Project 3: Ptolemaic Modeling

1 Modeling Your Solar System

Now that you have measured the motions of the planets in your solar system, you are ready to construct a model of that system. For this project you will construct your model using Ptolemy's principles for planetary motion. Because of the simple structure of your solar system, you can use a simplified version of Ptolemaic astronomy that does not include eccentrics or equants. Therefore the motion of the Sun (Barnard's Star) will be uniform circular motion centered on your home world. The motions of the planets you observed will be composed of uniform motion on an epicycle whose center moves uniformly along a deferent that is centered on your home world.

Your job is to determine the parameters for this Ptolemaic model. Some of these parameters can be drawn directly from your observations. Others must be calculated using equations we have discussed in the course. For each parameter you determine, you must write one or more complete, grammatically correct sentences to explain how you determined the value of that parameter from your observations. Use correct terminology (ie, sidereal day, synodic period, opposition, quadrature, etc) in your explanations. Don't just give numbers, tell me what those numbers represent. Feel free to use equations, but make sure to explain what each symbol in the equation represents. Show your work for any calculations.

2 Parameters for the Ptolemaic System

To construct the Ptolemaic model of your solar system you should determine the following parameters (to one decimal place unless otherwise noted):

Rotational Period: the rotational period of the Celestial Sphere in hours,

Solar Period: the period of the Sun's orbit in days,

Deferent Period: the period of motion for the center of each planet's epicycle along its deferent in days,

Epicycle Period: the period of each planet's motion along its epicycle (relative to the deferent) in days,

Size Ratio: the ratio of the epicycle radius to the deferent radius for each planet (to two decimal places).

3 Diagram of Your Ptolemaic System

Please construct a properly scaled diagram of your Ptolemaic model. Your diagram should show your home world, the orbit of the Sun, and the deferents and epicycles for all planets. Ptolemy's system allows for some flexibility in how you scale these various circles, but you should scale them in a way that is consistent with Ptolemy's fundamental principles (ie, no overlapping orbits). Ideally the orbits should be scaled so that there is no empty space between the spheres for adjacent planets.

Mark the locations of the Sun and all planets on the diagram. Make sure you place the planets in locations that fit the constraints of Ptolemy's system. You should also indicate the direction of all of the circular motions using arrows. The diagram may be constructed on a computer or carefully drawn (using a compass and ruler) by hand. If you wish, you may draw or print your diagram on something larger than a letter-size piece of paper but you don't have to do so.

4 Description of Your Ptolemaic System

Please write a description of how each object in your Ptolemaic system moves *through space* (not on the sky). Be sure to describe any special constraints on the motion. Are some motions synchronized with others? How so?

You should also explain the ordering (from closest to your home planet, to farthest away) of the planets shown in your diagram. Why did you choose this particular ordering? Are other orderings possible?

5 What You Need to Turn In

Please submit a typed report that includes the following:

- A few sentences describing how you determined each parameter value, including equations and calculations if needed. Please organize these descriptions using the headings given in the Parameters section above. Use sub-headings for different objects if necessary.
- Your Ptolemaic diagram.
- Your written description of the motions for each object the explanation of your chosen ordering. Please organize these descriptions using headings for each object.

Please submit your report by October 10, 2013.