Experiment 2: Thin Divergent Lens Phys 431

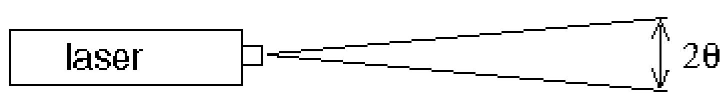
In this experiment you will gain some familiarity with another tool of the trade, the laser, and then use it to examine a thin divergent lens. Remember, never look directly into the laser. Just like last week, you will measure the radius of curvature and focal length, and then calculate the index of refraction of the glass.

We all know that a laser has a well-defined wavelength. This will remove a source of blurring known as chromatic aberration, and allow for more precise measurements. The laser also appears to produce a well-defined beam of parallel rays. That is to say, it appears to be a collimated source. You will see if this is really the case.

For a divergent lens, all the principles and conventions we use for the convergent lens apply equally well. The key difference is that a divergent lens cannot by itself form a real image of a real object. Hence, in this experiment we will measure f using a virtual object. The virtual object and real image are on the *same* side of the lens.

Procedure:

A. If the beam from the laser is not perfectly collimated, the diverging rays must spread over some angle θ .



Project the beam from your He-Ne laser on to a distant screen and measure the radius of the maximum spot size that can be discerned. Take a picture of it for your write-up.

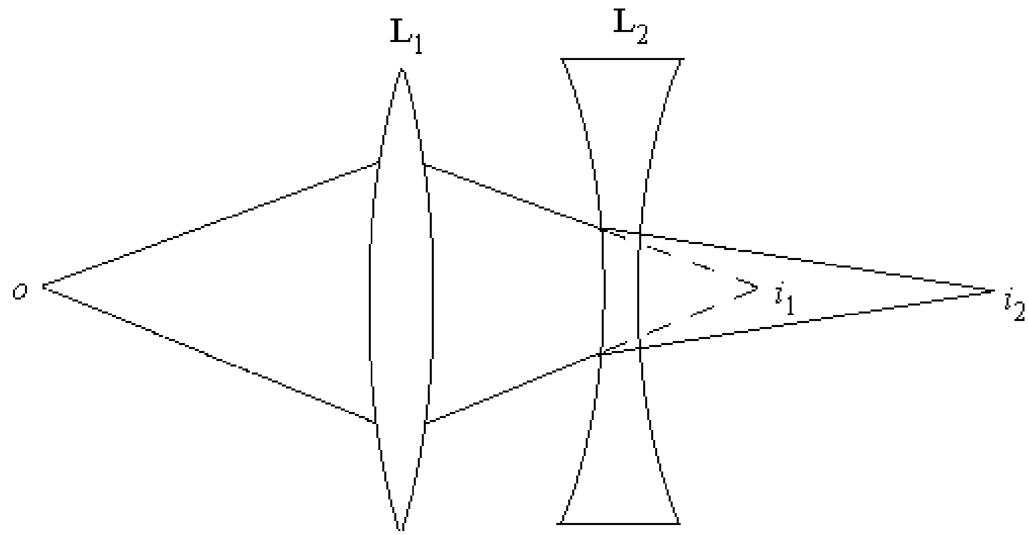
Q1 Is the spot of uniform brightness? Calculate θ in degrees and radians.

B. Use a spherometer to measure the radius of curvature for your divergent lens.

C. Next, use the laser to make an object. You cannot just use the laser beam as it is too well collimated. The object must have diverging rays that can then be focused to form the image. To do this, use a short focal length lens to expand the laser beam and illuminate a partially transparent object; a piece of tracing paper with a triangular border defined with masking tape makes a good object.

D. Use a convergent lens L_1 to form a sharp image i_1 of your object on a screen. Next, place a divergent lens L_2 between L_1 and i_1 as indicated below. Measure the distances to i_1 and i_2 to calculate f for the divergent lens. Repeat this for 3 positions of the i_2 by changing the lens-screen separation in units of about 1 cm. Find your best value for the focal length using the thin-lens equation.

Q2 How does your best value for f compare to the nominal value?



E. Try making an object without the use of the tracing paper. For example, you can cut away the paper inside the hole of your tape.

   Q3 Are you able to perform the experiment? What is going on here?

F. Calculate the index of refraction (including uncertainty) for the glass of your lens using the lensmaker's equation. Compare this to the value you found last week.