Aristarchus (310-230 BC)

• Proposed Earth orbited the Sun.
• More easily explained retrograde motion.

Animation
The direction of retrograde motion for a planet as seen by an observer on Earth is

A. west to east relative to the background stars.

B. east to west relative to the background stars.

C. west to east relative to the local horizon.

D. east to west relative to the local horizon.
Aristarchus (310-230 BC)

• His hypothesis was rejected
  – Earth does not feel like it is moving.
  – No parallax of stars was observed.
  – Foucault pendulum proof did not occur until 1851 AD
Parallax

• If you look at an object from two different places (but at same distance) it will appear to move with respect to the background.

• Change in position = parallax angle
Parallax

- The greater the distance, the smaller the parallax angle.
- The greater the baseline (distance from A to B), the greater the parallax angle.

\[
\text{parallax angle (°)} = 57.3 \times \frac{\text{baseline (km)}}{\text{distance (km)}}
\]

or

\[
\text{distance (km)} = 57.3 \times \frac{\text{baseline (km)}}{\text{parallax angle (°)}}
\]
If you increase your baseline to twice its original length, what happens to the observed parallax angle?

A. It increases to 2 times its original angle
B. It decreases to ½ its original angle
C. It increases to 4 times its original angle
D. It decreases to ¼ its original angle

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What is the distance to a star that has a parallax angle of 0.580 arcsec when the baseline is $3.00 \times 10^8$ km?

A. $1.74 \times 10^8$ km  
B. $5.17 \times 10^8$ km  
C. $2.77 \times 10^6$ km  
D. $1.07 \times 10^{14}$ km
What is the distance to a star that has a parallax angle of 0.580 arcsec when the baseline is $3.00 \times 10^8$ km?

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Convert to degrees:

$0.580 \text{ arcsec} \times \frac{1 \text{ deg}}{3600 \text{ arcsec}} = 1.61 \times 10^{-4}$ \degree

$r = \frac{57.3 \times b}{\theta} = \frac{57.3 \left( 3.0 \times 10^8 \text{ km} \right)}{1.61 \times 10^{-4} \circ} = \frac{1.07 \times 10^{14} \text{ km}}{9.46 \times 10^{15} \text{ m}} = 11.3 \text{ ly}$
• Parallax was not observed because the stars are too distant.

• Geocentric Model becomes accepted.
Nicholas Copernicus (1473-1543)

- Geocentric model had become complicated.
  - Based on naked eye observations.
  - Small inaccuracies in the past had become large

- Copernicus proposes heliocentric (sun centered) model of the Solar System.
Basic Heliocentric View

- Heliocentric Model = Sun at center
- All planets orbit the sun, inner planets faster than outer
- Moon orbits the Earth.
- Circular orbits
- Animation
The Heliocentric Model

• Could predict positions of planets in the sky
  – BUT only as well as Ptolemy’s model

• Could account for the order of the planets and retrograde motion but could not accurately determine the orbit distances from the Sun.

• Why did it gain acceptance? – It was simpler!
  – Occam’s Razor: If choosing between competing theories that are all similarly accurate, choose the simplest one.
Copernicus’ model for the planetary system

A. placed earth at the center of the solar system but eliminated epicycles.

B. placed the sun at the center of the solar system and could predict planetary positions more accurately than ever.

C. placed the sun at the center of the solar system and could simply explain retrograde motion.

D. placed earth at the center of the solar system and was the first to postulate that planets moved in epicycles.

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