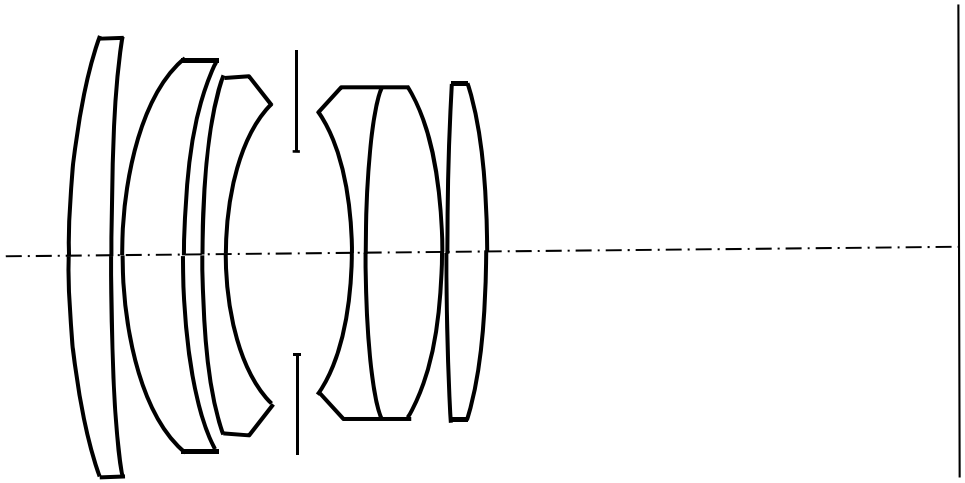
ROYAL INSTITUTE OF TECHNOLOGY

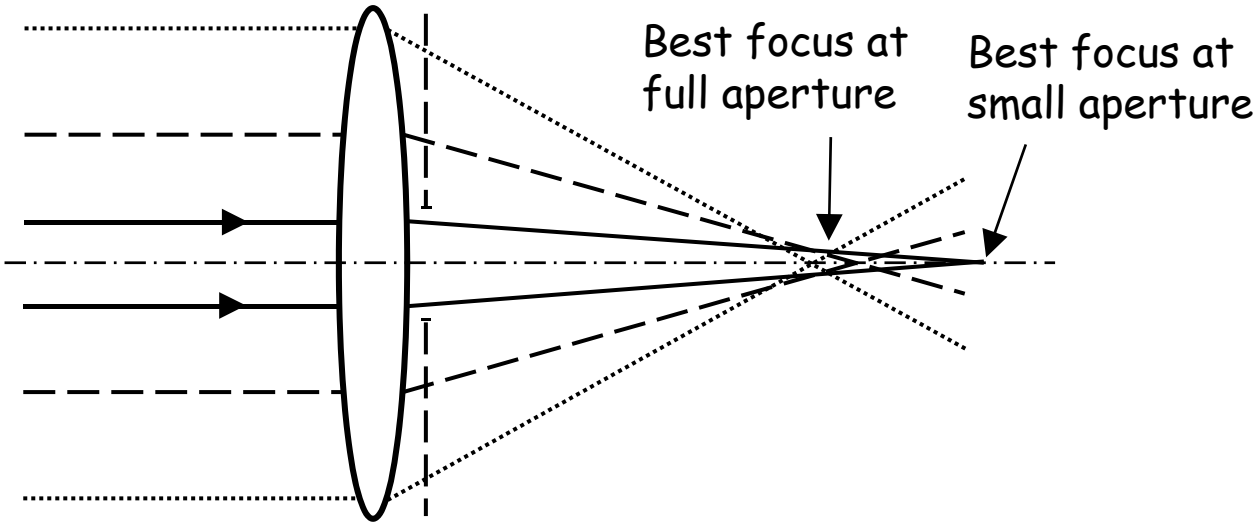
Kameraobjektiv har många linselement för att reducera avbildningsfelen.



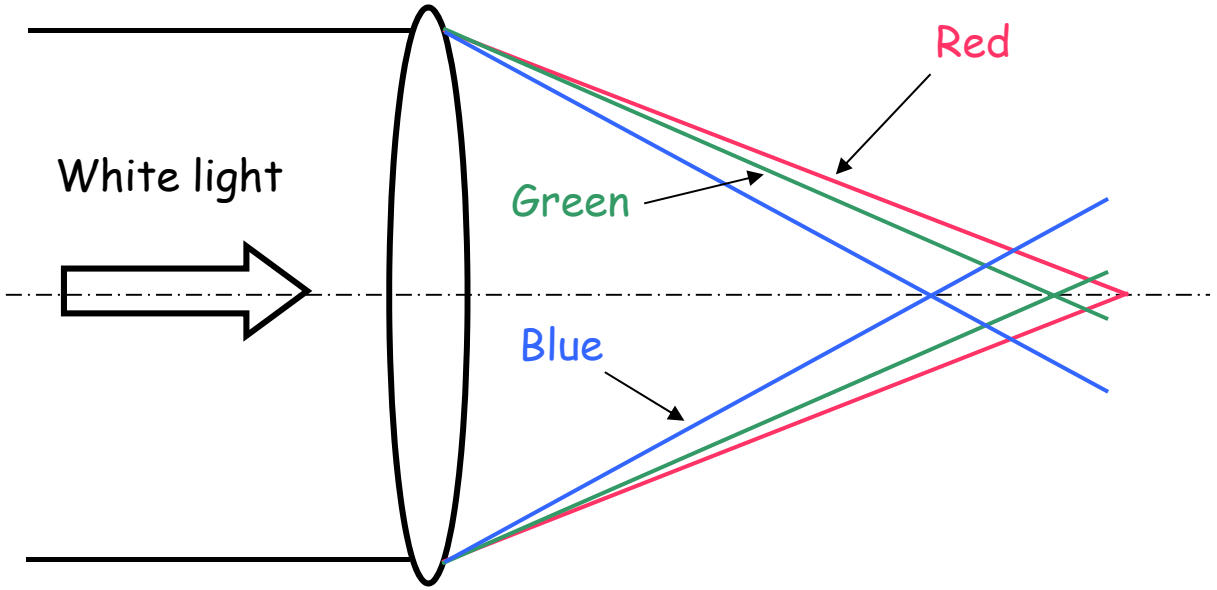
ROYAL INSTITUTE OF TECHNOLOGY

Aberrations

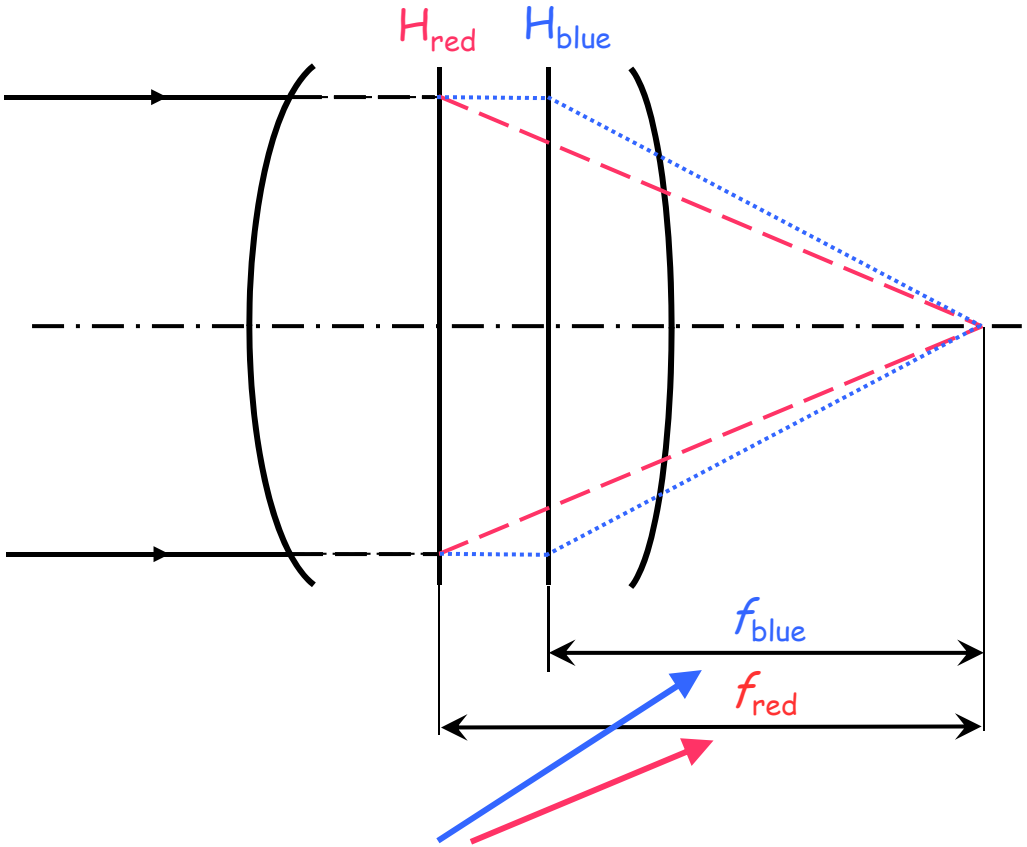
Spherical aberration



Chromatic aberration (longitudinal)

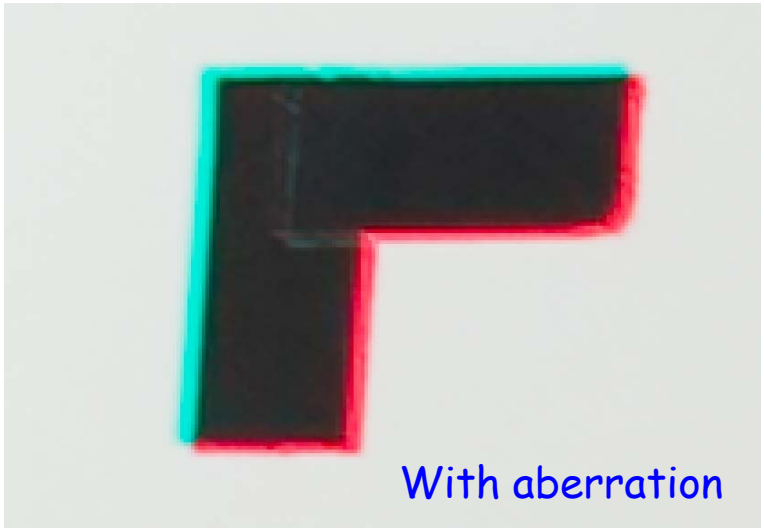


Lateral chromatic aberration



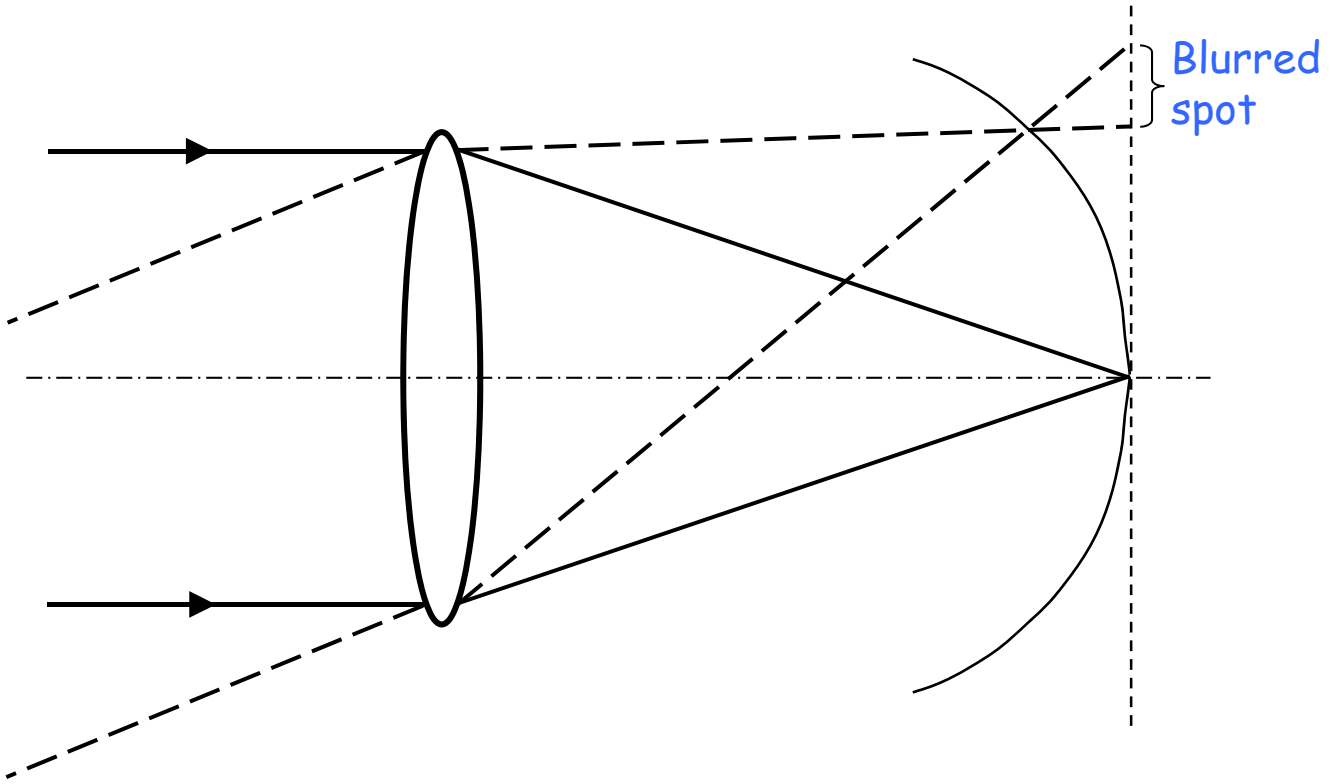
Different imaging scales for different colors

Image corner



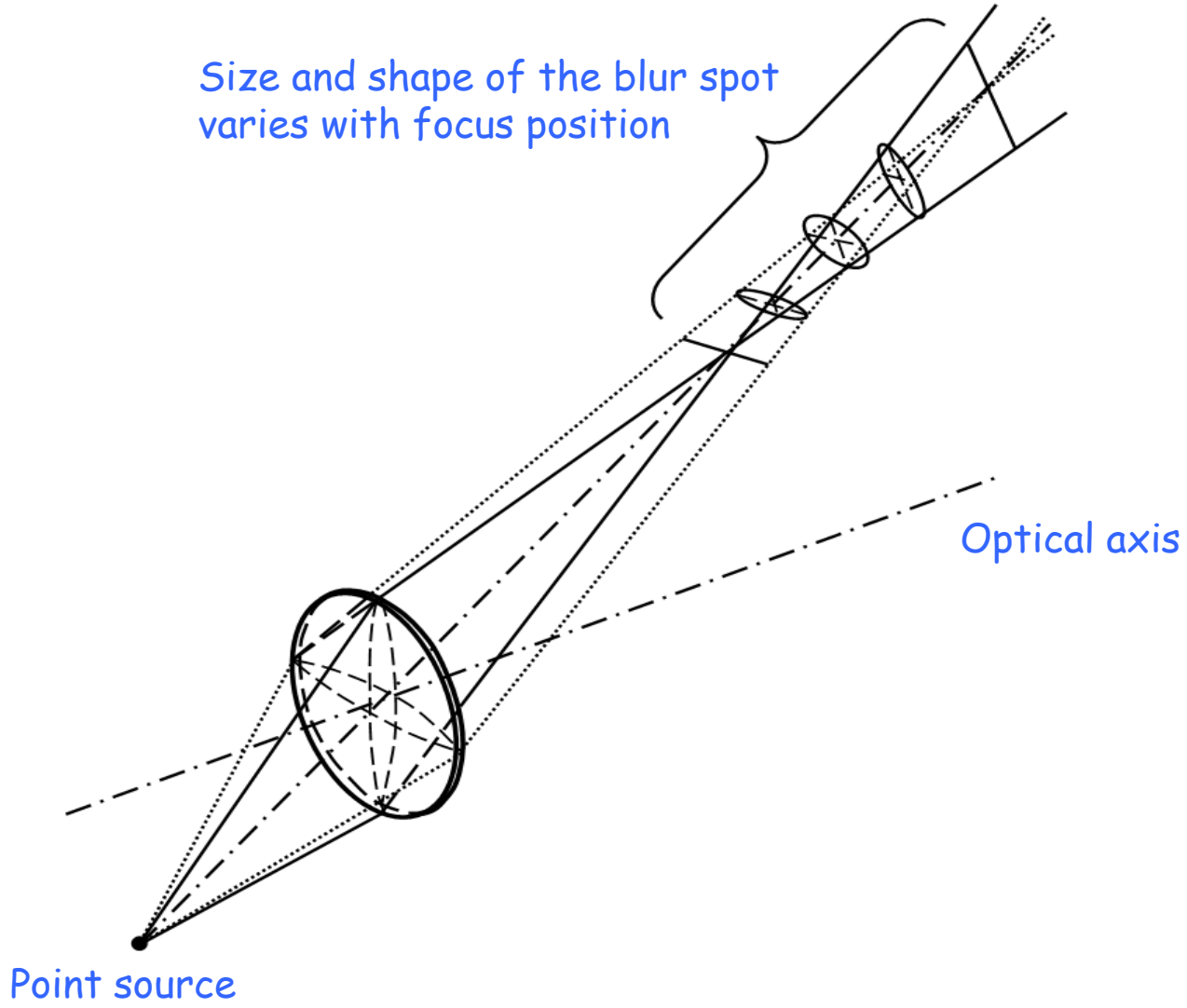
ROYAL INSTITUTE OF TECHNOLOGY

Curvature of field



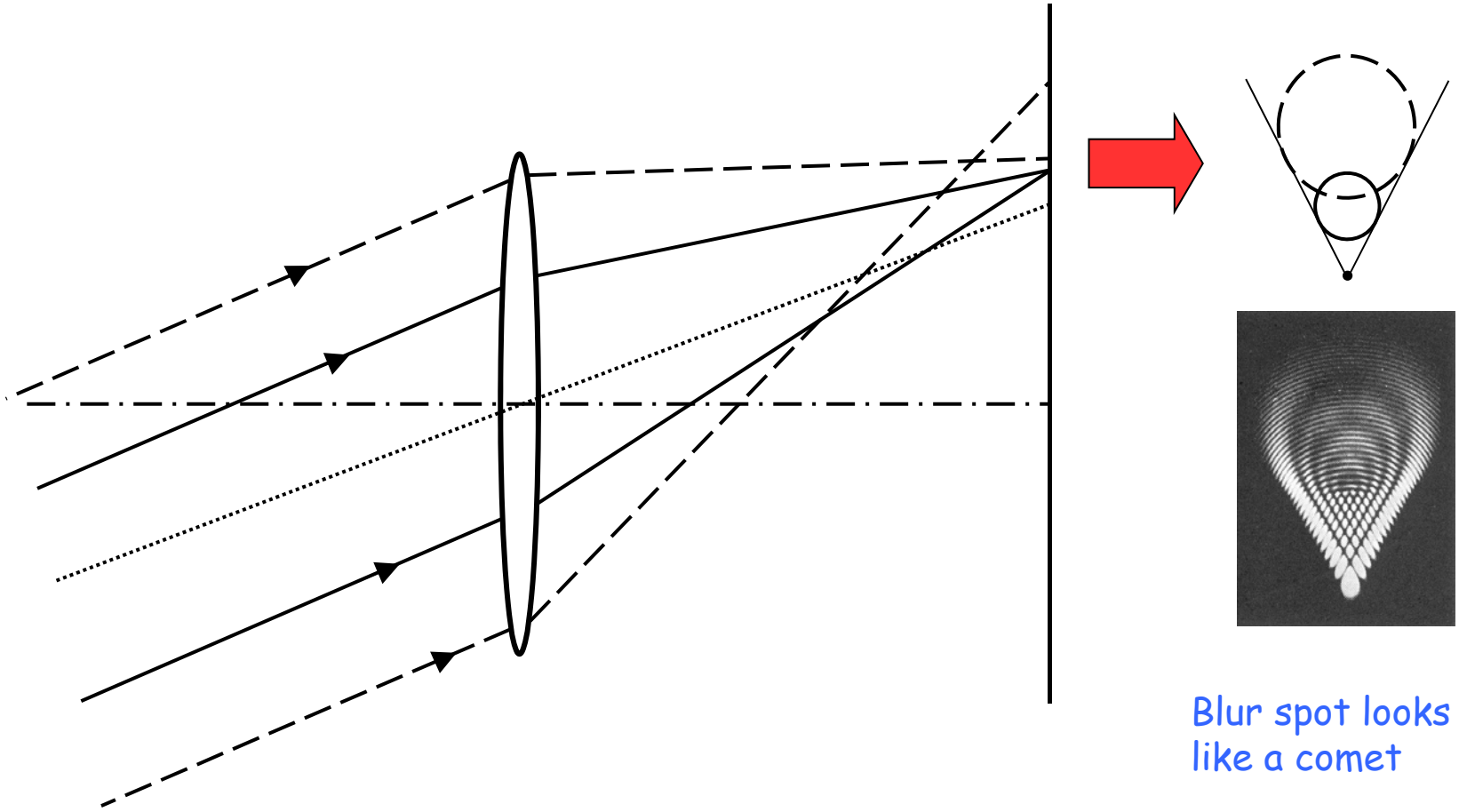
ROYAL INSTITUTE OF TECHNOLOGY

Astigmatism



ROYAL INSTITUTE OF TECHNOLOGY

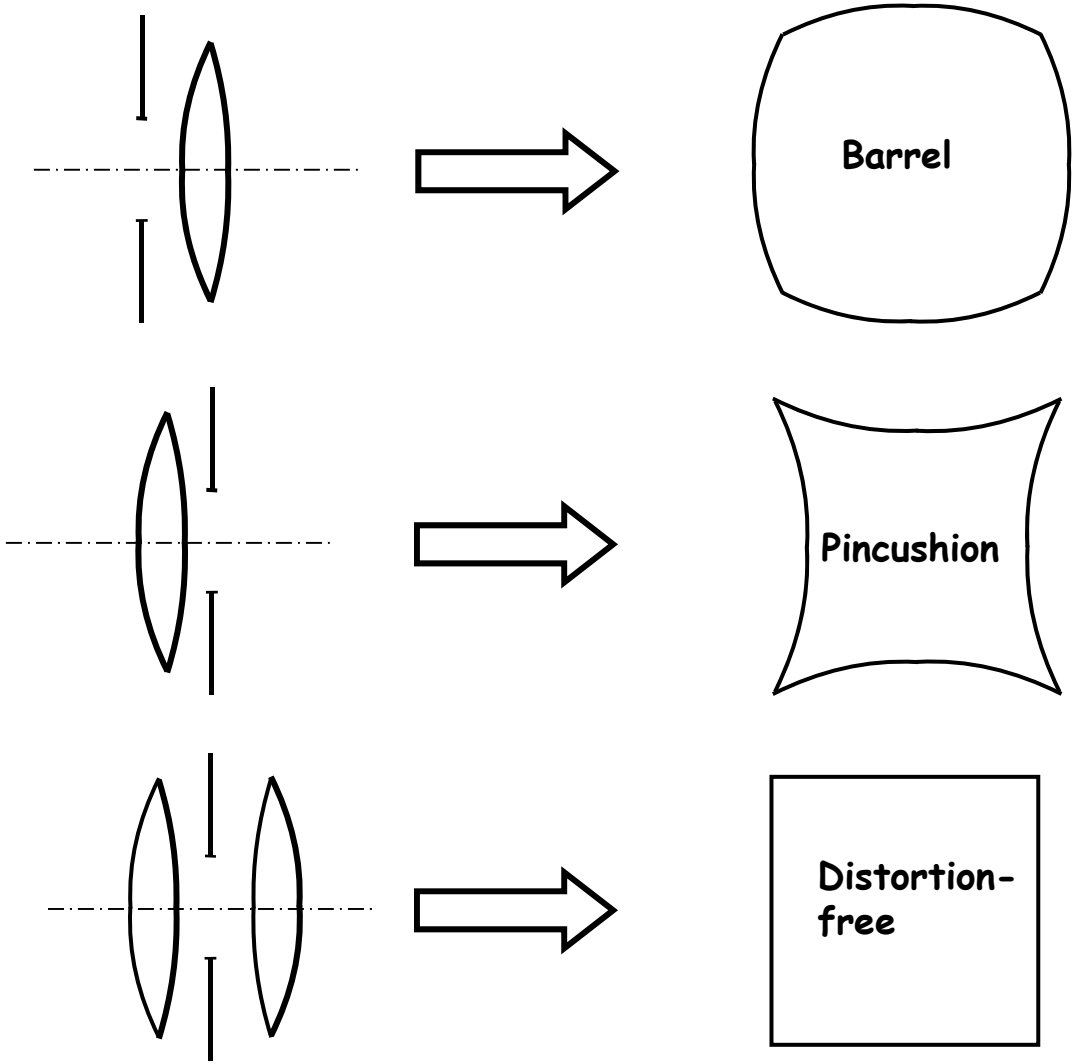
Coma



Blur spot looks like a comet

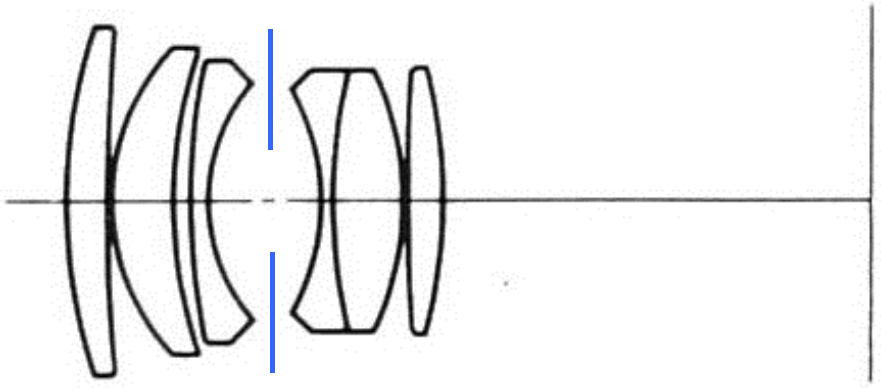
ROYAL INSTITUTE OF TECHNOLOGY

Distortion



ROYAL INSTITUTE OF TECHNOLOGY

To minimize aberrations

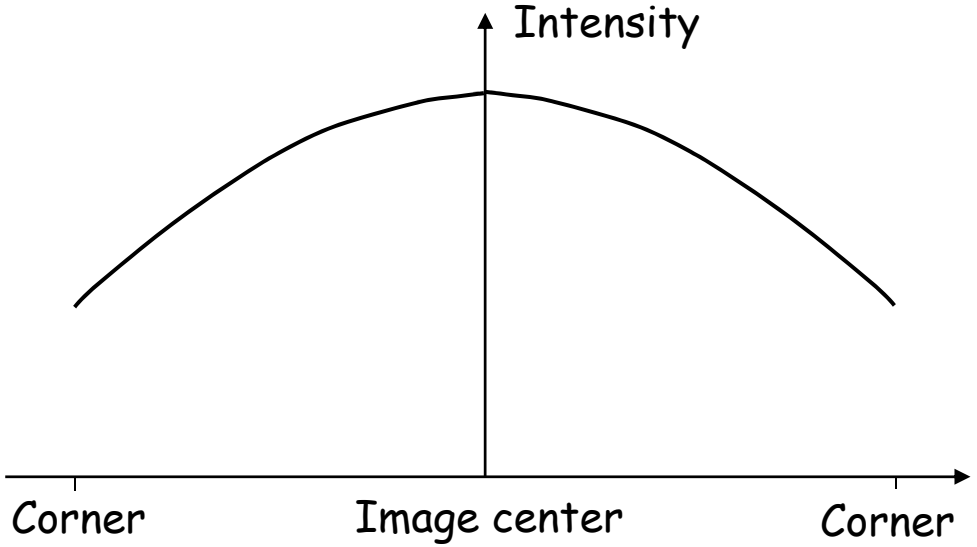


- Many lens elements
- Suitable types of glass
- Symmetric build-up
- Diaphragm (bländare) position

ROYAL INSTITUTE OF TECHNOLOGY

Vignetting

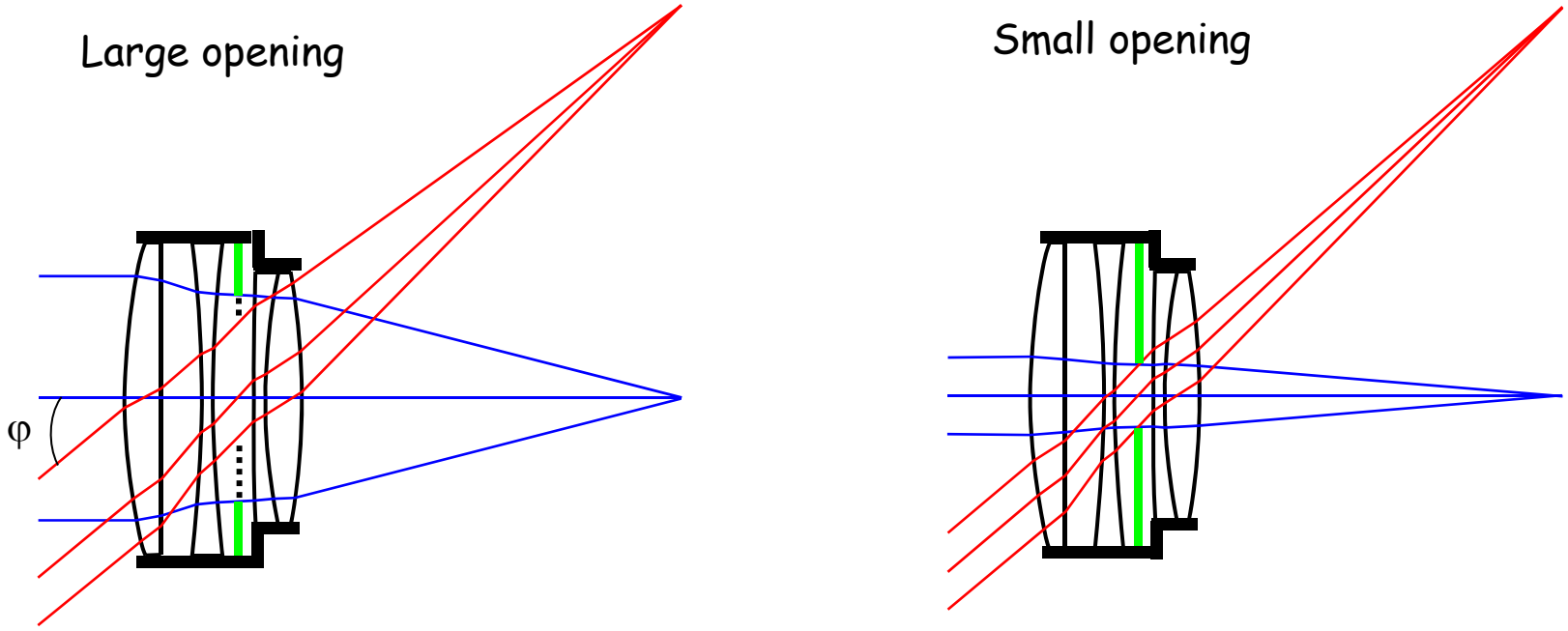
(Image corners are darker than the center)



ROYAL INSTITUTE OF TECHNOLOGY

2 effects: Shadowing and $\cos^4\varphi$

Shadowing:



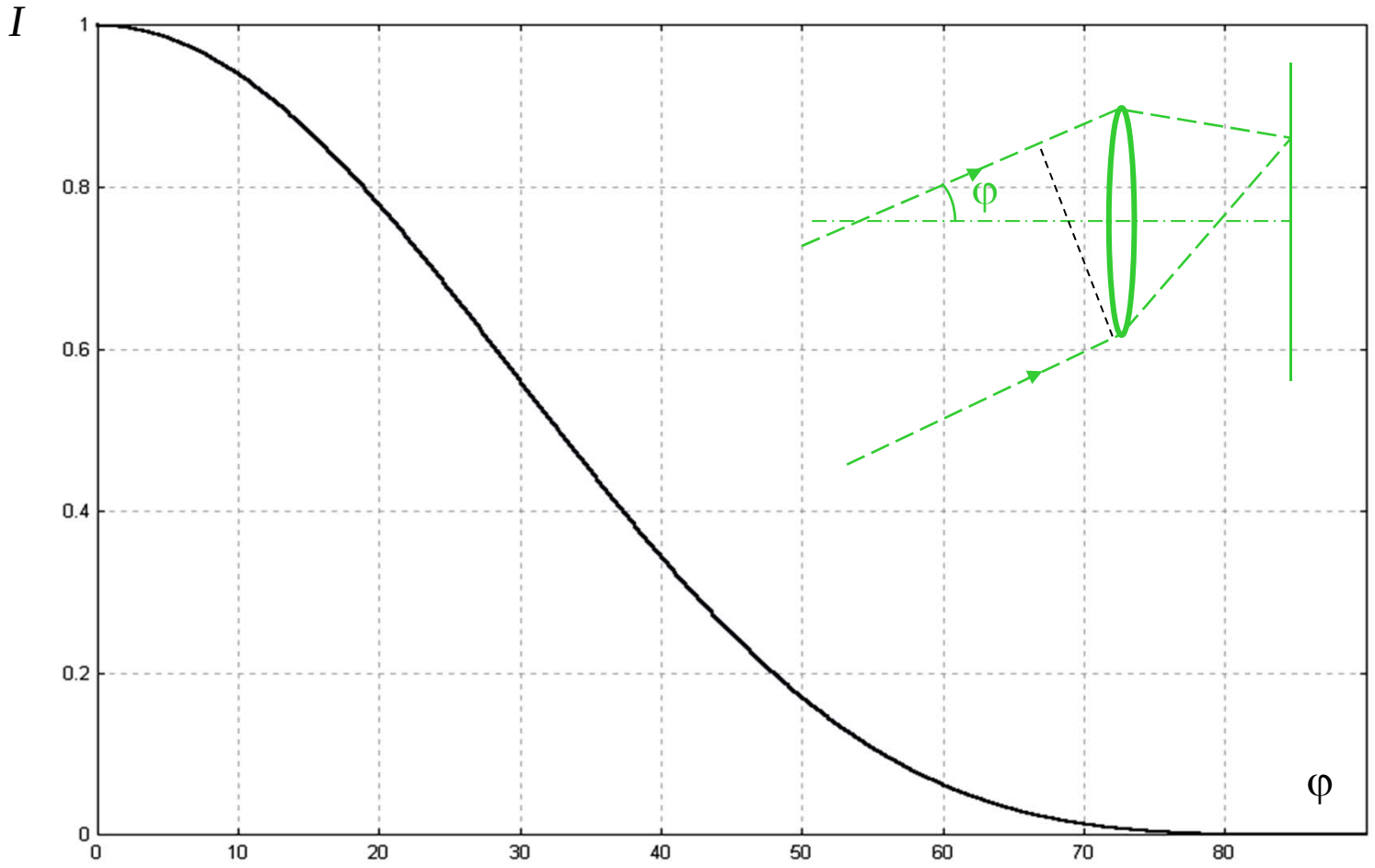
Shaded regions at oblique incidence

No shadowing = Less light fall-off at image corners

Small lens opening = Less vignetting!

ROYAL INSTITUTE OF TECHNOLOGY

$\cos^4\varphi$: (Caused by basic physical processes)



Most pronounced for wide-angle lenses, negligible for tele-photo lenses

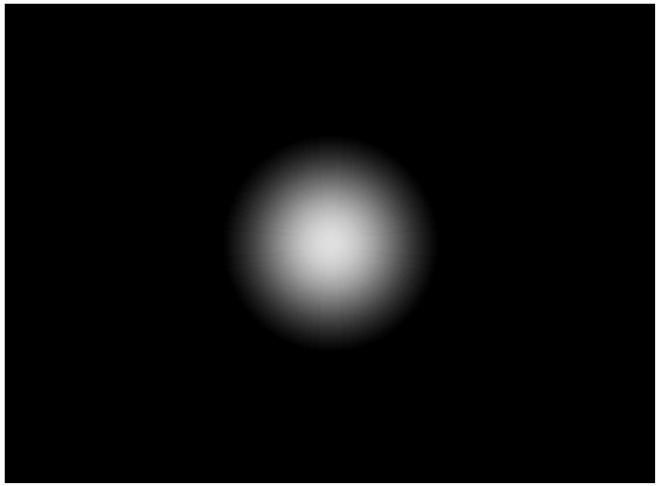
ROYAL INSTITUTE
OF TECHNOLOGY

Fish-eye lenses

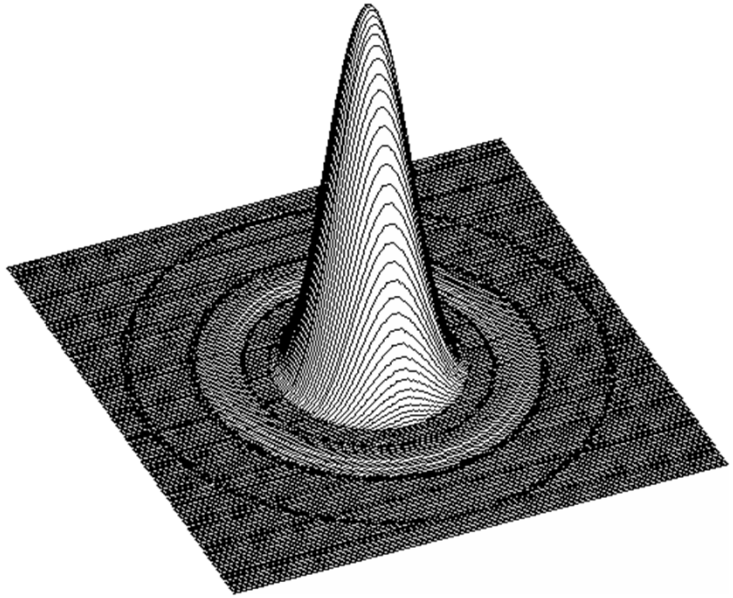
Introduce distortion to reduce vignetting

ROYAL INSTITUTE OF TECHNOLOGY

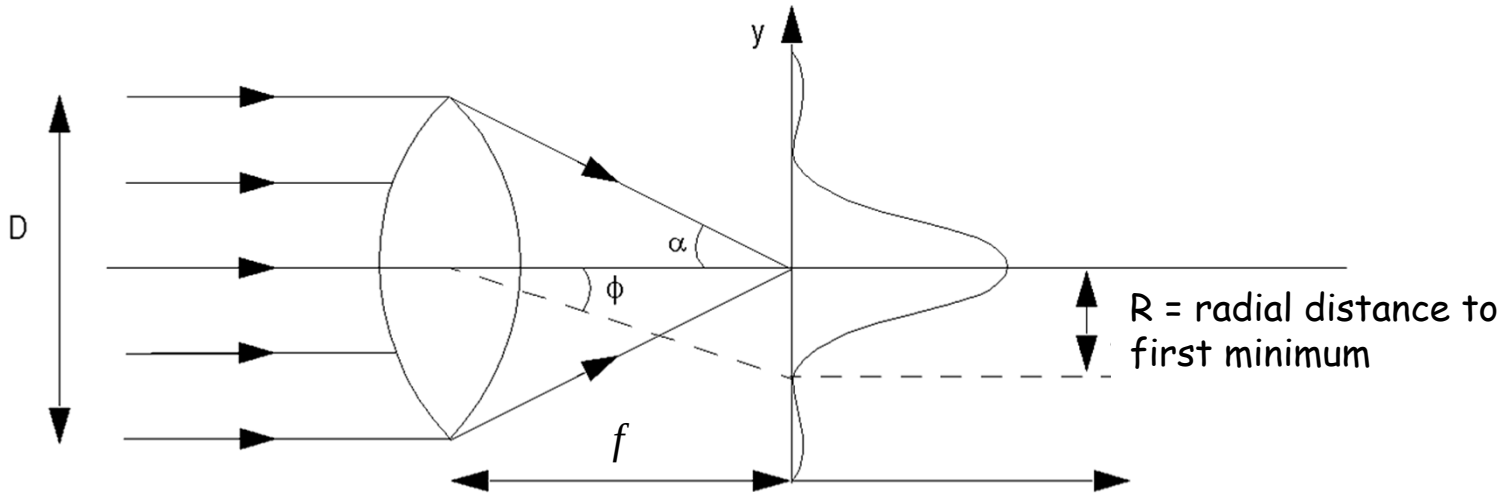
The image of a point object is blurred due to diffraction



Point spread function (psf)



Diffraction



$$D\sin\Phi = 1.22\lambda \qquad R \approx \frac{1.22\lambda f}{D} = 1.22\lambda F$$

← F-number (bländartal)

Small F-numbers: Image quality is limited by aberrations

Large F-numbers: Image quality is limited by diffraction

Best image quality is often obtained for $F \approx 8$

(Best balance between aberrations and diffraction)