Physics 344 Lab 2
Naked Eye Observing

Due: Thursday, September 25
Text Reference: Chapters 1 & 4

Purpose: Before the invention of the telescope in the early 1600's, all astronomical observations were made with the naked eye and simple measuring instruments. These observations were remarkably powerful, allowing the determination of the approximate sizes of the Earth, Moon, and Sun, and culminating in the heliocentric model of the solar system and Kepler's three laws of planetary motion. Much of the information that astronomers collected over the two millennia of systematic pre-telescopic observation consisted of determining angles between objects in the sky. This lab will duplicate some of these fundamental measurements.

Procedure: We will be observing outside on the roof of the Physics and Astronomy building – dress appropriately for the weather and bring a small flashlight (preferably with a red filter to preserve your night vision). We will use a cross-staff to measure angles. The longer arm of the device is 50 cm in length. Place the end of this arm just below your eye (carefully!) and sight through the circular aperture to align the long arm with one star. Then slide the movable marker along the inner edge of the other arm until it lines up with the other star. Read off the lateral displacement. **Important**: note that the 10 cm mark on the cross arm is on the axis of the long arm – so subtract 10 cm from each lateral arm measurement. Use simple trigonometry to calculate the angle. Please handle the devices with care – they are obviously somewhat fragile! List all your raw measurement data in your report, and show samples of your calculations. See the document about statistics on the class web page.

1. Identify the two bright stars Vega (α Lyr) and Deneb (α Cyg), and measure the angular separation between them with the cross-staff. Repeat the measurement five times and use the repeated measures to estimate the precision of your measurements. Use the mean of your measurements for the subsequent calculations. Look up the coordinates of the stars in The Sky, calculate their angular separation, and compare to your measurement.

2. Identify Jupiter and two nearby bright stars. The best stars to use are Nunki (Sigma Sagittarii) and Sabik (Eta Ophiuchi); other possible stars are Kaus Australis (Epsilon Sagittarii), bright but low in the sky, Antares, bright but low and distant, or Altair, very bright but distant. Measure the angular separation between Jupiter and each of the stars. Note: Antares will be very low by 9 pm, and Sabik by 10 pm. Look up the coordinates of the stars, and calculate the right ascension and declination of Jupiter.

3. Measure the elevation angle of the star Polaris and compute our local latitude. Note that you will need to reverse the cross-staff to measure the relatively large elevation angle. Use one of the telescope piers to keep the base of the cross-staff horizontal. The base of the reversed cross-staff is 39 cm long. Sight from the top of the base leg, and subtract 52.5 cm from the height measurement reading.