Astronomical Observation Labs
Due: December 13, 2006, 11am
(but don't procrastinate)

You must do at least one lab, but can do a second one for extra credit. If you have in mind a different (but class-related!) project you would like to do, get approval from your GSI. The extra credit assignment will be worth, at most, one homework assignment which will be added to your total homework grade.

In these labs you will get to watch the sky and see for yourself some of the phenomena we have been talking about in class. You will need to make observations on several clear days and/or nights, so you will not be able to put this off until the last minute because the weather may not cooperate. Therefore, strange as it seems, **you should get started on this right away**. When writing up the lab, first describe what you were trying to accomplish and what you expected to see. Then describe your method, including how you collected your data, and give your result. Finally, describe what you saw. Explain **clearly** the astronomical events which caused the events you witnessed. Given what you know, do your results make sense? *The part of the report where you explain why you saw what you saw constitutes one-third of the grade on this lab; the observations and their presentation are the rest.*

To measure angles, you'll need a protractor. If you don't have one you can buy one (they are cheap), or print one from `http://astron.berkeley.edu/b̃asri/astro10/protractor.JPG`.

Please write your full name, section number, and GSI's name on the front of your lab. Also, be sure to put your lab in the correct box in the basement of Campbell Hall. **Late labs WILL NOT be accepted.**

If you use any resource besides the textbook, lecture, or section (*e.g.* a web site), be sure to include proper attribution for the reference. Feel free to work with other students in the class, but remember that all work turned in must be your own (*i.e.* don't just copy the work of another student).

Also recall that falsifying lab data is a form of cheating that is punishable in the exact same was as any other form of cheating, so **don't do it!**

1. The Setting Sun

   This requires that you to choose **one** place where you can see the sunset on at least 4 days (more are desirable), spaced by at least 3 days between observation, when the Sun is visible while setting. Possibilities include the bridge between Birge and LeConte, or the roof of Campbell Hall. For best effect, a few days should pass between each observation (although it never hurts to have more observations). DO NOT look directly at the Sun until it is at least three-quarters gone, and preferably only through sunglasses then. On each occasion make a sketch of the horizon with landmarks and indicate where the Sun went down. If you have a digital camera with zoom, that would be a good way to record this. Record the time as well. Try to be as precise with both as possible. If you like, compare your time with the prediction in the paper. Don't forget to explain carefully why the location of the setting sun appeared to move along the horizon. Was it going north or south? How would this vary at different times of the year?

2. The Sun's Path

In this experiment, you will need to measure a shadow cast by the Sun at the same time on at least 4 days (more are desirable), spaced by at least 3 days between observtion. For best effect, a few days should pass between each observation (although it never hurts to have more observations). You can use a vertical stick (e.g. a flat–bottomed pen or pencil) to create a shadow on a flat piece of paper (which should be placed or mounted on a flat surface). Each time you observe the sun, mark on the sheet of paper where the tip of the shadow falls. *You should be careful to position the paper exactly the same each day.* Be sure to note the time and date for each observation (and which point on the paper they refer to). On at least one day, make measurements at several *different, well separated* times so you can trace the arc of the sun's shadow. How does the length of the Sun's shadow change at a given time of day, and from day to day? Give a careful explanation of why it is changing, and why it gets longer or shorter. How could you use the shadow of the Sun to find North? Is the shadow shortest exactly at noon by your watch (or the Campanile)? What happens when we go off Daylight Savings Time?

3. Phases and Positions of the Moon

   The idea here is to follow the Moon along part of its orbit. Measure its position with respect to the Sun or some stars on at least 3 nights (and these should be close to each other). Draw the phase as best you can each time. To measure the position, you have several possibilities. You can measure the angle of the moon above the horizon at a fixed time or the time when the Moon appears to pass a fixed reference (like a corner of a building or a tree branch). Or you can try to measure it with reference to a nearby star (say along the extension of the shadow line on the Moon). Finally, you could try to measure its angle with respect to the Sun, either directly during the day, or by noting its position at sunset, or by noting the time difference between sunset and moonrise or moonset. Why do you see what you see? (Remember, the Moon is sometimes up during the day, sometimes at night. You should be able to figure out when to look by what phase it is in.)

4. The Orbital Motion of the Earth

   This is to be seen by measuring the change in the position of stars at a fixed time of night. You can either use the time when a star sets, or when it passes a fixed reference point attached to the ground (like a building or tree). Good choices would be Deneb or Vega just after sunset (see page 14 of your textbook). The Earth turns 15 degrees per hour, and the stars rise 4 minutes earlier each day. Your measurement will have to be fairly precise, and it helps to have several days pass between measurements. Make at least 3 measurements. By what angle did the stars move per night? In which direction? Why do you see what you see?

5. The Orbital Motion of Saturn

   Saturn is an early morning object, rising in the West around midnight, in the constellation of Leo. Measure its position with respect to the ground and stars. Use the methodology of (3) or (4), and make at least 3 measurements. Is the planet moving apparently further from or closer to the Sun? By how much per week? Is that rate constant (should it be)? Is Saturn doing a retrograde loop? If not, when was the last one (look it up online)? How is the separation between Saturn and Regulus (the brightest star in Leo) changing (be quantitative)? Why do you see what you see? You should get started on this **right away**, as it is best done over a few weeks. (Have a look at `http://www.skyviewcafe.com/skyview.php` for determining the best times to observe.)

6. The Circumpolar Stars

   This is an exercise to experience circumpolar motion for yourself. Go out after it gets dark, and find the Big and Little Dippers. Note their orientation in the sky (relative to the horizon). Also, locate a star that is near the northern horizon. Then check again at least 3 hours later and note the new positions. Do this again in a week or two (the more the better). Do you think that the Big Dipper ever sets as viewed from Berkeley (explain)? How well could you tell that its stars were circumpolar? What do you think would happen if you wait 6 months and repeat the experiment? How about if your friend in Seattle had been doing it at the same time as you?