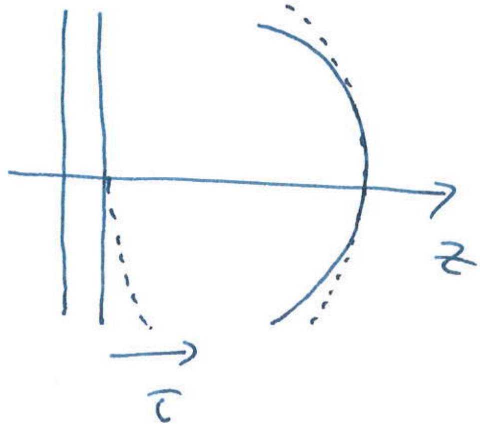
Schmidt - korektor



$$z = \frac{r^2}{2R} + (1+K)\frac{r^4}{8R^3} < 0$$

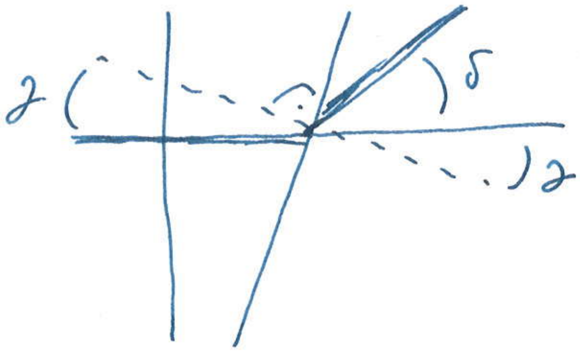
$$R < 0$$

$$\Delta z = \frac{r^4}{8R^3} < 0$$

$$(n-1)\tau + 2\Delta z = 0 \quad \Rightarrow \quad \tau = -\frac{2\Delta z}{n-1}$$

$$\tau = -\frac{r^4}{4R^3(n-1)} > 0$$

bar. vada



$$n \sin\gamma = \sin(\gamma+\delta)$$

$$n\gamma \sim \gamma + \delta$$

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

$$\underbrace{\frac{d\delta}{d\lambda}}_{\text{bar. vada}} = \gamma \underbrace{\frac{dn}{d\lambda}}_{\text{disperze}}$$

optimalizace

paraboloid $\dfrac{r^2}{2R_p}$

$r = r_0 \rho$

sféra $\dfrac{r^2}{2R} + \dfrac{r^4}{8R^3}$

$$\Delta z = r^2\left(\frac{1}{2R} - \frac{1}{2R_p}\right) + r^4 \frac{1}{8R^3} = \underbrace{\left(\frac{1}{2R} - \frac{1}{2R_p}\right) r_0^2}_{a} \rho^2 + \underbrace{\frac{r_0^4}{8R^3}}_{b} \rho^4$$

$$\Delta z = a\rho^2 + b\rho^4$$

$$|R_p| < |R| \rightarrow R_p > R \rightarrow a > 0 , b < 0$$

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bez újmy na obecnosti:

$$a = -xb$$

$$\Delta z = b(\rho^4 - x\rho^2)$$

$$\Delta z' = 2b\underbrace{(2\rho^3 - x\rho)}_{f(\rho)}$$

max derivace bude na hranici $\rho = 1$ nebo uvnitř

(1)

$$f(\rho = 1) = 2 - x$$

(2) hledám lok. maximum

$$f'(\rho) = 6\rho^2 - x \quad \rightarrow \quad \rho_{max} = \left(\frac{x}{6}\right)^{1/2}$$

$$f(\rho_{max}) = 2\left(\frac{x}{6}\right)^{3/2} - x\left(\frac{x}{6}\right)^{1/2}$$

$$= \frac{2}{6^{3/2}} x^{3/2} - \frac{1}{6^{1/2}} x^{3/2} = x^{3/2} \frac{2-6}{6^{3/2}} = -\frac{4}{6^{3/2}} x^{3/2}$$

$$= -\frac{2^{1/2}}{3^{3/2}} x^{3/2}$$

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hraniční případ

$$x = \frac{3}{2}$$

$$f(\rho = 1) = 2 - \frac{3}{2} = \frac{1}{2}$$

$$f(\rho_{max}) = -\frac{2^{1/2}}{3^{3/2}}\left(\frac{3}{2}\right)^{3/2} = -\frac{1}{2}$$

$$x < \frac{3}{2} \rightarrow f(\rho = 1) > \frac{1}{2}$$

$$x > \frac{3}{2} \rightarrow f(\rho_{max}) < -\frac{1}{2}$$

$x = \frac{3}{2}$ je optimální volba

profil opt. korektoru

$$\Delta z = b\rho^2\left(\rho^2 - \frac{3}{2}\right) = \frac{r_0^4}{8R^3}\rho^2\left(\rho^2 - \frac{3}{2}\right)$$

$$\tau = -\frac{2\Delta z}{n-1}$$

$$\tau = -\frac{r_0^4}{4R^3(n-1)}\rho^2\left(\rho^2 - \frac{3}{2}\right) < 0$$

neutrální zóna

$$\tau' \propto 4\rho^3 - 3\rho = 0$$

$$\rho^2_{neutr} = \frac{3}{4}$$

$$\rho_{neutr} = \sqrt{\frac{3}{4}} \sim 0,866$$

Konstrukce korektoru

$$\tau = -\frac{r_0^4}{4R^3(n-1)}\rho^2\left(\rho^2-\frac{3}{2}\right)$$

$$AD = -\frac{1}{4R^3(n-1)} > 0$$

ref. poloměr křivosti

$$\frac{3}{2}\frac{r_0^4}{4R^3(n-1)}\rho^2 = \frac{r^2}{2R_p}$$

$$\frac{3r_0^2}{4R^3(n-1)}\cancel{r^2} = \frac{\cancel{r^2}}{R_p}$$

$$R_p = \frac{4R^3(n-1)}{3r_0^2}$$

při

$R = -1200\,mm$

$r_0 = 100\,mm$

BK7 $n = 1{,}5164$

$\Rightarrow$ $AD = 2{,}8\cdot 10^{-10}$

$R_p = -1{,}2\cdot 10^{5}$ OSLO: $-9{,}6\cdot 10^{4}$

Křivost pole

Petz. povrch – obr. pole AST = 0

$$k = -n'_f \sum_i \left(\frac{n'-n}{n'nR}\right)_i$$

plankonvex. čočka:

$$k_e = -\frac{n-1}{nR_e} + \frac{n-1}{n\infty} = -\frac{n-1}{nR_e}$$

$$k + k_e = 0$$

$$\Rightarrow \frac{2}{R} - \frac{n-1}{nR_e} = 0$$

$$\boxed{R_e = \frac{n-1}{n}\frac{R}{2} = \frac{(n-1)f}{n}}$$

SCH. OSLO

D = 200 mm

R = −1200 mm

korektor →||← 1 mm BK7

kulové zrcadlo + AP

field angle 3–5°

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optimalizace

std. asféra AD

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slider – wheel

spot diagram

vs.

CV $-1 \cdot 10^{-5}$ step 10^{-6}

AD $2{,}8 \cdot 10^{-10}$ step $2 \cdot 10^{-13}$

IMS – paraxial focus

za zrcadlem solve ax. height = 0