Homework 1 **Due by 5 pm (at my mailbox in 610 Cobleigh), Tuesday, Jan 20, 2015**

☺ Read and understand Greivenkamp pp. 1-21 and Geary chapters 1 and 2. If you don't understand anything, ask in class or come visit with me and we'll take care of it.

1. Geary chapter 1 homework (page 8).

With the information provided in Geary's Figure 1.9 (shown below) for a thin lens, find:

a. the effective focal length (EFL),
b. the lens power ϕ
c. surface curvatures C_1 & C_2 (first do equiconvex, then repeat for plano-convex with flat rear surface)
d. radii of curvatures R_1 and R_2 (also equiconvex, then repeat for plano-convex with flat rear surface)
e. format size (side dimension of a square detector whose corners fit within the illuminated circle as shown below), and
f. Airy disk diameter (dia. of blur circle between first nulls of diffraction pattern)

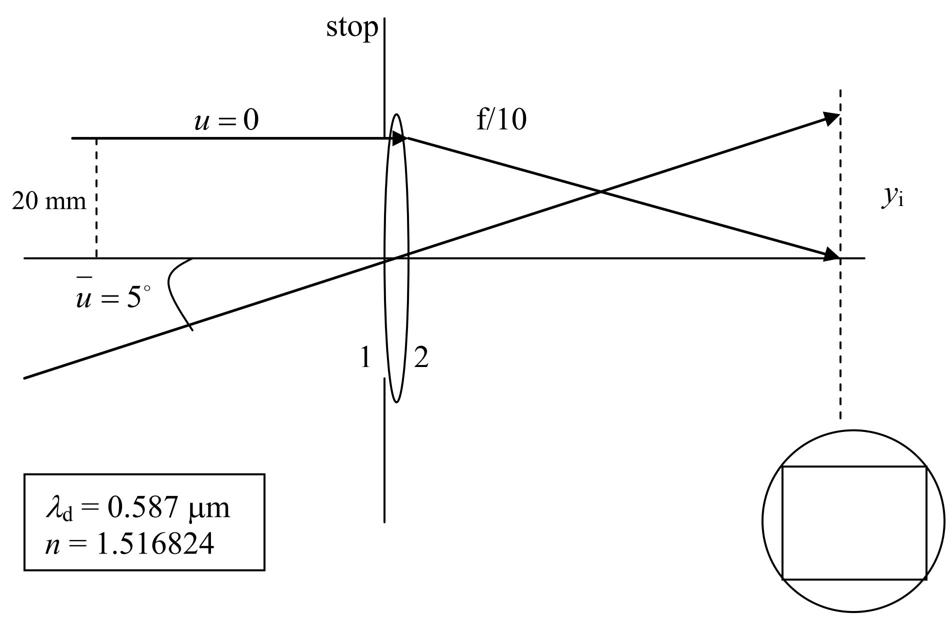

Fig. 1. Illustration for homework (adapted from Geary p. 8).

2. Thin lens imaging

Find the focal length of a single thin lens required to image a square display measuring 10 cm × 10 cm onto a CCD chip measuring 1 cm × 1 cm. For a total distance between object and image of 1 m, where should you locate the lens?

3. Thick-lens cardinal points
A plano-convex singlet lens is used in air with the curved surface on the object side and the plano surface on the image side. The lens has n = 1.5, center thickness t = 6 mm, and effective focal length f_e = 150 mm. Make a scale drawing showing the following (using Greivenkamp convention):

a. surface powers
b. effective focal length
c. front and back focal distances
d. principal plane locations

4. Thick lens cardinal points, #2

A lens with center thickness t = 6 mm and refractive index n = 1.5 has the following radius of curvature values for its front and rear surfaces, respectively:

$$R_1 = 60 \text{ mm}$$
$$R_2 = 120 \text{ mm}$$

a. Calculate the effective focal length of this lens.

b. Use paraxial ray trace equations to calculate the back focal length and δ', the distance from the back surface to the second principal plane.

5. Install Zemax Optics Studio software

a. Download the software from \\ohm.coe.montana.edu\eceapps\zemax
Note: download the 32- or 64-bit version appropriate to the computer you are using.

b. Copy the file *sntlconfig.xml* to the install directory c:\Program Files\Zemax OpticsStudio\

This file has been modified to point to the license server 153.90.127.88 (ohm).

c. Make sure the Zemax software runs on your computer.

6. Geometric ray tracing
Make a sketch illustrating the use of a single positive lens element as a "simple magnifier" (magnifying glass). On your sketch, show the front focal point, the object point, and sketch rays that demonstrate the location and size of the image.

7. (582 students only) Fermat's principle from Hamiltonian optics
Read the wiki page http://en.wikipedia.org/wiki/Hamiltonian_optics and write a short paragraph explaining the conceptual meaning of Fermat's principle.