

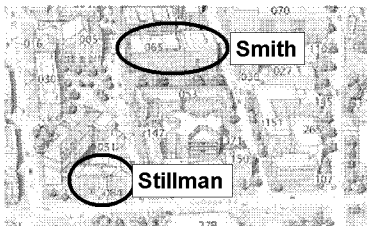
Monday, September 27
The Copernican Revolution:
What is Our Place in the Universe?



The Copernican Revolution
Key Concepts

- 1) Ptolemy's elaborate **geocentric** model used epicycles to explain the motion of planets.
- 2) Copernicus proposed a **heliocentric** model for the universe.
- 3) Copernicus' model was not widely adopted until it was further improved.

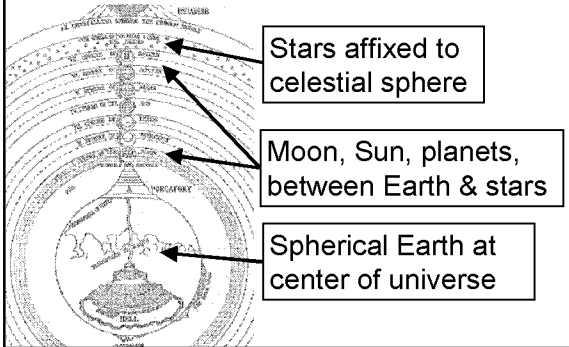
Planetarium Show & Roof Night



Tonight, at 7:30 pm (please be prompt!)
Smith Lab, fifth floor (north end of building)

Also: Tomorrow, Tue Oct 5, Wed Oct 6, Wed Oct 13, Thu Oct 14

For 2000 years, a **geocentric** model for the universe was widely assumed.



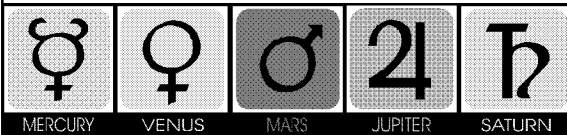
Most famous advocate of geocentric model: the astronomer **Ptolemy** (2nd century AD).



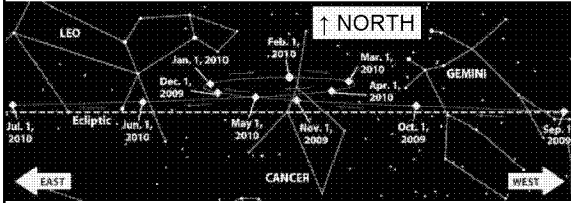
He developed an elaborate model to describe motion of stars, Sun, Moon, & planets.

Describing motions of **stars**, **Sun**, and **Moon** was easy in the geocentric model.

Describing motion of **planets** was difficult.

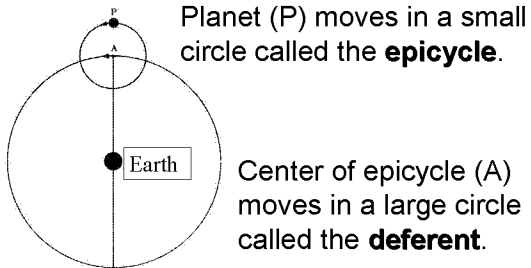


Planets (“wanderers” in Greek) were distinguished by their **motion** relative to stars.

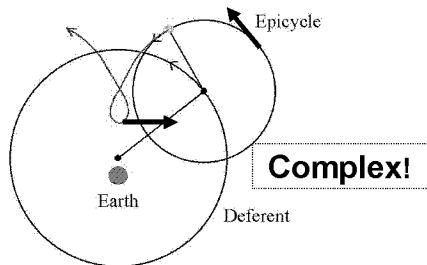


Planets usually move west to east, but sometimes east to west (**retrograde**), relative to the background stars.

Ptolemy's explanation of retrograde motion:



Combination of small and large circles creates “loop-the-loop” retrograde motion.



A bold minority opinion:



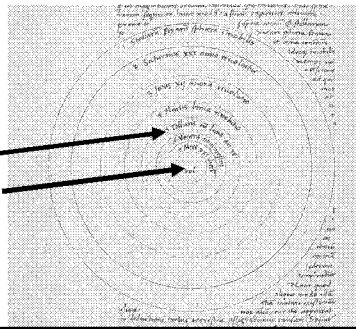
Aristarchus (3rd century BC) proposed that the Earth rotates on its axis & goes around the Sun.

First **heliocentric** (Sun-centered) model.

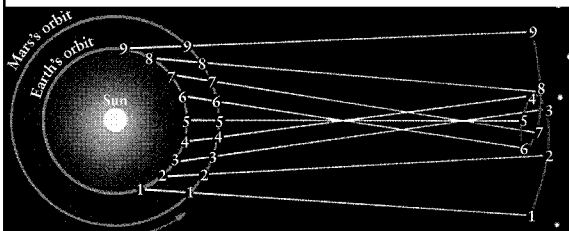
The heliocentric model was ignored for 18 centuries until it was revived by Copernicus.



Earth
Sun



The heliocentric model explains **retrograde motion** of planets.



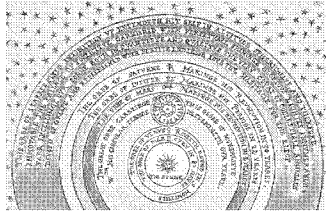
1 → 2 → 3: prograde (forward) 4
4 → 5 → 6: retrograde (backward) 4
7 → 8 → 9: prograde (forward)

Startling Realizations!

The Earth is a planet: no division between “perfect” heavens and “corrupt” Earth.

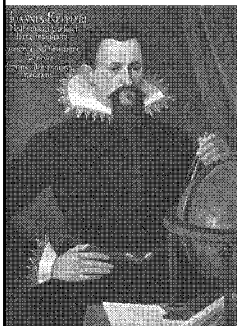
The Sun is a star: universe is full of glowing, spherical, Sun-like objects.

Thomas Digges (1546-1595) discarded the “celestial sphere”.



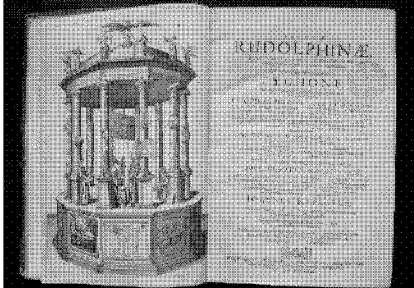
Stars are at different distances from the Sun. Nearby stars are bright; more distant stars are dimmer; very distant stars are too dim to be seen.

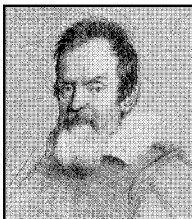
Johannes Kepler (1571-1630) discarded epicycles.



Kepler's laws of planetary motion state that planets go around the Sun on **ellipses** rather than **circles**, at **changing** speeds rather than **constant** speeds.

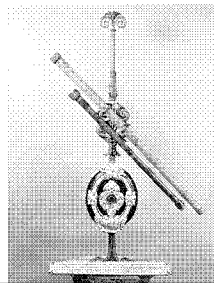
With his laws of planetary motion, Kepler made **more accurate** predictions of planetary positions, contributing to the triumph of heliocentrism.



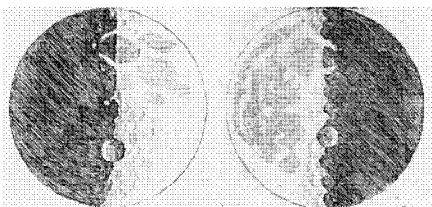


Galileo Galilei
(1564-1642)

Made observations with the newly invented "telescope" that supported the heliocentric model.

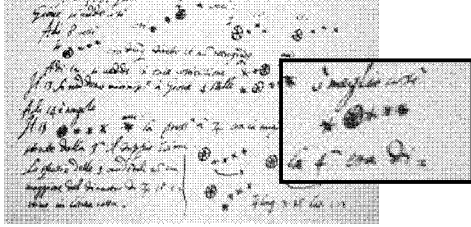


Observations of Galileo:
The Moon has mountains.



Aristotle, Ptolemy: The Moon is a perfect sphere.
Galileo: Moon is no more perfect than Earth.

Jupiter has moons.



Four "Galilean" satellites of Jupiter.
The Earth can't be the center of **all** orbits in the universe.

Tomorrow's Lecture:
Geological Revolution:
How Old is the Earth?

This week's reading:

Chapters 2 & 3

