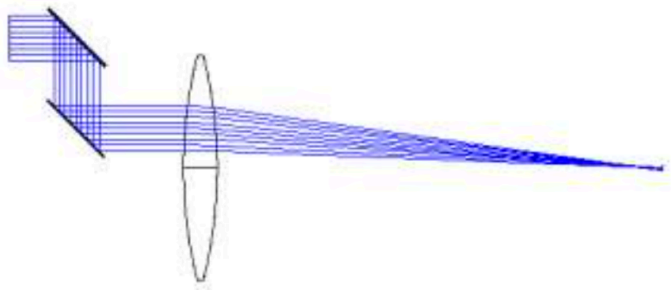
1.1 Stair-mirror-setup (PhD ex)

Setup a system with a stair mirrro pair, which decenters an incoming collimated ray bundel with 10 mm diameter by 40 mm in the -y direction. The wavelength of the beam is λ= 632.8 nm. After this pair of mirrors a decentered main objectiv lens with focal length f = 200 mm made of BK7 is located 25 mm below the optical axis and focusses the beam.

a) setup the system b) generate layout drawings in 2D and in 3D c) calculate the beam cross section on the second mirror, what is the size of the pattern ? d) determine the optimal final sensor plane location. Calculate the spot of the focussed beam. Discuss the shape of this pattern. e) now extend the separation between the two mirros to 200mm. The system now should be modified to have an intermediate focal point in the midpoint between the mirrors. Calculate the radii of the mirrors to recollimate the beam before the refractive lens. Determine again the best image plane. If the spot diagram is considered, what is the reason for the drastic change ?



4.3 Strehl ratio and geometrical vs Psf spot size (PhD ex)

A single lens made of K5 with focal length f = 25 mm and thickness d = 5 mm is illuminated by a diverging beam with numerical aperture NA = 0.1. After the lens the light should be collimated. If the collimated beam is refocussed without further aberrations, the point spread function is not diffraction limited.

a) Calculate the accurate Strehl ratio, the estimated Strehl ratio and the geometrical and diffraction encircled energy inside the ideal Airy diameter. b) . Now reduce the numerical aperture and describe what it happens. Calculate the largest NA, for which the Strehl ratio decrease of 20%. What amount for the geometrical and diffraction encircled energy inside the Airy diameter is obtained here ?

c) Show the Strehl ratio as a function of the numerical aperture as a universal plot. What is the maximum value for getting a diffraction limited correction with $D_S > 0.8$?

3.1 Performance of an achromate

Load a classical achromate out of a vendor catalog with focal length f = 100 mm. a) What is the numerical aperture of the system in the image side ? Is the system diffraction limited ? b) Determine the longitudinal aberrations for the colors eF'C'. What is the largest spherical aberration in the green ? What is the height of the corresponding ray in the pupil ? What is the largest difference of the axial color aberration ? c) Calculate the Seidel surface contributions of the system in the desired orientation and for the reversed lens. d) Determine the range of finite field angles, for which the original achromate is diffraction limited, if λ = 546 nm and a reduced aperture diameter of 15 mm is considered.