Astronomy (Schroeder) Name: ____________________

Exercise 8

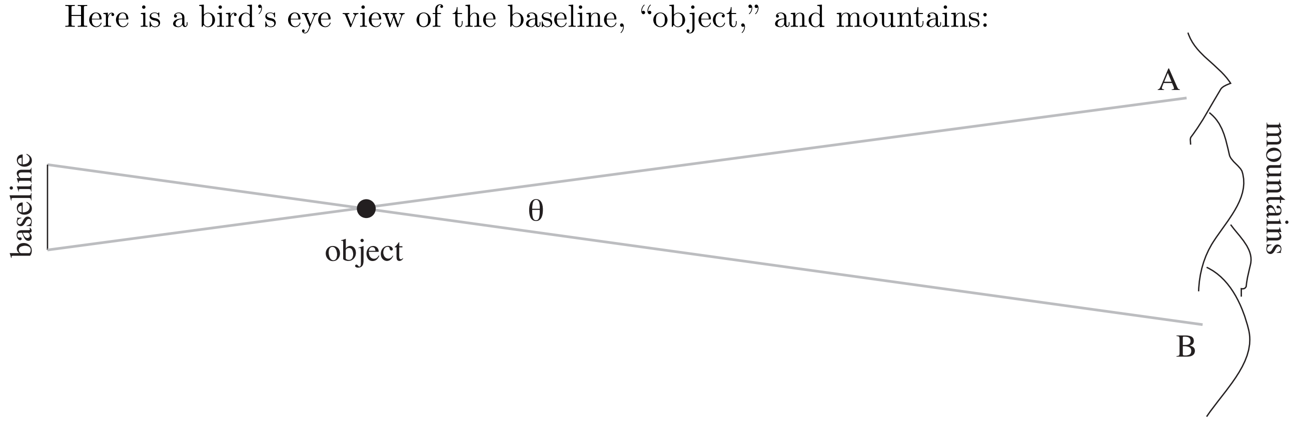
Due Monday, October 24, 5:00 pm

Part I: Parallax

In this exercise you will measure the distance to a terrestrial object using the method of parallax.

Go out to the sidewalk immediately east of the Lind Lecture Hall. Taped to the low concrete wall along the sidewalk you'll see two sheets of paper, each labeled "End of Baseline." These signs mark the ends of a baseline that you will use to measure the parallax, and hence the distance, of our object of interest: the nearest tall lamppost up on the parking lot to the east (the one with four light fixtures at its top). The length of the baseline is 18 feet.

Here is a bird's eye view of the baseline, "object," and mountains:



As you walk from one end of the baseline to the other, you should see the object "move" against the background mountains. This is the parallax effect. Now compare what you see to the attached photo, which shows the mountains *without* the object in front. Draw the object in *twice*: once at its position as viewed from each end of the baseline. Note carefully the two positions on the mountains that lie directly behind the object as viewed from the two ends. These positions are labeled A and B in the illustration above. Using your fist or fingers held at arm's length, estimate the angle between points A and B on the mountains, and write that angle here:

Angle between A and B as measured from baseline = ________

The angle you just measured isn't quite equal to the angle θ on the illustration above, because you measured it from the baseline, not from the object. But since the mountains are much farther away from you than the object is, the two angles are nearly identical. Assuming that they are identical, use the angle and the length of the baseline to compute the distance to the object. This is a "big circle problem", with the center of the circle located at the object and the baseline lying on the circle. Draw a sketch of the big circle on the following page, and calculate the quantities indicated. (You'll probably need a calculator.)

Big circle calculation:

Number of baselines that would fit around circle = ________

Circumference of big circle in feet = ________

Distance from baseline to object in feet = ________

You have now measured the distance to the object, without ever leaving the baseline. As a check, you may wish to pace out the distance to the object for a more direct estimate.

Part II: The Inverse-Square Law for Light

1. The star Merak, in the Big Dipper, appears (from its spectrum) to be almost identical to Sirius, the brightest star in our night sky. However, Sirius appears 36 times brighter (as viewed from earth). How many times farther away is Merak, compared to Sirius? If Sirius is 9 light-years away, how many light-years is it to Merak? (Explain your reasoning.)

2. The star Alpha Centauri A appears (from its spectrum) to be quite similar to our sun. However, α-Cent-A is obviously much dimmer as viewed from earth. Although it isn't easy to measure the difference in brightness between these two stars, it turns out that our sun is brighter by a factor of 50 billion, or 5×10^{10}. By what factor is α-Cent-A farther away from us than the sun? If our sun is 8.3 light-minutes away, how many light-minutes is it to α-Cent-A? How many light-years away is it? (Explain your reasoning.)