Physics 108 – Introduction to Cosmology

Spring 2012 Myers

Homework 2

Please write all your work and answers on separate paper. (You can turn in this page with the questions or not, as you wish). Show all your work on calculations and explain your reasoning whenever you can.

1. **Polaris:** Looking up at the night skye from Marist College, what will be the altitude and azimuth of Polaris, the north star?
2. **Why not?** Even though many of his contemporary thinkers found the heliocentric model interesting, and even compelling, Tycho Brahe rejected it, for what he thought was a very good reason. What was that reason? Don't just name it, explain how it works.
3. **Synodic period:** Ceres is the largest object in the Asteroid Belt (it's now classified as a dwarf planet). Ceres has a siderial period of 1680 days, while Earth has a siderial period of 365.25 days. What is the synodic period of Ceres?
4. **What star is this?** Using Stellarium, determine the identity of the object at one of the sky coordinates listed below (selected at random by the roll of a die). You are looking for the major sky object closest to these celestial coordinates.

   1) $06^h45^m09.3^s$, $-16°42'47.3''$
   2) $05^h55^m10.3^s$, $+07°24'25.3''$
   3) $05^h34^m31.9^s$, $+22°00'52.2''$
   4) $00^h42^m44.3^s$, $+41°16'07.5''$
   5) $18^h36^m56.2^s$, $+38°46'58.1''$
   6) $03^h45^m48.0^s$, $+24°22'00.0''$
   7) $13^h25^m11.6^s$, $-11°09'40.5''$
   8) $10^h08^m22.5^s$, $+11°58'01.9''$

5. **Following Galileo:** Using Stellarium (or other planetarium software) find Jupiter and zoom in until you can see the planet and the four Galilean moons.
   a. Sketch what you see, showing the relative positions of the planet and the moons. Label your sketch with the date and time of your "observation".
   b. Use the time controls of the software to advance the time forward by one day. This is where the moons will be tomorrow. Make another sketch of the planet and moons, and again label it with the date and time.

(continued...)

6. **Testing Kepler III:** Using Stellarium (or other planetarium software) we can attempt to verify Kepler's third law using the Galilean moons of Jupiter. First, find and zoom in on Jupiter and the four Galilean moons.

    a. Using the time controls, run time forward or backward fast enough that you can see the moons move toward and away from Jupiter. Adjust the zoom so that the farthest moon just fits on the screen when it is farthest away from Jupiter (this should give you better results).

    b. For each moon, find the point where the moon is farthest from Jupiter. Measure the distance from the moon to the *center* of Jupiter, measured in Jupiter diameters. (You can easily get the diameter of Jupiter from the screen by holding up a piece of paper.) Call this distance a. It is an estimate of the length of the semi-major axis.

    c. Record the time the moon is farthest away from Jupiter, then run time fast forward until the moon goes around one orbit and is again in the position farthest away from Jupiter. Record the new time, and compute the difference between the two times, in hours. Call this, P. It is an estimate of the period of the orbit of the moon around Jupiter.

    d. For each moon, compute the value of P^2/a^3. If Kepler's third law holds for Jupiter's moons then the values should be the same for every moon of Jupiter. They won't be exactly the same, but are they close enough?

    Hint: don't zoom in or out while you are making your measurements or you will change the length scale (diameters of Jupiter) and ruin the calculations.