I do not know what I may appear to the world, but to myself I seem to have been only like a boy playing on the sea-shore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me.

Introductory Astronomy

Week 2: Newton's Universe

Clip 1: What Else Moves?

Wanderers

- Five wandering stars (planets) also move along paths very near the ecliptic
- Rates of motion vary among planets, so each located on its own sphere. We now have seven spheres
- Planetary motion less regular than Sun or Moon. Rate changes and sometimes turns retrograde

Ptolemaic Astronomy

- Hipparchus (150BC): Planets move on epicycles which move along deferents
- Ptolemy (150AD) elaborates model to account for small deviations
- Ptolemaic model predicts planetary motions accurately – successful scientific model
- Ptolemaic order of spheres: Moon, Mercury, Venus, Sun, Mars, Jupiter, Saturn; Fixed Stars

How it works

- Venus never too far from Sun
- Its deferent circles about once a year
- Epicycle rotation accounts for periodic change in elongation
- When West/East of Sun we see morning/ evening star

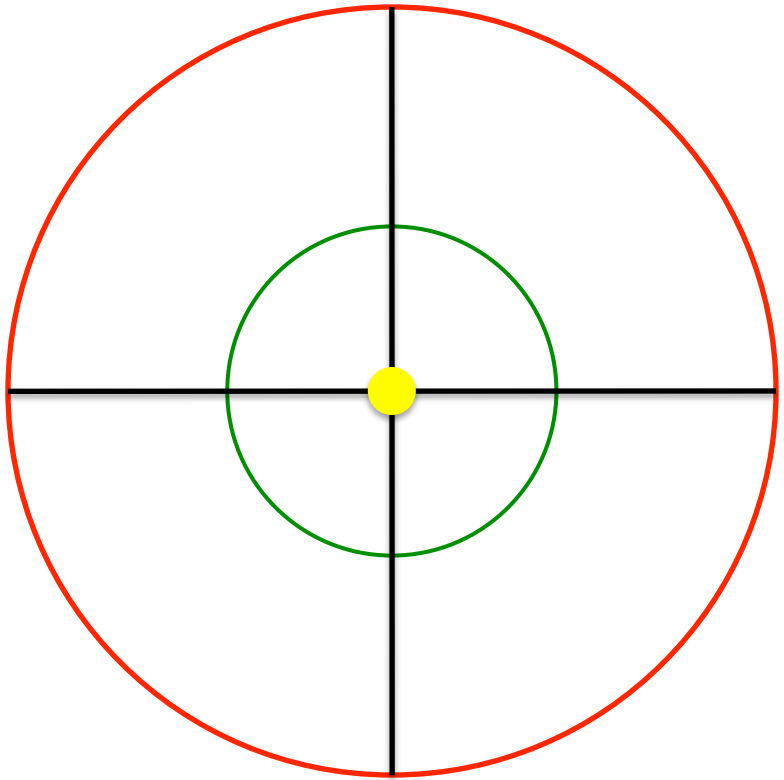
An Alternate Model

- Heliocentric model (Aristarchus 270BC): planets – and Earth - orbit the Sun
- Perceived motion of planets results from relative motion of planet and Earth
- Retrograde motion explained simply
- Copernicus (1543) produces a detailed heliocentric model competitive with Ptolemy

Periods

- Planet orbits Sun in time *P* – sidereal period
- Earth orbits Sun in time *E* - sidereal year
- Planet's synodic period *S* is time between conjunctions/oppositions for inferior/superior planets
- Can relate them mathematically

Computing Periods



So Which is it?

- Both models produce predictions matching observations of apparent motion
- Culturally difference is huge: does Earth move? Is it central?
- Scientifically difference is in motion of planets in 3d.
- Other things change in the heavens: Comets come and go and their motion does not fit well with either model
- Real determination: better observations with new technology
- Leads to new understanding of fundamental laws that are universal. That is the scientific revolution and next week's topic

Credits

- Sky Simulation: Starry Night
  http://www.starrynight.com/
- Astronomy Animations: University of Nebraska-Lincoln Astronomy Education Group
  http://astro.unl.edu/