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

OMG, is fulla starz.

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.

- Stars affixed to celestial sphere
- Moon, Sun, planets, between Earth & stars
- Spherical Earth at center of universe

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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.

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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:

- Planet (P) moves in a small circle called the epicycle.
- Center of epicycle (A) moves in a large circle called the deferent.

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.

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

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