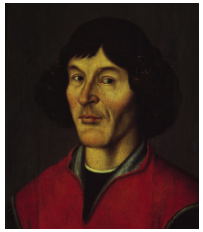
The Copernican Revolution—5 Sept



Nicholas Copernicus
(1473-1543)

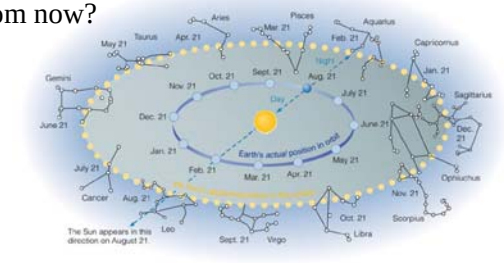
Tycho Brahe
(1546–1601)

Johannes Kepler
(1571–1630)

The Celestial Sphere

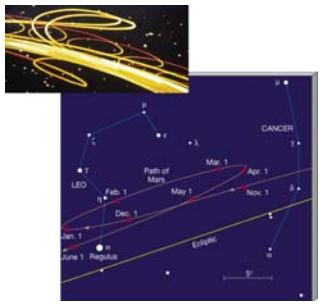
- The sun "moves" into different constellations of the zodiac during the year.

4. Taurus rises at 8 pm tonight. When does it rise two months from now?
   A. 8 pm
   B. 4 pm
   C. noon
   D. midnight
   E. 4 am

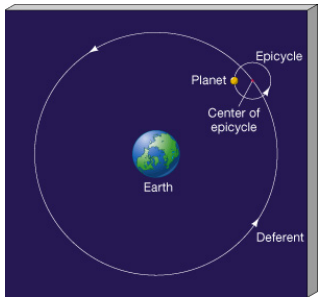


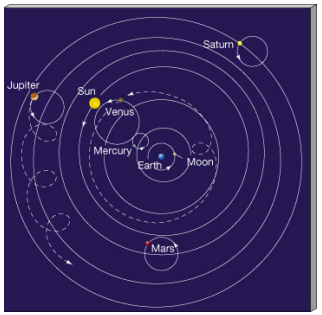
Motion of Planets

- Greek astronomers
  - Explained the motion of the sun, moon, & stars successfully, as we did with plastic celestial sphere.
  - Their explanation of the motion of planets was complicated and wrong.
- What is the motion of the sun with respect to the stars? West to east about 1 degree per day.
- Motion of planets
  - Planets usually move west to east with respect to the stars. (Prograde)
  - Sometimes, they move backwards. (Retrograde)
  - When the earth is nearly between the sun and Mars, it moves backwards. When Venus is nearly between the sun and earth, it moves backwards.



Ptolemy's Model in *Syntaxis (Almagest)*, 140AD



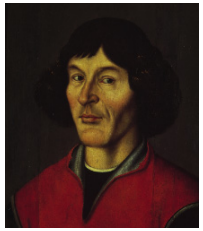


Ptolemy's model

1. How did Ptolemy explain the passing of a day?
   A. The earth spins around its axis once.
   B. The earth moves around the sun once.
   C. The sun spins around its axis once.
   D. The sun moves around the earth once.
- Retrograde motion
- Venus is never seen far from the sun. Never seen at midnight

Copernicus

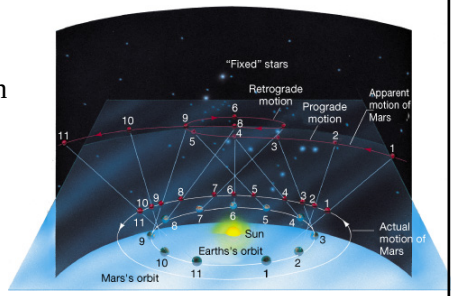
- Aristotle: The natural motion of "base" objects is to come to rest. The natural motion of "heavenly" objects is to move in a circle at constant speed.
- Copernicus: *De Revolutionibus Orbium Coelestium*, 1543
  - The Earth is not at the center. The Earth is not immobile.
  - The sun is at the center. The planets orbit the sun.

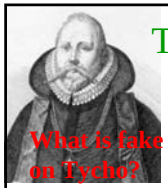


Nicholas Copernicus (1473-1543)

How did Copernicus explain

- Night & day
- Venus is never seen far from the sun. Never seen at midnight
- Retrograde motion





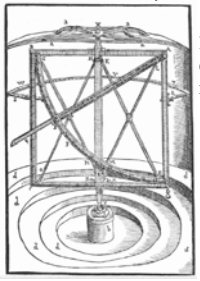
What is fake on Tycho?

Tycho Brahe's Observations

•On Uraniborg, Tycho measured positions of the planets for 20 years
•Highly accurate & reliable
•Accuracy limited by human eye, not by instruments. Superseded only with telescopes.
•Tyco measured & compensated for instrument flexure, the biggest error.

Uraniborg.

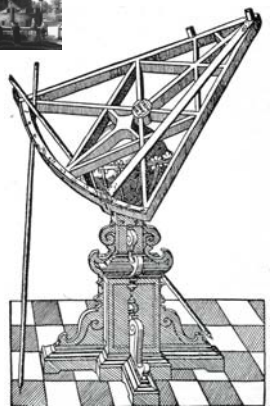
Great quadrant (1582)



Revolving steel quadrant, 2 m radius (1588)

Brass azimuthal quadrant, 65 cm radius (ca 1576)

Sextants at Uraniborg



Great quadrant (1582)