Project: Understand Spherical Aberration

(40% score of midterm for course Optics, Due by May 1, 2022)

Write Matlabs programs for generating spot diagrams for lenses, similar to Fig. 1 (Fig 7.15 in textbook). Please understand Fig. 2 first. Only Snell's Law is simply used. Basic system requirements are:

- Aperture Diameter= 32 mm
- EFL=116 mm

	Spectral line	λ nm	BK7	F2
n_F	Blue hydrogen line	486.13	1.52238	1.63208
n_d	Yellow helium line	587.56	1.51680	1.62004
n_C	Red hydrogen line	656.27	1.51432	1.61503

- BK7 and d wavelength are used
- Object at infinity and field is zero
- Lens thickness 7.2 mm
- Plot spot diagram
- Find the minimized GEO (Geometrical radius) on Gaussian image plane

You should complete at least first two duties below:

1. A Plano-Convex lens, curvatures C2=0, as shown in Fig.3. Find C1, Back Focal Length (BFL) first. Find the Geometrical radius (Similar to GEO radius 193.13 μm as shown Fig. 1) on Gaussian image plane.
2. Repeat 1. But reverse the lens orientation as shown in Fig.4, where C1=0
3. Not required, for bonus only. EFL=116 mm. To minimize the spot size by splitting a lens into two, as shown in Fig.4. Then there are four curvatures. Let C2=C4=0. Optimize C1 and C3 to minimize the spot size, making Geometrical radius size as small as possible. Lens thicknesses are 7.0 mm. Distance between two lenses is 1 mm. Find the minimized GEO.

Figure 7.16. Spherical aberration as a longitudinal effect. The marginal rays focus closer to the lens than the paraxial rays: This is called *undercorrected* spherical aberration. The opposite condition is *overcorrected*.

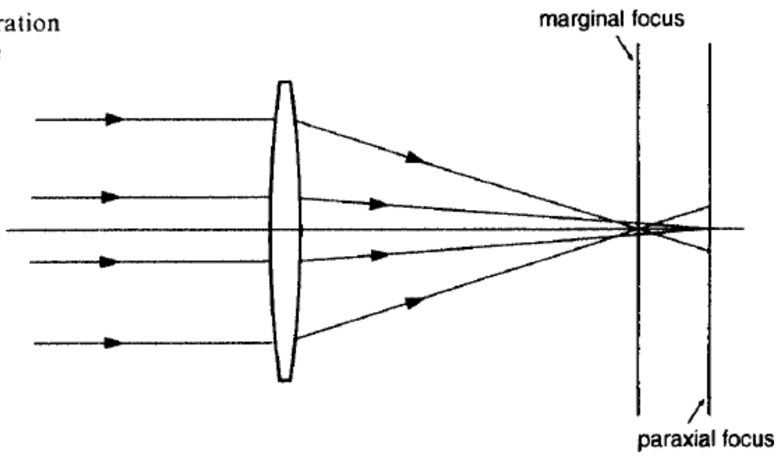


Figure 1: Sample layout

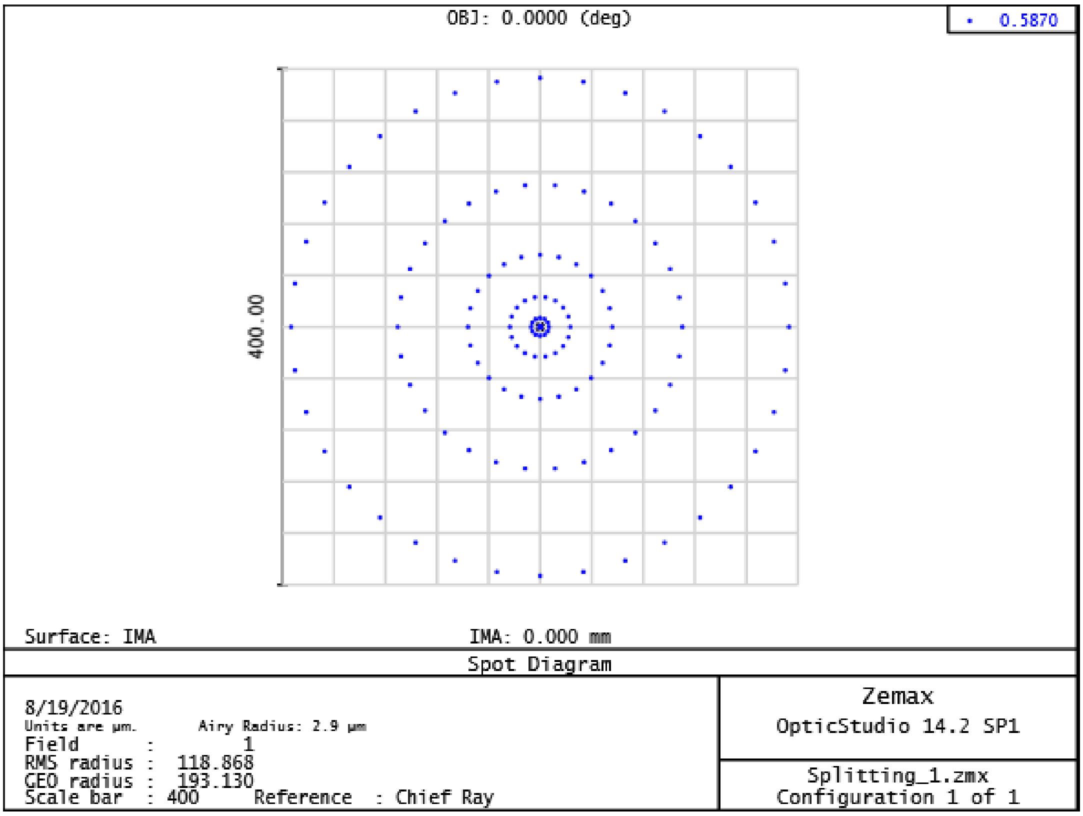
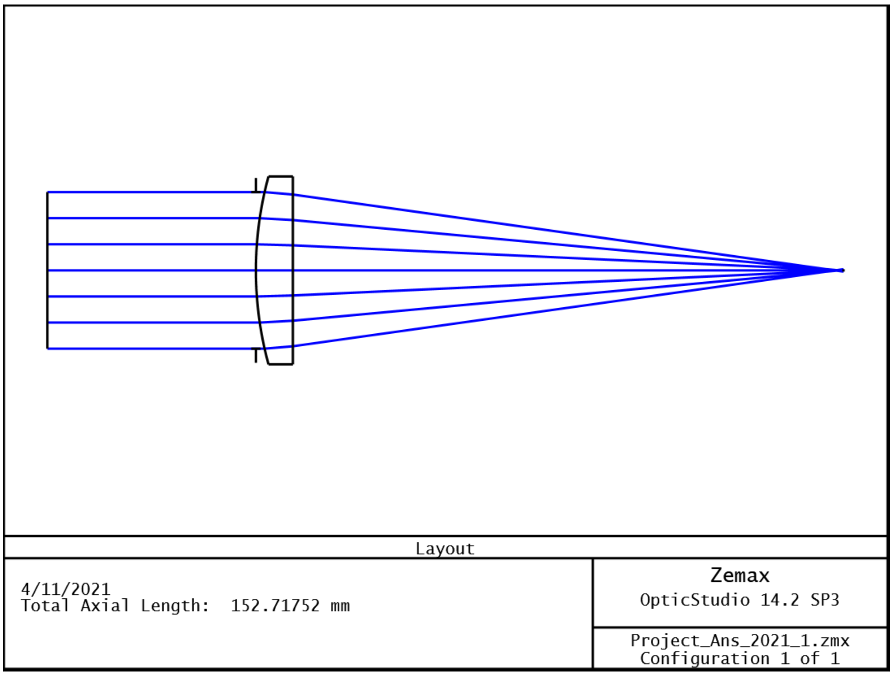


Figure 2: Sample Spot Diagram



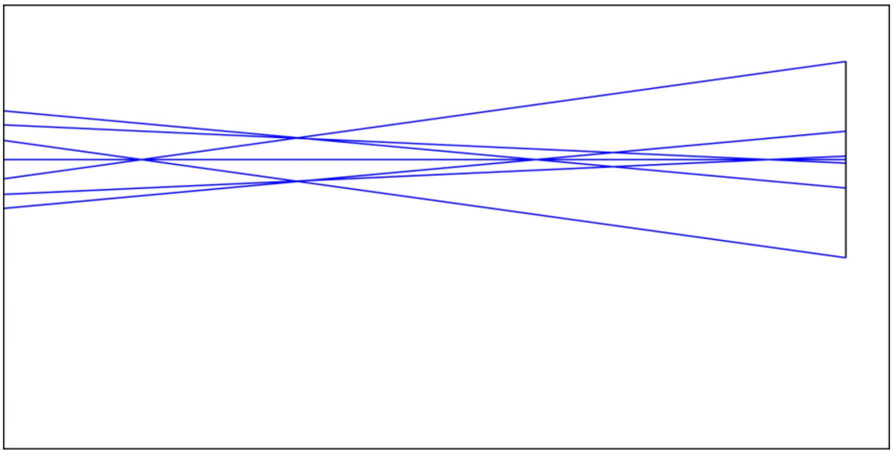


Figure 3: Sample Layout and close look near Gaussian plane for duty # 1

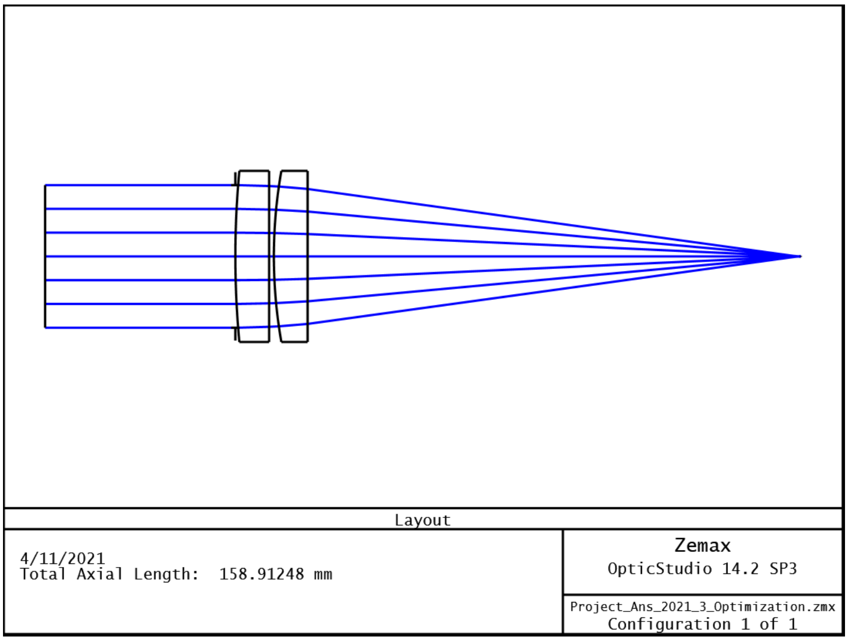


Figure 4: Sample Layout for duty # 3