LAB 7 LENS SYSTEMS

EXPERIMENTAL GOALS

The focal point of a converging lens is defined to be the point where parallel rays entering the lens converge. The focal point of a diverging lens is defined to be the point from which initially parallel rays entering the lens *appear* to diverge when they come out. In the *Thin Lenses* experiment, you measured the focal length of a converging lens. In this experiment, you will develop a theoretical strategy and an experimental procedure to measure the focal length of a diverging lens.

LABORATORY SKILLS you will be developing

The primary educational purpose of this lab is to continue our development of the model of ray optics that we began exploring in the *Thin Lenses* lab. Because of the peculiar nature of the images developed by a diverging lens, your experimental procedure will necessarily involve understanding and using lens systems.

SOME PROCEDURAL SUGGESTIONS AND NOTES

You measured the focal lengths of your converging lenses (and determined their uncertainties) in the *Thin Lenses* lab. Use the same apparatus that you did for the *Thin Lenses* lab if at all possible, so that you can use these measurements. (Otherwise, you will have to measure these focal lengths again, as the lenses in the different setups are not sufficiently identical.)

The central question in this experiment is the measurement of the focal length of a concave lens. Although none of the pre-lab exercises deals *specifically* with this situation, in total they contain some fairly broad hints about how you might make such a measurement. For this experiment, *you* will need to decide how a general strategy for making the measurement, use the thin-lens equation and/or a ray diagram to get from your general strategy to a quantitative equation for the focal length, and then make the measurement you describe. Unless you come up with some unforeseen method for making the measurement, your experimental procedure will almost certainly be an obvious application of your theoretical strategy.

Here are some questions that to think about as you develop your experimental procedure:

1. How is it possible (in theory) to measure the focal length of a diverging lens using the thin lens formula?
2. What actual procedure will we actually employ to adapt this theoretical approach to the equipment on hand? How should we determine how to place the lenses that we use? How many different lens positions will we use to make our measurements?
3. How will we calculate the uncertainty of our measured focal length? Are the measurements that we made repeatable in the technical sense?

Be sure that you have your helper check out your procedure before you take any serious data.

(OPTIONAL) BUILD A TELESCOPE!

If (but *only* if) you have some time after completing the measurements for this experiment but before 5:00 pm (or perhaps while you are waiting for an interview), you can futher build your skills in ray optics by using your two converging lenses to build a simple telescope. See section 7.5 in the *Lab Reference Manual* for instructions. You might also check that equation 7.1 is at least qualitatively correct. If you do this, describe your efforts and results briefly in your notebook. (While no credit will be given for doing this, your curiousity and drive will make a favorable impression on the lab staff.)