Physics 312

Lab 3: Thin lenses

Experiment 1

Goal: To measure the focal length of a lens with two methods, using the equipment in Figure 1, and comparing the values to the nominal value, $f = 200$ mm.

First method: By using the thin's lens equation and measuring various object and image distances, measure the focal length of the lens.

Second method: Estimate the focal length of the lens by measuring the image distance for a distant object (eg. a light at the other side of the room.)

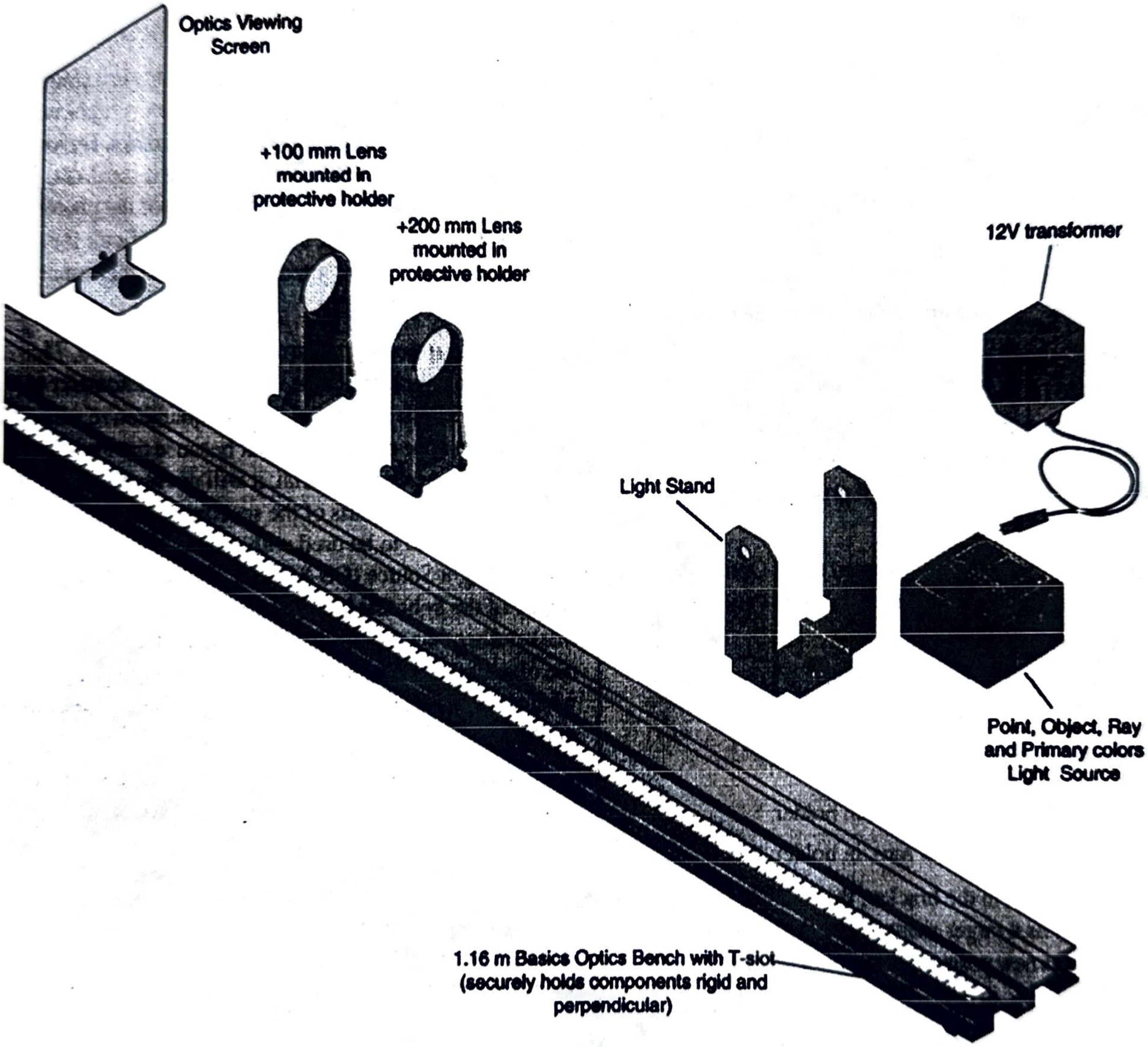

Figure 1. The equipment for Experiment 1 and 2. Diode laser to be used for the telescope is not shown.

Experiment 2

Goal: Using two lenses, construct a Keplerian telescope and (if time) a compound microscope.

Keplerian telescope: Construct a Keplerian telescope as in Fig. 2. Shine a laser beam through both lenses first in one direction, then in the other. Measure the entering and emerging beam diameters and compare to predictions.

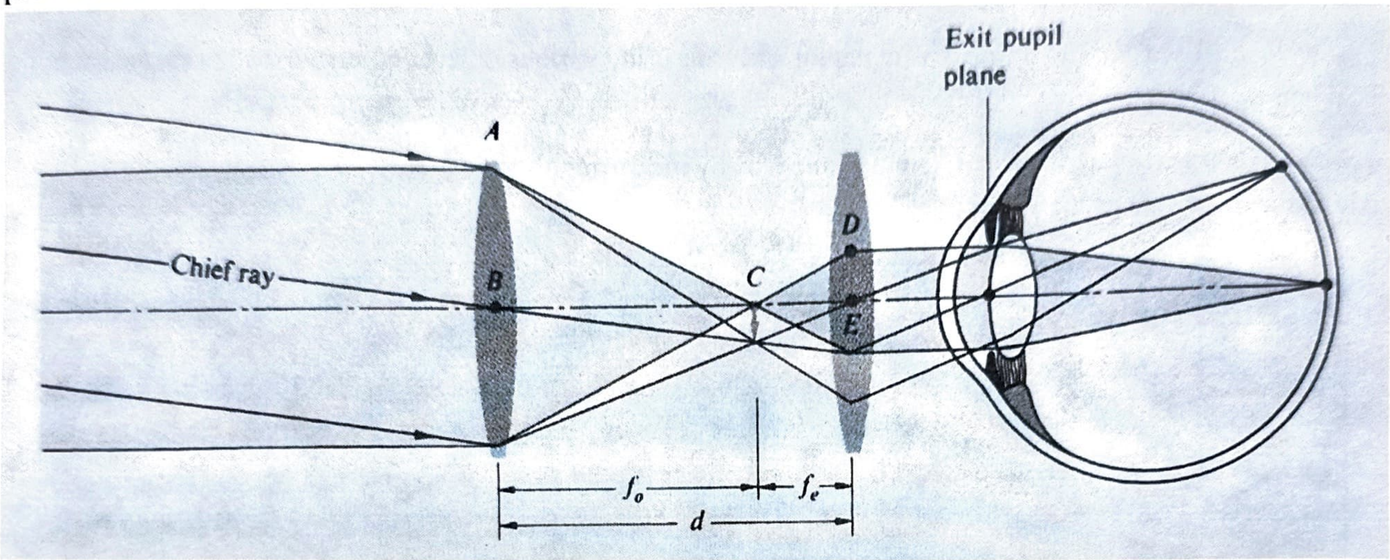

Figure 2. Keplerian or astronomical telescope (Hecht).

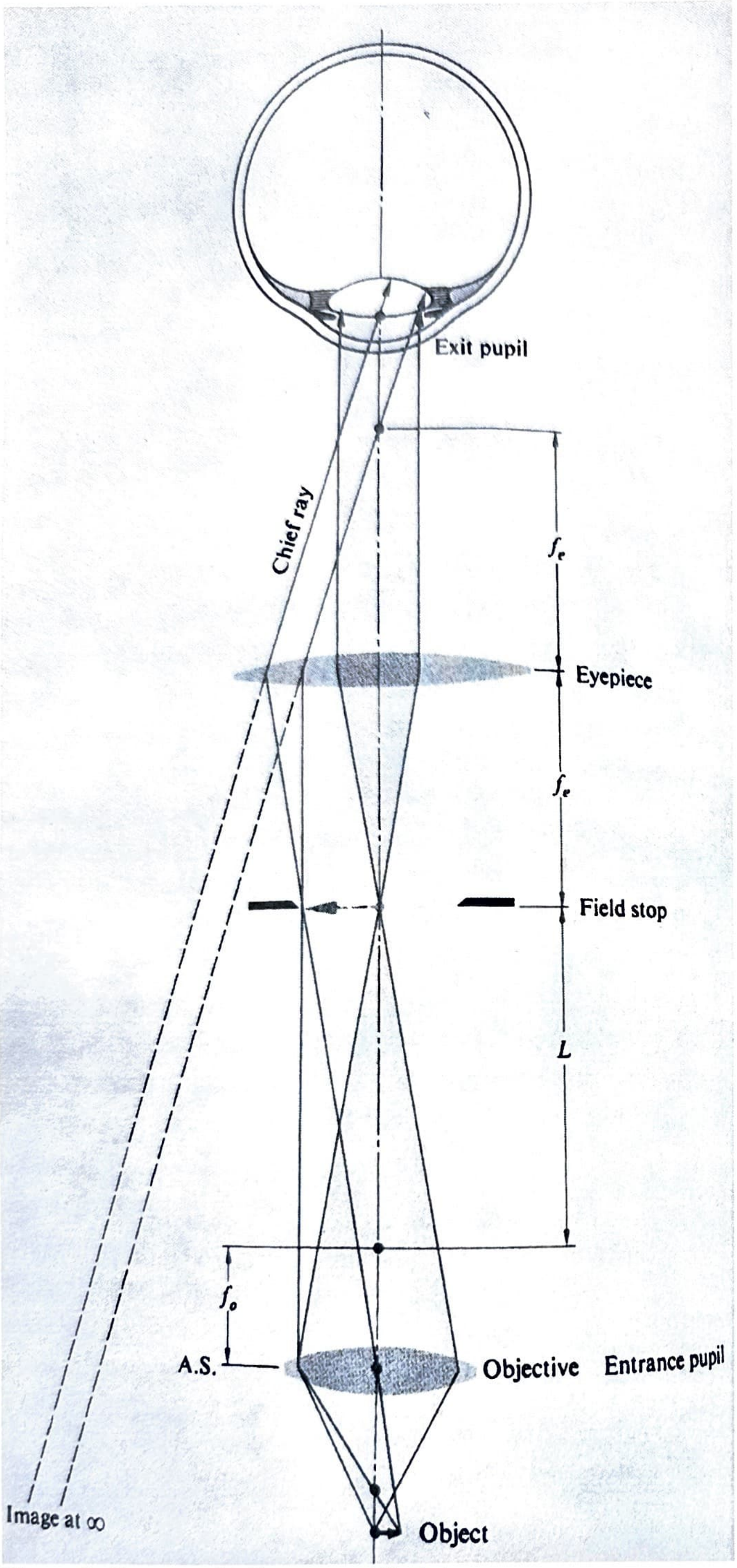

Figure 3. Compound Microscope (Hecht).

(Optional) Compound microscope: The microscope is a device for enlarging the image of a tiny nearby object. It does this by capturing as much of the emitted light as possible using a short focal length that is held close to the object, in this case the arrow of the light box. That produces a real image, as shows in Figure 2, with a large *transverse* magnification M_T. This intermediate image is further magnified by an eyepiece functioning as a magnifying glass.

With the object 15 cm in front of the shorter focal length lens, measure the image distance and transverse magnification of the intermediate real image and compare to predicted values. Place the eyepiece such that the intermediate image is at its focal point. With your eye at the standard near point (25.4 cm) away from eyepiece, determine the magnifying power of your constructed microscope. The magnifying power is equal to the angle made by the final image as a fraction of the angle made if the object was placed at the standard near point.

The magnifying power of the entire system is predicted to be the product of the transverse magnification M_T and the *angular* magnifying power of the eyepiece, $M_A = 25.4\text{ cm}/f$.