Observations

+

Assumptions
(ideas, beliefs)

⇓

Theory/Model

⇓

Predictions

⇓

Observations
{yes or no}

Motion of Planets on Celestial Sphere

- Move continuously relative to fixed stars
- Found near Ecliptic
- Inferior planets (Mercury, Venus)
  - Seen E or W of Sun up to a maximum elongation
    - 47° for Venus
    - 27° for Mercury
- Superior Planets
  - At any point along Ecliptic relative to Sun
  - Retrograde motion at opposition

Greeks, etc.

Observations

1. Planets lie along Ecliptic
   - ∴ 'flat' solar system
2. No stellar parallax
   - ∴ Earth stationary OR stars very distant

Model

- Earth stationary (geocentric)
- Moon, planets, Sun orbit Earth
- Orbits: circles, epicycles,...
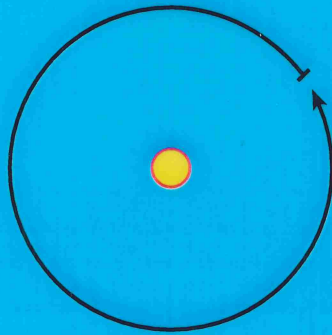
Scale, ordering....arbitrary

Copernicus

Heliocentric Solar System →

- Scale of planetary system (rel. sizes of orbits)
- Simple explanation of retrograde motion of superior planets (e.g. Mars)
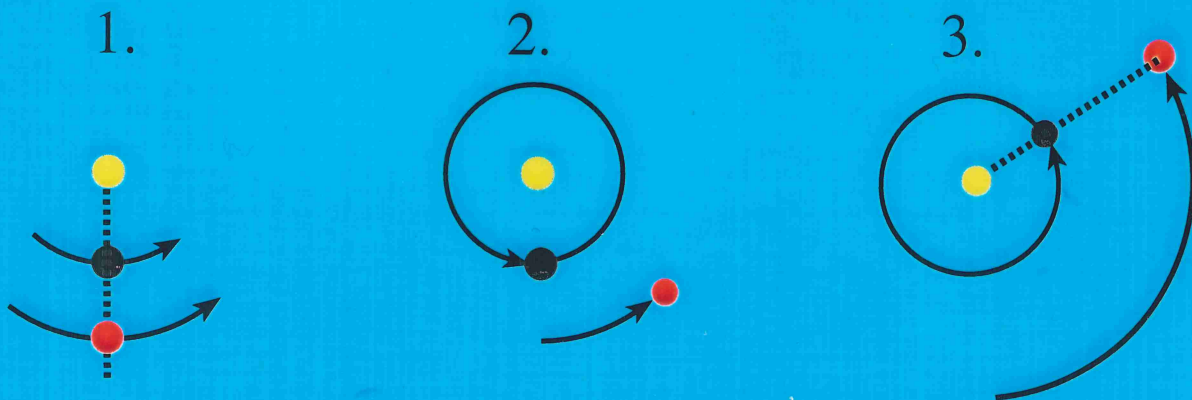- Calculation of sidereal from synodic periods

Orbits assumed circular

Sidereal + Synodic Periods

- ## Sidereal: Time to complete orbit about Sun

- ## Synodic: Apparent period of revolution W.R. to Sun

1.   2.   3.

Sidereal + Synodic Periods

Synodic Period of Venus/Mercury greater than sidereal period

Observe synodic period but need to know sidereal to understand planetary orbits

Formula:

$$\frac{1}{P} = 1 \pm \frac{1}{S}$$

+ for inferior
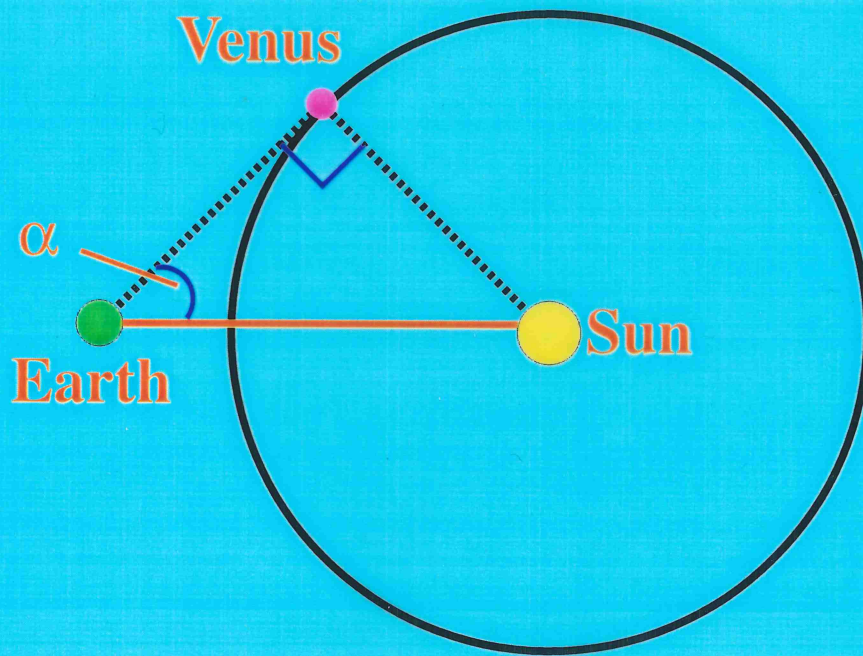– for superior } Planet

P = SIDEREAL

S = SYNODIC

Scale of Planetary System
Inferior Planets

α = angle of maximum elongation (E or W)
= observed angle
This fixes triangle
Earth-Venus-Sun in terms of
Earth-Sun distance ($\equiv$ AU)

Scale of Planetary System

Distances of Planets from the Sun

Planet	Copernicus	Modern
Mercury	0.38	0.387
Venus	0.72	0.723
Earth	1.00	1.00
Mars	1.52	1.52
Jupiter	5.22	5.20
Saturn	9.18	9.54