Heliocentric Models and Modern Astronomy

Heliocentric models and European Renaissance

- 3000 BC; Chinese astronomy

- 2700-2100 BC; Egyptians & Babylonians

- 625 BC-150 AD; Greek scientists and geocentric models (Thales, Pythagoras, Democritus, Plato, Eudoxus, Aristotle, [Aristarchus], Apollonius, Hipparcus, Ptolemy)

- 300 BC; Expansion of Greek empire into Middle East (Egypt, Mesopotoamia)

- 300 BC-400 AD; Library of Alexandria

- 600-800 AD ; House of Baghdad; compilation of knowledge by Arabs from Egyptians, Greeks, Hindu, Chinese. Development of arithmetic.

- 800-1400 ; Knowledge compiled by Arabs spreads throughout the Byzantine Empire

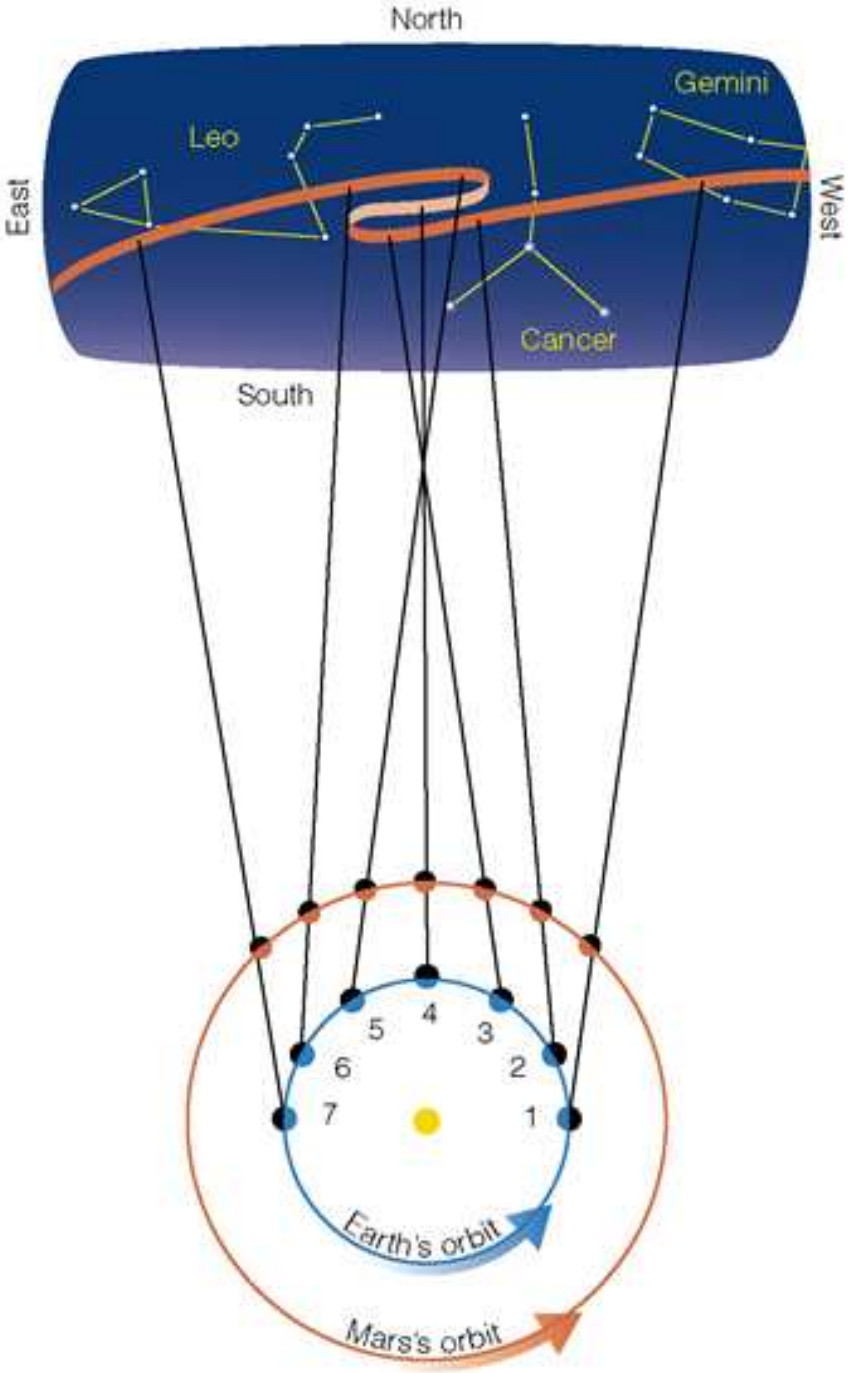
- 1453 ; Capital of Byzantine Empire falls to the Turks . Eastern scholars move to Europe transferring knowledge ….European Renaissannce

- 1473—1642 ; Heliocentric models and birth of modern astronomy : radical change in only 200 years (Copernicus, Brahe, Kepler, Galilei)

- 1642-1747 Newton: Laws of gravity

- 1905-1915 Einstein's Special and General Theory of Relativity

Heliocentric Models and Modern Astronomy

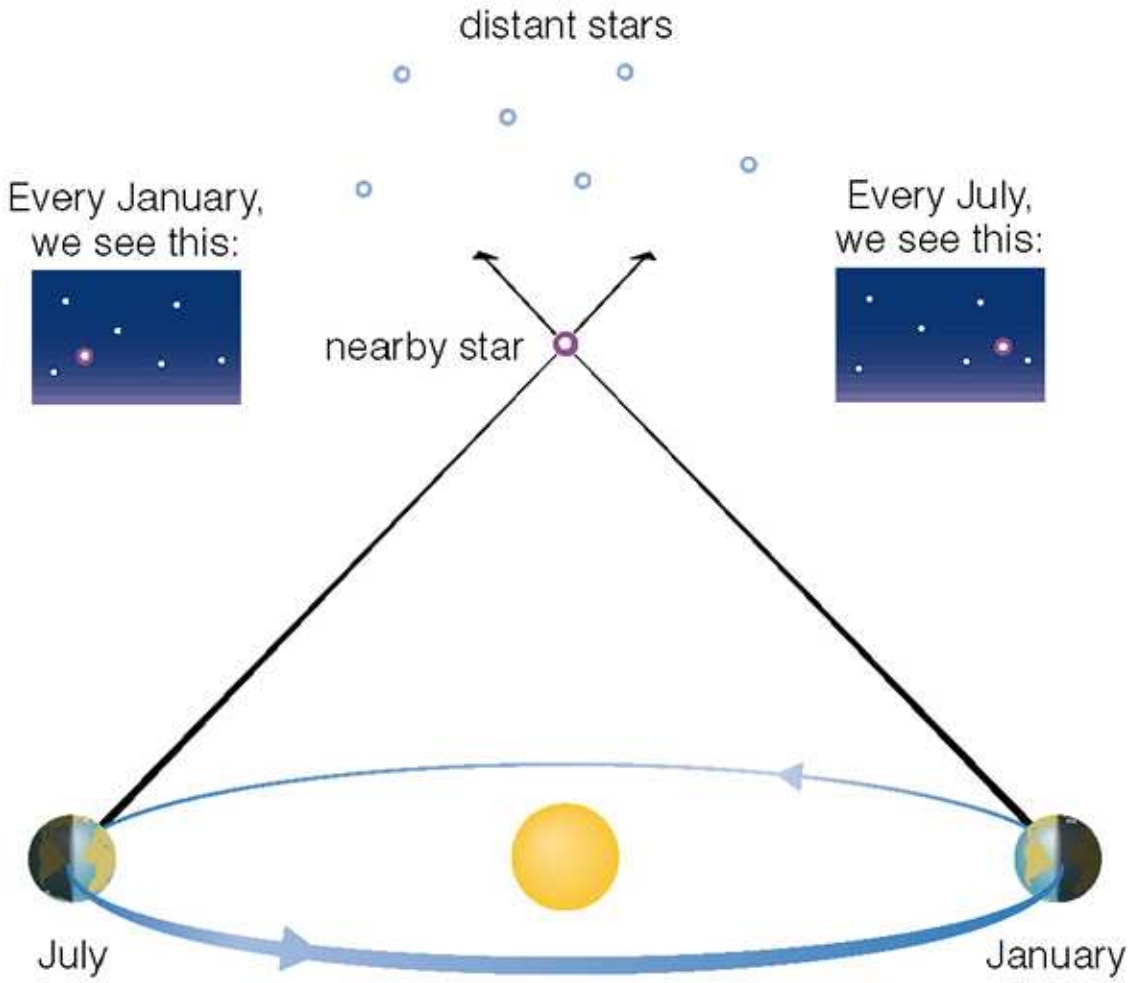


Apparent retrograde motion of Mars easily explained in Heliocentric model

Heliocentric Models and Modern Astronomy

Naked-eye observatory
of Tycho Brahe

Heliocentric Models and Modern Astronomy

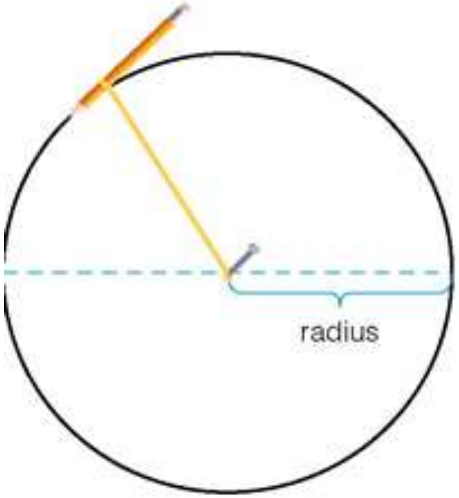


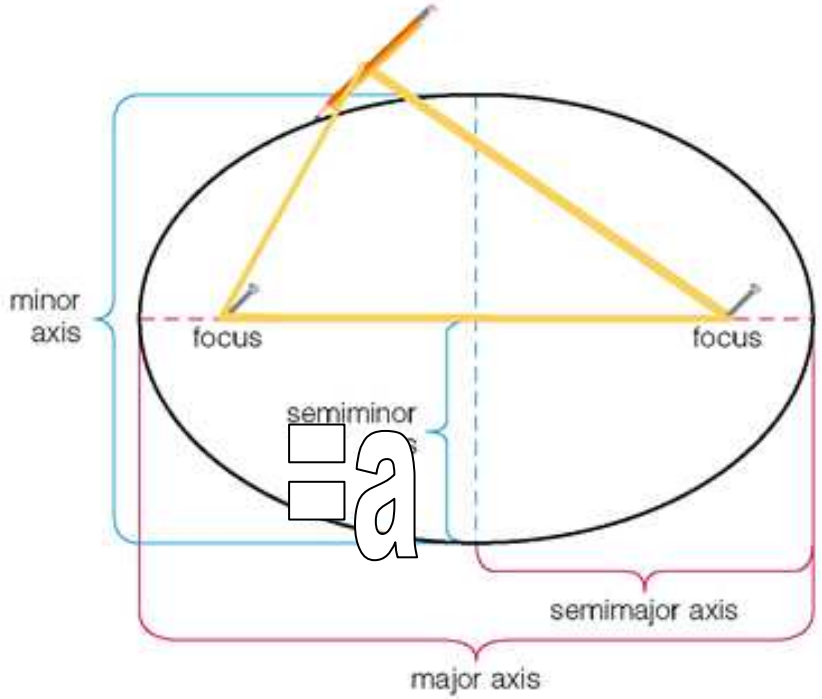
- Stellar parallax = apparent shift of a nearby star against backround of distant stars ,as seen from Earth, due to the motion of Earth about Sun
- Too small to see in naked-eye observation by Tycho

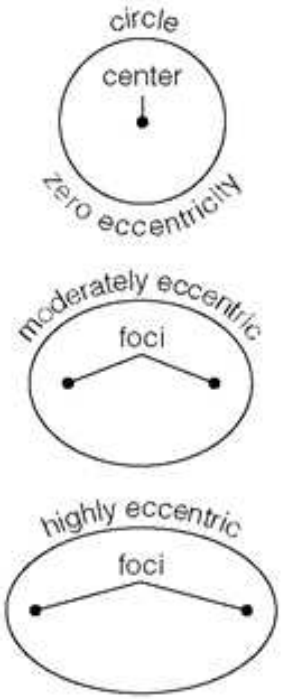
Heliocentric Models and Modern Astronomy

Johannes Kepler
1571-1630

Kepler's laws of heliocentric planetary motions







Ellipse = Oval defined by 2 points called foci as above

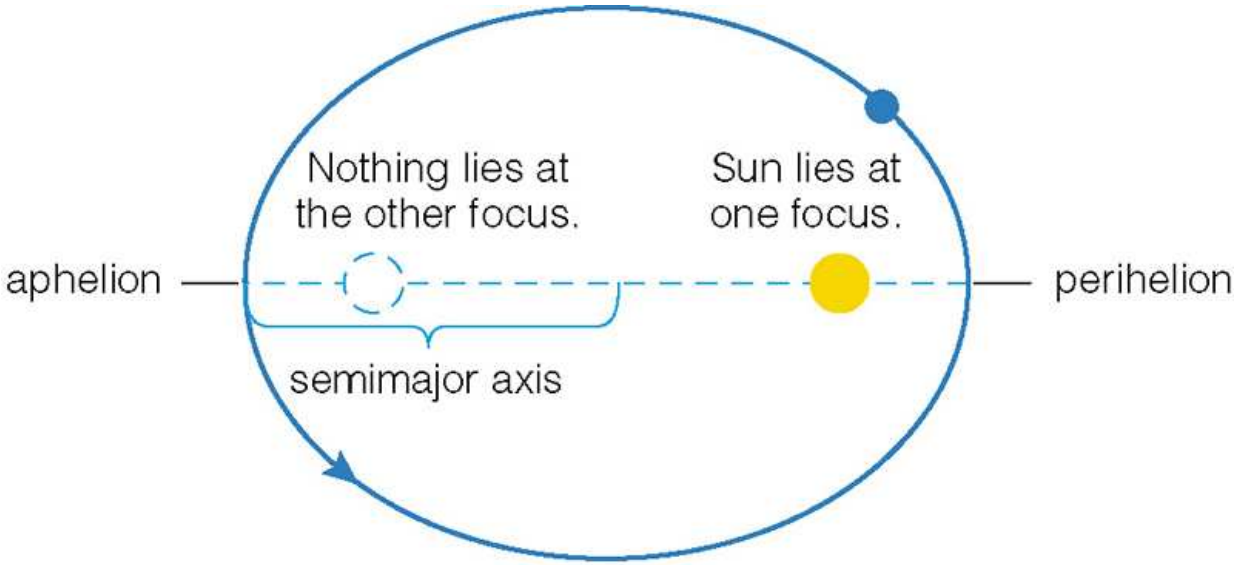
Distance from planet to focus varies; aphelion=furthest , perihelion=closest

Semimajor axis =a Semiminor axis=b . For ellipse b/a<1

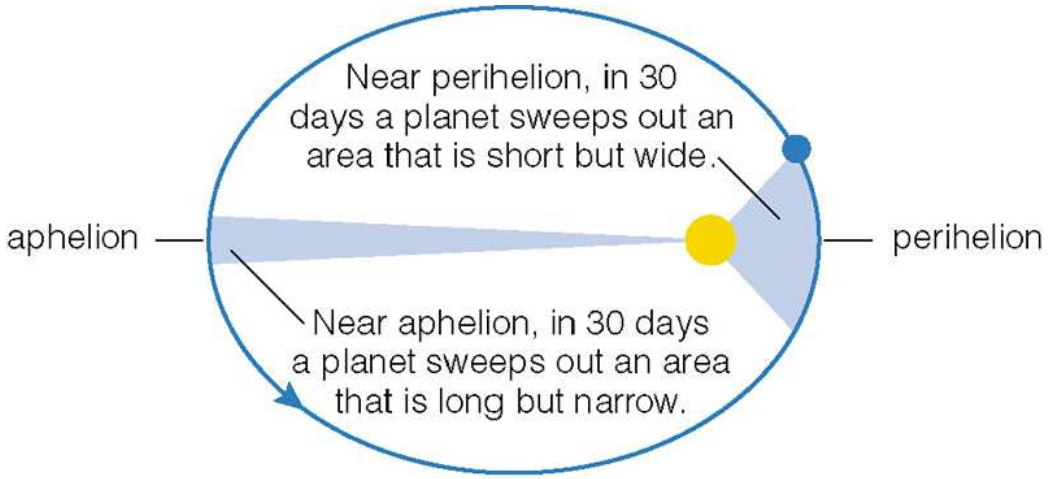
Circle = Defined by one focus or center

b=a=radius of circle; For circle b/a=1

Kepler's laws of heliocentric planetary motions



Law I : Orbit of each planet about the Sun is an ellipse with the Sun at one focus

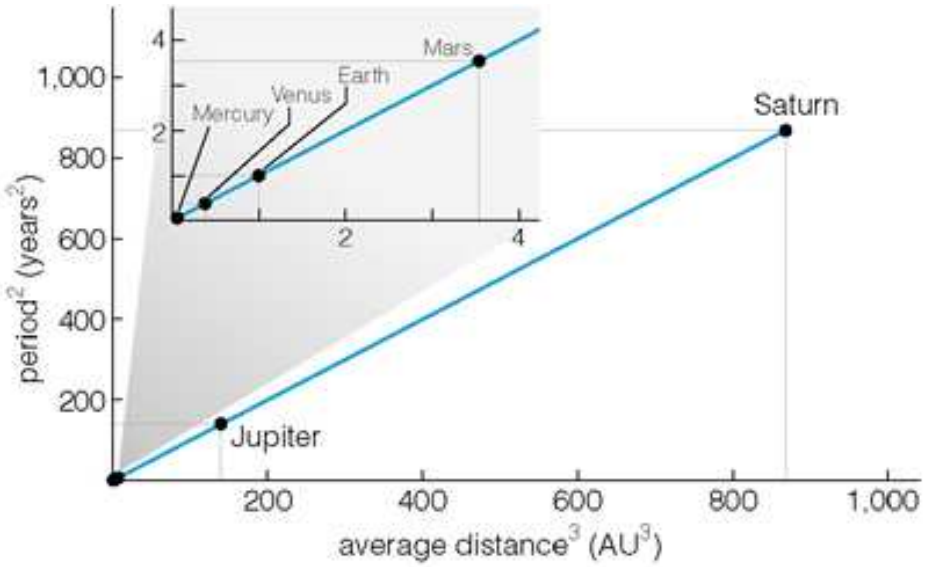


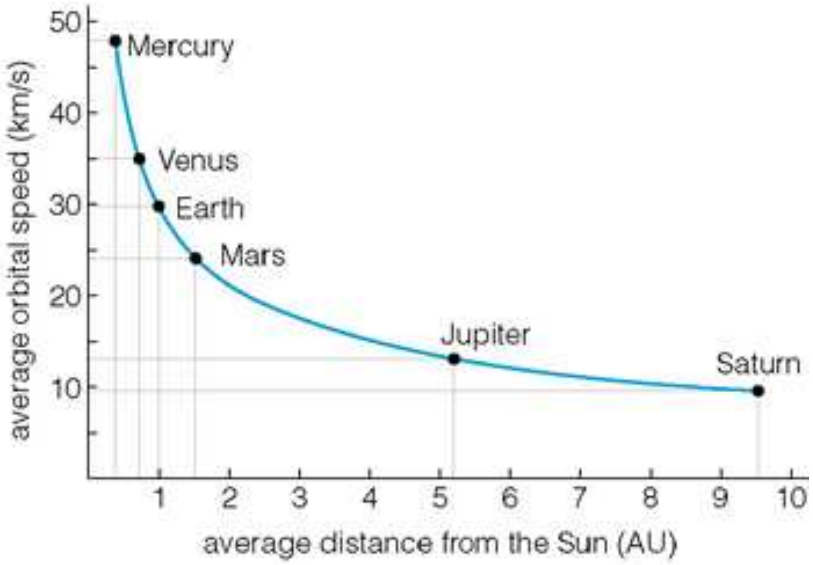
Law II : Line joining Sun and planet sweeps out equal areas in equal areas of time

à planet moves slower when it is farther from Sun

à Max speed at aphelion

Kepler's laws of heliocentric planetary motions





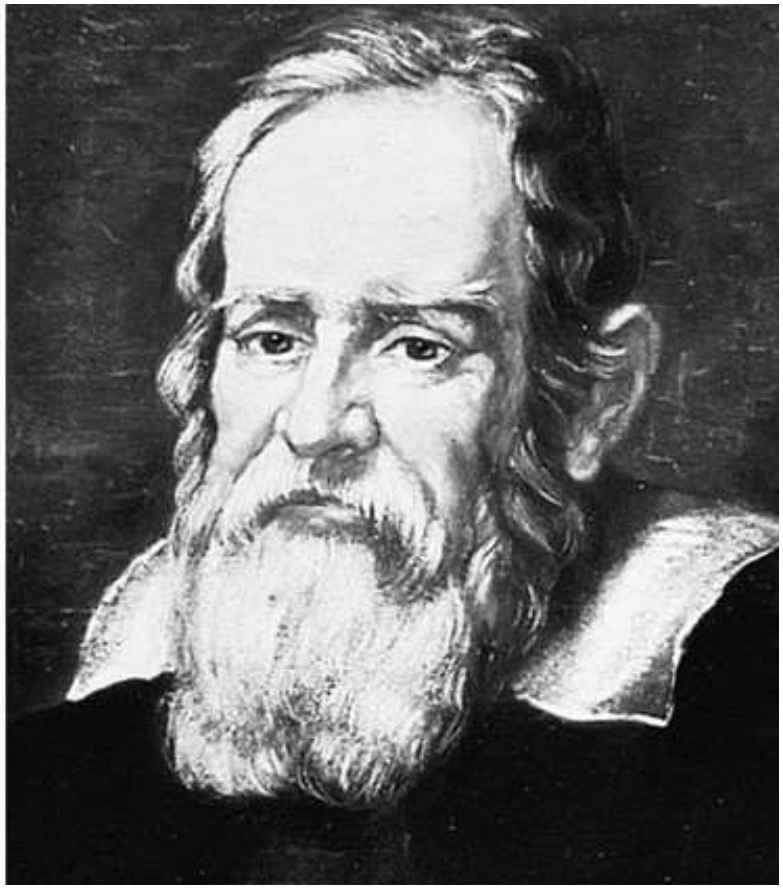
Law III : Planet moves around Sun such that they obey the relationship

(Period P in years)^2 = (Semi-major aixs a in AU) ^{3}

à planet moves slower when it is farther from Sun

à can use observed Period P infer a, and hence mean orbital speed in km/s

Heliocentric Models and Modern Astronomy



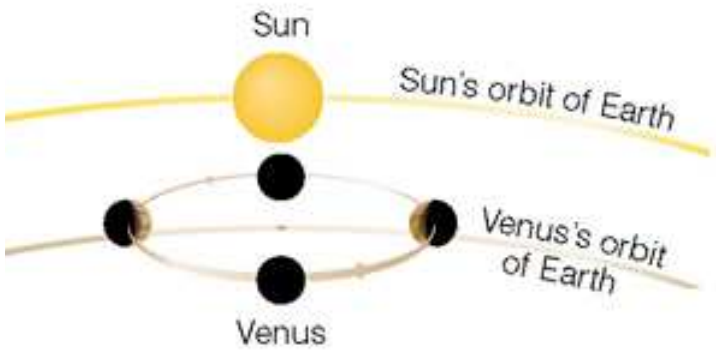
Galileo Galilei
1564-1642

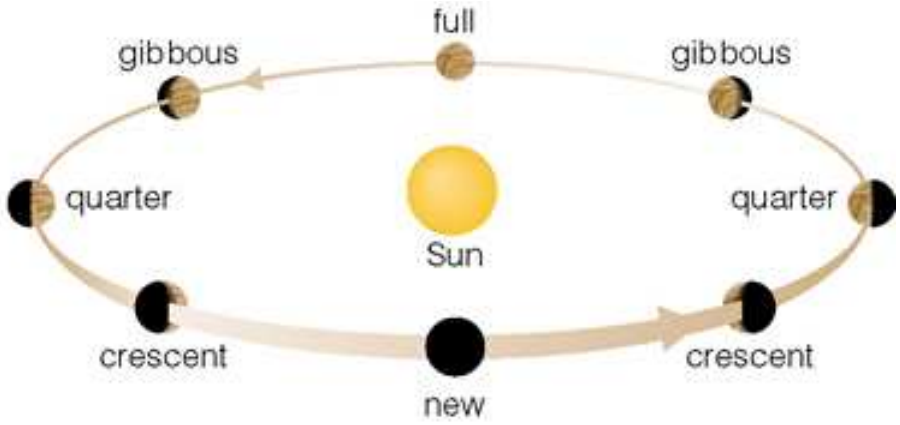
Kepler's laws of heliocentric planetary motions

à consistent will all of Tycho Brahe's data

à but obtained very strong support only after vindication by accurate + unprecedented observations taken by Galileo Galilei with the recently invented telescope

Heliocentric Models and Modern Astronomy





- Observations of Venus phases (going through full phases new-crescent-full rather than only new-to -crescent phases) by Galileo implies Venus orbits Sun not Earth

- Imperfections on the surface of the Moon and sunspots on Sun observed by Galileo
  à Heavenly bodies are not perfect
  à need not move in perfect shapes=circles

- Moon of Jupiter orbit Jupiter and NOT Earth
  à not everything revolves around E