Reading: Chap. 2, Sec. 2.4, 3.1-3.3
Homework 3: Due Friday/Monday
Exam 1: 2 weeks from today: Tuesday, Oct. 1, in the evening

Last time: Early Science - prehistory forward

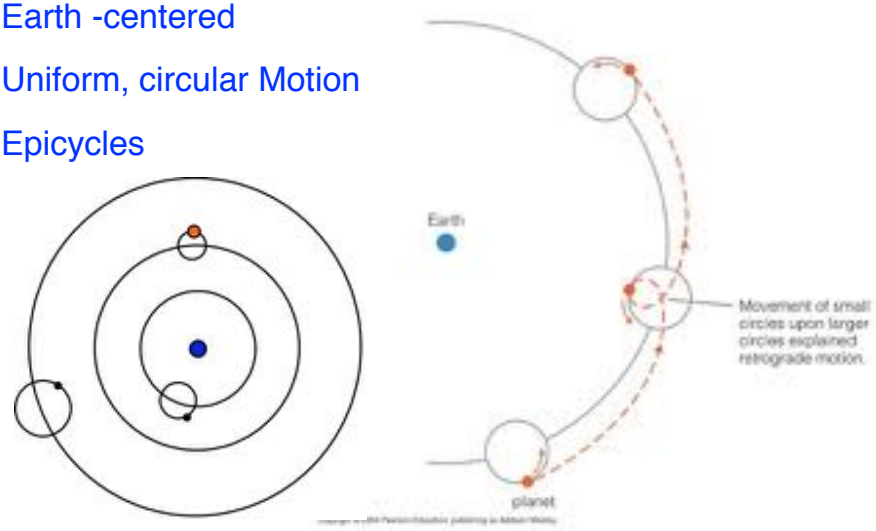
- Early Science
  - prehistoric discoveries: visual observations - motivations
- Motions of the Planets:
  concluding the discovery of our solar system

Today: Towards Newton: Copernicus, Tycho, Galileo, to Kepler

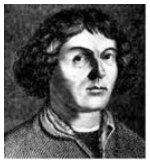
- Greek Astronomy: perfect, immutable sky with Earth at the center
  - uniform circular motions - epicycles
- The Renaissance
  - Copernicus - Sun to the center
  - Tycho Brahe - detailed observations
  - Galileo - telescope views of planets + physics experiments
  - setting the stage for Kepler

Philosophy + some observation culminated in

- Ptolemy's computational scheme for celestial motion
  - Earth -centered
  - Uniform, circular Motion
  - Epicycles



towards the modern view

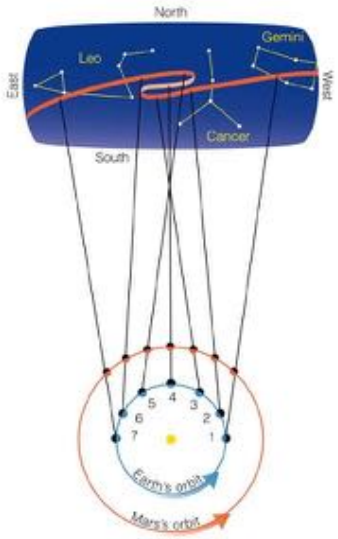


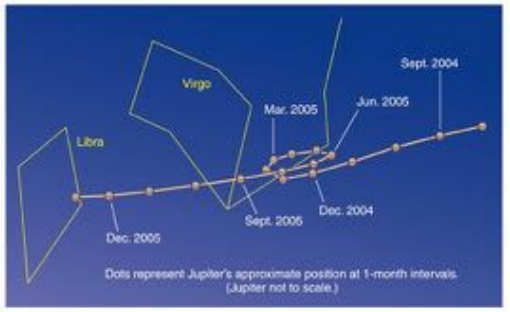
- 1200s: Ptolemy's method off by several *degrees*
  - response: add more epicycles . . .
- 1543: Copernicus
  - moved sun to center -----> Revolutionary!

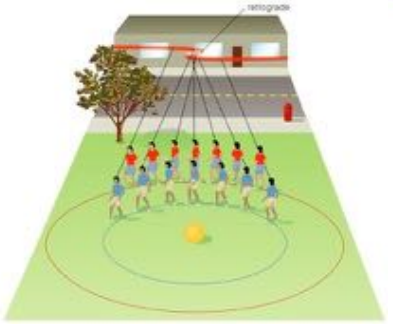
- 1580: Tycho Brahe
  - precise positions of planets
  - stars are fixed, therefore very distant
  - sky is not immutable

- 1609: Galileo
  - astronomer: telescope studies show Copernicus right
  - physicist: experiments with Gravity

Looping Planets

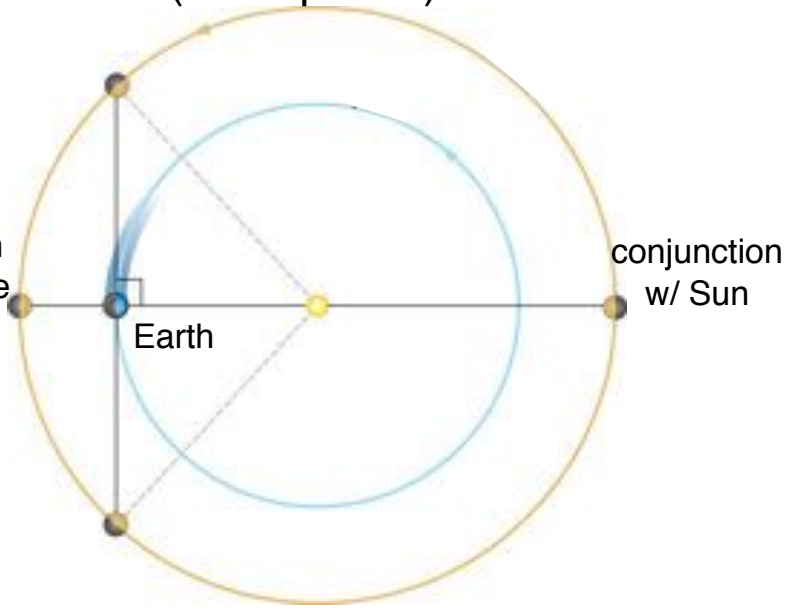




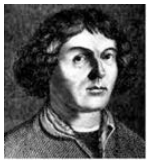


planetary alignments

(outer planet)



towards the modern view



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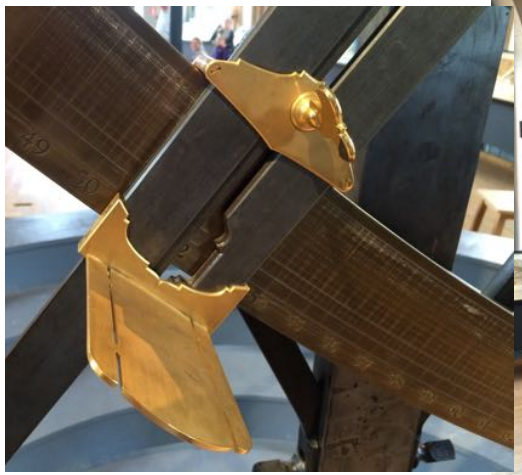
Brahe's Tools



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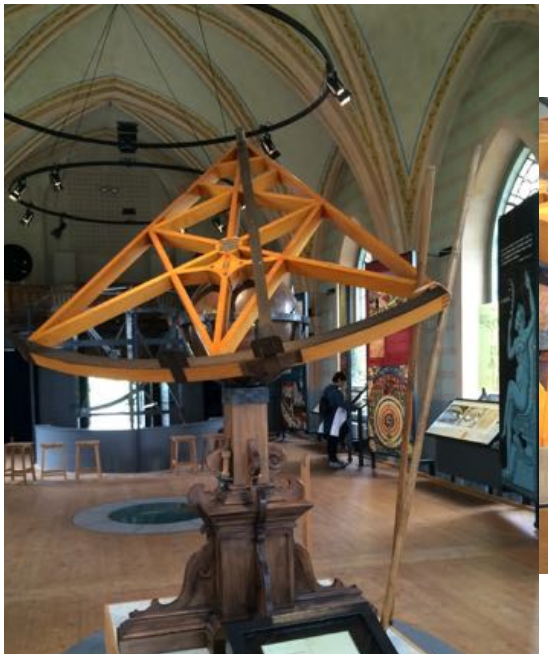
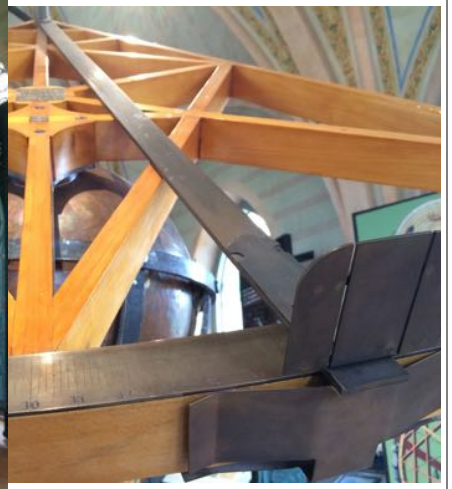


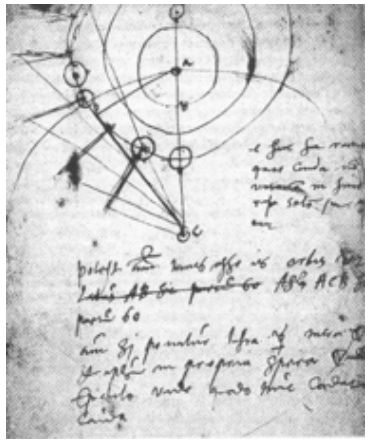


Brahe's Tools

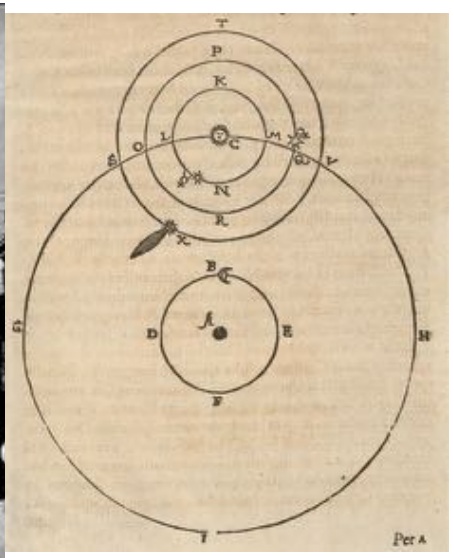
Brahe's demonstrations of the ***non***-immutable heavens

Supernova in Cassiopeia in 1572

The Great Comet of 1577: not in our atmosphere, but farther than the Moon



Brahe's Tools and Ideas



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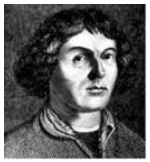

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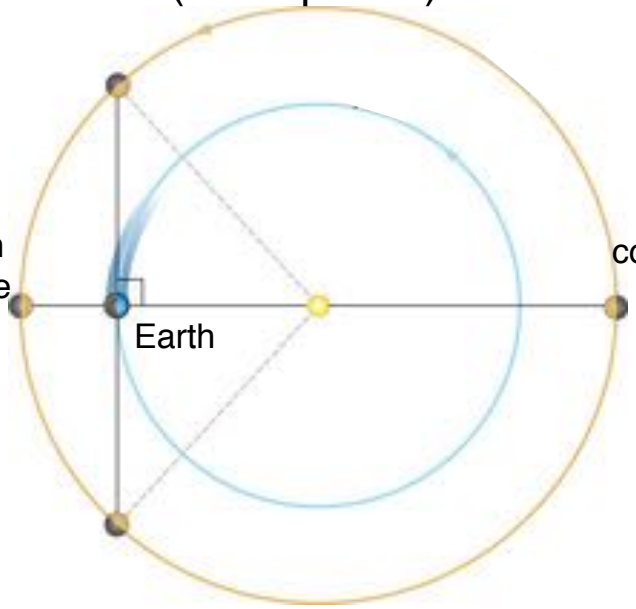
(outer planet)



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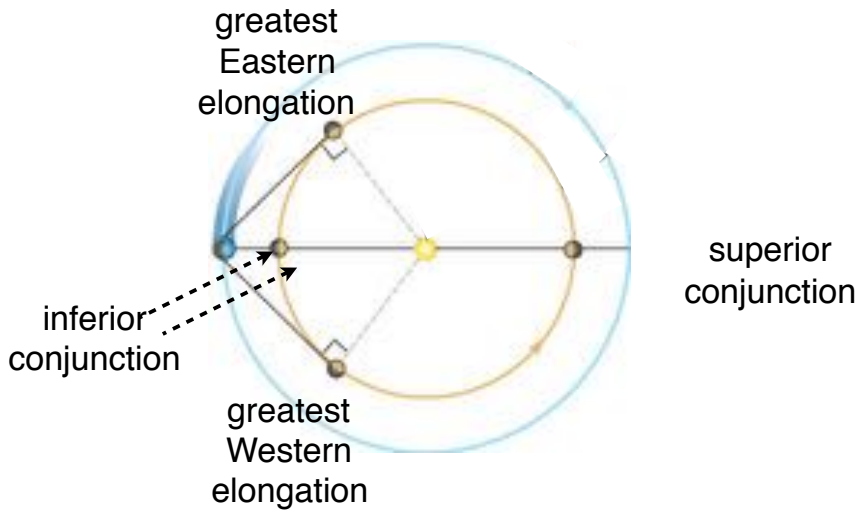
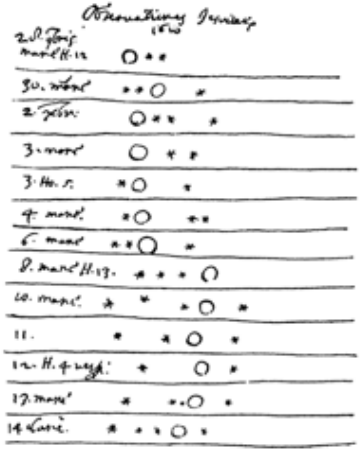
(inner planet)



Galileo's observations

- full set of phases of Venus

- Jupiter's system of moons (the Galilean satellites)



a famous experiment

1612 (?)

1971

1610 - Johannes Kepler

mathematician and klutz

used Tycho's data on the motion of Mars:
with no circular motion bias
to discover

Kepler's Laws of Planetary Motion

These are simple empirical laws explaining planetary motion, derived from data only, with no preconceptions.