$I_\parallel = I_0 \cdot \cos^2\theta$

$\begin{cases} i_B + r_B = 90° \\ n_1 \sin i_B = n_2 \cos r_B \end{cases} \Rightarrow \begin{cases} n_1 \sin i_B = n_2 \sin(\pi/2 - i_B) \\ n_1 \sin i_B = n_2 \cos i_B \end{cases}$

deci: $\frac{\sin i_B}{\cos i_B} = \left(\frac{n_2}{n_1}\right) = \operatorname{tg} i_B$.

3.13/144

$n = 1,9$

$\lambda = 5893 Å$

$i_B = ?$

$\operatorname{tg} i_B = 1,9 = n/1$

$\Rightarrow i_B \simeq 62°$

3.14

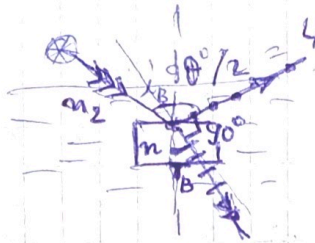
$n = 1,5$

$n_2 =$

$\theta = 97°$

$n_1 = ?$

$i_B = ?$



$\operatorname{tg} i_B = \left(\frac{n}{n_2}\right) = \operatorname{tg}\left(\frac{\theta}{2}\right)$

$\Rightarrow n_2 = n / \operatorname{tg}(\theta/2)$

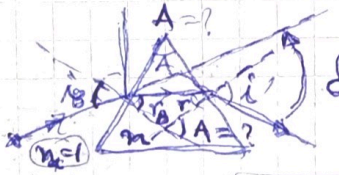
3.15/144

Δ, $n = 1,5 = 3/2$ = sticlă

$i = i' = i_B$.

$A = ?$

$\delta_m = ?$



$\delta_m = 2i_B - A$

$\operatorname{tg} i_B = \left(\frac{n}{n_a}\right) = \frac{n}{1}$

$i_B = \operatorname{arctg} n$

$\operatorname{tg} 1,5 \simeq 14,10$

$\begin{cases} i_B + r_B = \pi/2 \\ i' + r' = \pi/2 \end{cases}$

$A = 2i - 2r = 2(i - r)$

$i_B + r_B = \pi/2 \Rightarrow r_B = \pi/2 - i_B$

$A = 2\left(i_B - \frac{\pi}{2} + i_B\right) = 4i_B - \pi$

$\delta_m = 2i_B - A$

Polarizarea luminii

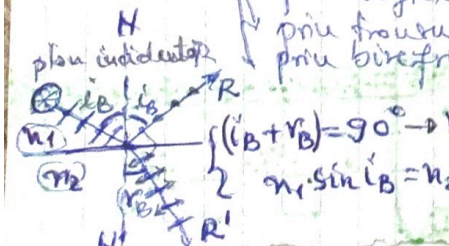
$\vec{E} \perp \vec{B} \perp \vec{v}$

Lumina: a) naturală – nepolarizată (circular)
b) parțial polarizată (eliptic)
c) total polarizată (liniar)

a) b) c)

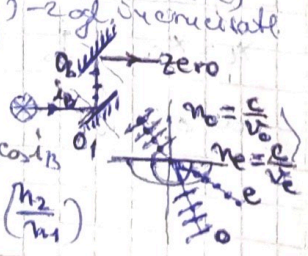
Polarizare – trecerea luminii din stările naturală/nepolarizată/parțial polarizată în starea de lumină total polarizată / liniară / circulară

Polarizarea → cu **polaroidul** (peliculă de polimer care conține o rețea periodică de celule/molecule liniare)
→ prin reflexie (Aparatul Horreuberg) – 2 grade de libertate
→ prin fenomene neliniare
→ prin birefringență



$\begin{cases} (i_B + r_B) = 90° \rightarrow r_B = (\pi/2 - i_B), \; n_1 \cdot \sin i_B = n_2 \cdot \cos i_B \\ n_1 \cdot \sin i_B = n_2 \sin r_B \end{cases}$

$\left(\operatorname{tg} i_B = \frac{\sin i_B}{\cos i_B} = \left(\frac{n_2}{n_1}\right)\right)$



în două raze { o – rază ordinară / respectă legea refracției ($n_o = \frac{c}{v_o}$)
e – rază extraordinară / nu respectă legea refracției ($n_e = \frac{c}{v_e}$)

Polarizarea prin birefringență – constă în divizarea luminii în ($CaCO_3$)

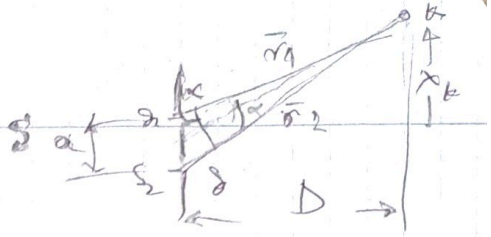
$\delta = a \sin\alpha$.

$\operatorname{tg}\alpha = x_k / D$.

$\sin\alpha \approx \operatorname{tg}\alpha \approx \alpha \; (< 5°)$.

$\sin\alpha = \frac{\delta}{a} \simeq \frac{x_k}{D} = \operatorname{tg}\alpha$

$\delta = \left(\frac{a}{D}\right) x_k = \begin{cases} \delta_{max} = (2k)\frac{\lambda}{2} \rightarrow x_k^{max} = (2k)\left(\frac{\lambda}{2}\right)\frac{D}{a} \\ \delta_{min} = (2k+1)\frac{\lambda}{2} \rightarrow x_k^{min} = (2k+1)\frac{\lambda}{2}\cdot\frac{D}{a} \end{cases}$



$\begin{cases} \lambda_0 = cT \\ v = \frac{c}{n} \\ \lambda = v \cdot T = \frac{cT}{n} = \frac{\lambda_0}{n} \end{cases}$ $\boxed{\lambda_0 = n\lambda}$

$\boxed{\lambda = \frac{a i}{D}}$

$i = (x_{k+1} - x_k)$

$i = (2k+2)\frac{\lambda}{2}\frac{D}{a} - 2k\frac{\lambda}{2}\frac{D}{a} =$

$\boxed{i = \frac{\lambda}{2}\frac{D}{a}}$ $\begin{cases} i_0 = \frac{\lambda_0 D}{2a} \\ i_n = \frac{n\lambda D}{2a} \end{cases}$

Aplicații ale polarizării luminii

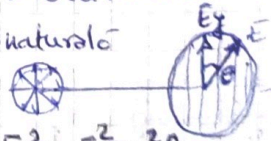
→ polarizarea rotorie → polarimetre.

zaharul { zaharoză – levogir (-)
dextroză – dextrogir (+)

→ pelicule polaroide { ochelari de soare
parbrizele și farurile mașinilor.
fotografia prin reflexie.
monitoarele computerelor.

Legea lui Malus

l. natural



l. pol.

$E_y = E\cos\theta$

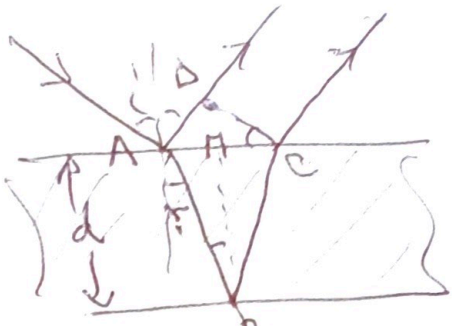
deci $I(\theta) = I_m \cos^2\theta \sim E_y^2 = E^2\cos^2\theta$

$I_y \sim E_y^2 \sim E^2\cos^2\theta$

$I_y^{(\theta)} = I_0 \cdot \cos^2\theta$

Interferența Localizată pe straturi subțiri

Lama cu fețe pl. paralele.



$\delta = (AB+BC)\cdot n - (AD + \lambda/2)$

$\sin i = n \cdot \sin r$

$\cos r = \frac{d}{AB} \rightarrow AB = \frac{d}{\cos r} = AC$

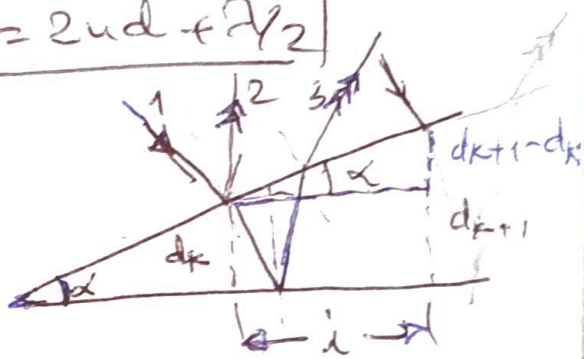
$AD = 2AM = 2d\frac{\sin r}{\cos r}$ $\quad \frac{AM}{MB} = tg\, r = \frac{AM}{d} \rightarrow AM = d\, tg\, r = d\frac{\sin r}{\cos r}$

$\delta = \frac{2nd}{\cos r} - \left(2d\frac{\sin r}{\cos r}\cdot \sin i - \frac{\lambda}{2}\right)$ $\quad \sin i = \frac{AD}{AC} \rightarrow AD = AC \sin i$

$$\boxed{\delta_n = 2nd\cos r + \lambda/2} \quad || \quad \boxed{\delta_n = 2nd + \lambda/2}$$

$i = 0 \rightarrow r = 0 \rightarrow \cos 0 = 1$

Pana optică



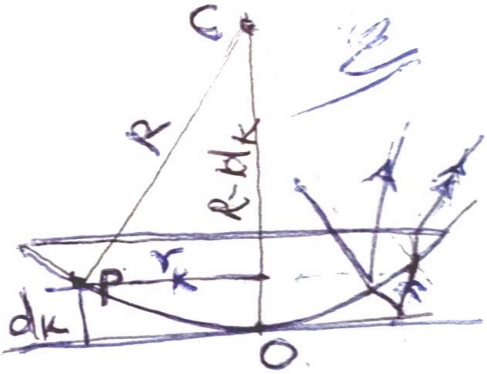
$$\begin{cases} 2nd_k + \lambda/2 = \delta_n = k\lambda \\ 2nd_{k+1} + \lambda/2 = \delta_n = (k+1)\lambda \end{cases}$$

$2n(d_{k+1} - d_k) = \lambda \rightarrow (d_{k+1} - d_k) = \lambda/2n$

dar $tg\,\alpha = \frac{(d_{k+1}-d_k)}{i} \simeq \alpha \rightarrow (d_{k+1}-d_k) = \alpha \cdot i$

$\alpha \cdot i = \frac{\lambda}{2n} \rightarrow \boxed{i = \frac{\lambda}{2n\alpha}}$

Inelele lui Newton



$\delta_n = 2nd_k + \lambda/2$

$R^2 = [(R-d_k)^2 + r_k^2] = R^2 - 2Rd_k + d_k^2 + r_k^2$ ($d_k^2 = 0$)

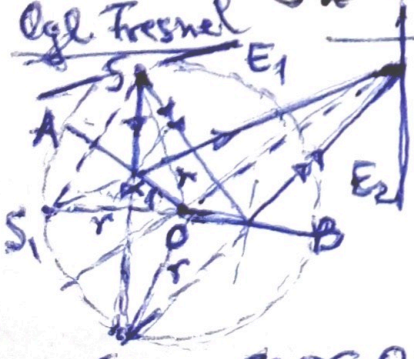
$d_k << R \rightarrow 2Rd_k = r_k^2 \rightarrow \boxed{d_k \simeq \frac{r_k^2}{2R}}$

deci $\delta_n = 2n\left(\frac{r_k^2}{2R}\right) + \lambda/2$

$\delta_k^{Max} = (2k)\frac{\lambda}{2} \rightarrow$ Max

$\delta_k^{min} = (2k+1)\frac{\lambda}{2} \rightarrow$ min

Ogl. Fresnel



$S_0 = S_1O = S_2O = r$

$e = \frac{\lambda}{(n-1)} = \frac{6 \cdot 20 \cdot 10^{-7}}{0,5}$