

Aufgabe 2:

Geg: $r_1 = 80 \text{ mm}$ $r_2 = -120 \text{ mm}$ $d = 40 \text{ mm}$ $n = 1,4$

a)
$$\varphi = (n-1) \left(\frac{1}{r_1} - \frac{1}{r_2} \right) + \frac{d \cdot (n-1)^2}{n \cdot r_1 \cdot r_2}$$

Radien + Strecken
in m!

$$\varphi = 0,4 \left(\frac{1}{0,08} - \frac{1}{0,12} \right) + \frac{0,04 \cdot 0,4^2}{1,4 \cdot 0,08 \cdot 0,12}$$

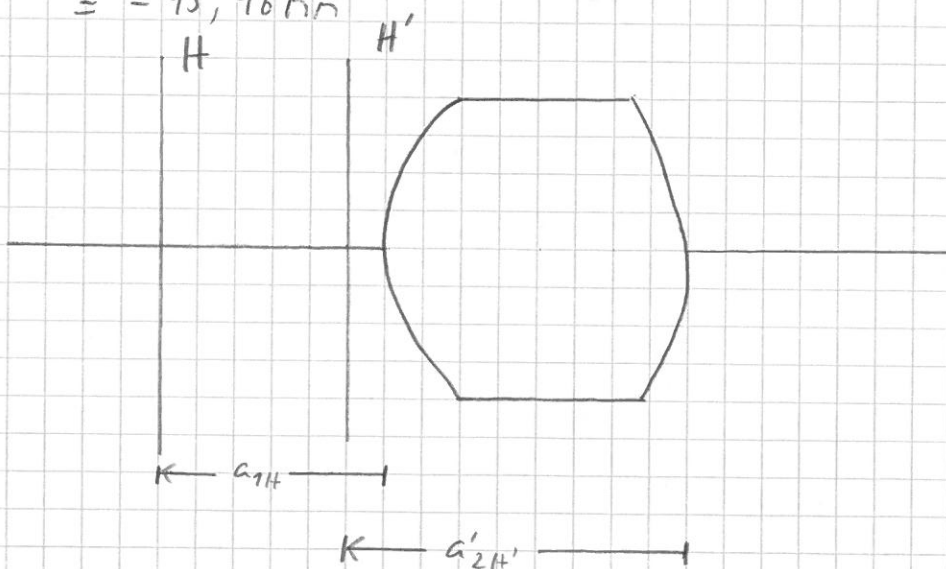
$$= 7,857 \text{ dpt} \quad (\Rightarrow f' = 127,275 \text{ mm})$$

b)
$$a_{1H} = f' \cdot \frac{1}{f_2'} \cdot \frac{d}{n} = 127,275 \text{ mm} \cdot \frac{1}{-120 \text{ mm}} \cdot \frac{40 \text{ mm}}{1,4}$$

$$= -30,3 \text{ mm}$$

$$a'_{2H'} = -f' \cdot \frac{1}{f_1'} \cdot \frac{d}{n} = -127,275 \text{ mm} \cdot \frac{1}{80 \text{ mm}} \cdot \frac{40 \text{ mm}}{1,4}$$

$$= -95,46 \text{ mm}$$



$$c) \quad s = s_0 - a_{1H} = -200 \text{ mm} - (-39,3 \text{ mm}) = -160,7 \text{ mm}$$

$$\frac{1}{s'} - \frac{1}{s} = \frac{1}{f'} \Rightarrow \frac{1}{s'} = \frac{1}{f'} + \frac{1}{s}$$

$$\frac{1}{s'} = \frac{1}{127,275 \text{ mm}} - \frac{1}{160,7 \text{ mm}} = 0,00796425 \frac{1}{\text{mm}}$$

$$\Rightarrow s' = 509,1 \text{ mm}$$

$$s_0' = s' + a_{2H}' = 509,1 \text{ mm} - 45,46 \text{ mm} = 463,64 \text{ mm}$$

$$d) \quad \frac{1}{s'} = \frac{1}{f'} + \frac{1}{s} = \frac{1}{127,275 \text{ mm}} - \frac{1}{100 \text{ mm}} = -0,002143 \frac{1}{\text{mm}}$$

$$s' = -466,64 \text{ mm}$$

$$\frac{y'}{y} = \frac{s'}{s} \Rightarrow y' = \frac{s'}{s} \cdot y$$

$$y' = \frac{-466,64}{-100} \cdot 2 \text{ cm} = 9,33 \text{ cm}$$

$$k = \frac{f'}{\text{Distanz}} = \frac{127,275 \text{ mm}}{20 \text{ mm}} \approx 6,36$$

$$e) \quad \varphi_{G3} = \varphi_1 + \varphi_2 - \alpha \varphi_1 \varphi_2$$

$$\Leftrightarrow \alpha \varphi_1 \varphi_2 = \varphi_1 + \varphi_2 - \varphi_{G3}$$

$$\Leftrightarrow \alpha = \frac{\varphi_1 + \varphi_2 - \varphi_{G3}}{\varphi_1 \varphi_2}$$

$$\alpha = \frac{786 \text{ dpt} + 50 \text{ dpt} + 40 \text{ dpt}}{786 \text{ dpt} \cdot 50 \text{ dpt}} = 0,429 \text{ n} = 42,9 \text{ cm}$$

Aufgabe 3:

a) $\alpha = 25^\circ$ $\sin i_6 = \frac{n'}{n}$

$\Rightarrow n = \frac{\sin i_6}{\sin 25^\circ}$ $n = \frac{n'}{\sin i_6} = \frac{1}{\sin 25^\circ}$

$n = 2,366$

b)

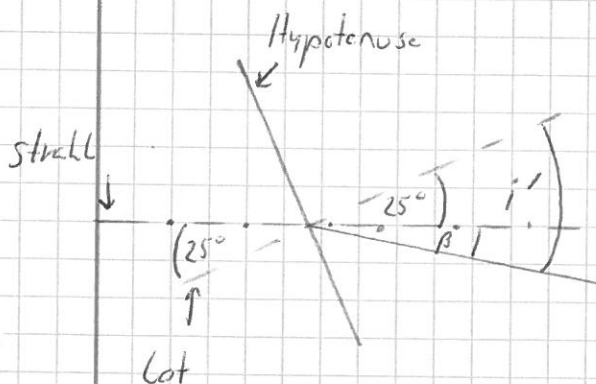
$n \cdot \sin i = n' \cdot \sin i'$

mit $\begin{cases} n_{\text{blau}} = 1,53 \\ n_2 = 1,51 \\ \sin i = 25^\circ \end{cases}$ $n' = 1$

$\Rightarrow i' = \arcsin \left(\frac{n}{n'} \cdot \sin i \right)$

$i'_{400} = \arcsin (1,53 \cdot \sin 25^\circ) = \cancel{39,34^\circ} 40,25^\circ$

$i'_{700} = 39,65^\circ$

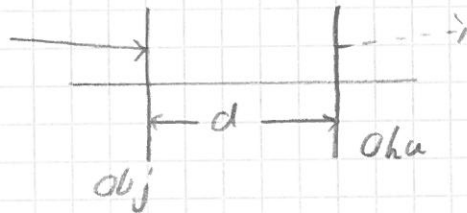


$\Rightarrow \beta = i' - 25^\circ$

$\beta_{400} = 15,29^\circ$

$\beta_{700} = 14,65^\circ$

Aufgabe 4:



$$\begin{pmatrix} y_2 \\ u_2 \end{pmatrix} = M \cdot \begin{pmatrix} y_1 \\ u_1 \end{pmatrix}$$

$$\begin{pmatrix} y_1 \\ u_1 \end{pmatrix} = \begin{pmatrix} 5 \text{ mm} \\ 5^\circ \end{pmatrix} = \begin{pmatrix} 5 \text{ mm} \\ 0,087266 \end{pmatrix}$$

$$M = M_{oku} \cdot M_d \cdot M_{obj}$$

$$= \begin{pmatrix} 1 & 0 \\ 1/50 \text{ mm} & 1 \end{pmatrix} \cdot \begin{pmatrix} 1 & -150 \text{ mm} \\ 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} 1 & 0 \\ 1/40 \text{ mm} & 1 \end{pmatrix}$$

$$= \begin{pmatrix} 1 & -150 \text{ mm} \\ 1/50 \text{ mm} & -2 \end{pmatrix} \cdot \begin{pmatrix} 1 & 0 \\ 1/40 \text{ mm} & 1 \end{pmatrix} = \begin{pmatrix} -2,75 & -150 \text{ mm} \\ -6/200 \text{ mm} & -2 \end{pmatrix}$$

$$\begin{pmatrix} y_2 \\ u_2 \end{pmatrix} = \begin{pmatrix} -2,75 & -150 \text{ mm} \\ -6/200 \text{ mm} & -2 \end{pmatrix} \cdot \begin{pmatrix} 5 \text{ mm} \\ 0,087266 \end{pmatrix} = \begin{pmatrix} -26,84 \text{ mm} \\ -0,324532 \end{pmatrix}$$

$$\begin{pmatrix} y_2 \\ u_2 \end{pmatrix} = \begin{pmatrix} -26,84 \text{ mm} \\ -18,59^\circ \end{pmatrix}$$

$$c) \quad T_{mick} = -\frac{t}{f'_{ckl}} \cdot T_{oku}$$

$$T_{oku} = \frac{250 \text{ mm}}{f'_{oku}} = \frac{250}{50} = 5$$

$$t = d - f'_{obj} - f'_{oku} = 150 \text{ mm} - 40 \text{ mm} - 50 \text{ mm} = 60 \text{ mm}$$

$$T_{mick} = -\frac{60 \text{ mm}}{40 \text{ mm}} \cdot 5 = -7,5$$

Aufgabe 5:

a) $E = h \cdot f = h \cdot \frac{c}{\lambda} = 3,61 \cdot 10^{-19} \text{ J} = 2,245 \text{ eV}$

$$\Phi_v = I_v \cdot d\Omega \quad \text{mit } d\Omega = 2\pi \cdot (1 - \cos \theta)$$

$$\begin{aligned} \Phi_v &= 25 \text{ cd} \cdot 2\pi \cdot \left(1 - \cos\left(\frac{5^\circ}{2}\right)\right) \text{ sr} \\ &= 0,1495 \text{ lm} \end{aligned}$$

$$\Phi_v = 683 \frac{\text{lm}}{\text{W}} \cdot V(\lambda) \cdot \Phi(\lambda)$$

$$\Rightarrow \Phi(\lambda) = \frac{\Phi_v(\lambda)}{683 \frac{\text{lm}}{\text{W}} \cdot V(\lambda)} = \frac{0,1495 \text{ lm}}{683 \frac{\text{lm}}{\text{W}} \cdot 1}$$

$$= 2,19 \cdot 10^{-4} \text{ W} \approx 0,22 \text{ mW}$$

b) $0,5 I_0 = I_0 \cdot e^{-\alpha z} \quad \text{mit } z = 2 \text{ mm}$

$$\Leftrightarrow 0,5 = e^{-\alpha z}$$

$$\ln(0,5) = -\alpha z \quad \Rightarrow \quad \alpha = -\frac{\ln(0,5)}{z}$$

$$\alpha = -0,3466 \frac{1}{\text{mm}}$$

c)

$$w(t) = w_0 \sqrt{1 + \left(\frac{t}{t_0}\right)^2} \quad (\Rightarrow) \quad w(t)^2 = w_0^2 \cdot \left(1 + \left(\frac{t}{t_0}\right)^2\right)$$

$$w_0^2 = \frac{w(t)^2}{\left(1 + \left(\frac{t}{t_0}\right)^2\right)} = \frac{0,1^2 \text{ m}^2}{\left(1 + \left(\frac{2000}{6}\right)^2\right)}$$

$$= \frac{0,01 \text{ m}^2}{111112,1}$$

$$w_0 = \sqrt{\frac{0,01 \text{ m}^2}{111112,1}} = 3 \cdot 10^{-4} \text{ m} = 0,3 \text{ mm}$$

Aufgabe III: Strahlkonstruktion (6 Punkte)

Konstruieren Sie die Bilder y' der beiden optischen Systeme.

