

Les conditions d'interférence:

$$\omega_1 = \omega_2 = \omega$$

$$\varphi_2 - \varphi_1 = \varphi(r) \text{ stationnaire}$$

$$\vec{e}_1 \cdot \vec{e}_2 \neq 0$$

$$\vec{E}_1 = E_{01} e^{i(\omega_1 t - \varphi_1)} \vec{e}_1$$

$$\vec{E}_2 = E_{02} e^{i(\omega_2 t - \varphi_2)} \vec{e}_2$$

$$\vec{E} = E_{01} e^{i(\omega_1 t - \varphi_1)} \vec{e}_1 + E_{02} e^{i(\omega_2 t - \varphi_2)} \vec{e}_2$$

$$\vec{E}^* = E_{01} e^{-i(\omega_1 t - \varphi_1)} \vec{e}_1 + E_{02} e^{-i(\omega_2 t - \varphi_2)} \vec{e}_2$$

$$I = \langle \vec{E} \cdot \vec{E}^* \rangle$$

$$= E_{01}^2 + E_{02}^2 + 2 E_{01} E_{02} \langle \cos(\Delta\omega t - \Delta\varphi) \rangle \underbrace{\vec{e}_1 \cdot \vec{e}_2}_{\neq 0}$$

$$I = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos(\Delta\varphi) \cdot (\vec{e}_1 \cdot \vec{e}_2)$$

PT2 2016, et MP2 2015

Sorient

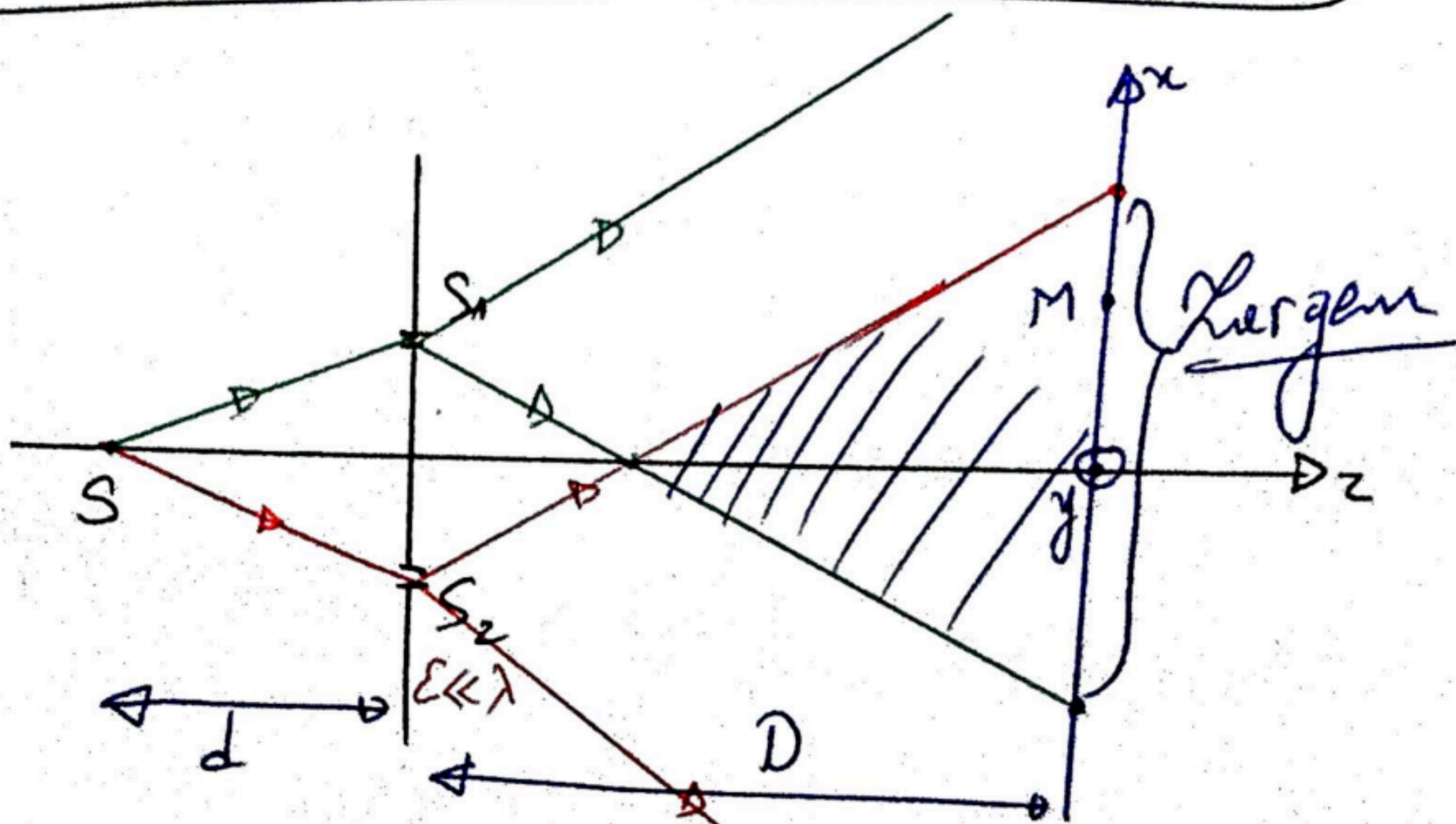
$$P_1 = P_{01} \exp i(\omega t - \varphi_1)$$

$$P_2 = P_{02} \exp i(\omega t - \varphi_2)$$

$$P = e^{i(\omega t - \varphi_1)} [P_{01} + P_{02} e^{-i(\varphi_2 - \varphi_1)}]$$

$$PP^* = I = P_{01}^2 + P_{02}^2 + 2P_{01}P_{02} \cos(\Delta\varphi)$$

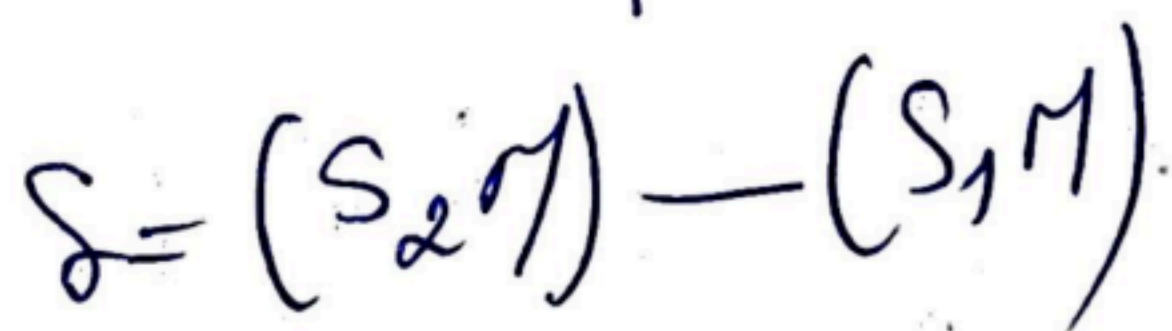
$$I = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos(\Delta\varphi)$$



$$S_1 S_2 = a = 2,6 \text{ mm} \ll D = 1 \text{ m}$$

$$\ll d = 0,5 \text{ m}$$

$$\delta(r) = (SS_2 r) - (SS_1 r)$$

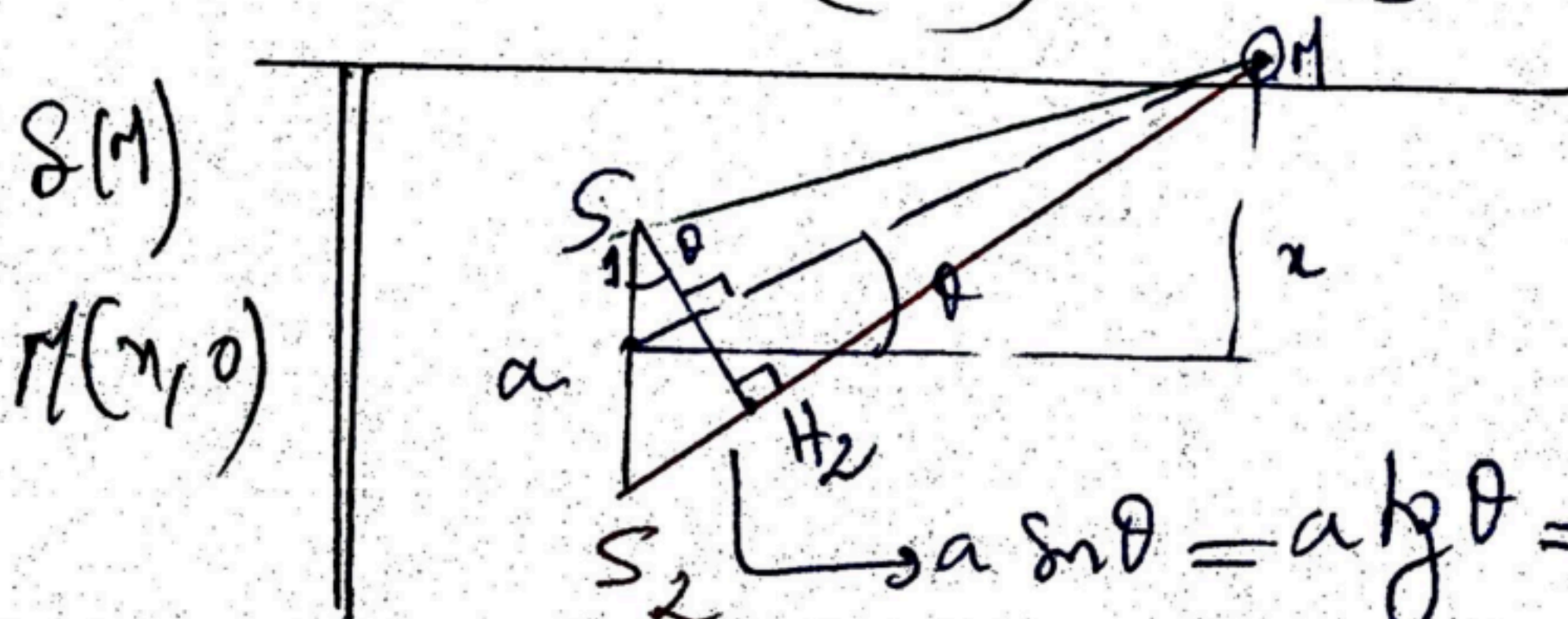


$$(S_{21})^2 = D^2 + \left(x + \frac{a}{2}\right)^2 + y^2$$

$$(S_{2r}) = D^4 \left[1 + \frac{M^2}{2D^2} + \frac{(n + \frac{1}{8})^2}{2D^2} \right]$$

$$S_1 \eta \approx D \left[1 + \frac{\eta^2}{2D^2} + \frac{(x - a/2)^2}{2D^2} \right]$$

$$\boxed{\delta = \frac{a\pi}{D}} = \frac{(S_1 S_2) \cdot OM}{(S_1 S_2) \rightarrow (E)}$$



$$S_2 \xrightarrow{H_2} a \sin \theta = a \lambda \theta = \frac{a \lambda}{D}$$

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

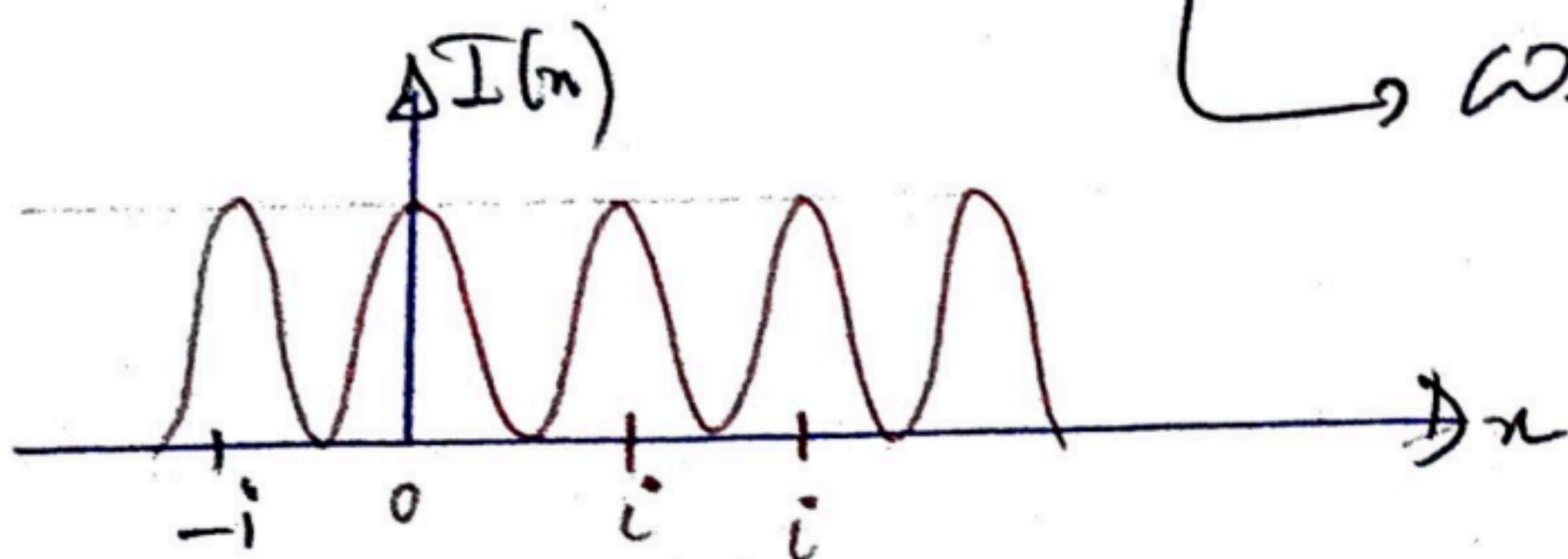
$$I = I_0 + I_0 + 2I_0 \cos(\Delta\varphi)$$

$$I = 2I_0 (1 + \cos(\Delta\varphi))$$

$$= 2I_0 \left(1 + \cos\left(\frac{2\pi}{\lambda} \delta(m)\right) \right)$$

$$I = 2I_0 \left(1 + \cos\left(\frac{2\pi}{\lambda} \frac{ax}{D}\right) \right)$$

$\cos\left[\frac{2\pi x}{\left(\frac{\lambda D}{a}\right)}\right]$



$$i = \text{interfrange} = \frac{\lambda D}{a}$$

franges brillantes $I_{\max} = 4I_0; \cos(\Delta\varphi) = 1$

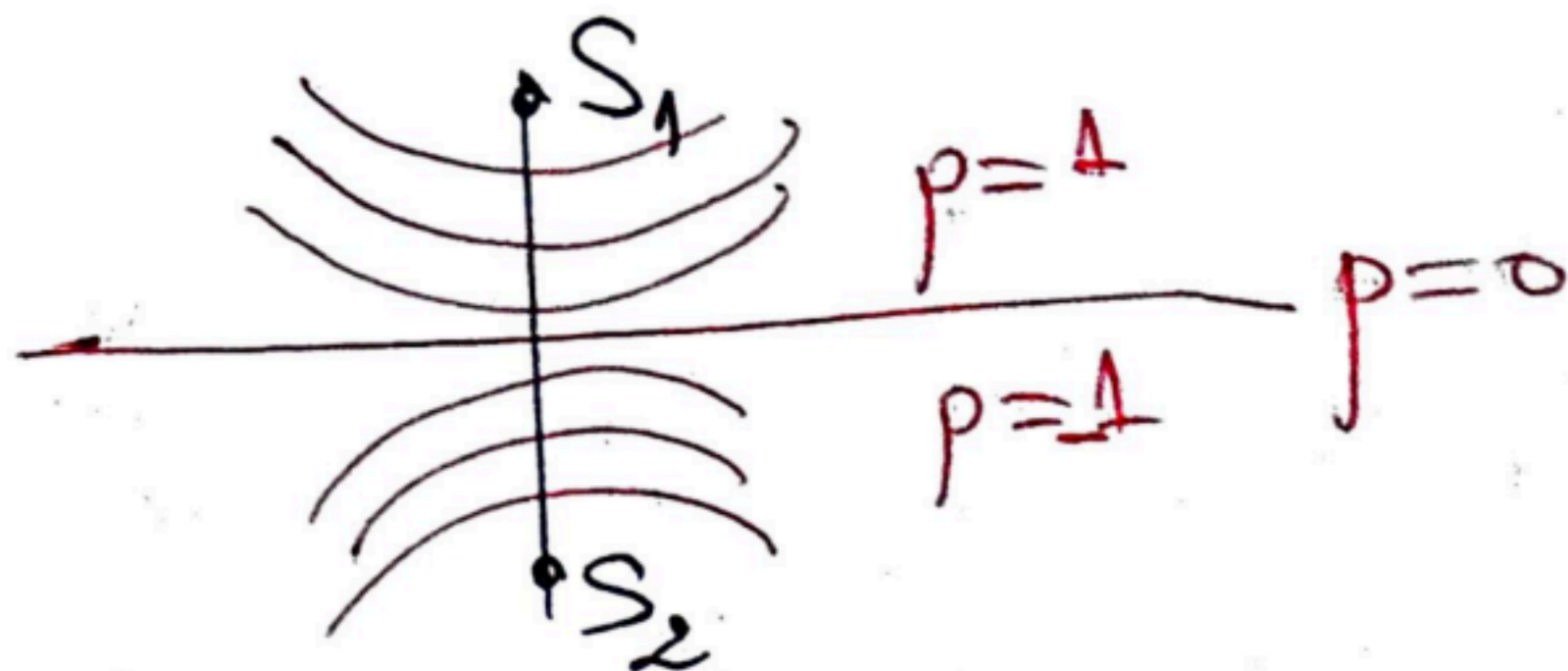
$$\Delta\varphi = 2k\pi; \quad \delta = k\lambda$$

$$x_k^B = k \frac{\lambda D}{a}$$

$$x_{k+1}^B - x_k^B = \frac{\lambda D}{a} = i$$

$$\text{Ordre d'interférence} = p = \frac{\delta}{\lambda}$$

$$p = \frac{ax}{\lambda D}$$



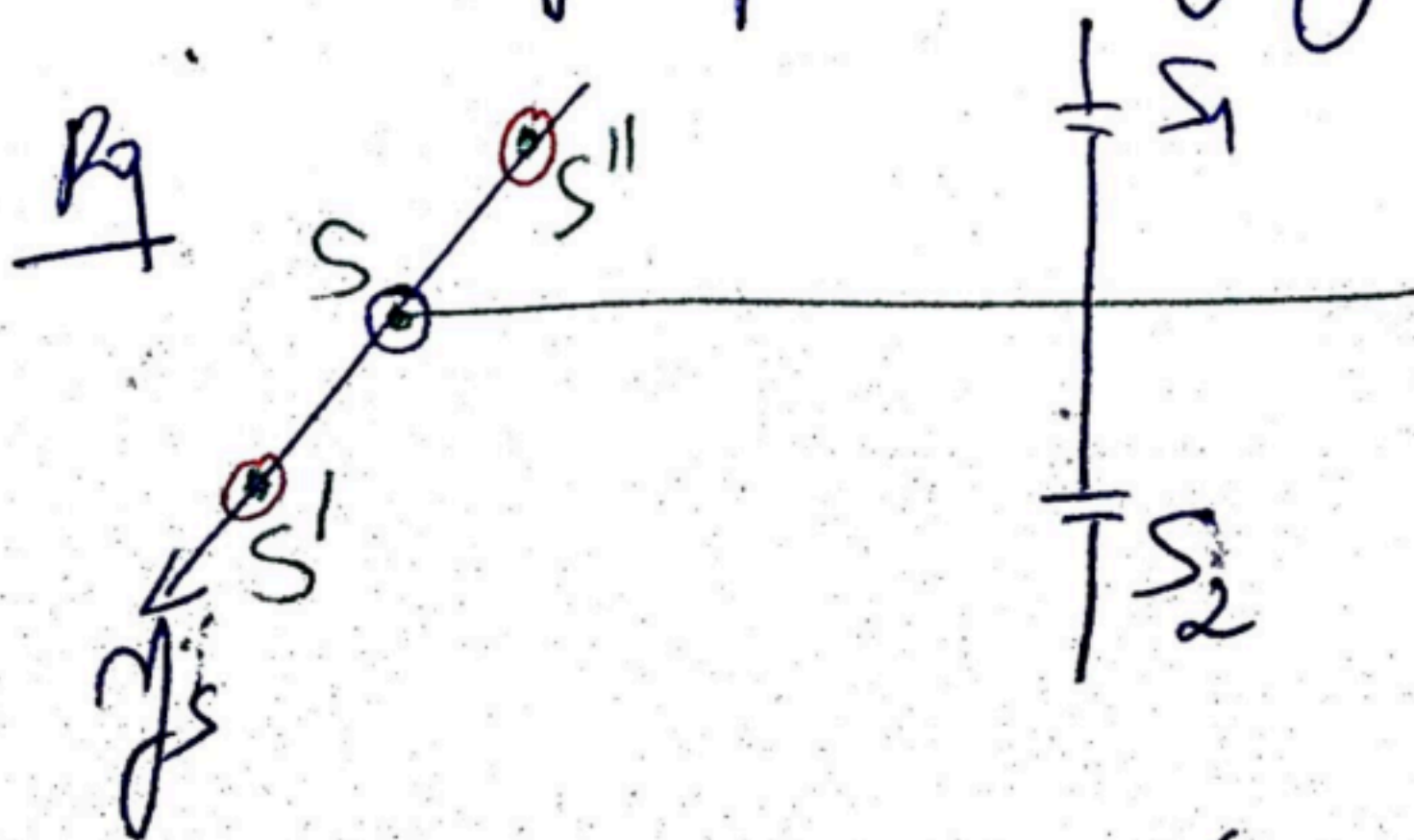
$$\delta = S_2M - S_1M = ct$$

Hyperboloïdes

$p=0$, frange centrale

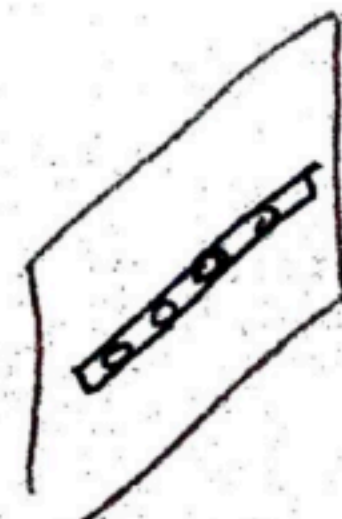
4) on déplace la source suivant (Oys)

$\Rightarrow (SS_1) - (SS_2) \Rightarrow \delta(M) = S_2M - S_1M = \frac{ax}{D}$
ne modifie pas la figure d'interf

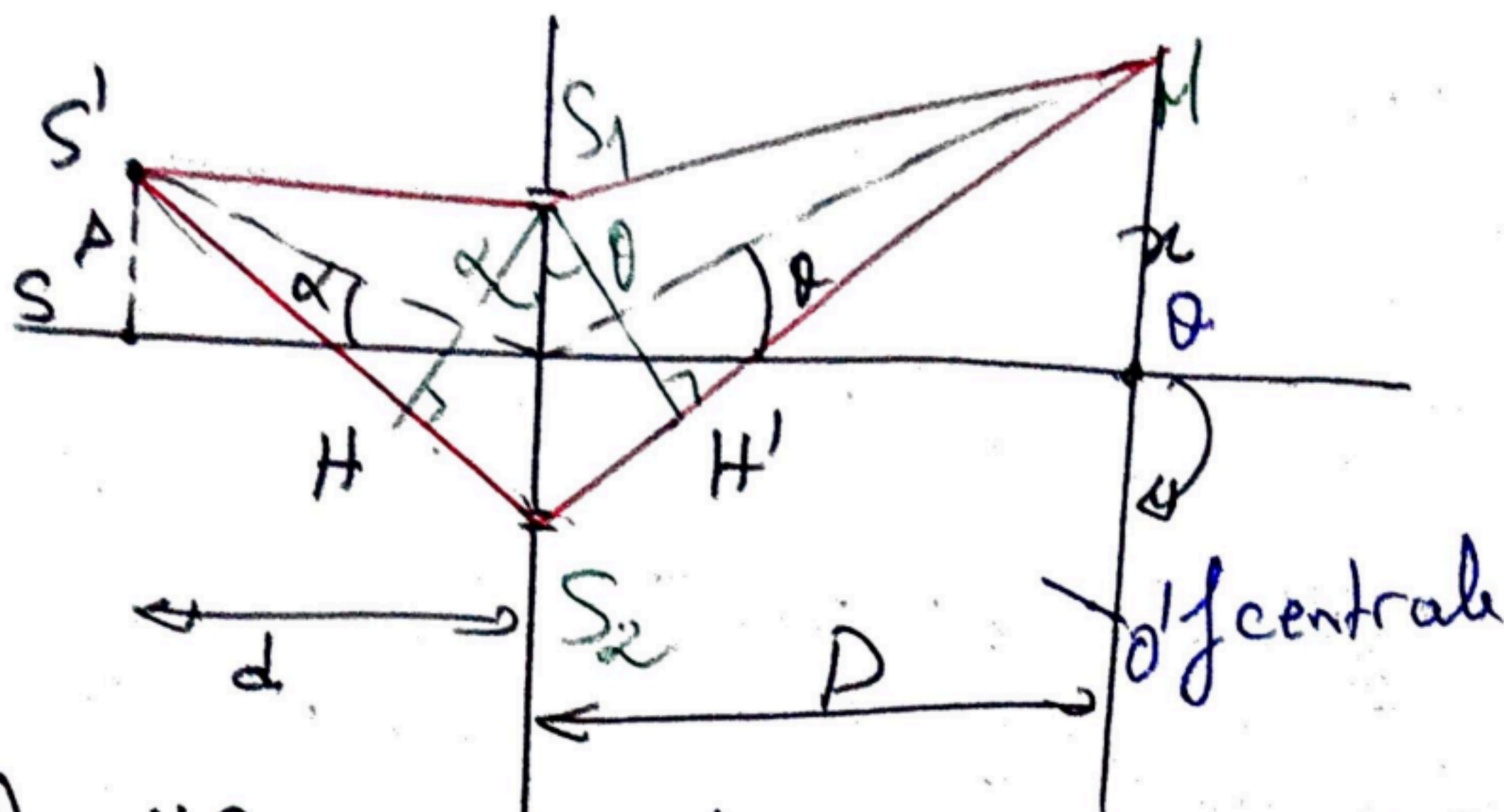


$$I = 2I_0 \left(1 + \cos\left(\frac{2\pi}{\lambda} \frac{ax}{D}\right) \right)$$

$I_{\max} = 4I_0 \Rightarrow$ fente fine



A) b)



$$\delta'(M) = HS_2 + S_2H' = a \sin \alpha + a \sin \theta$$

$$\delta'(M) = \frac{a\Delta}{d} + \frac{ax}{D}$$

fringe centrale

$$\delta'(M) = p'(M) = 0$$

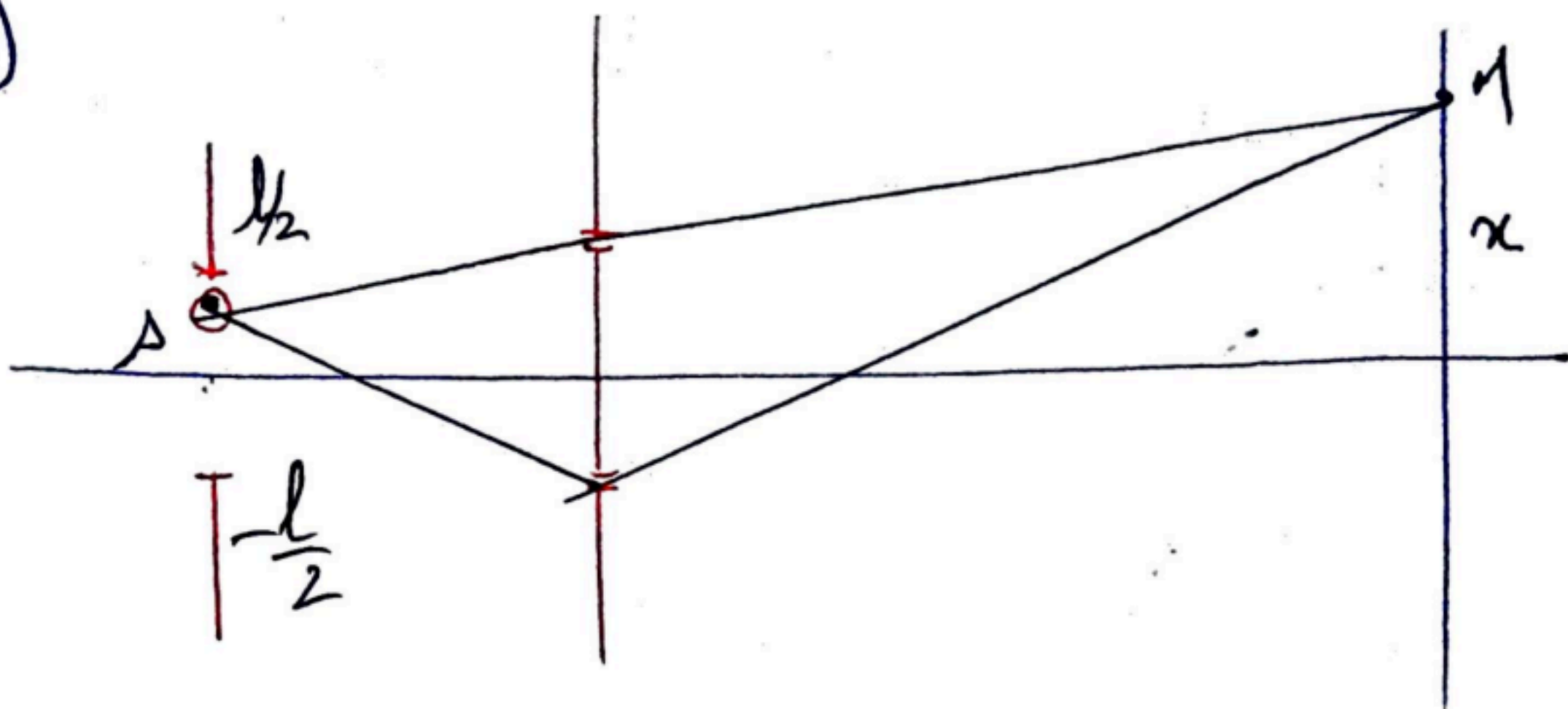
$$\Rightarrow \frac{x_0}{D} + \frac{\Delta}{d} = 0, \quad \boxed{m_0 = -\frac{D}{d}\Delta}$$

$$\delta'(M) = \frac{a \overline{O'M}}{D} = \frac{a}{D} \left(n + \frac{\Delta D}{d} \right)$$

$$\overline{O'O} + \overline{O'M} = \left(\frac{\Delta D}{d} + x \right)$$

$$\frac{OO'}{D} = \frac{\Delta}{d}$$

4) c)



$$\delta' = a \left[\frac{x}{D} + \frac{A}{d} \right]$$

$$dI = 2 dI_0 \left(1 + \cos \left(\frac{2\pi a}{\lambda} \left(\frac{x}{D} + \frac{A}{d} \right) \right) \right)$$

$$I = \frac{2I_0}{l} \left(1 + \cos \left(\frac{2\pi a}{\lambda} \left(\frac{x}{D} + \frac{A}{d} \right) \right) \right) dx$$

$$I_0 \rightarrow l$$

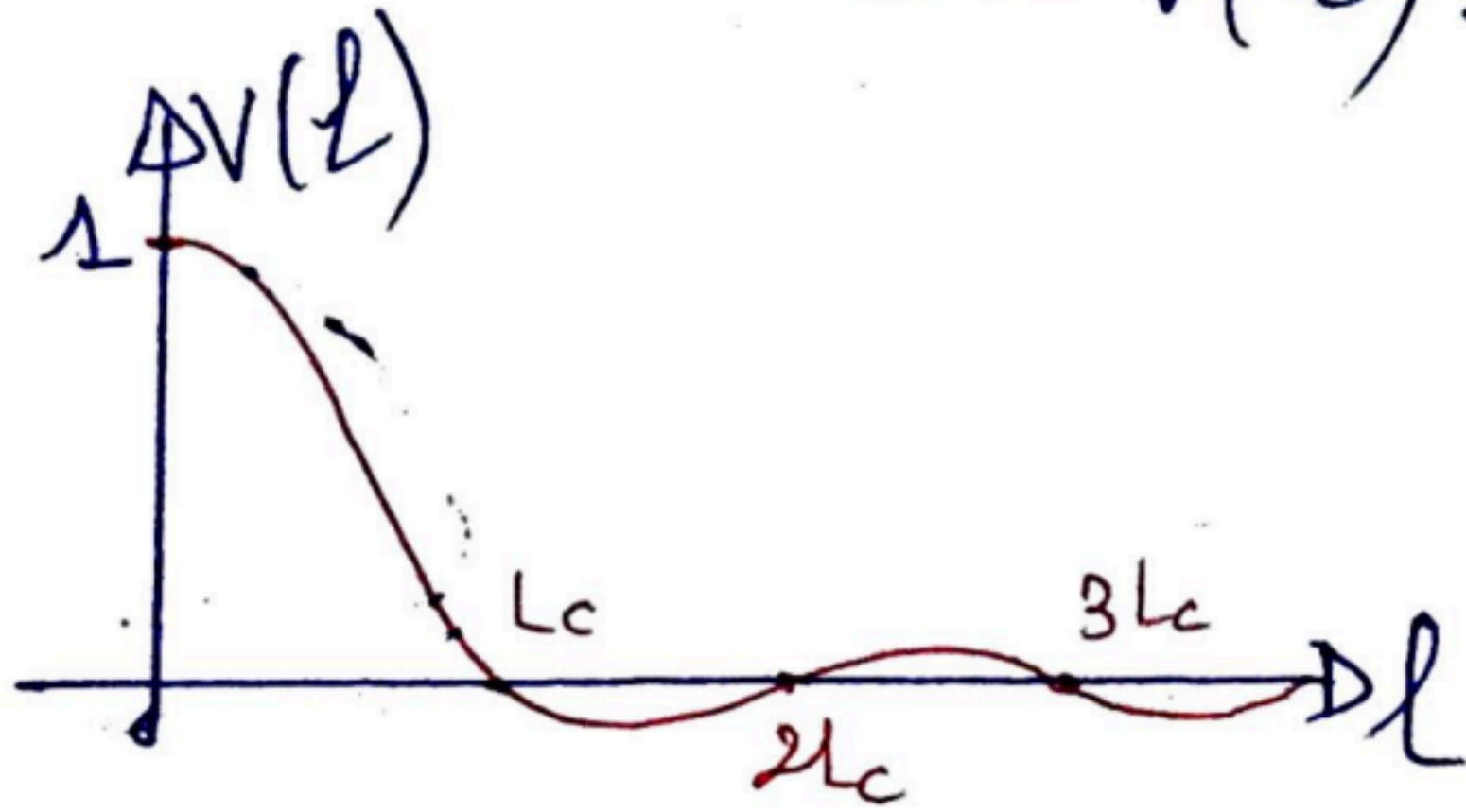
$$dI_0 \rightarrow dA$$

$$\frac{dI_0}{I_0} = \frac{dA}{l}$$

$$I = \frac{2I_0}{l} \left[A + \frac{\lambda d}{2\pi a} \sin \left(\frac{2\pi a}{\lambda} \left(\frac{x}{D} + \frac{A}{d} \right) \right) \right]_{-\frac{l}{2}}^{\frac{l}{2}}$$

$$I = 2I_0 \left[1 + \sin c \left(\frac{\pi a l}{\lambda d} \right) \cos \left(\frac{2\pi x}{\lambda} \right) \right]$$

facteur de visibilité $= V(l) = \text{sinc}\left(\frac{\pi a l}{\lambda d}\right)$



$\hookrightarrow V(l)$;

$V(l)=0, \quad l=L_c \quad 1^{\text{ere}} \text{ frs}$

$\hookrightarrow \frac{\pi a l}{\lambda d} = k\pi, \quad k \in \mathbb{N}^*$

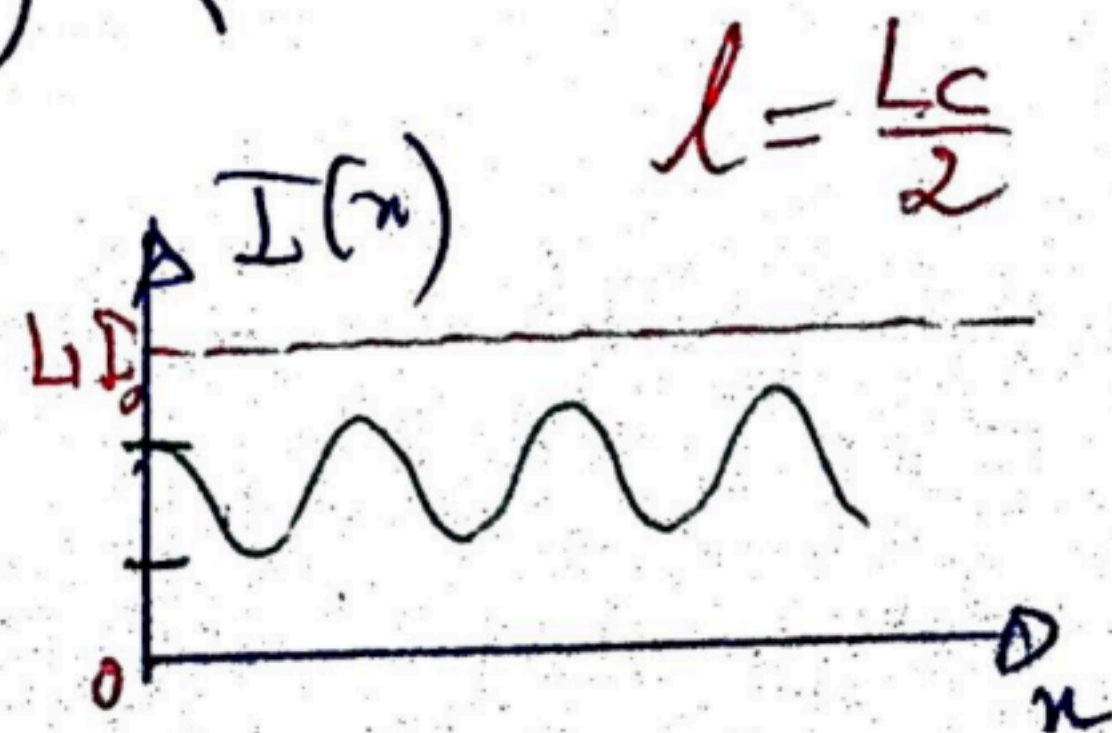
$l = k \frac{\lambda d}{a}, \quad \underline{k=1}; \quad l = L_c = \frac{\lambda d}{a}$

$l \in [L_c; 2L_c]; \quad V(l) < 0$

Inversion de position

$I_{\max} = 2I_0 (1 + |V(l)|)$

$I_{\min} = 2I_0 (1 - |V(l)|)$



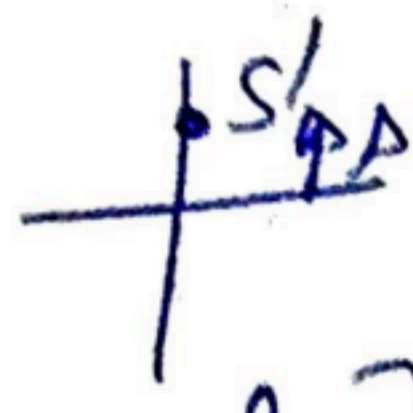
$C = \frac{I_{\max} - I_{\min}}{I_{\max} + I_{\min}} = |V|$

$$c) L_c = \frac{\lambda d}{a} = \lambda$$

$$p(M) = \frac{\delta(M)}{\lambda} = \frac{a x}{\lambda d}$$



$$p'(M) = \frac{\delta'(M)}{\lambda} = \frac{a x}{\lambda d} + \frac{a \Delta}{\lambda d}$$



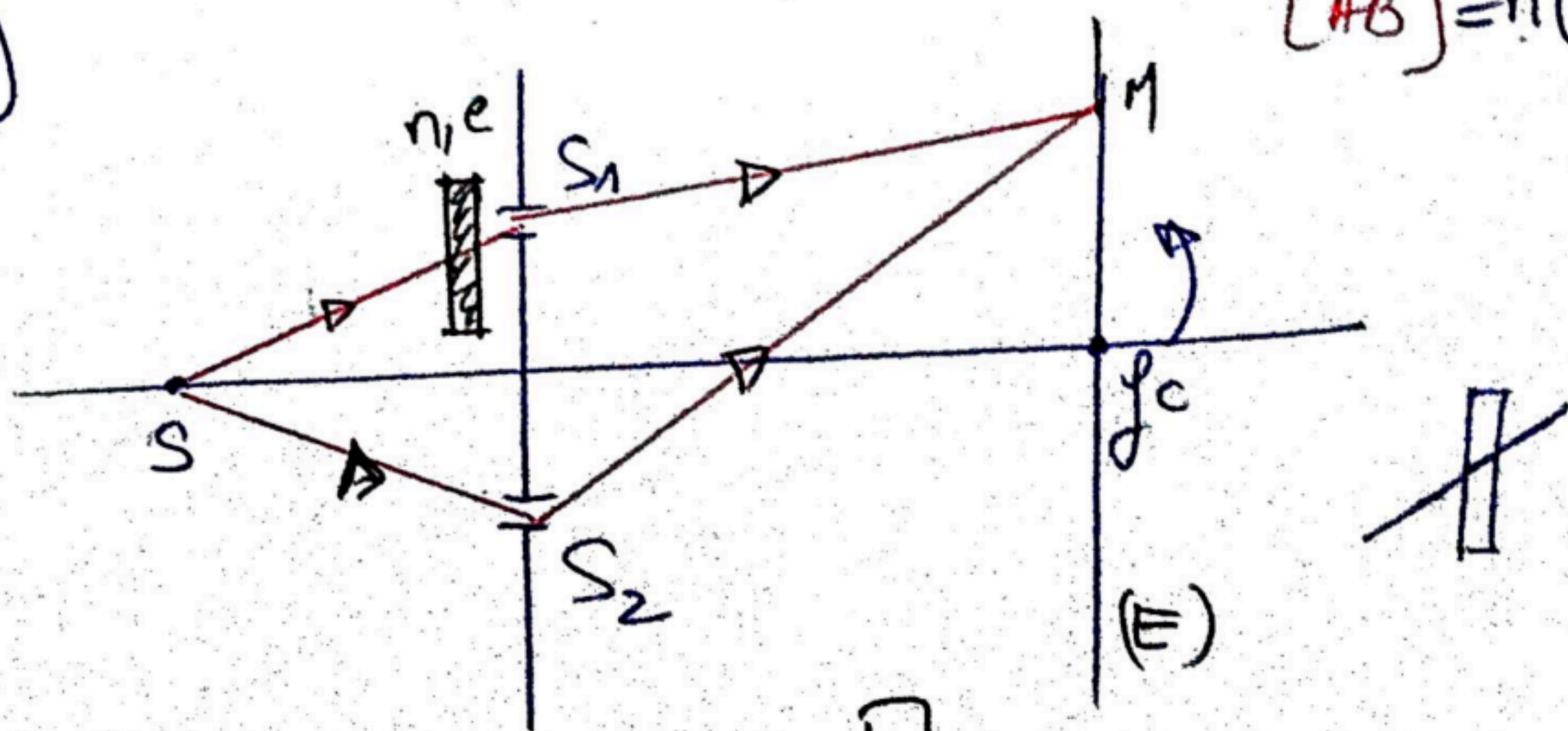
$$\Delta p = p' - p = \frac{a \Delta}{\lambda d}, \quad \Delta \in \left[0, \frac{l}{2}\right]$$

$$\Delta p = \frac{a l}{2 \lambda d} \leq \frac{1}{2}$$

$$l \leq \frac{\lambda d}{a} = L_c$$

5)

$$[AB] = n(AB)$$

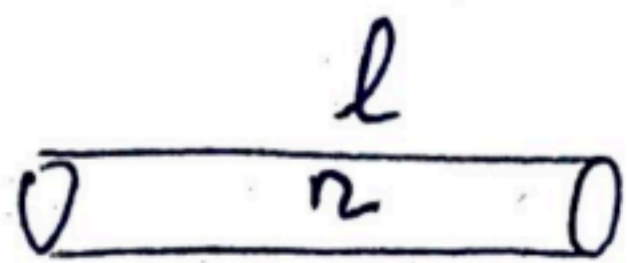


$$\delta = [SS_2M] - [SS_1M]$$

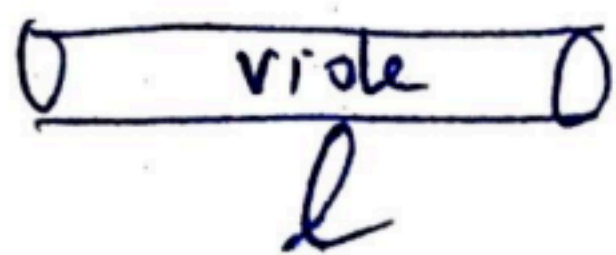
$$= (SS_2M) - ((SS_1 - e) + ne) - (S_1M)$$

$$\delta = (ax/d) - (n-1)e$$

$$\delta = 0 \Rightarrow x_0 = \frac{D}{a} (n-1) e$$



$$\delta = n l - l = (n-1) l$$



$$\rho = \frac{\delta}{\lambda} = \left(\frac{n-1}{\lambda} \right) l$$

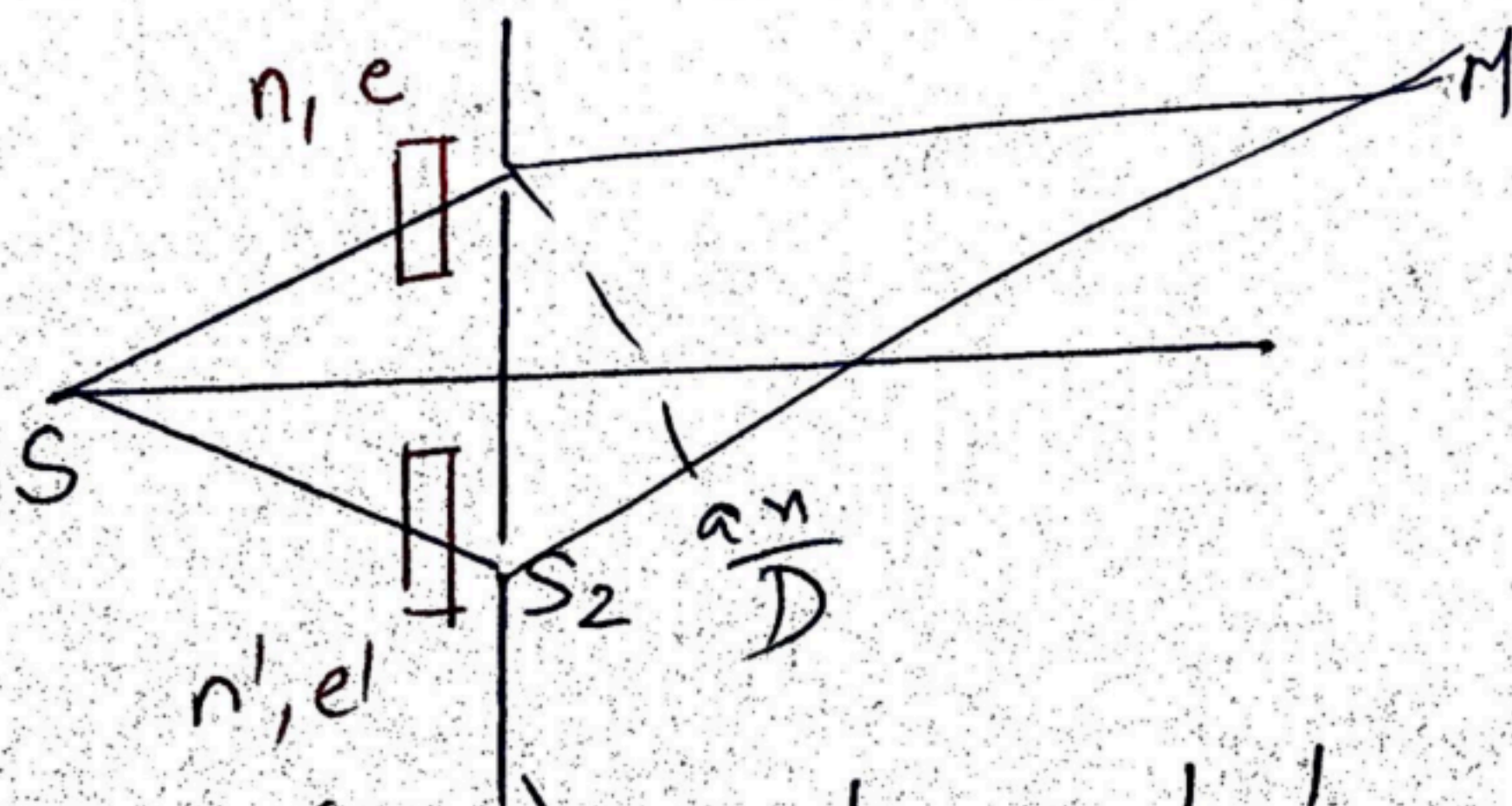
$$\Delta \rho = \frac{l}{\lambda} \Delta n$$

$$\boxed{(n-1) T = c t s}$$

G.P. Ghosh

$$\ln(n-1) + \ln T = c t s.$$

$$\frac{dn}{n-1} + \frac{dT}{T} = 0 \Rightarrow \frac{\Delta n}{n-1} = - \frac{\Delta T}{T}$$



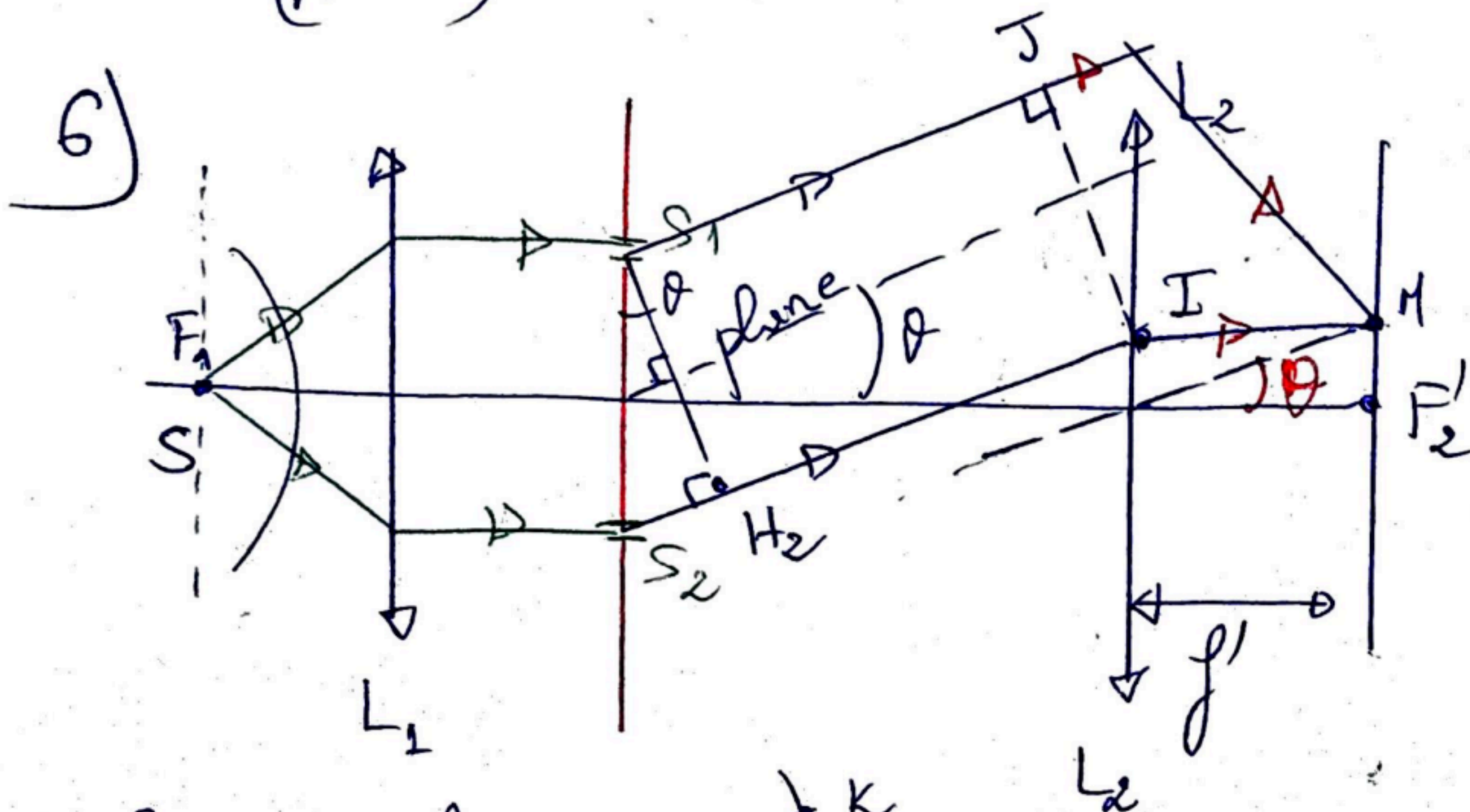
$$[SS_2] = (SS_2) - e' + n'e'$$

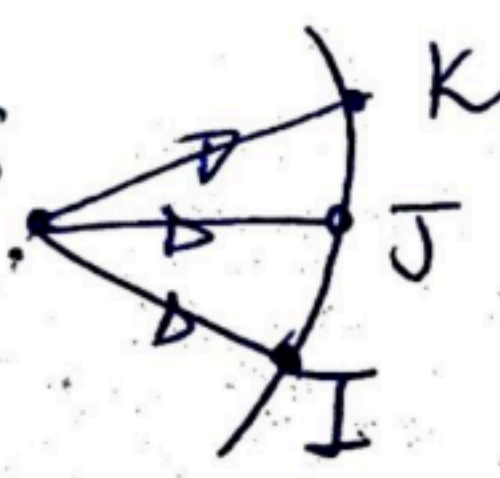
$$[SS_1] = (SS_1) - e + ne$$

$$\delta(M) = \frac{ax}{D} + (n' - 1)e' - (n - 1)e$$

frange centrale revienne à sa position initiale
 $n \rightarrow \infty, \delta \rightarrow 0$

$$e' = \frac{(n - 1)}{(n' - 1)} e = 0,3 \text{ mm}$$

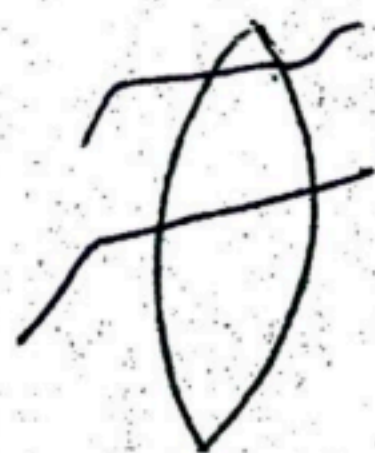


Théorème de Malus: S  $[SI] = [SJ] = [SK]$

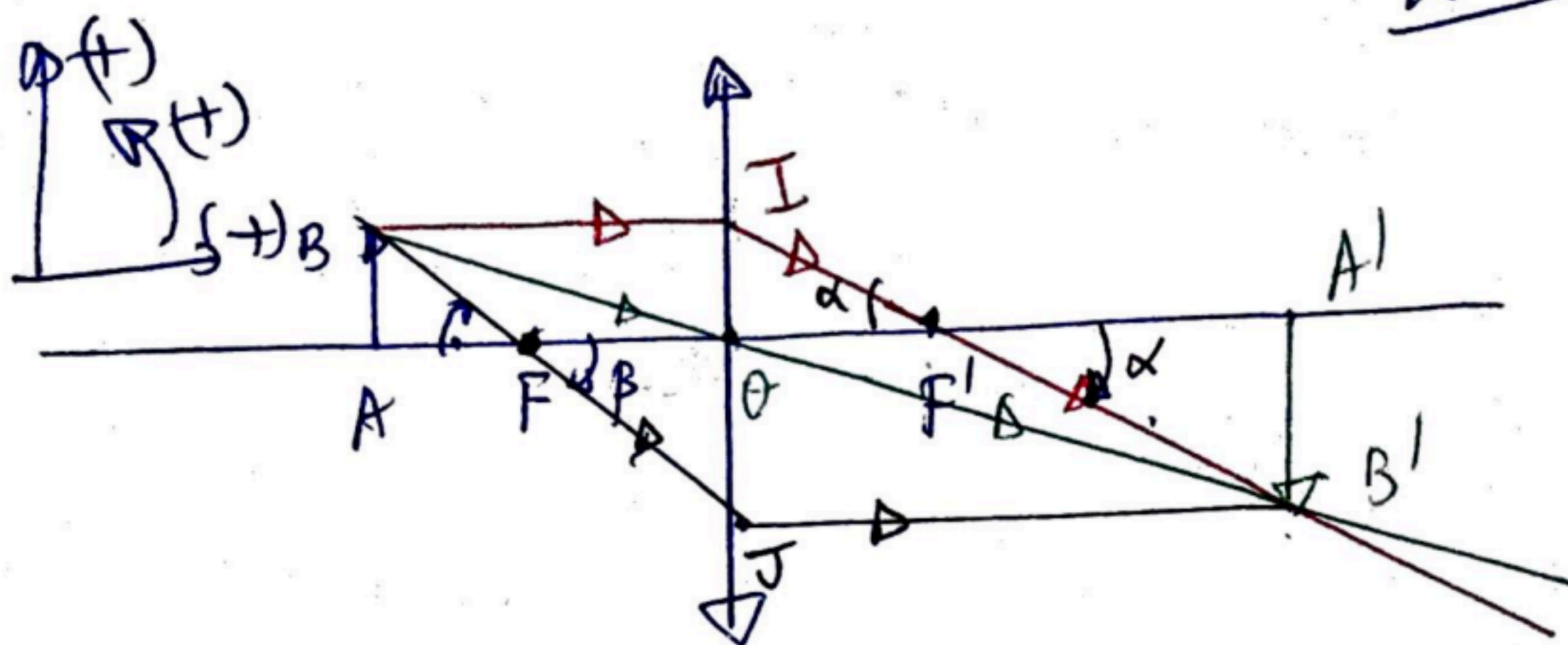
$$[MI] = [MJ]$$

$$\delta = S_2 H_2 = a \sin \theta = a \tan \theta$$

$$\delta = a \frac{x}{f'}$$



PC2
2003



$$f \alpha = \frac{\overline{A'B'}}{\overline{F'A'}} = \frac{\overline{AB}}{\overline{FO}} < 0 \quad \frac{\overline{A'B'}}{\overline{AB}} = \frac{\overline{F'A'}}{\overline{FO}} = \gamma$$

$$f \beta = \frac{\overline{AB}}{\overline{FA}} = \frac{\overline{A'B'}}{\overline{FO}} < 0 ; \quad \frac{\overline{A'B'}}{\overline{AB}} = \frac{\overline{FO}}{\overline{FA}} = \gamma$$

$$\overline{FA} \cdot \overline{F'A'} = -(\overline{OF'})^2 \quad \text{Newton}$$

$$(\overline{FO} + \overline{OA})(\overline{FO} + \overline{OA'}) = -(\overline{OF'})^2 \times \frac{1}{\overline{OA} \overline{OA'} \overline{OF}}$$

$$\frac{1}{\overline{OF'}} = \frac{1}{\overline{OA'}} - \frac{1}{\overline{OA}} = \frac{1}{p'} - \frac{1}{p}$$

$$f = \frac{pp'}{p - p'} > 0$$

Sachant

$$\Delta p = \Delta p' = 1 \text{ mm.}$$

Déterminer $\Delta f'$

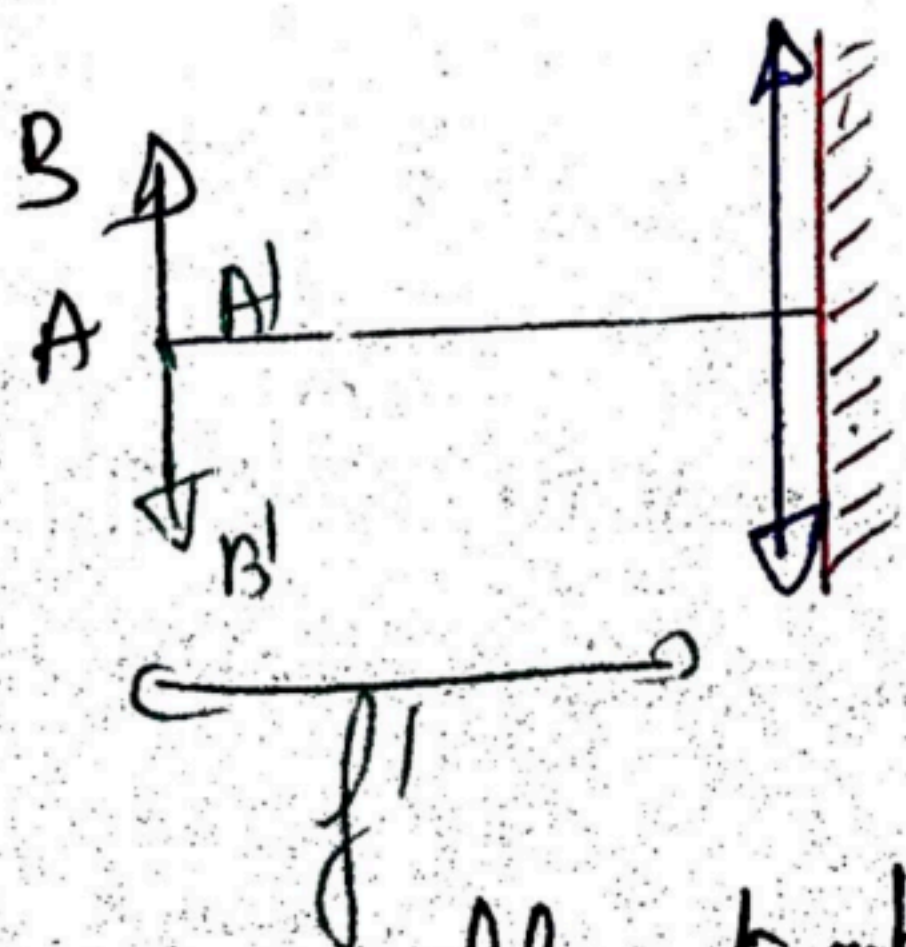
$$\frac{1}{p'} - \frac{1}{p} = \frac{1}{f'}$$

$$d\left(\frac{1}{p'}\right) - d\left(\frac{1}{p}\right) = d\left(\frac{1}{f'}\right)$$

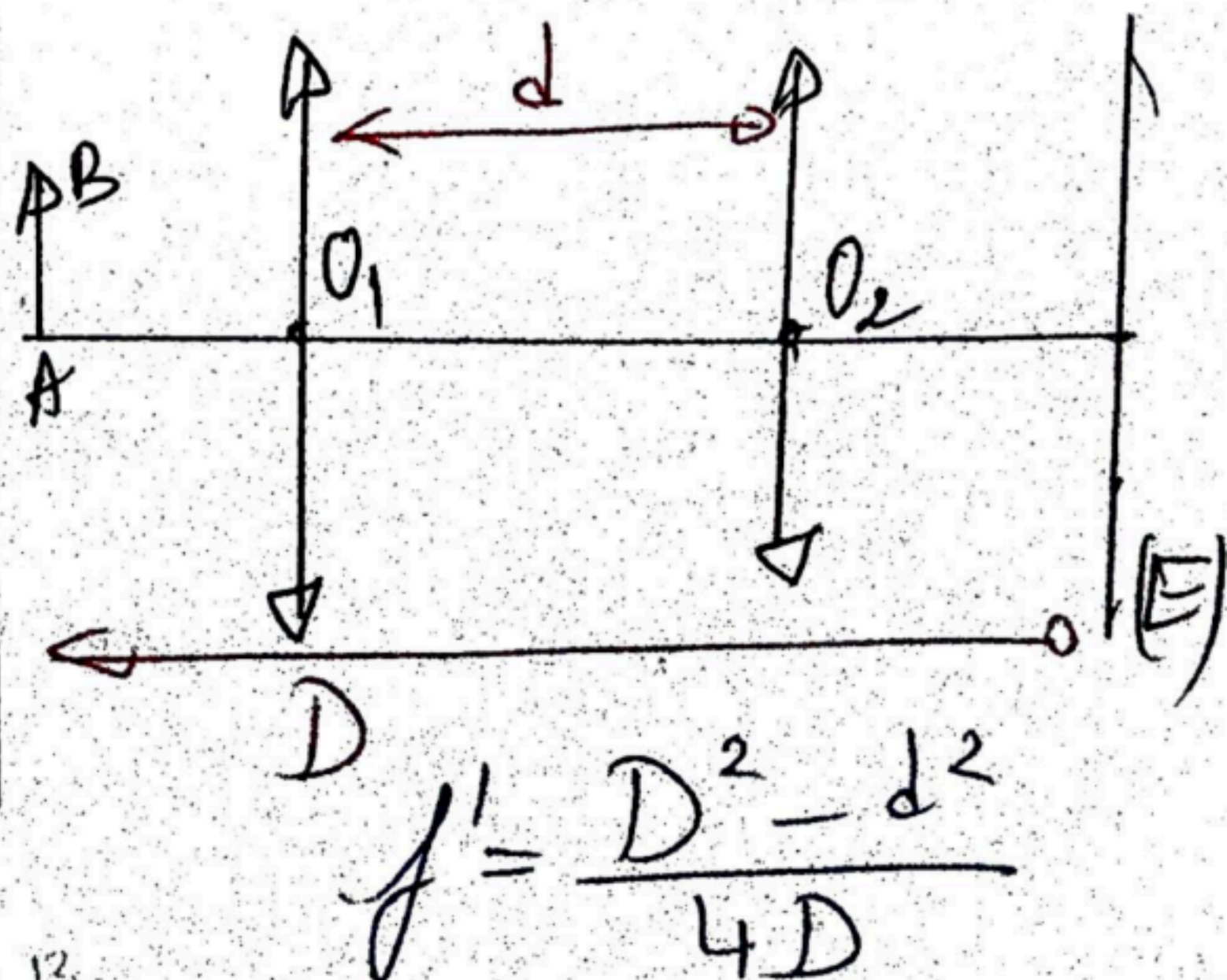
$$-\frac{dp'}{p'^2} + \frac{dp}{p^2} = -\frac{df'}{f'^2}$$

$$\boxed{\frac{\Delta p'}{p'^2} + \frac{\Delta p}{p^2} = \frac{\Delta f'}{f'^2}}$$

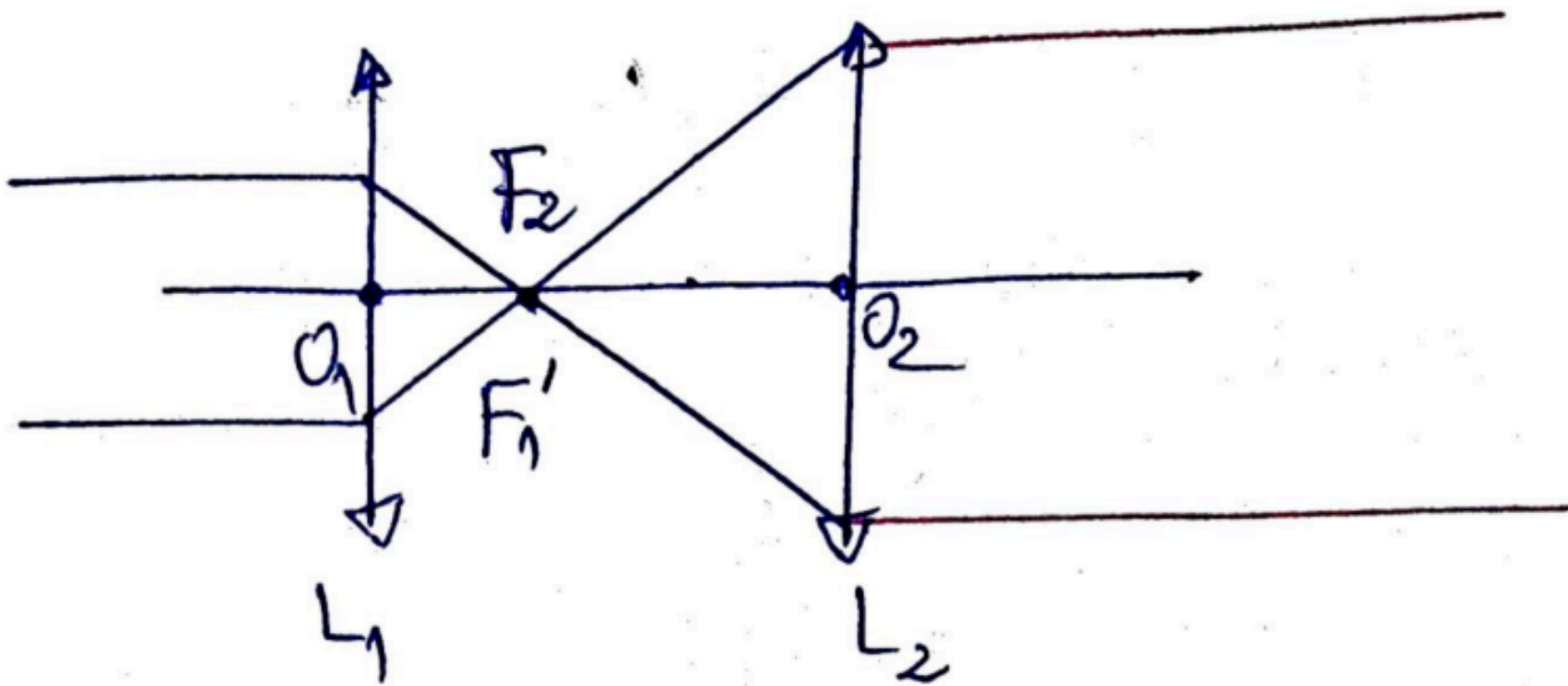
Bessel



d'autocollimation

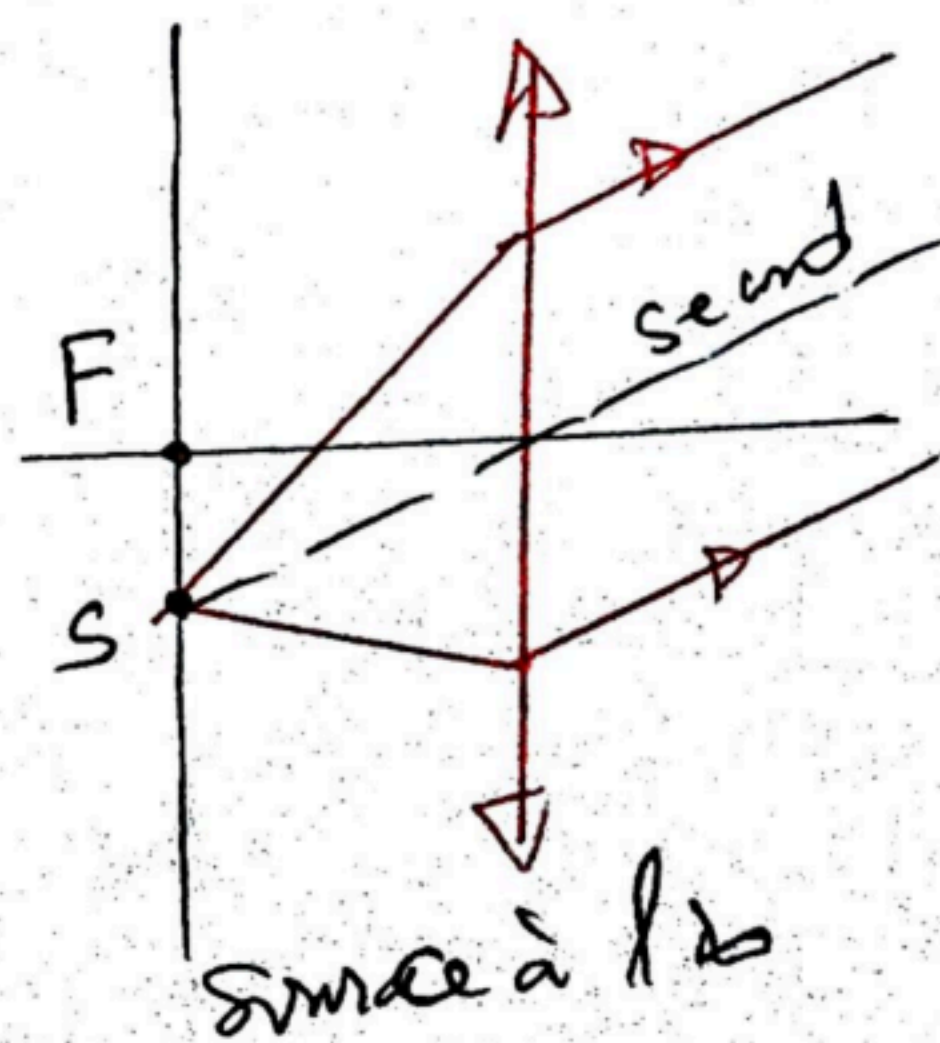
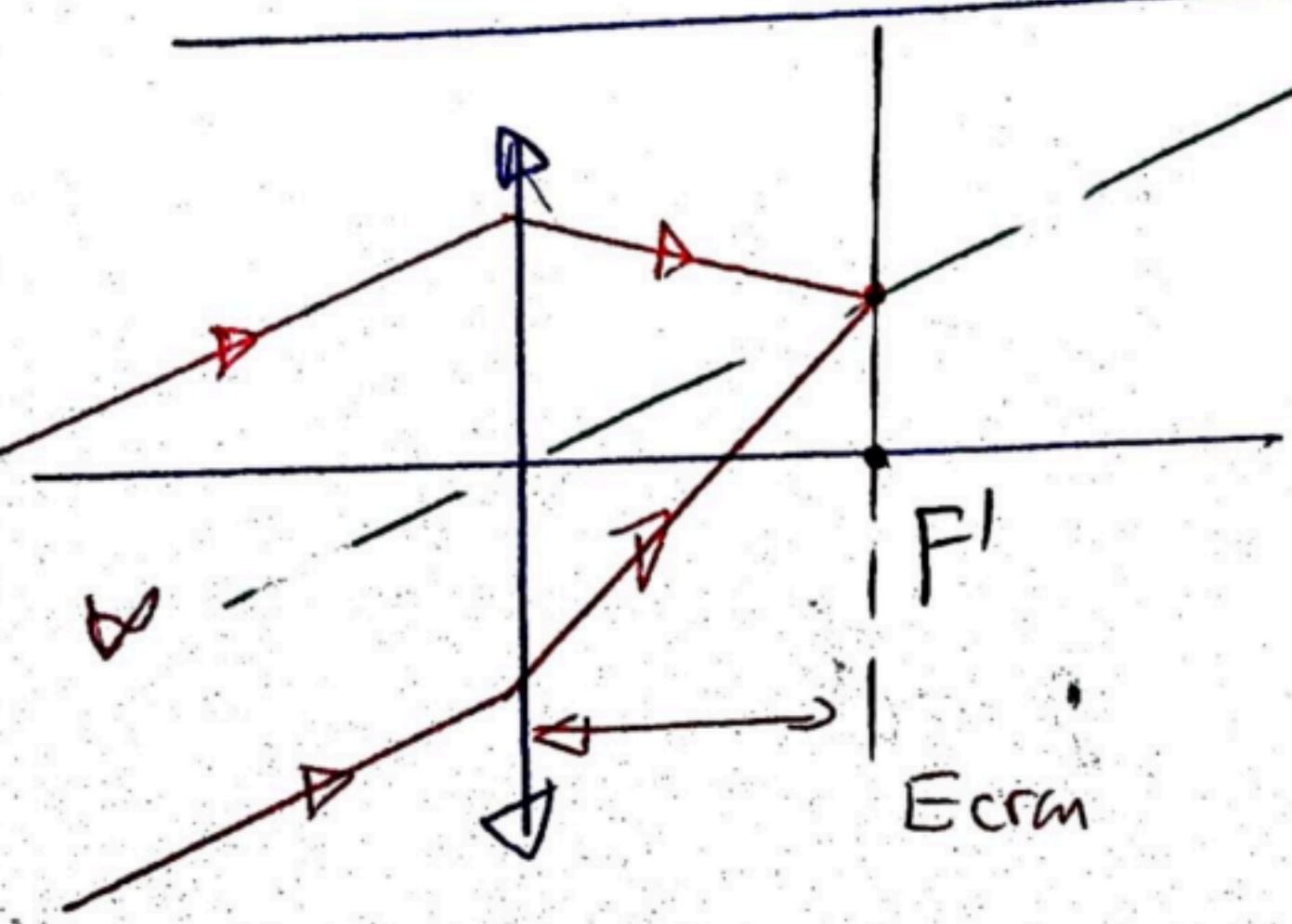


$$f' = \frac{D^2 - d^2}{4D}$$

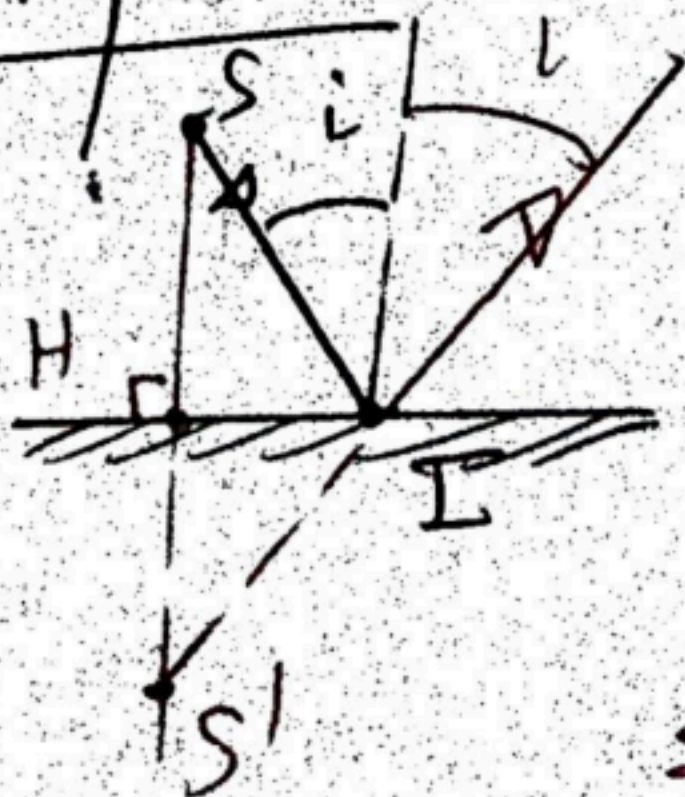


Viseur

$$\frac{1}{f'} = \frac{1}{f_1'} + \frac{1}{f_2'} - \frac{e}{f_1' f_2'}$$



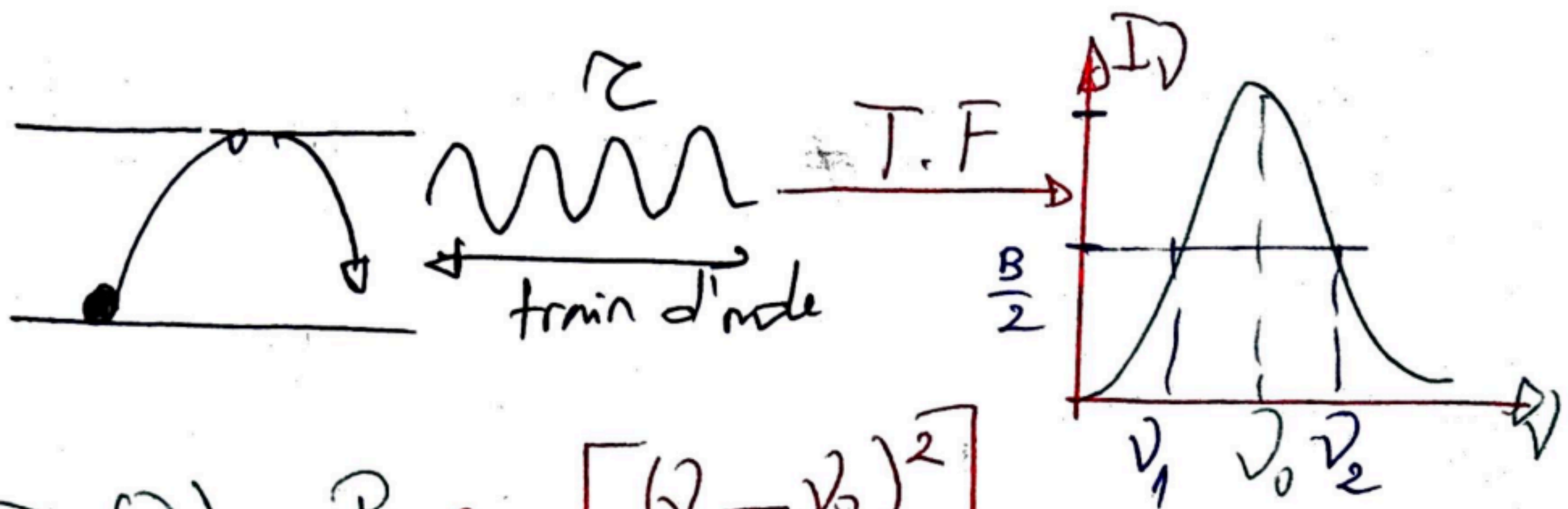
Miroir plan



- rotation miroir d'un angle α : l'image tourne 2α
- translation n : l'image $2n$

2C2 2005: Prisme

Source monochromatique $\nexists$



$$I_\nu(\nu) = B \exp \left[-\frac{(\nu - \nu_0)^2}{\alpha^2} \right]$$

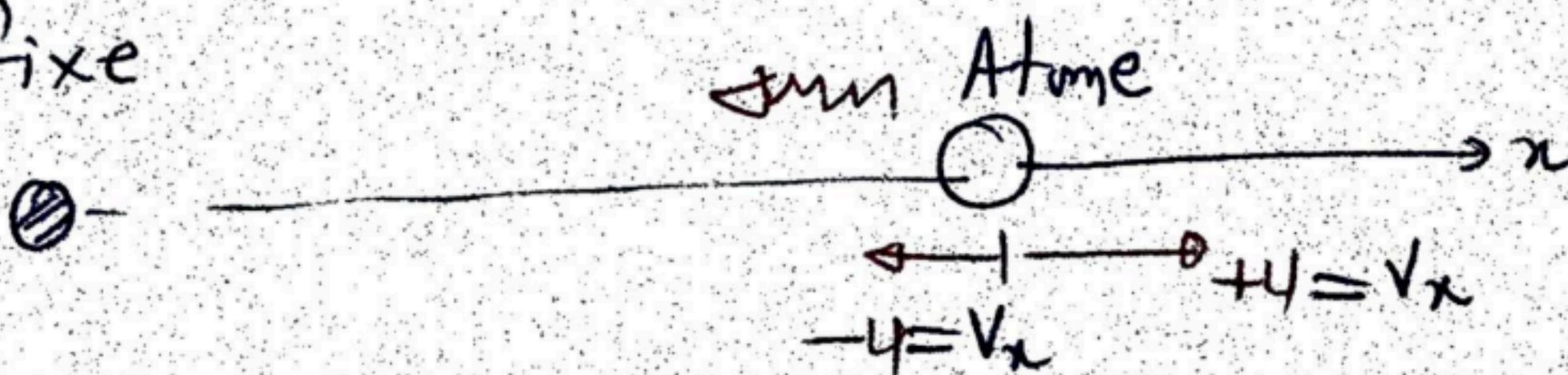
$\nu_2 - \nu_1 = \Delta\nu =$ largeur à mi-hauteur spectrale
 = " "

$$\boxed{\Delta\nu \sim \frac{1}{\tau}}$$

monoch $\Delta\nu \Rightarrow$
causes d'élargissement

$\tau = \infty$ Δ
 } Effet Doppler
 } " thermique

Détecteur
 fixe



Arrière

t

$t + T_0$

Délecteur

$$t' = t + \frac{x(t)}{c}$$

$$t' + T = (t + T_0) + \frac{x(t + T_0)}{c}$$

$$\Rightarrow T = T_0 + \frac{x(t + T_0) - x(t)}{c}$$

$$T = T_0 + \frac{v_x(t + T_0) - v_x t}{c}$$

$$T = T_0 + T_0 \frac{v_x}{c} = T_0 \left(1 + \frac{v_x}{c} \right)$$

$$\frac{1}{T} = \frac{1}{T_0} \left(1 - \frac{v_x}{c} \right) \quad \underline{\underline{\text{d.l.}}} \quad v_x \ll c$$

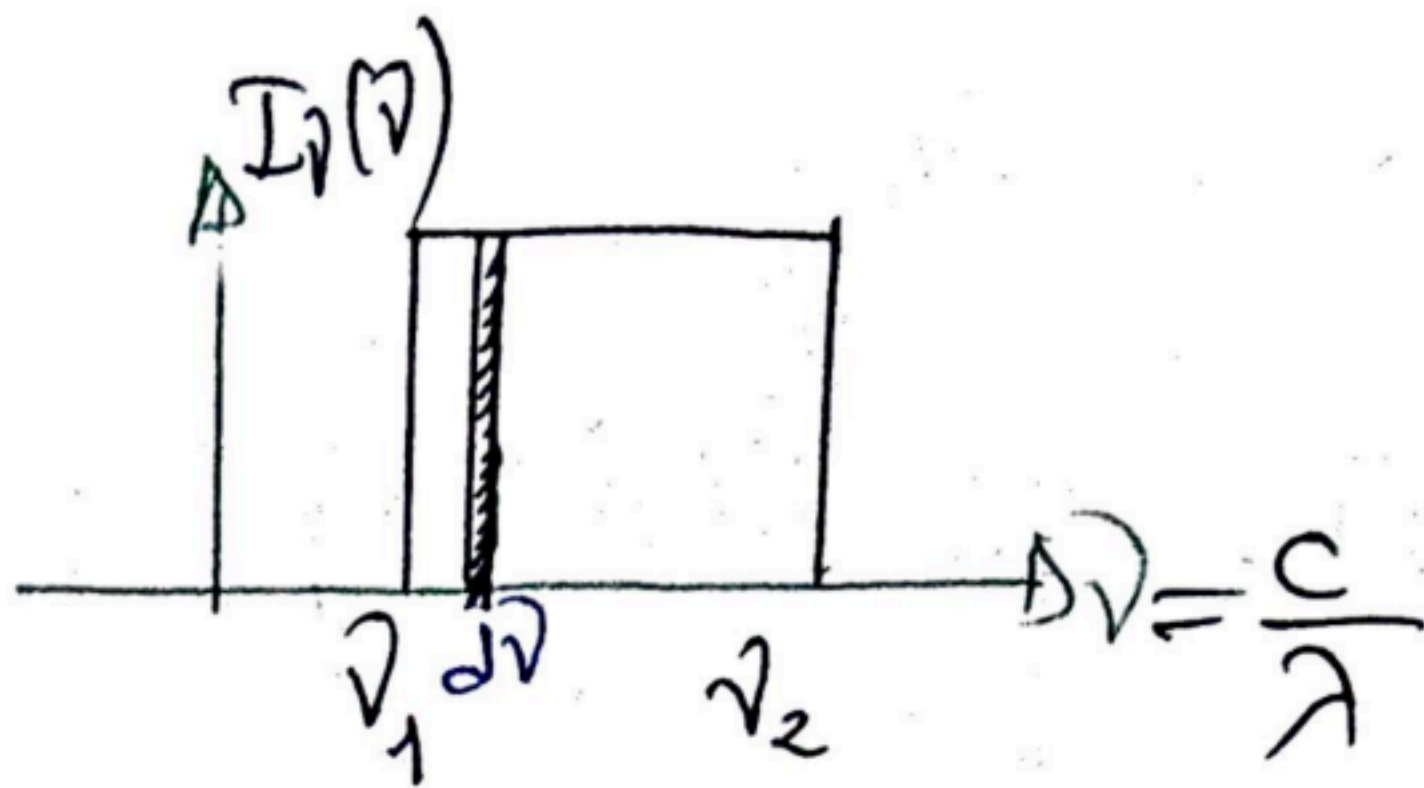
$$\lambda = \lambda_0 \left(1 - \frac{v_x}{c} \right)$$

$$\lambda_1 = \lambda_0 \left(1 - \frac{v}{c} \right)$$

$$\lambda_2 = \lambda_0 \left(1 + \frac{v}{c} \right)$$

$$\boxed{\Delta \lambda = \lambda_0 \frac{2v}{c}}$$

PT2 2022



$$dI = 2 dI_0 \left(1 + \cos \left(\frac{2\pi \nu \delta}{c} \right) \right)$$

$$I_0 \rightarrow \nu$$

$$dI_0 \rightarrow d\nu$$

$$dI_0 = \frac{I_0 d\nu}{\Delta \nu}$$

$$I = \int_{\nu_1}^{\nu_2} \frac{2I_0}{\Delta \nu} \left(1 + \cos \left(\frac{2\pi \delta \nu}{c} \right) \right) d\nu$$

$$= 2I_0 \left[1 + \text{Sinc} \left(\frac{\pi \delta \Delta \nu}{c} \right) \cos \left(\frac{2\pi \delta \nu_0}{c} \right) \right]$$

$$\nu_2 - \nu_1 = \Delta \nu$$

$$\nu_0 = \frac{\nu_1 + \nu_2}{2}$$

$$V(\delta) = \text{sinc} \left(\frac{\pi \delta \Delta \nu}{c} \right)$$

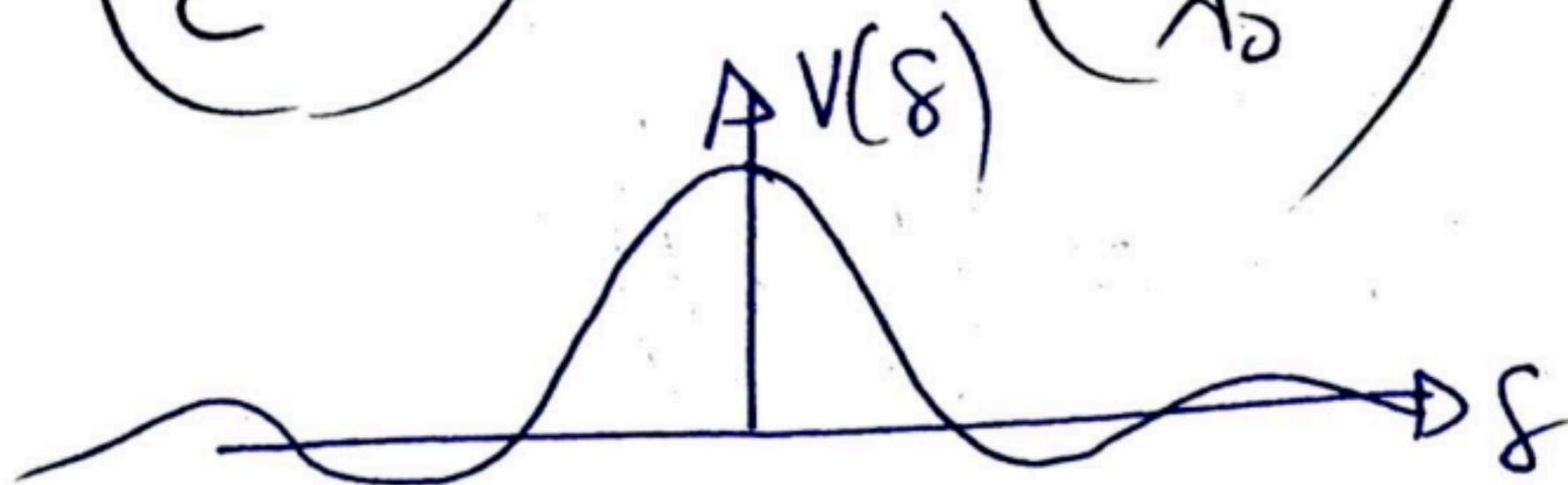
$$\nu_0 = \frac{c}{\lambda_0}$$

$$\nu = \frac{c}{\lambda} \Rightarrow \ln \nu = \ln c - \ln \lambda$$

$$\frac{d\nu}{\nu} = 0 - \frac{d\lambda}{\lambda} \Rightarrow \frac{\Delta \nu}{\nu} = \frac{\Delta \lambda}{\lambda} \Rightarrow$$

$$\Delta \nu \approx \frac{v_0}{\lambda_0} \Delta \lambda = c \frac{\Delta \lambda}{\lambda_0^2}$$

$$\text{sinc}\left(\frac{\pi \delta}{c} \Delta \nu\right) = \text{sinc}\left(\frac{\pi \delta \Delta \lambda}{\lambda_0^2}\right)$$



$$V(\delta) = 0$$

$$\delta = k \frac{c}{\Delta \nu}$$

$$, k \in \mathbb{Z}^*$$

$$\frac{c}{\Delta \nu} = L_c = \text{temporelle};$$

$$L_c = \frac{\lambda_d}{a} = \text{spatial}$$

$$\frac{1}{\Delta \nu} = \tau$$

$$L_c = c \tau$$