

2/5/09

①

$$\Delta z = z_R - z_I$$

$$= S \rho^4 - C y \rho^2 + A y^2 \rho^2 + K y^2 \rho^2 + D y^5 \rho$$

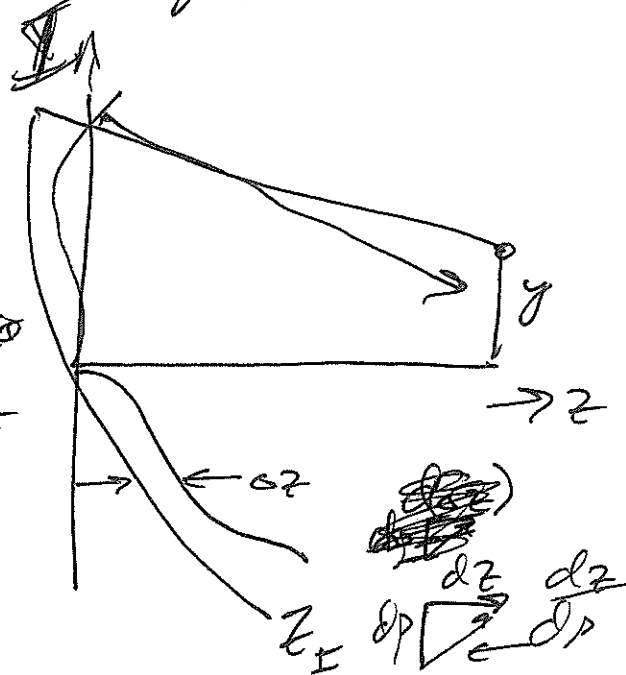
$S \Rightarrow$ Spherical

$C \Rightarrow$ Coma

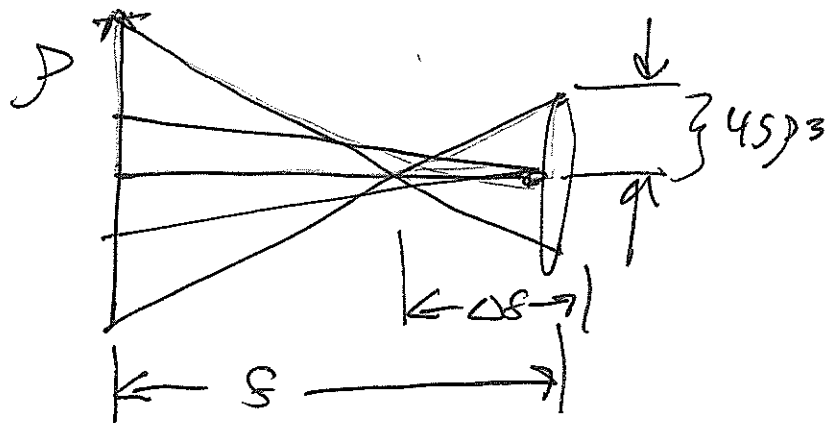
$A \Rightarrow$ Astigmatism

$K \Rightarrow$ Field curvature

$D \Rightarrow$ Distortion



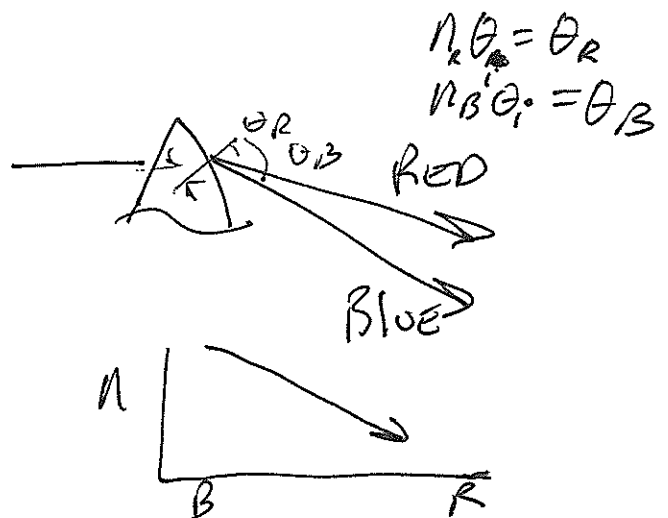
SPHERICAL - One Axis



$\Delta s \ll s$

$$\frac{d \Delta z}{d p} = 4 s p^3$$

$$\frac{\Delta s}{(s + \Delta s)} = \frac{4 s p^3}{p} = 4 s p^2$$



~~Distortion~~ $\frac{y}{x} \rightarrow p$ [Most complicated] (2)

CSMT

$$OZ = -C_y \sqrt{X^2 + Y^2} = -C_y (X^2 + Y^2)^{1/2}$$

Slope error

$$\frac{dOZ}{dX} = -2C_y X \sqrt{X^2 + Y^2} = -C_y p^2 (2 \sin \theta \cos \theta)$$

$$X/p = \sin \theta \Rightarrow -C_y p^2 (\sin 2\theta)$$

$$Y/p = \cos \theta$$

$$\sin 2\theta = 2 \sin \theta \cos \theta$$

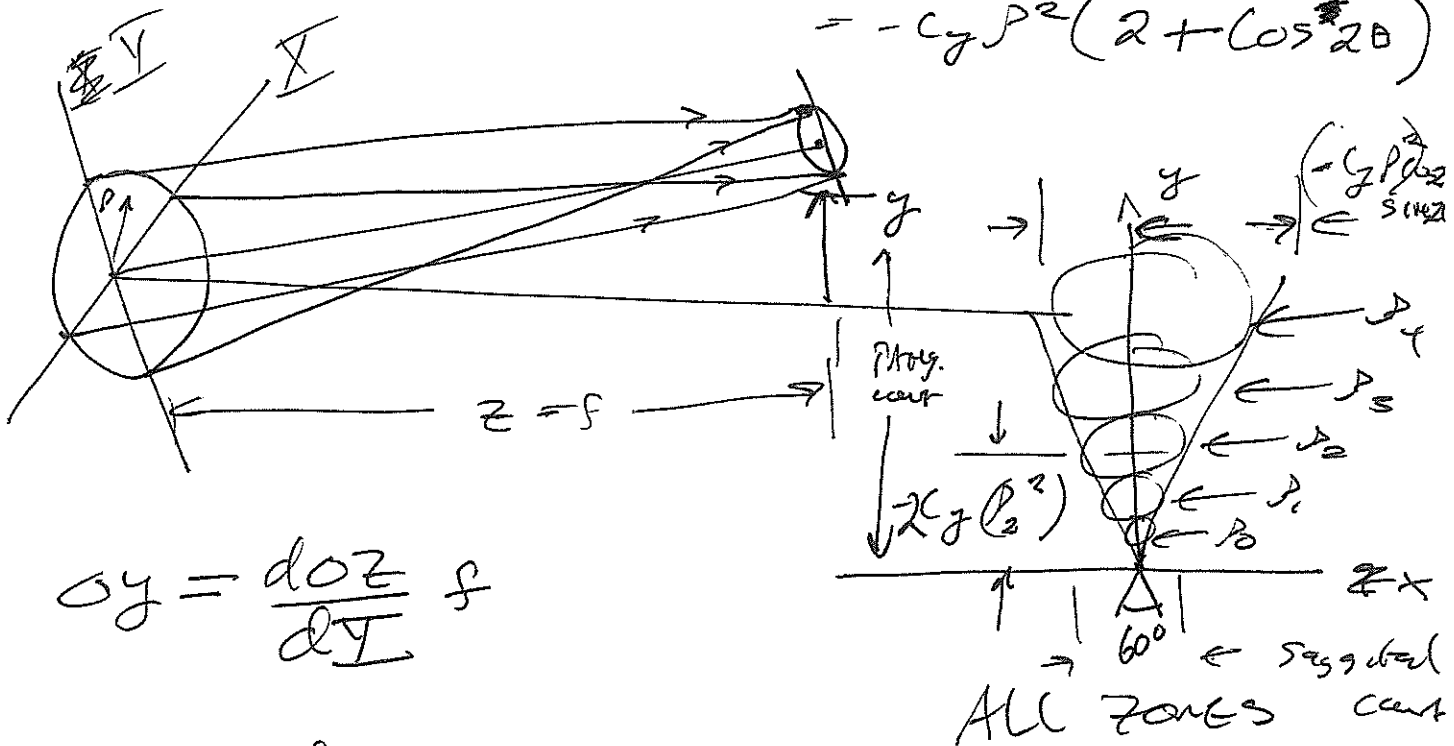
$$\frac{dOZ}{dY} = -C_y (X^2 + 3Y^2) = -C_y p^2 (\sin^2 \theta + 3 \cos^2 \theta)$$

$$= -C_y p^2 (1 + 2 \cos^2 \theta)$$

$$\cos^2 \theta = 2 \cos^2 \theta - 1$$

ONE ZONE

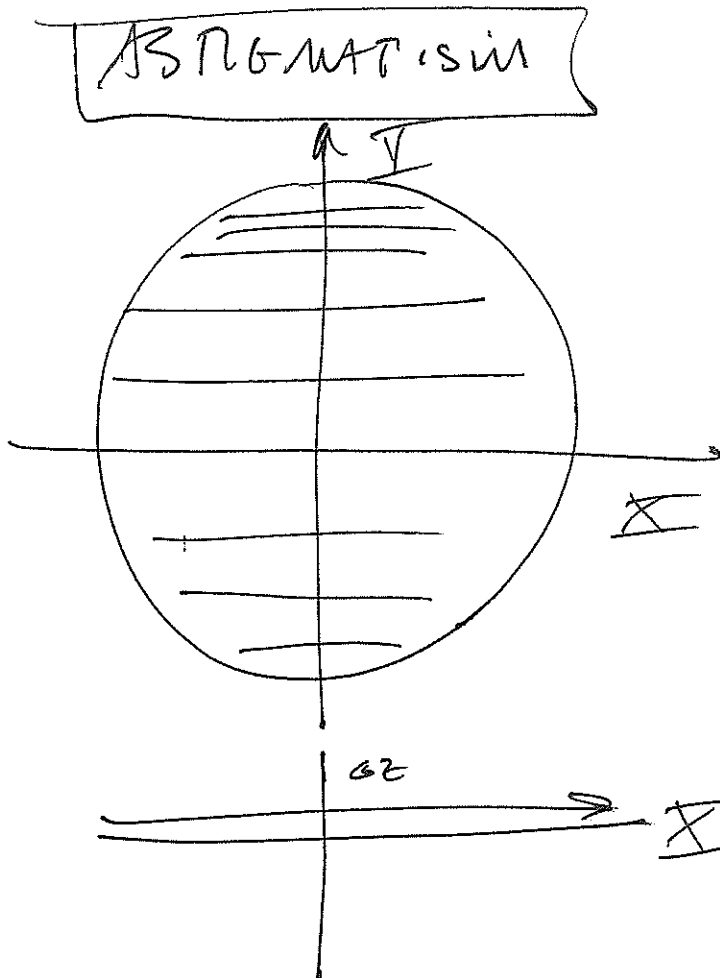
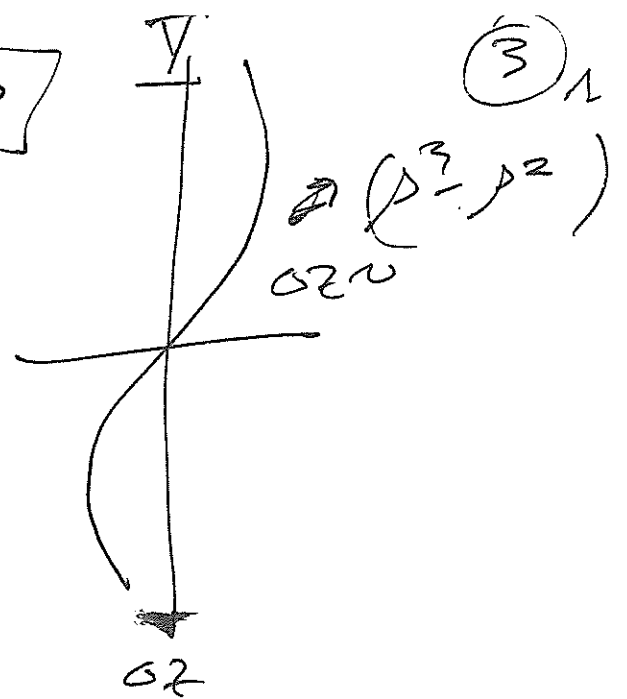
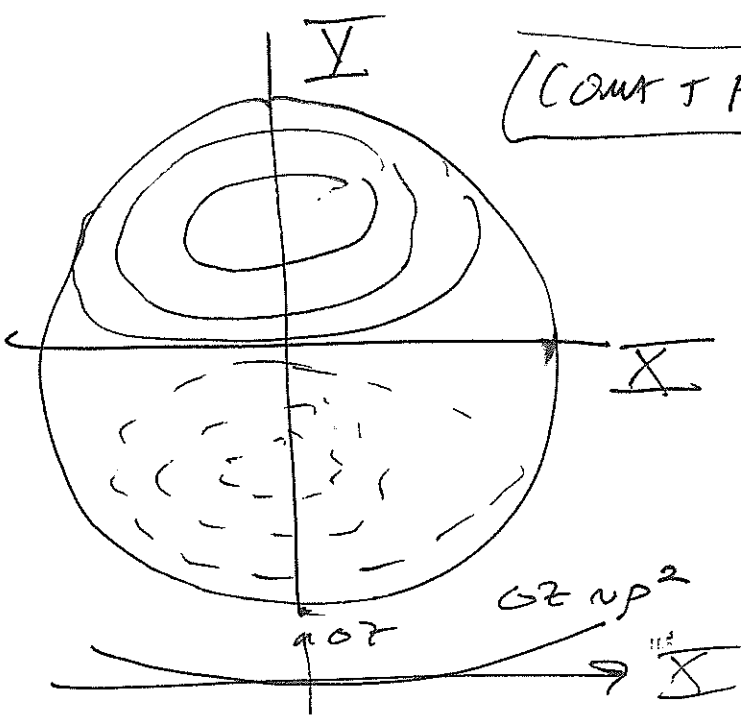
$$= -C_y p^2 (2 + \cos^2 2\theta)$$



$$Oy = \frac{dOZ}{dY} f$$

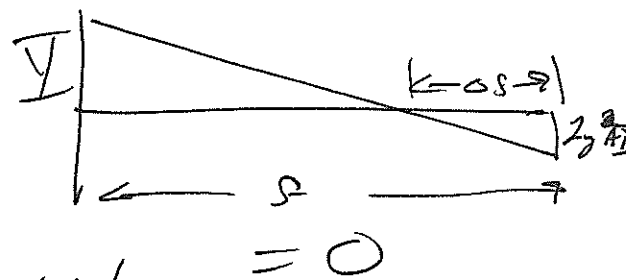
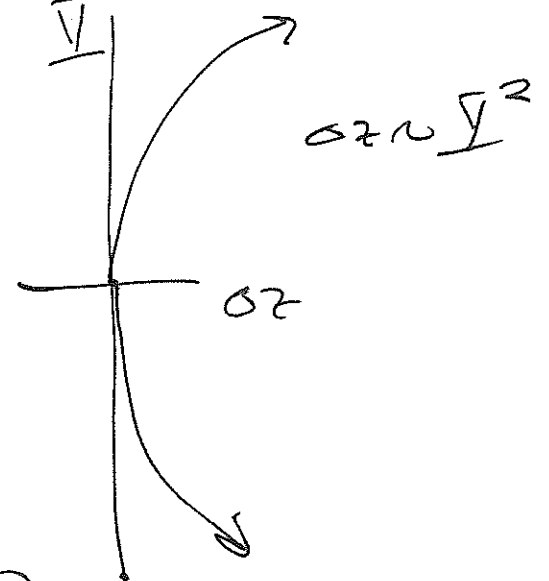
$$Ox = \frac{dOZ}{dX} f$$

$\sqrt{X^2 + Y^2} \Rightarrow$ Tangential Plane
 $X^2 \Rightarrow$ Sagittal Plane



$$OZ = A Y^2$$

$$\frac{dOZ}{dY} = 2 A Y$$



$$\frac{dOZ}{dY} = 0 \quad \Delta f \big|_{x \text{ plane}} = \text{Sagittal plane}$$

$$\frac{dOZ}{dY} = 2 A Y$$

$$\frac{Y}{S} = \frac{2 A Y}{\Delta f}$$

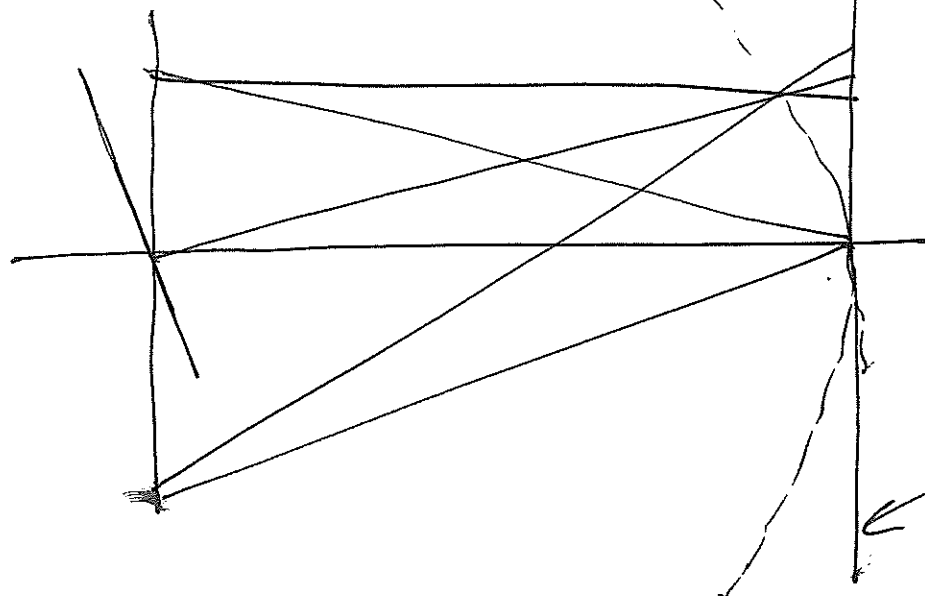
$\Delta f \sim 2 Y^2 A$

Tangential Plane

Simple MIRROR

$$K_e = \frac{4}{R} = \frac{2}{F}$$

(4)

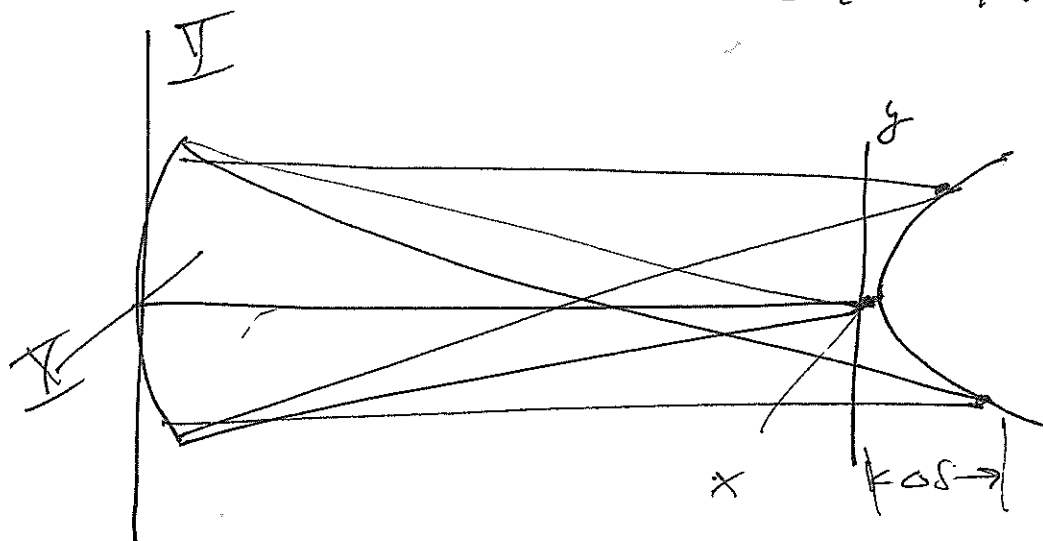


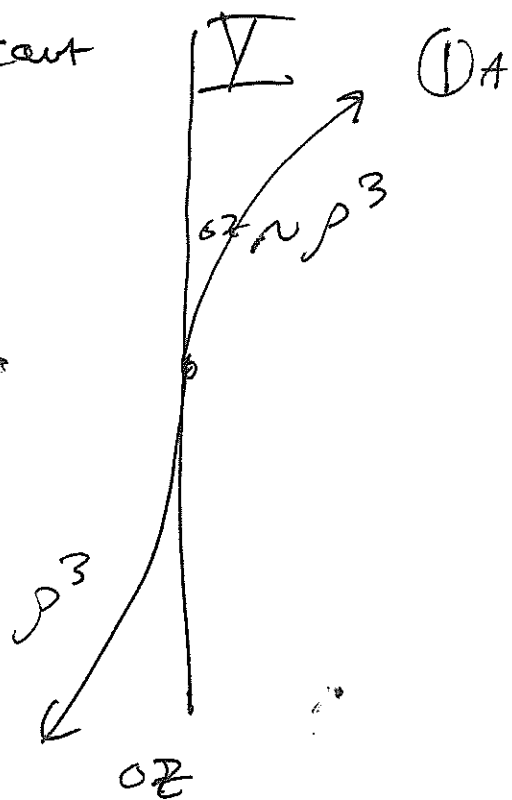
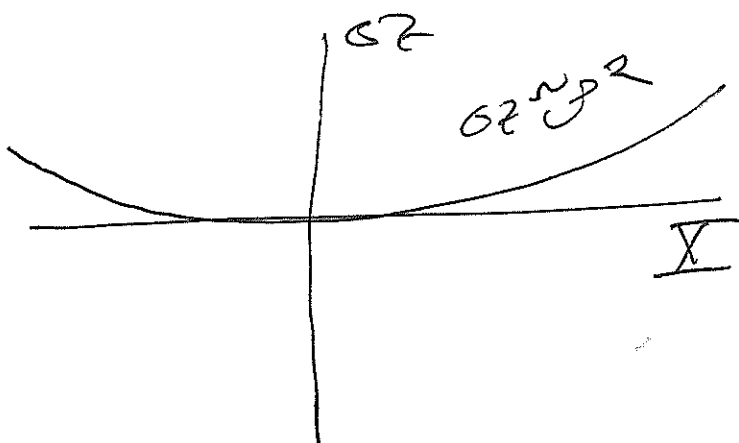
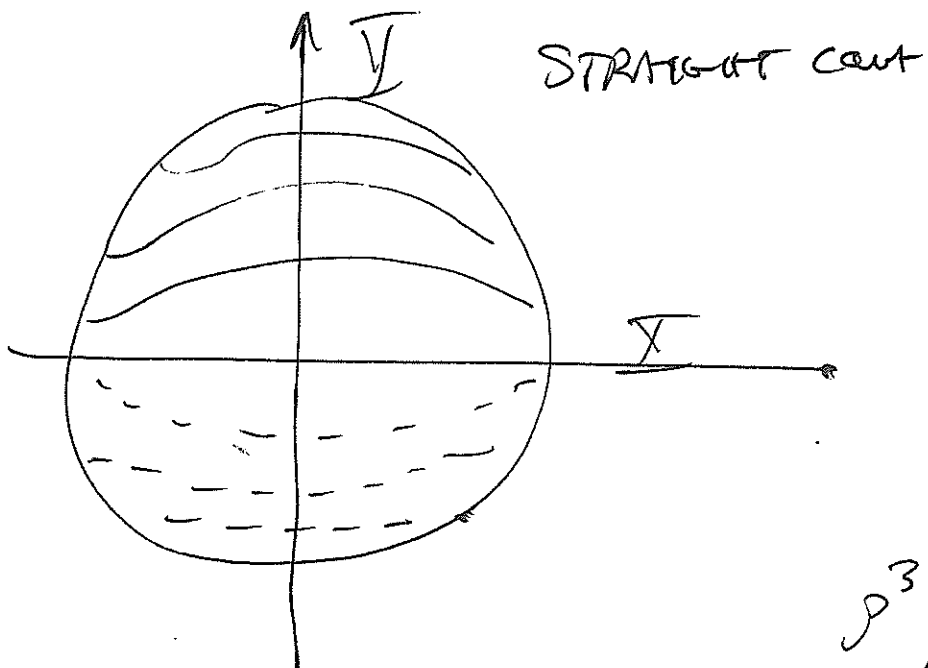
$$K_s = 0 \text{ (For concave mirror)}$$

Field Curvature

$$\Delta z = K y^2 p^2$$

↑
FOCAL SHIFT
w/ y^2





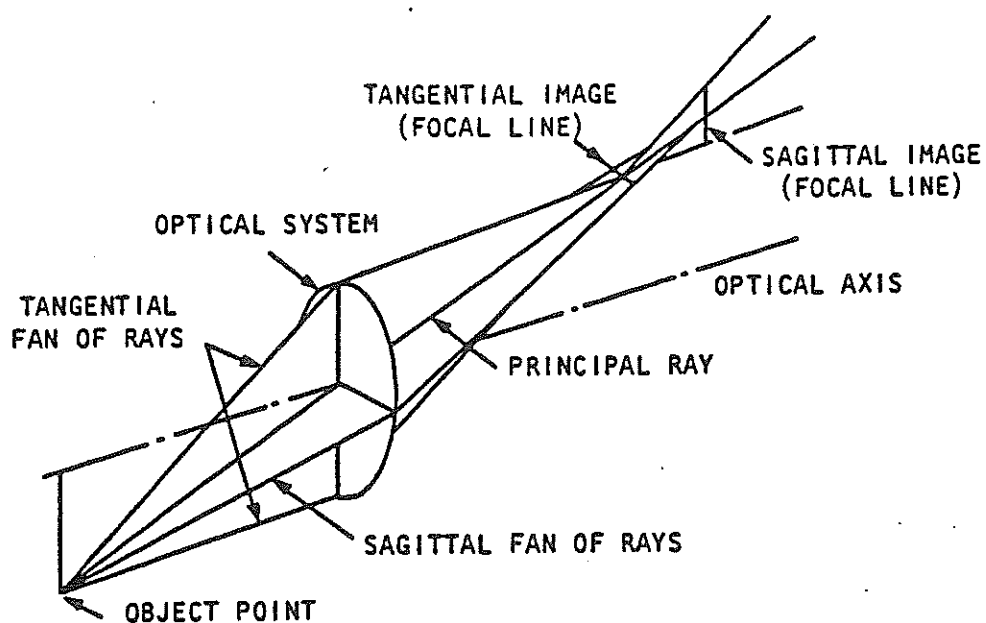


Fig. 1-22. Sagittal and tangential foci.

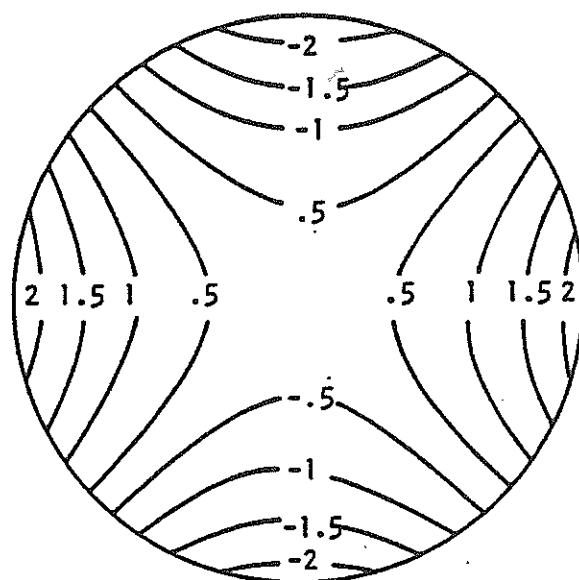


Fig. 1-23. Contours of astigmatic wavefront defocused to give circle of least confusion.

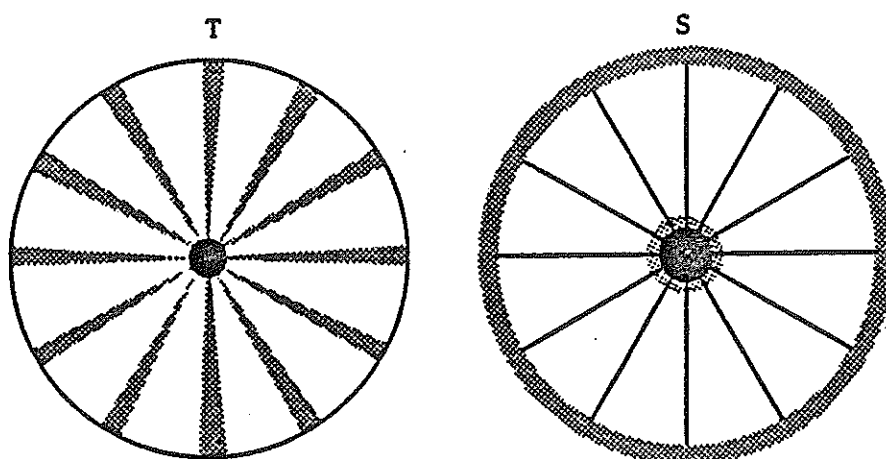


Fig. 1-24. Astigmatic images of a spoked wheel.

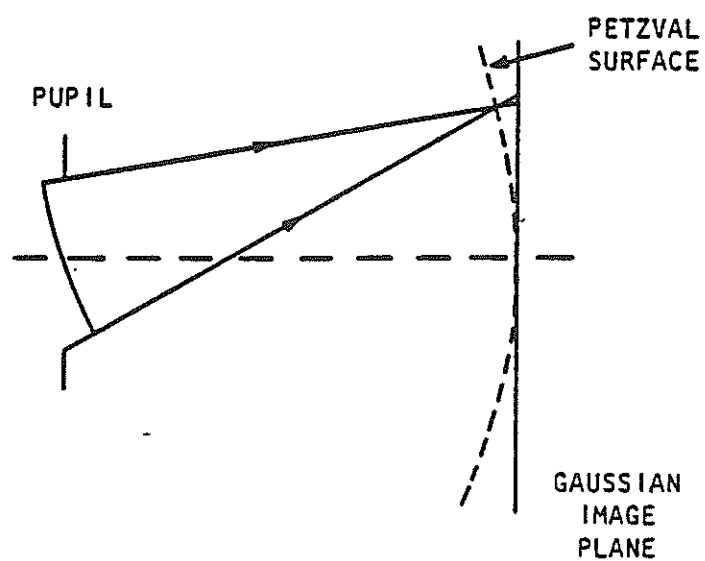


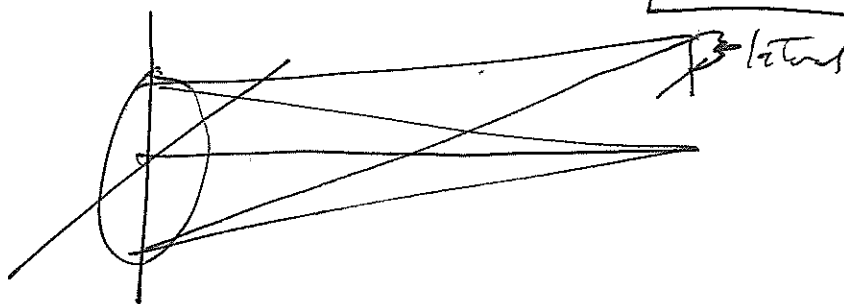
Fig. 1-25. Field curvature.

Distortion

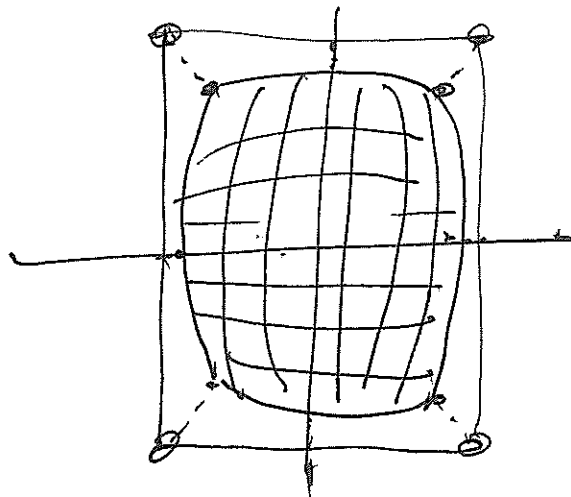
$$\sigma_z = D y^3 \frac{y}{r}$$

(5)

lateral shift
proportional to y^3



$D_{neg} \Rightarrow$ Barre



$D_{pos} \Rightarrow$ Pincushion

