Chapter 1: Introduction

Welcome to Astronomy 499. This is not a lecture based course. Instead, you and your group will get your hands dirty using our small amateur-class telescopes. I think that's the best way to learn some of the important aspects of telescopes. Hopefully by the time the course is finished, you will agree with me.

I will only officially meet with the class once or twice. After that, I am on call. In fact, my goal is to not see you very much at all-- that means that nothing is broken. In general, you and your group will work independently on 4 labs with your own keys to the observatory. You will go when it is convenient to your group and when the weather is good to observe.

Some helpful hints on how to succeed.

1. Don't wait until the last minute to make your observations. Weather in Illinois can change quickly. Best to do the labs as soon as you can and not worry about bad weather and very cold weather at the end.
2. Plan on spending more time than you think. Things rarely go the way you expect, especially late at night in the dark trying to get your observations done.
3. This is a big hint. To loosen a screwed on item (i.e. eyepiece), turn it counterclockwise. To tighten, turn clockwise. You can also use the phrase: "Righty Tighty, Lefty Loosey", which means that clockwise to tighten and counterclockwise to loosen, or "Time is always tight", which again means clockwise to tighten. This sounds simple, but most of the issues and damage that occur are from doing this the wrong way.
4. Don't over tighten. All of the telescope components just need to be snug-- overtightening can destroy some components.
5. Work with your group. Make group decisions and work together for success.

The course consists of 4 labs:

1. Alignment: align the telescope and use it to look at a 4-5 sources. Draw them by hand.
2. Using a CCD camera with an aligned telescope to image a source with three colors (or line filters).
3. Using a spectrometer with an aligned telescope to obtain the spectrum of two sources.
4. Make a proposal for an interesting project, and if approved do it. Projects such as:
   a. Characterization of the CCD camera. Measure the properties of the CCD, predict the performance with time, filter, and object. Evaluate varying data reduction techniques. Evaluate observational setups.
   b. Compare regular images of stars to AO images. How is the image improved? What physical parameter? The SBIG AO device uses tip tilt. Why does tip/tilt improve an image?
   c. Take near diffraction limited images of a planet using the fast USB camera. Make sure to shift and add. Compare the short integrations to long integrations. Why is there a difference?
   d. Make a CCD color image of a nebula. Play with the color mapping. What are the options for making a color image? How does the color mapping affect the scientific potential? Compare mages in H-alpha, OIII, or SII. What causes differences?
   e. Observe a giant planet over many days and make an image of the moons. What are their periods? What can we learn from these images?
   f. Observe the spectra of a few of stars with different spectral classes. Compare and contrast. Why are they different?
   g. Observe the light curve of a variable star. (Hint, make sure to observe a source with an appropriate period.) Calculate the period and discuss any issues with the measurements.
   h. Observe an optical binary. (Hint, make sure to observe a source with an appropriate period.) From multi-epoch observations, derive the period. Discuss any issues with the measurements.
   i. Observe a galaxy and derive redshift. Is it a peculiar velocity?

j. Observe a transiting planet. Can you detect the change in light?

k. Observe a star cluster. Place the stars on an HR diagram. Estimate the age of the cluster.

l. Spectral observations of Planets or Comets. Image CO_2 in the atmosphere of Venus, ammonia or H_2 in the atmosphere of Jupiter, or numerous bands in bright comets (if one is available), such as CN, CH, C_2, C_3, and NH_2.