2.2 Geocentric Models

PRE-LECTURE READING 2.2

- *Astronomy Today,* 8th Edition (Chaisson & McMillan)
- *Astronomy Today,* 7th Edition (Chaisson & McMillan)
- *Astronomy Today,* 6th Edition (Chaisson & McMillan)

VIDEO LECTURE

- Geocentric Models[1] (22:58)

SUPPLEMENTARY NOTES

Basic Geocentric Model

- See Basic Geocentric Model[2].

Earth

- Center of the universe
- Does not rotate

Stars

- Fixed to the celestial sphere
- Celestial sphere revolves around Earth east to west once every sidereal day (23.93 hours)

Sun

- Fixed to a different sphere
- Sun sphere revolves around Earth east to west once every solar day (24 hours)
- Since the solar day is longer than the sidereal day, the sun moves across the sky more slowly than the stars do.
- Consequently, the sun moves very slowly west to east (*prograde*) *with respect to the stars.*

Moon

- Fixed to a different sphere
- Moon sphere revolves around Earth east to west once every 24.84 hours

[1] http://youtu.be/oJ51wyoth4Q
[2] http://en.wikipedia.org/wiki/Geocentric_model

- Since this is longer than the sidereal day, the moon moves across the sky more slowly than the stars do.
- Consequently, the moon moves slowly west to east (prograde) with respect to the stars.

Planets

- Only the five naked-eye planets—Mercury, Venus, Mars, Jupiter, and Saturn—were known at this time. Earth was not considered to be a planet.

The planets have three properties that both geocentric and heliocentric models of the universe must explain:

- Unlike the sun and the moon, the planets do not move across the sky at a uniform rate. They "wander," which is what the word "planet" means. Most of the time, they move prograde, but periodically they slow down and stop, change course and move *retrograde* (east to west with respect to the stars) for a while, slow down and stop again, and then resume their prograde motion.
- The planets are brightest when in retrograde.
- Mercury and Venus are always within certain angles of the sun. This is not the case for the other planets, which can be opposite of the sun in the sky.

Aristotle (384-322 BC)

- See Aristotle[3].
- Guided by his mentor Plato's[4] aesthetic of uniform, circular motion, Aristotle modeled retrograde motion with epicycles on deferents.
- In this model, planets are closest to Earth, and hence brightest, when in retrograde.
- Mercury's and Venus's deferents are chosen to revolve at the same angular rate as the sun's deferent, with Mercury's and Venus's epicycles between Earth and the sun. Consequently, these planets are always within certain angles of the sun, and never opposite of the sun in the sky.
- Aristotle's model described the motions of the planets *qualitatively* (descriptively), but was not very accurate *quantitatively* (numerically).

Ptolemy (2nd century AD)

- See Ptolemy[5].

[3] http://en.wikipedia.org/wiki/Aristotle
[4] http://en.wikipedia.org/wiki/Plato
[5] http://en.wikipedia.org/wiki/Ptolemy

- Wrote *Megale Syntaxis tes Astronomias* (*Great Syntaxes of Astronomy*), also known as *Syntaxis*, but more commonly known as *Almagest*[6] (*The Greatest*) (c. 141 AD)
- Shifted the center of each planet's deferent by a different amount in a different direction
- Shifted the center of each planet's epicycle by a different amount in a different direction (but then projected the planet back onto the original epicycle—a detail that you may ignore)
- Ptolemy's model described the motions of the planets very accurately (but not perfectly).
- However, see Occam's Razor[7].

EXERCISES

- Experiment with UNL's Ptolemaic Orbit of Mars[8].
- Experiment with UNL's Ptolemaic System Simulator[9].

ASSIGNMENT 2

- Do Question 2.

[6] http://en.wikipedia.org/wiki/Almagest
[7] http://en.wikipedia.org/wiki/Occam's_razor
[8] http://astro.unl.edu/classaction/animations/renaissance/marsorbit.html
[9] http://astro.unl.edu/naap/ssm/animations/ptolemaic.html