

Construction of a Refracting Telescope Lab
Astronomy 25

I. Purpose:

To build and examine the characteristics of a simple refracting telescope.

II. Theory:

An astronomical refracting telescope designed for visual observation consists of two lenses: the objective, and the eyepiece. The objective forms a real image at the focal plane. (Place a white card there to see that this is true.) The larger the diameter of the objective, the brighter the image because it gathers more light. The eyepiece acts as a magnifying lens for the image and also collimates the light (makes the rays parallel) so that the eye (which is an additional lens) can accept and focus them on its own focal plane. The focal length of a lens is printed on its side. Eyepieces with shorter focal length magnify the image more than one with a shorter focal length, using the same objective lens. The magnification is calculated by dividing the focal length of the objective lens by the focal length of the eyepiece.

III. Procedure:

Set up an optical rail with holders for two different lenses. Select two different focal lengths. The objective lens must have a longer focal length (not necessarily be physically larger) than the eyepiece or a microscope will be created. Set up the lenses so that you view through the eyepiece, then the objective, then across as much of the room as possible by varying the distance between the two lenses until the object is clear. Focus on some object at maximum distance. A book is a good target. The two lenses should be a distance apart about equal to the sum of their two focal lengths. (Remember that they are in millimeters.) Estimate the magnification by looking at the object with and without the telescope. Do this with three different lens combinations. (Don't use the 50mm and 500mm lenses in combination. The result will be poor.) Calculate the magnification using the equation:

$$\text{Calculated magnification} = \frac{\text{Objective lens focal length}}{\text{Eyepiece lens focal length}}$$

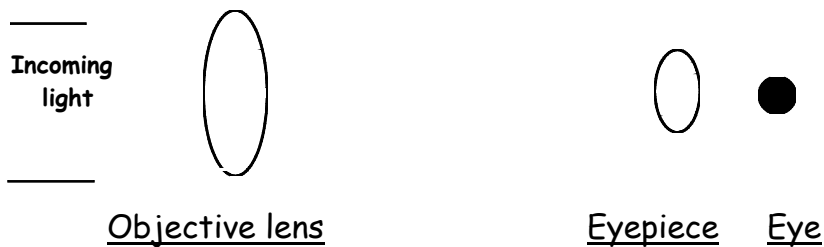
If the result is less than 1, the lenses are reversed. Look through the other end!

IV. Data:

<u>Objective F.L.</u>	<u>Eyepiece F.L.</u>	<u>Mag. Estimate</u>	<u>Calculated Mag.</u>

Answer the following questions:

- 1) Is the observed image erect or inverted?
- 2) Which lens is responsible for this condition, the objective or the eyepiece?
- 3) Cover more than half of objective with a card to block light from entering it. What happens to the field of view? The image's brightness?
- 4) Is it possible to see the image formed at the objective's focal plane with just your eye? Why? Complete the light ray description in the diagram below:



- 5) Which of these three telescopes has the largest field of view? (Assume all the lenses have the same apparent field of view.) What is responsible for this difference in the field of view?