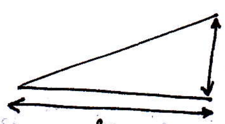
7.21 Plane plates of glass are in contact along one side and held apart by a wire 0.05 mm in diameter, parallel to the edge in contact and 20 cm distant. Using filtered green Hg light ($\lambda = 546$ nm), directed normally on the air film between plates, interference fringes are seen. Calculate the separation of the dark fringes. How many dark fringes appear between the edge and the wire?



Let the horizontal distance from the point of contact of the glass plates to a given position in the air wedge be x, corresponding to a thickness of t of the film.

Dark fringe: $2t + \lambda/2 = (m+\frac{1}{2})\lambda \Rightarrow t = m\lambda/2$

$$\frac{x}{t} = \frac{0.2\,m}{0.5\times 10^{-4}\,m} = \frac{2x}{m\lambda} = 4000$$

For $\Delta m = 1$: $\Delta x = 2000\,\lambda\,\Delta m = 2000\lambda = 1.092$ mm

For $x = 20$ cm: $m = \frac{2x}{4000\lambda} = 183.15$

Counting the $m=0$ dark fringe, 184 fringes would appear.

11.17. (a) Show that in a double-slit Fraunhofer diffraction pattern, the ratio of widths of the central diff. peak to the central interference fringe is $2\,a/b$, a/b is slit separation / slit width.

(b) Determine the peak-to-fringe ratio when $a = 10b$.

(a) Diff. minima: $m\lambda = b\sin\theta$ (11.28) $\Rightarrow m\lambda \approx b\theta$

Angular width of central ($m=1$) diff. peak: $\Delta\theta_{1/2\,d} = \lambda/b$

Interf. minima: $(p+\frac{1}{2})\lambda = a\sin\theta \approx a\theta$: $\Delta\theta_{1/2\,i} = \lambda/2a$ $(p=0)$

$$\Rightarrow \frac{\Delta\theta_{1/2\,d}}{\Delta\theta_{1/2\,i}} = \frac{2a}{b}$$

(b) $$\frac{\text{peak width}}{\text{fringe width}} = \frac{2a}{b} = 20$$

<u>Other topics:</u> relativity, scattering (plane EM wave, non-rel), Chapter 6 Pedrotti's HW.

13.9 A zone plate is to be produced having a focal length of 2m for a laser of $\lambda = 632.8\,nm$. An ink drawing of 20 zones is made with alternate zones shaded in, and a reduced photographic transparency is made of the drawing.

a. The radius of the 1st zone is 11.25 cm in the drawing, what is the reduction factor?

b. Radius of the last zone in the drawing? (Fresnel zone).

---

a. Before reduction: $R_1 = 11.25\,cm$.

Require: $R_1 = \sqrt{n\lambda f_1} = \sqrt{1(632.8\times 10^{-9})(2)} = 0.1125\times 10^{-2}\,m.$
(13.23)
$= 0.1125\,cm.$

$\Rightarrow$ reduced by 100 times.

b. $R_N = \sqrt{N}\,R_1 = \sqrt{20}\,R_1.$

$\uparrow$

$R_N = \sqrt{N r_0 \lambda}$ (13.20)
$= \sqrt{N}\,R_1.$

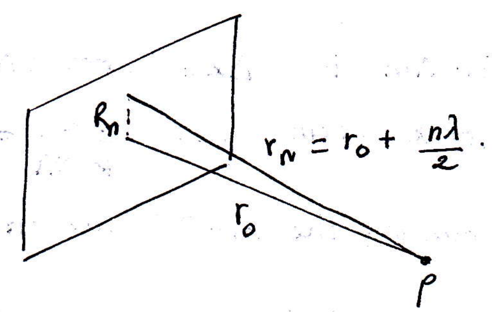


Fig. 13.8

14.12. A beam of laser passes through a combination of linear polarizer & QWP, with OA of the QWP at 45° to the TA of the polarizer. What happens to this light after reflection from a plane surface and transmission back through this device?

Light from a linear pol (α) passing through the QWP twice (before & after reflection) is equiv. to passing through a HWP that rotates the pol. dir. by 2α:

$$\underset{HWP}{\begin{bmatrix}1 & 0\\ 0 & -1\end{bmatrix}}\underset{LP,\alpha}{\begin{bmatrix}\cos\alpha\\ \sin\alpha\end{bmatrix}} = \begin{bmatrix}\cos\alpha\\ -\sin\alpha\end{bmatrix} = \begin{bmatrix}\cos(-\alpha)\\ \sin(-\alpha)\end{bmatrix}$$

Here $\alpha = 45°$.

$\rightarrow$ Then the light returns to the LP $\perp$ TA ($2\alpha = 90°$)

$\therefore$ No light passes back through the polarizer after reflection.