AST 120 Activity 15
Tycho and the Comet of 1577

In this activity we want to re-enact some of the observations that Tycho Brahe made of the comet of 1577. Unfortunately Stellarium doesn't display comets, so we can't just use Stellarium to reproduce Tycho's comet observations. Instead we will use a program called Starry Night to make a similar series of observations of Halley's comet which passed relatively nearby in late 1985 and early 1986. We will work through this activity as a class.

1. Run Starry Night. In the Options menu at the top, select Viewing Location. Click the Latitude/Longitude tab. Change the Latitude to 0° N Longitude to 0° E and then click Go To Location (press the spacebar to go there quickly). Turn off daylight (Ctrl-D). Stop the simulation and set the date and time to 12:00 PM on December 22, 1985 (when Halley's comet was easily visible and also close to the celestial equator). Use the Find tab to locate and center on Halley's comet, which should be just above the Eastern horizon. Click the Info tab and record the right ascension and declination (J2000 values) of Halley's comet in the space below. Be as precise as possible.

   RA = _____

   Dec = _____

2. Now we are going to change our viewing location by moving 140° eastward around the Earth. In the Options menu at the top, select Viewing Location. Click the Latitude/Longitude tab. Change the Longitude to 140° E and then click Go To Location (press the spacebar to go there quickly). The comet should still be centered and it should be low on the Western Horizon. MAKE SURE NOT THE LET THE SIMULATION PLAY DURING THIS TIME. Use the info Tab to find the right ascension and declination of the comet as seen from this location and record these values below.

   RA = _____

   Dec = _____

3. Find the difference in RA between these two locations. Calculate this first in minutes of *time*, then convert to degrees of arc by multiplying by the appropriate conversion factor, (360°)/(1440 m).

   change in RA (m) = _____

   change in RA (°) = _____

4. Now compute the change in Dec in degrees:

   change in Dec (°) = _____

5. Explain why we can ignore the change in Declination.

6. Record the parallax angle below.

   θ = _____

7. Historical records show that Tycho was able to measure the coordinates of the planets to within $4'$. Do you think Tycho could have measured the parallax of this comet? Explain.

8. Use the same procedure you used for the Moon and Sun in the previous lab to determine the distance to Halley's comet at the time of your observations. Show all of your work below.

9. Compare the distance you get for Halley's comet to the distances you found for the Moon and Sun in the previous lab. According to the distance you determined Halley's comet is _____.

   (a) closer than the Moon

   (b) between the Moon and the Sun in distance

   (c) farther than the Sun

10. Now let's look at how the appearance of the comet changes over the course of many nights. Click the Options tab and turn off the local horizon. Set the Time Flow Rate to sidereal days. Play the animation BACKWARD until the comet fades from view. Then play the animation forward. In the space below draw a picture showing what the comet looks like at three different times: a few days before it passes by the Sun, just as it passes by the Sun, and a fewdays after it passes by the Sun. Draw the Sun, and then draw the location of the comet relative to the Sun (and its proper appearance) for these three times.

11. Based on your observations of the comet's motion, would you conclude that it orbits the Earth or orbits the Sun? Explain your answer.

12. Consider the Aristotelian cosmos, with solid spheres for each celestial body. If this comet orbits the sun, then can there be solid, impenetrable spheres for each heavenly body? Why or why not?

13. Recall that ancient and medieval astronomers thought that the planets were carried around by these solid spheres that rotated about the Earth. Without these solid spheres, how could the planets move around? Try to give an answer that might have been given by an astronomer in the 16th century.

14. Even before he saw the 1577 comet, Tycho saw the appearance (and eventual disappearance) of a new star in the constellation Cassiopeia in 1572. As with the comet, Tycho could not detect any parallax for this new star. Was this object located in the "sublunary region" or in the "heavens"? How do you know?

15. Explain how the "new star" (*nova*) and the comet both serve to contradict Aristotle's views on the composition of the heavens.