Physics 223
Experiment 6: Compound Lenses

March 24, 2009

Most useful optical instruments are made with compound lenses, made up of two or more individual lenses. When analyzing a compound lens, it is convenient to treat the two lenses sequentially with the image of the first lens acting as the object of the second lens and so on. Each lens will obey the thin lens equation:

$$\frac{1}{f_1} = \frac{1}{p_1} + \frac{1}{i_1}, \quad \frac{1}{f_2} = \frac{1}{p_2} + \frac{1}{i_2}$$

The separation of the two lenses will determine the relationship between i_1 and p_2.

You will be provided a high intensity lamp source, a white screen, an optical rail, a meter stick, and 4 lenses, marked **A**, **B**, **C**, and **Z**. Make a simple compound lens by taping the **A** and **B** lenses together and determine the focal length and magnification for this combination. Compare to what you expect from analysis using the focal lengths of the individual lenses you measured in the previous lab. How much does the result change when you make the approximation that the two lenses have a separation of zero?

Using this same method of taping two lenses together into a compound lens, devise a procedure to measure the focal length of lens **Z** with the aid of lenses **A**, **B**, and **C**, of which you have already measured the focal length. Would you expect it is possible to measure the focal length of **Z** without the use of the other lenses?

Using at least 2 of the 4 lenses of which you now know the focal length, construct a compound optical system which takes the light source and produces a magnified (larger) upright image. Verify your design and make sure you know how to determine if the image of the source is upright or inverted. Provide a full analysis of your system including an accurate ray diagram.