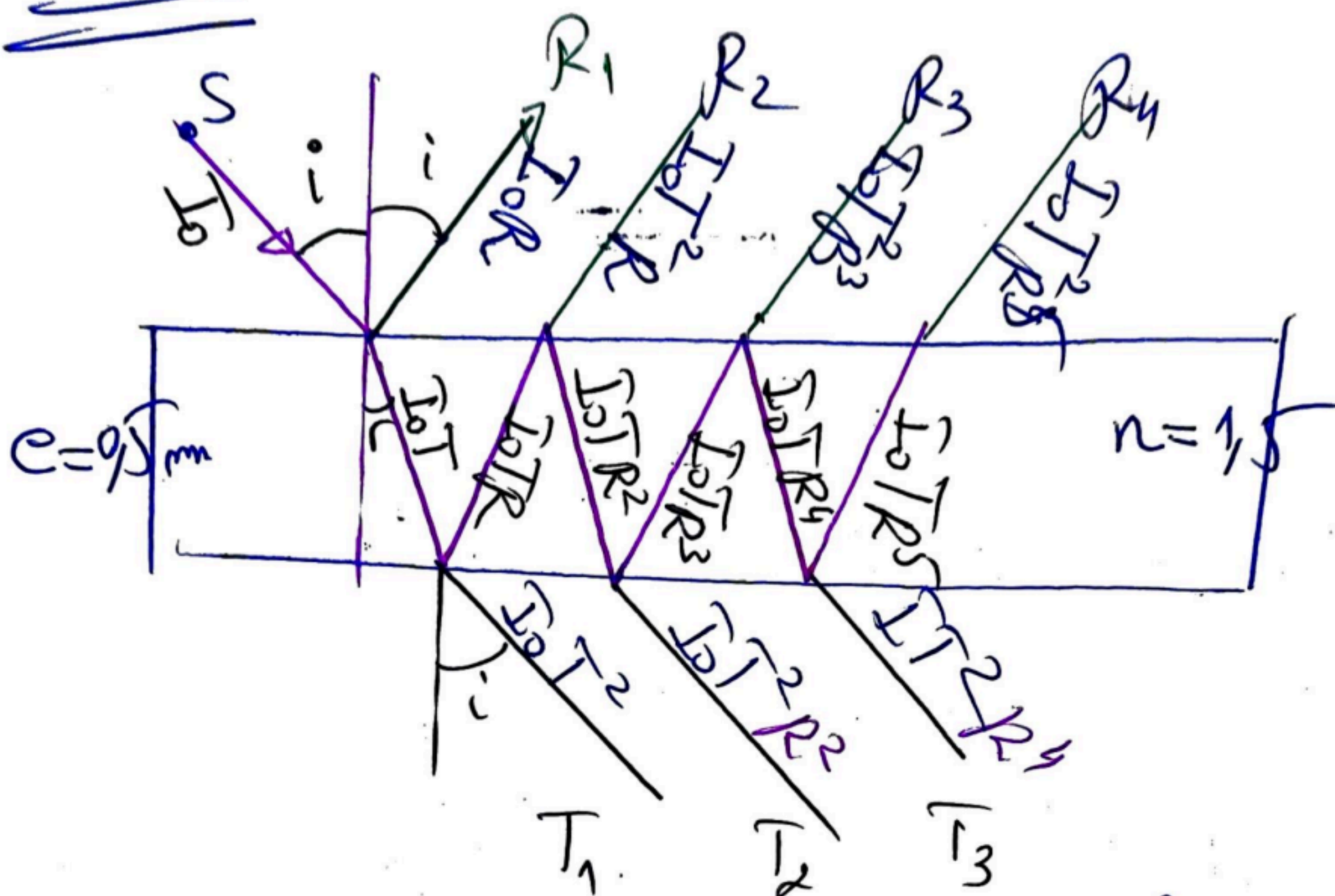
$$= \frac{e}{\cos r} (n \cos^2 r - \cos i \cos r)$$

$$\delta = e (n \cos r - \cos i)$$

M22 2004

Pb4

$$R+T=1$$



$$R = |r_{12}|^2 = \left(\frac{n_1 - n_2}{n_1 + n_2} \right)^2 = \left(\frac{1 - n}{1 + n} \right)^2 = 0.04$$

$$\frac{I_2}{I_1} = T^2 = (1 - 0.04)^2 \approx 1 \quad \left| \quad \frac{I_4}{I_1} = R^4 T^2 \right.$$

$$\frac{I_3}{I_1} = R^2 T^2$$

$$(0.04)^2 (0.96)^2 \ll 1$$

$\ll 1$

phénomène d'interférence à 2 ondes.

$$C = \frac{2\sqrt{I_1 I_2}}{I_1 + I_2} = \frac{2\sqrt{(I_0)^2 R^2 T^2}}{I_0 R (1 + T^2)}$$

$$C = \frac{2\cancel{T}}{1 + T^2} = \frac{0,96 \times 2}{1 + (0,96)^2} \approx 1$$

* par transmission

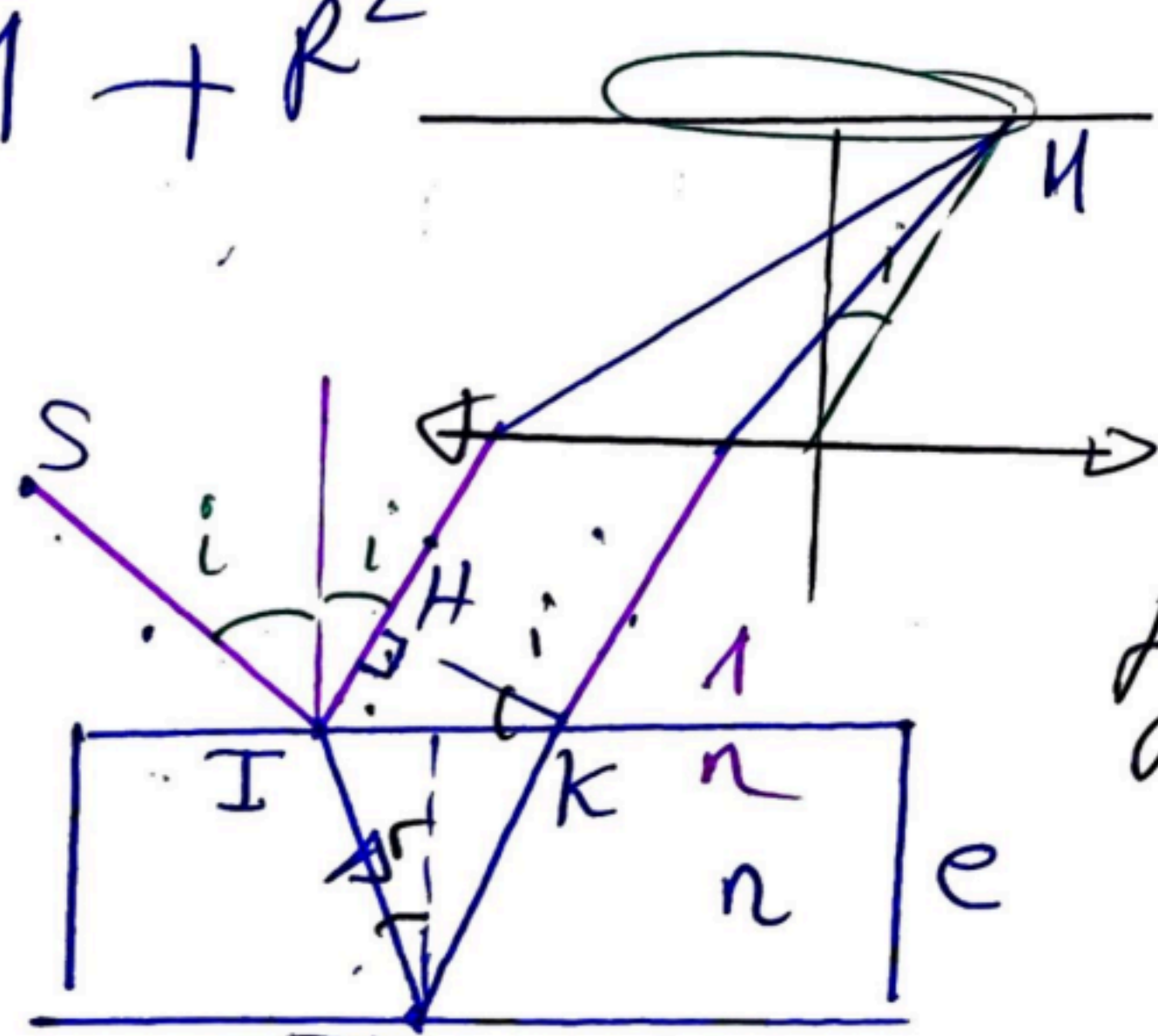
$$\frac{I_2}{I_1} = R^2 = (0,04)^2 \ll 1$$

$$C = \frac{2R}{1 + R^2} \approx 0,08 \ll 1$$

2)

$$\cos r = \frac{e}{IJ}$$

$$\sin i = \frac{IH}{IK}$$



$$\sin r = \frac{IK}{2e}$$

$$[IJK] - [IHH] = 2(IJ)n - (IH) + \frac{\lambda}{2}$$

$$\delta_{\text{Ref}} = 2ne \cos r + \frac{\lambda}{2}$$

لا يقول حياء

$$r_{\text{air/verre}} = \left(\frac{1-n}{1+n} \right) < 0$$

$$\delta_H = 2ne \cos r + \frac{\lambda}{2}$$

$$p(r) = \frac{2ne}{\lambda} \cos r + \frac{1}{2}$$

$$p(r) = \frac{2ne}{\lambda} \left(1 - \frac{r^2}{2} \right) + \frac{1}{2}$$

$$p(r) = p_0 - \frac{ne}{\lambda} r^2 ; \quad \sin i = n \sin r$$

$$p = p_0 - \frac{ne}{\lambda} \frac{i^2}{n^2}$$

$$p = p_0 - \frac{e}{\lambda} \frac{i^2}{n}$$

$$i = \sqrt{\frac{\lambda n}{e}} \sqrt{p_0 - p} = \frac{e}{f'}$$

$$f = f' \sqrt{\frac{\lambda n}{e}} \sqrt{p_0 - p}$$

$$0 < \varepsilon < 1$$

or $p_0 = k + \varepsilon$

$$p_{1B} = (p_0 - \varepsilon), \quad p_{2B} = p_0 - \varepsilon - 1$$

$$p_{3B} = (p_0 - \varepsilon) - 2;$$

$$p_{kB} = p_0 - \varepsilon - (k - 1)$$

$$p_0 - p_{kB} = \varepsilon + (k - 1)$$

$$f_{kB} = f' \sqrt{\frac{\lambda n}{e}} \sqrt{\varepsilon + (k - 1)}$$

2) b) $p_0 = \frac{2en}{\lambda} + \frac{1}{2} = \frac{3f_0^2}{2}, \quad f = k + \varepsilon$

$$\varepsilon = 0,5$$

$$f_{kB} = f' \sqrt{\frac{\lambda n}{e}} \sqrt{(k - \frac{1}{2})}$$

$$I_B = \int' \sqrt{\frac{\lambda n}{2e}}$$

$$I_{2B} = \int' \sqrt{\frac{\lambda n}{2e}} \sqrt{3} = I_B \sqrt{3}$$

$$I_{3B} = \int' \sqrt{\frac{\lambda n}{2e}} \sqrt{5} = I_B \sqrt{5}$$

$$(I_{3B} - I_{2B}) < (I_{2B} - I_B)$$

3) $e = 0,29 \mu m$ $n = 1,5$

$$\lambda \in [400 nm - 750 nm]$$

a) $i = i_{min} ??$

$$p = \left(\frac{2ne}{\lambda} \cos r + \frac{1}{2} \right) = N$$

$$\frac{2ne}{\lambda_v} \cos r = \left(N - \frac{1}{2} \right)$$

$$\cos r = \frac{\left(N - \frac{1}{2} \right) \lambda_{verte}}{2ne}$$

$$\cos r = 0,625 \left(N - \frac{1}{2}\right)$$

$$N=1; \cos r = \frac{0,625}{2}$$

$$\underline{N=2} \quad \cos r = 0,625 \times \frac{3}{2} = \cos r_m$$

$$N=3 \quad \cos r > 1$$

$\underbrace{\quad \quad \quad}_{\pi \text{ 2ht min}} \quad \underbrace{\quad \quad \quad}_{(\cos r)_{\max}}$

$\nearrow$

$$i = 28^\circ$$

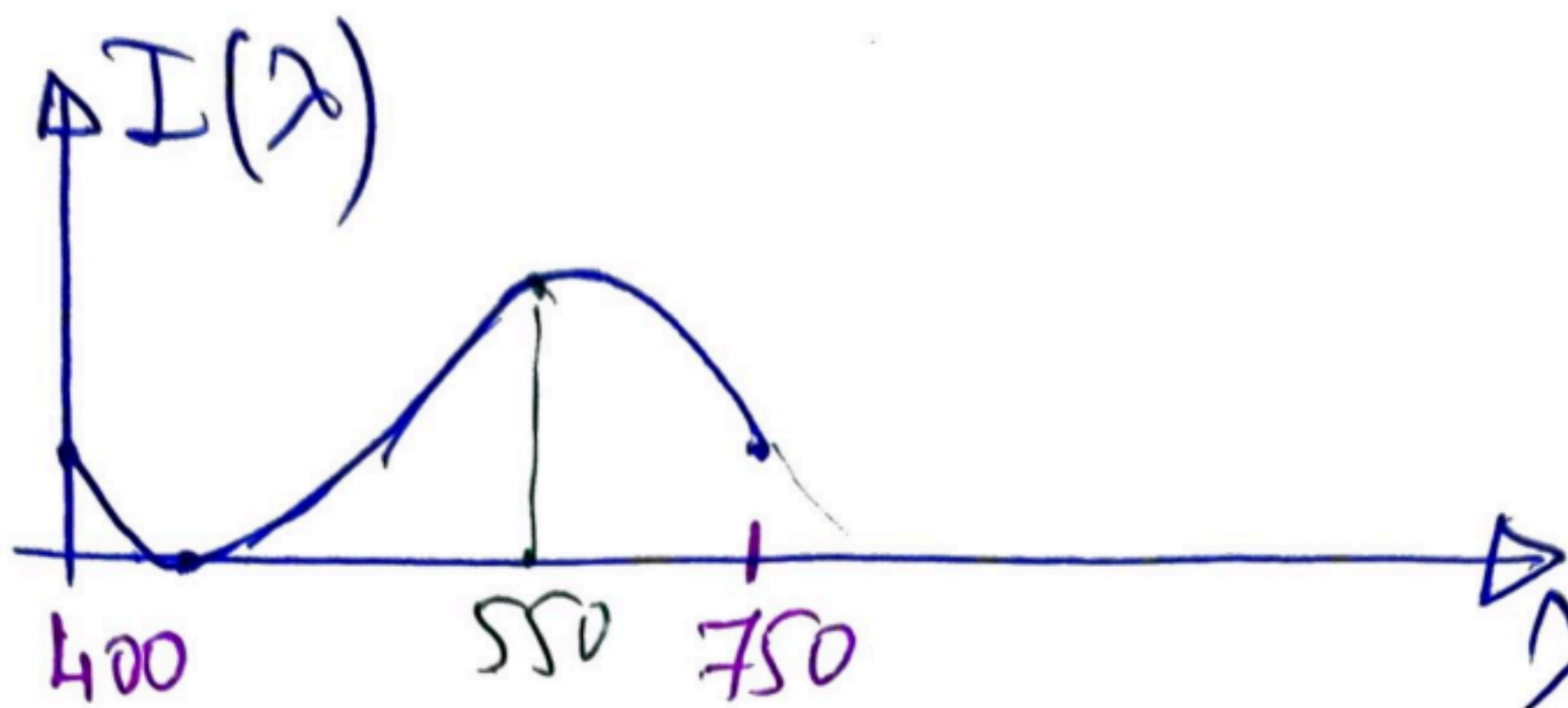
b) radiation éteinte

$$\frac{\delta}{\lambda} = p = N' + \frac{1}{2}$$

$$p = \frac{2ne}{\lambda_0} \cos r_{\min} + \frac{1}{2} = N' + \frac{1}{2}$$

$$\lambda_0 = \frac{2ne \cos r_{\min}}{N'} = \frac{0,825}{N'} (\mu m)$$

- $N' = 1; \quad \lambda_0 \notin IR$
- $N' = 3 \quad \lambda_0 \notin UV$
- $N' = 2: \quad \lambda_0 = 412 \text{ nm.}$



$$I(\lambda) = 2I_1 \left(1 + \cos \left(\frac{2\pi}{\lambda} \delta + \pi \right) \right)$$

$$= 2I_1 \left(1 - \cos \left(\frac{2\pi}{\lambda} \delta \right) \right)$$

$$= 2I_1 \left(1 - \cos \left(\frac{2\pi}{\lambda} 2e \cos r_m \right) \right)$$

$$I = 2I_1 \left(1 - \cos \left(\frac{\pi 1.65}{\lambda_{(nm)}} \right) \right)$$

B)

$$g = f' \sqrt{\frac{\lambda n}{e}} \sqrt{p_0 - p}$$

have d'air

$$n = 1$$

$$g = f' \sqrt{\frac{\lambda}{e}} \sqrt{p_0 - p}$$

$$p(r) = \frac{2ne \cos r}{\lambda}$$

$$p = \frac{2e \cos i}{\lambda}$$

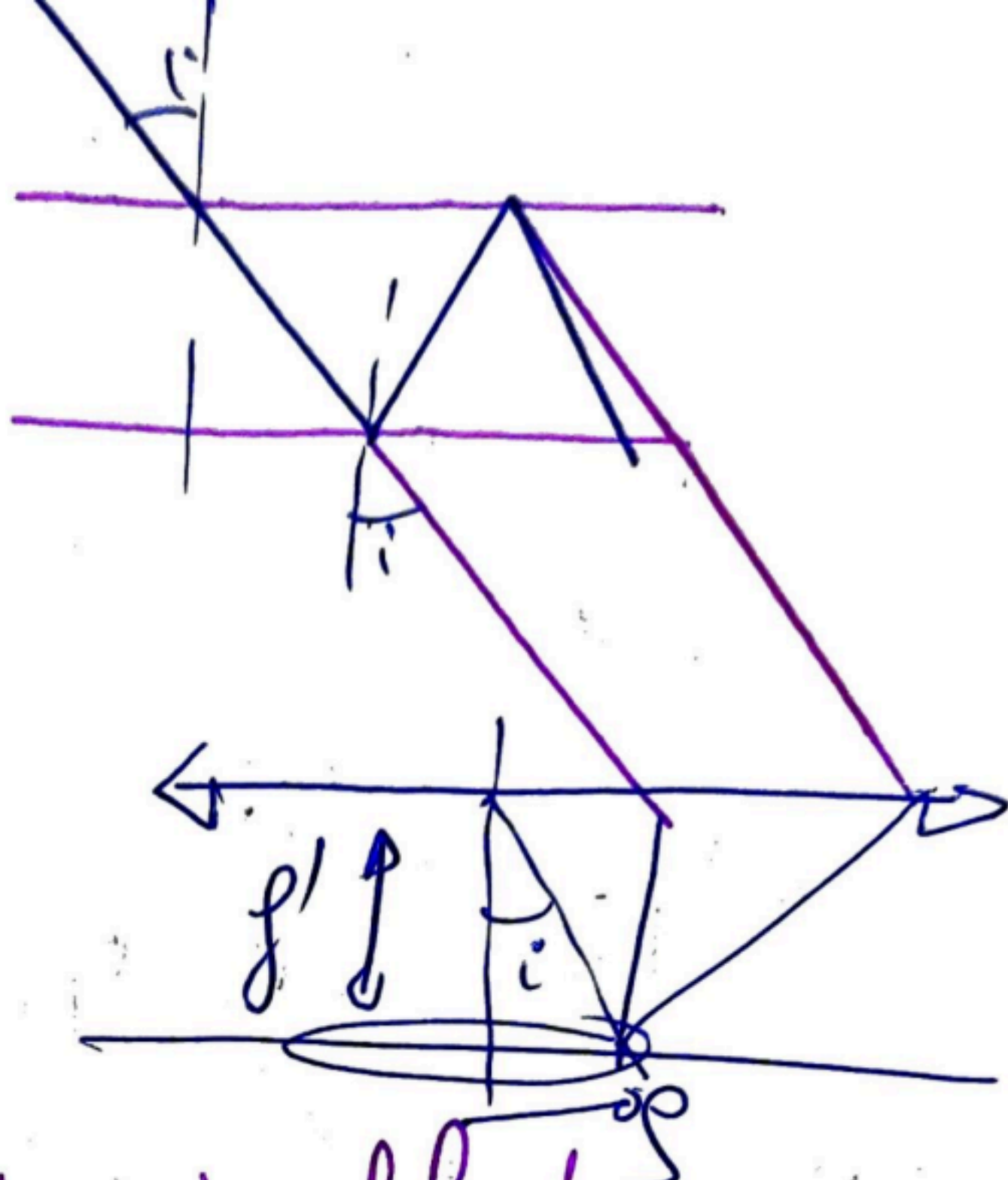
$$\rho_{3B} = 8 \text{ mm}$$

$$\lambda = 480 \text{ nm}$$

$$f' = 20 \text{ cm}$$

$$e = ??$$

$$\rho_{3B} = f' \sqrt{\frac{\lambda}{e}} \sqrt{p_0 - \rho_{3B}}$$



$\frac{x}{\lambda} p_0 = \frac{2e}{\lambda} = \text{à centre brillant}$
 $p_0 = \underline{\underline{\text{entier}}}$

$$p_{1B} = p_0 - 1$$

$$p_{2B} = p_0 - 2$$

$$p_{3B} = p_0 - 3$$

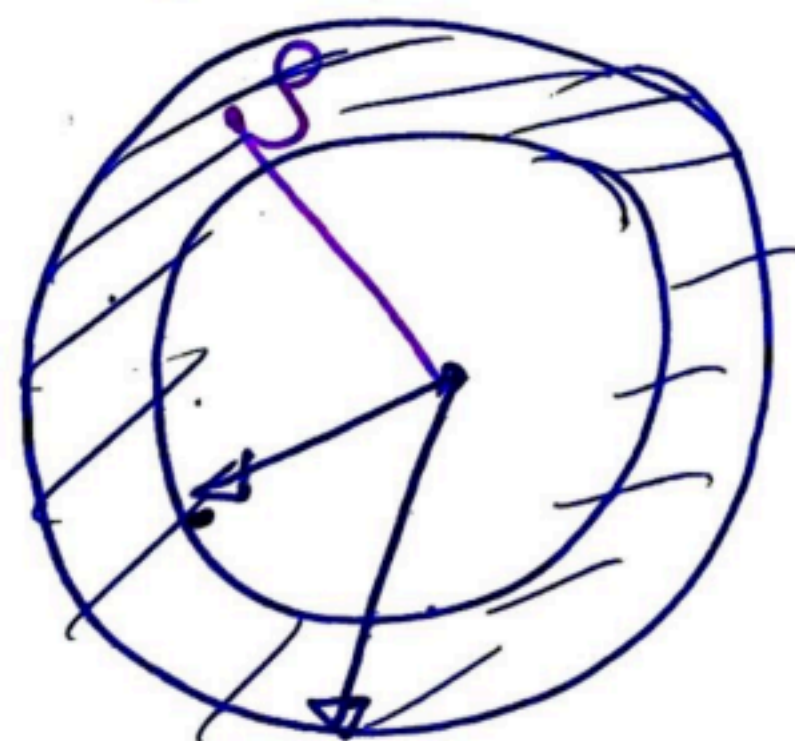
$$p_{KB} = p_0 - K$$

$$e = \frac{\lambda f'^2}{\rho_{KB}^2} K$$

$$e = \frac{3 \lambda f'^2}{\rho_{3B}^2} = 300 \mu\text{m}$$

$$5) \delta = 2e \sin i = p \lambda$$

$$\lambda \in \left[\lambda_0 - \frac{\Delta \lambda}{2}, \lambda_0 + \frac{\Delta \lambda}{2} \right]$$



$$2e d(\omega s i) = p d\lambda$$

$$2e \sin i \Delta i = p \Delta \lambda \quad ; \quad \sin i \approx i = \frac{p}{f'}$$

$$2e \frac{p}{f'^2} \Delta p = p \Delta \lambda$$

$$\Delta p_{KB} = \frac{f'^2 p_{KB} \Delta \lambda}{2e p_{KB}} \quad ; \quad p_{3B} = p_0 - 3$$

$$\Delta p_{3B} = \frac{p_{3B} f'^2}{2e p_{3B}} \Delta \lambda = 156 \mu m.$$

$$\ast \underline{Pg} \quad \Delta p_{KB} = \frac{f'^2 p_{KB} \Delta \lambda}{2 p_{KB} \frac{\lambda f'^2}{p_{KB}} k}$$

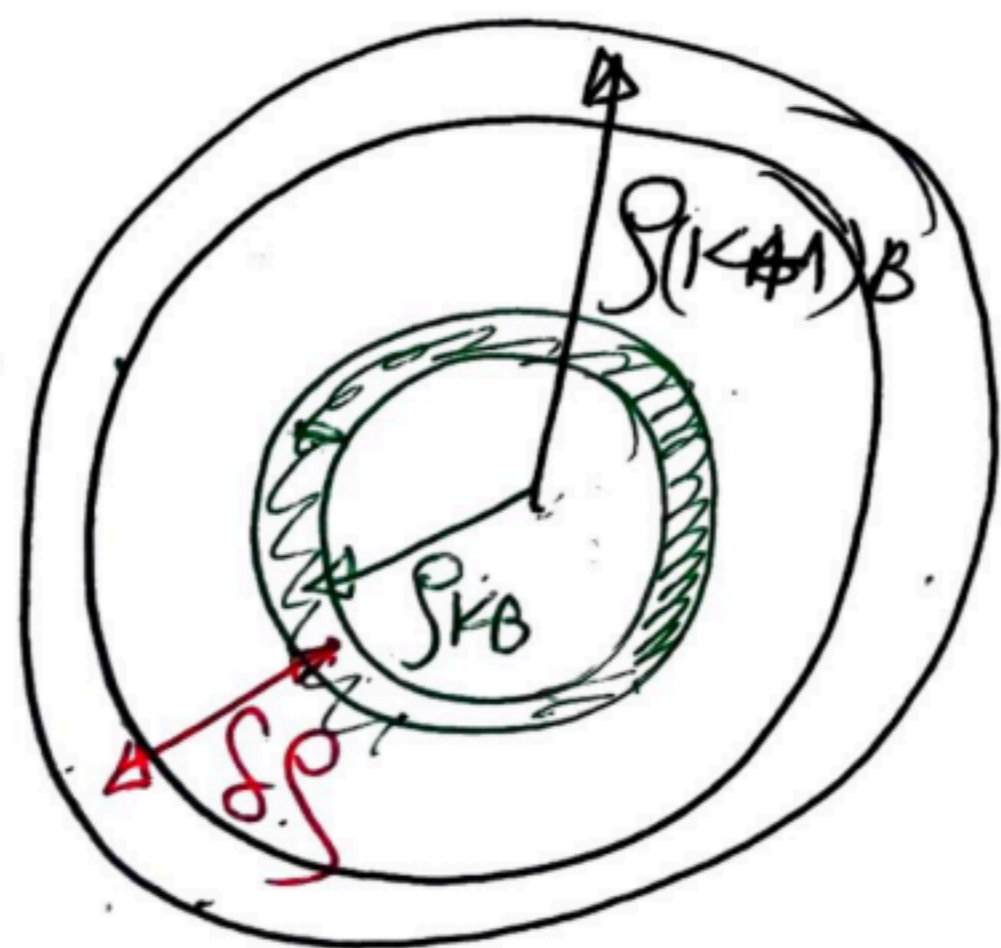
$$\Delta p_{KB} = \frac{p_{KB} \Delta \lambda}{2 \lambda k}$$

Bichromat

$$\delta p_{KB} > \Delta p_{KB}$$

$$p_{(k+1)B} - p_{KB}$$

$$p_{KB} = f' \sqrt{\frac{\lambda}{e}} \sqrt{k}$$



MP2
2004