The Care and Feeding of Your Observing Notebook

Materials: One spiral-bound notebook

Your observing journal is your primary record of your astronomical observations, analysis, and in-class work. A log of observations is important to remind yourself of what you did and for use in interpretation of your observations at a later date. Maintaining an accurate log is very important. You will need this information for your analysis, and you can certainly guarantee that you won't remember the details of each observation in a few weeks time.

In Class Work

On cloudy nights (hopefully not too many), we will be working with various methods of astronomical analysis. The computer assignments are available on the class website. The syllabus gives a list of the required assignments. If we don't finish the computer assignments in class, you are expected to complete the assignments outside of class. You will need a working copy of the AIP4WINV2 program. **In-class work accounts for 20% of your final journal grade.** Record your work and answers to questions in your Observing notebook. ***You will not receive credit if completed handouts (including answers to ALL QUESTIONS) are not included!!!***

CLEA Virtual Observatory
This will depend on how many clear nights we have during the semester.

Many people think of an astronomer as someone who gathers data through the eyepiece of a telescope. This is no longer true. Most observations are actually completed remotely. The CLEA Virtual Observatory gives the opportunity to experience remote observing. The syllabus gives a list of the required assignments. Record your answers in your observing notebook. The CLEA observing will depend on how many clear nights we have during the semester.

Observations

Your journal will contain records of your observations during this class. It will contain two types of observations. One type is your observations using your astrolabe. The second type records observations you make at the telescopes.

High-tech Astronomy – Telescope Observations
24 inch telescope observations

For each individual observation with the 24 inch telescope, record the following in your observing template:

1. **the date of the observation**
2. **the time of the observation**
3. **the observer's name**
4. **the weather conditions**
5. **the type of telescope**
6. **the focal length of the telescope (2438 mm for the 24 inch)**
7. **the object's name**
8. its **right ascension and declination**
9. its **magnitude**
10. **a description** of the object in the Notes section.
11. Be sure to complete the **sky conditions section** of the observing template.
12. You do not need to complete a drawing of the observed object.
13. **YOU ARE RESPONSIBLE FOR VISITING the 24 inch dome periodically to see what is being observed.**

No further information is required for 24 inch observations. Coordinates (right ascension and declination) can be retrieved from the ECU computer screen, or various planetarium programs. NOTE: Points will be deducted for required information left unanswered.

Other telescopes (4.5 inch refractor, 10/11 inch Schmidt Cassegrains and any other telescopes used during class)

A list of targets and required eyepieces for the small telescopes will be distributed at the start of class. Please use a different observing template for each object and eyepiece combination. A single object telescope observing template can be found at the class website. If your observations require different filters, please use the observing template for filters.

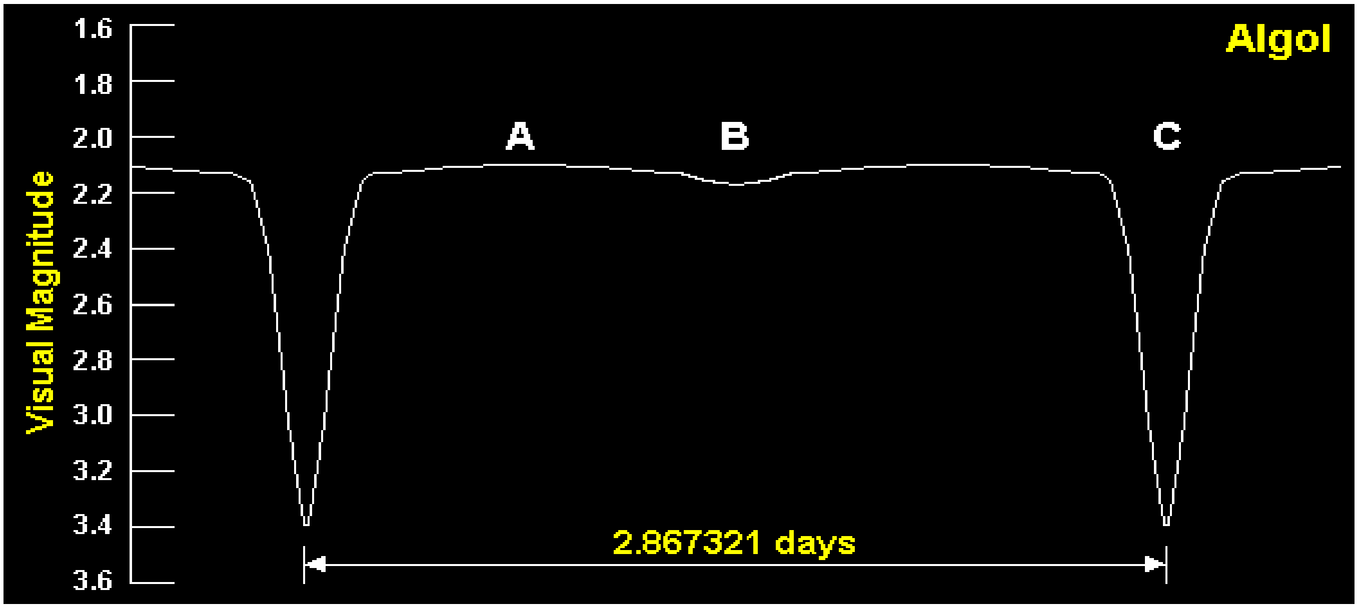
During clear nights, we will have multiple telescopes available simultaneously. You are responsible for learning to set up and use each telescope and obtaining the required observations with each telescope. **Use a separate template for each object. Use a separate observation template for each observation from each telescope.** A single observation observing template is available at the class website. You should use the filter template for filters for an observations requiring multiple filters at the same telescope. Fill out the following sections in the observing template:

1. **the date**
2. **the time**
3. **the observer's name**
4. **the weather conditions**
5. **the type of telescope**
6. **the focal length of the telescope**
    1. **2800mm for 11 inch telescope,**
    2. **1200 mm for the 10 inch**
    3. **1828 mm for the 4 inch refractor**
7. **the focal length of the eyepiece**
8. **the magnification (focal length of telescope divided by the focal length of the eyepiece)**
9. **any filters used (multiple filters for the same object should use the multiple drawing template)**
10. **the object's name**
11. **the object's magnitude**
12. **a drawing(s)** of the object as you see it in the telescope
13. **a description** of the object in the Notes section
14. Be sure to complete the **sky conditions section** of the observing template.

Take some time with the drawings. I don't expect photographic quality, but I do expect some realism. Include notes about what you are seeing in the eyepiece. Part of the purpose of this exercise is to learn to pay attention to the details. ***OBSERVATIONS WILL NOT BE GRADED IF THE OBSERVING TEMPLATE IS NOT COMPLETE. FOR DRAWINGS: A squiggle surrounded by random dots will not be graded.***

Visual Observations of Algol

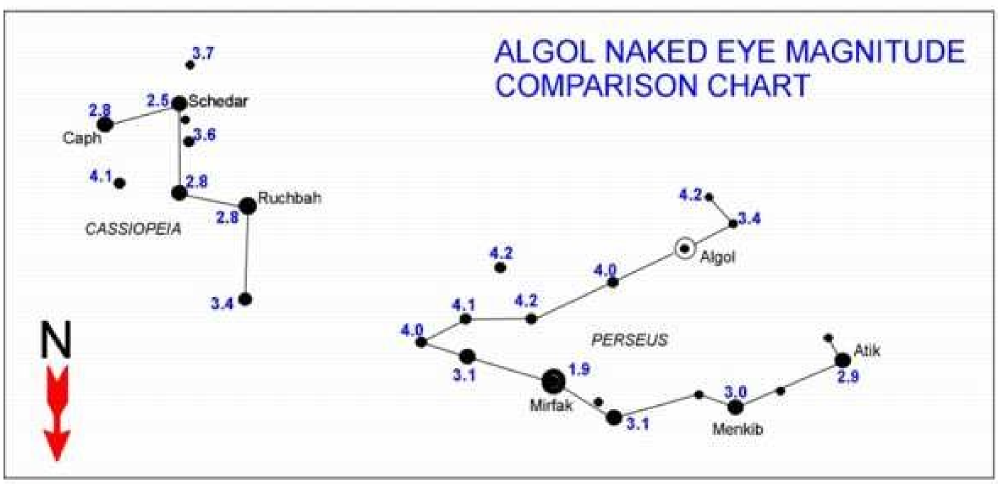
Algol varies its brightness in predictable ways. Algol is an eclipsing system, in which one star passes between us and the second star in the system. Many binaries appear nearly constant between eclipses because the brighter star of the pair is approximately spherical. We see observe longer periods of the same brightness, followed by much more sudden changes in brightness. We will monitor Algol's brightness as compared to the surrounding stars twice each class night, as well as during the week long astrolabe measurement session described below. Choose three stars surrounding Algol. Record which stars you are using as comparisons and use the same stars for each observation. Estimate the brightness of Algol as compared to these surrounding stars. For example, lets say you choose Ruchbah, Mirfak, and Menkib. Ruchbah has a magnitude of 2.8, Mirfak 1.9, and Menkib is 3.0. If Algol's brightness is halfway between Ruchbah and Mirfak, you could estimate the magnitude to be 2.5 (larger magnitudes mean dimmer stars).



Bulletins of the Arkansas Sky Observatory

Observing the Variable Star ALGOL

(Beta Persei - Magnitude 2.2 to 3.5, Period: 2 days 20 hours 49 minutes)



OBSERVING NOTE: use stars in BLUE to compare with the brightness of the star ALGOL. Binoculars will help in the comparison, by taking each star slightly out of focus to make a bright "disk" which can be more easily compared than can the "point" of a star.

Astrolabe Observations

Measuring the Nightly Motion of Objects in Altitude
Polaris (North Star), a star in Cassiopeia, a star in the Big Dipper, Jupiter, Aldeberan, Algol, Castor/Pollux, Betelgeuse, the Pleiades, and the Moon:

During class, you will observe 1) Polaris, 2) a star in Cassiopeia, 3) a star in the Big Dipper, 4) Jupiter, 5) Aldeberan, 6) Castor or Pollux, 7) the Pleiades, 8) Betelgeuse, 9) Algol, and 10) the moon.

Measure the altitude above the horizon of Polaris, any star in Cassiopeia, any star in the Big Dipper, Jupiter, Aldeberan, Algol, Castor/Pollux, Betelgeuse, the Pleiades, and the moon at three different times during the same night/day (for example, 8:00 pm, 9:30 pm and 10:30 pm.. To improve your accuracy, take ***three measurements at each time and compute their average.*** Include the standard deviation for your measurements. If the moon is not above the horizon, record that information. If it is visible, record its shape/phase. Repeat this sequence for every clear night we have during class.

DURING Mar 17-24 and Apr 17-24, you will record the altitude of all objects from your home location once for every clear night during the week. **Choose a time that matches the times we have been using in class.** ALSO, estimate the magnitude of Algol once a night during these same weeks.

Your journal should contain entries that look like the following (this is an example of astrolabe measurements for one night)

January 23, 2055, Mt. Cuba Observatory.
Sky conditions: clear with thin clouds to the west. Stars in the Little Dipper are easily visible.

		#	Time			Phase/Shape of moon
Object	Instr		7:00 pm	8:30 pm	10:00 pm	
Polaris	Astrolable	1	42	38	43	
		2	46	42	41	
		3	38	40	37	
Average (+ err)			42±1.6	40±1.2	40.3±1.2	
Cassiopeia Star	Astrolable	1	56	65	70	
		2	58	63	68	
		3	57	57	69	
Average (+ err)			57±1.2	61.7±1.2	69±1.2	
Jupiter	Astrolabe	1	23	35	46	
		2	21	35	44	
		3	25	35	48	
Average (+ err)			23±1.4	35	46±1.4	

It is important to understand how accurate your observations are. You can calculate the "standard deviation" of your observations of your observations. The mathematical formula is:

Standard deviation = $\sqrt{(1/(N-1) \times (\sum(o_i - o_{av})^2)}$
N is the total number of observations.

So for the 7:00 pm observations of the Cassiopeia star, N is 3. The average is 57. So I subtract 56 –57, square it (get 1), 58-57, square it (get 1) and 57-57, square it (get zero). The sum of that is 1+1+0=3. Now I multiply by 1/(N-1) which is 1/(3-1) = ½, or 0.5. 3*0.5 is 1.5. Now the final answer is the square root of 1.5 = 1.2.

This just means that, while your average is 57, any number between 55.8 and 58.2 can be considered equally correct, too. No observation is ever perfectly exact. There is always "noise", and the standard deviation gives an indication of the importance of the noise.

You will not receive full credit if you do not include the graphs!!!!

1) Generate a set of plots of the altitude of all your objects as a function of time using your observations**.** For each object, plot the observations you took on each day (**include error bars)**. Time will be the x axis, and altitude will be the y axis. For example, if your first observation is January 13 at 7:00, then you will choose that time as Time=0. Your next observations are at 8:00 and 9:30 pm on that same day. Using your T=0, these points will have times of 1 hr and 2.5 hrs respectively. Your second set of observations are on Jan 14 at 7:00, 8:00 and 9:30 pm, and so will have times of 24, 26, and 27.7 hrs (or whatever time unit you prefer as long as you are consistent). You will end up with one graph for each object. Each graph will show all of your observations over the entire semester.
2) Generate a second set of plots of the altitude of your objects as a function of time of day. For example, let's say you have 8 Polaris observations at 7:00, 5 at 8:00 and 6 at 9:30. The x-axis will be time (7:00, 8:00, and 9:30). The y axis will be altitude. Plot all of your 7:00 observations at 7:00 location on the x-axis. Repeat for 8:00 and 9:30. Use different symbols to indicate observations on different days.
3) Search the internet (or use the included chart) to find the magnitudes of the stars surrounding Algol. Use your comparisons to estimate the brightness of Algol during this semester. Plot your results.

Answer the following questions and include them in your journal:

You will not receive full credit if you do not include these answers in your journal!

1) Examine your plots for Polaris. How does the altitude of Polaris change in an hour (calculate the average change during each night and how your calculations)? How would the altitude of Polaris change during a 24 hr period? How do you account for these measurements?
2) Examine your first set of altitude plots for Algol, Aldeberan, Castor/Pollux, Betelgeuse, and the Pleiades. By how many degrees does the altitude of each change from hour to hour (calculate the average change during each night, and calculate the average change. Show your calculations. How should their altitudes change during a 24 hr period? How closely do your results agree?

3) Examine your second set of altitude plots for Algol, Aldeberan, Castor/Pollux, Betelgeuse, and the Pleiades. Look at your measurements for the same time each night, and calculate any change. How do you account for any change you find?

4) Examine your plots for your Cassiopeia/Big Dipper stars. By how many degrees do their altitudes change from hour to hour? Day to day? Are the numbers different than for Algol, Aldeberan, and Betelgeuse? Can you account for any differences?

5) Do your answers to the above questions make physical sense? Justify your answer.

6) Examine your first set of plots for the Moon. By how many degrees does the moon's altitude change from hour to hour? What is the maximum change (in degrees) you observed for the change in the moon's altitude from hour to hour?

7) Examine your plots for the Moon at the same time each night. Does the Moon's altitude increase or decrease when looking at the same time from night to night? Can you account for these changes?

8) What do your answers to 6 and 7 mean for the motion of the moon through the sky?

9) Repeat questions 6-8 for Jupiter.

10) How do your moon and Jupiter observations compare with the data for your other objects?

11) Astronomers try to explain their observations with theories – explanations of the physical phenomena causing the observed behavior. What differences do you observe between the behavior of your stars and planets? What physical processes do you think is responsible for your observations?

12) Imagine that you are Christopher Columbus' navigator. You only have your astrolabe and your measurements to explain to the King and Queen that you will not fall off the edge of the earth if you sail west. What arguments would you use to justify this claim?

13) Do you think your astrolabe is an accurate measurement tool? Explain.

14) Do your results say that Algol is a constant brightness, or does it change over time? Describe how it changes.