



BRIEF

BASIC PHYSICS

Kepler's Laws



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Kepler's Laws



Overview: This presentation discusses Kepler's Laws which govern the orbits of objects in space.



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Kepler's Laws

Johannes Kepler (1571 –1630)

- Mathematician, astronomer, assistant to Tycho Brahe
- Used Brahe's measurements to determine the shape of each planet's orbit by triangulation using observations made at different times of the year from the Earth's orbit
- From the data developed 3 Laws of Planetary Motion
 - **IMPORTANT:** These laws apply to all orbits, not just planets.

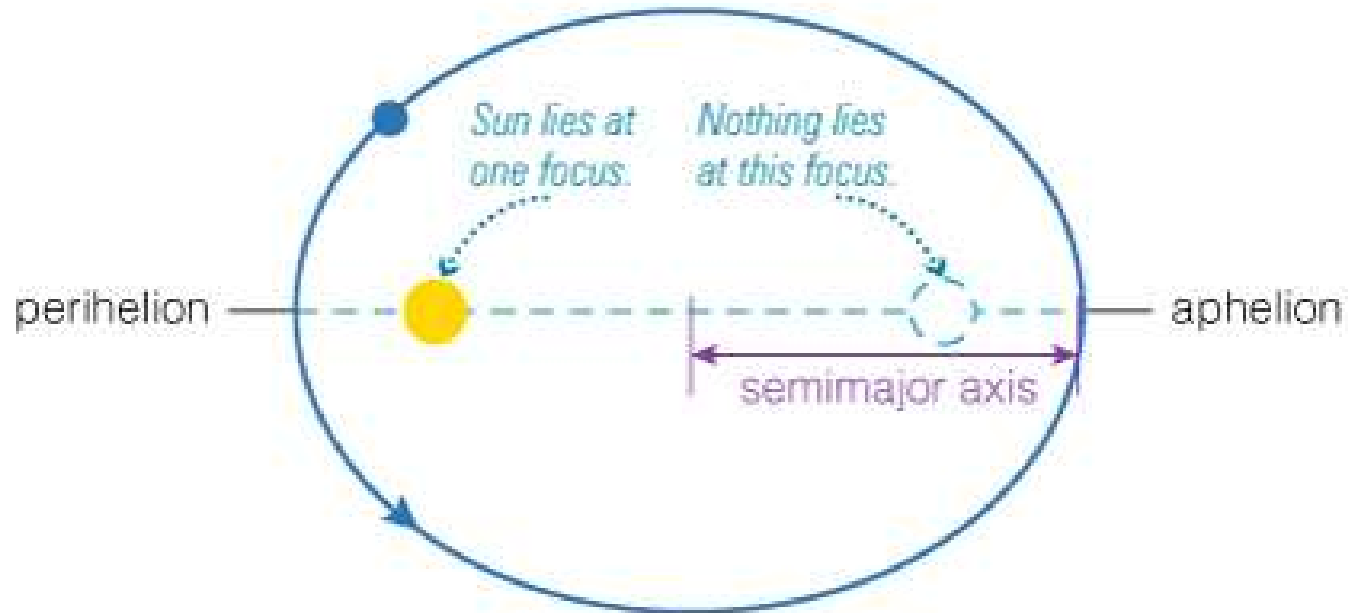




Kepler's Laws

Kepler's Laws of Planetary Motion:

1. The orbits of the planets are ellipses with the sun at one focus.
 - NOTE: the other focus is of no particular significance
 - Its location can be figured out by measurements, but it is irrelevant
 - The eccentricity and length of a semimajor axis are all that is needed to describe the size and shape of a planets orbital path

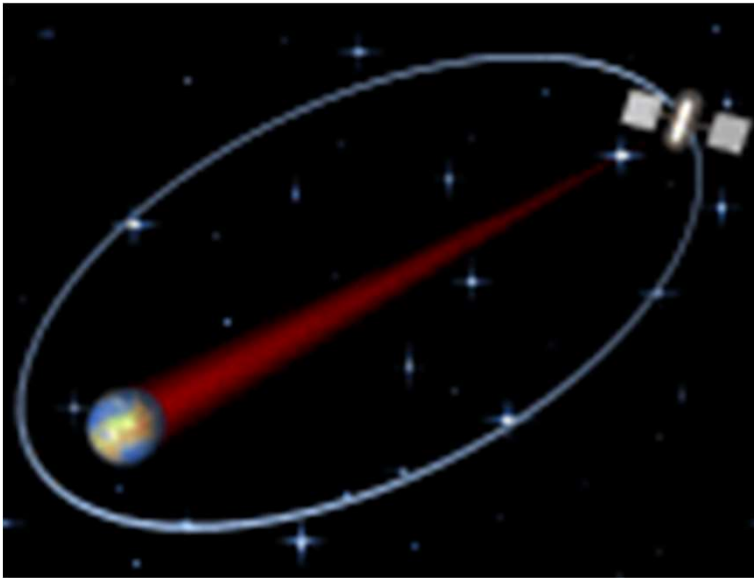




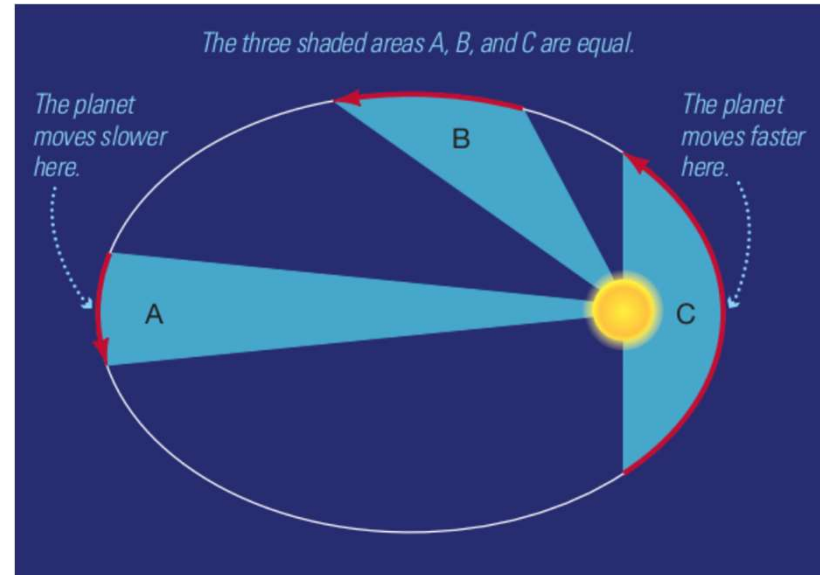
Kepler's Laws

Kepler's Laws of Planetary Motion:

1. The orbits of the planets are ellipses with the sun at one focus.
2. A line from a planet to the sun sweeps over equal areas in equal intervals of time.



Aphelion



Perihelion

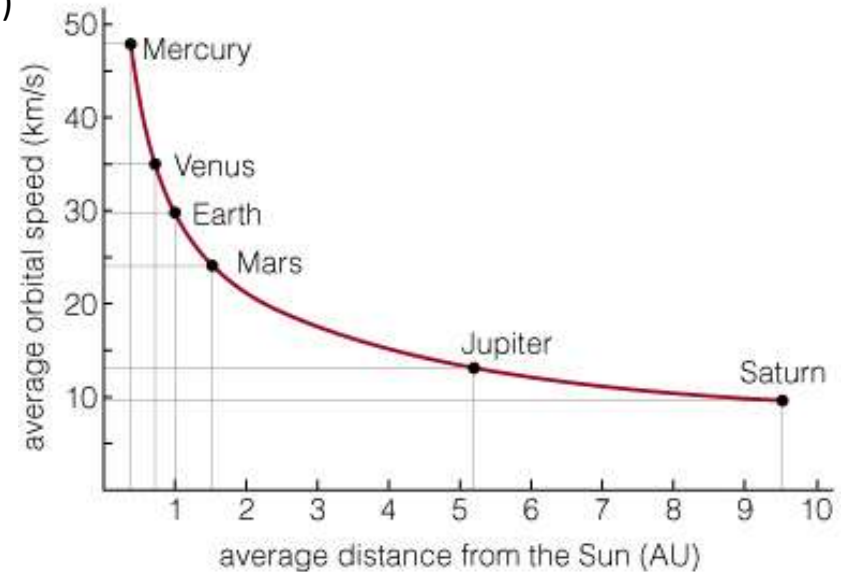
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Kepler's Laws

Kepler's Laws of Planetary Motion:

1. The orbits of the planets are ellipses with the sun at one focus.
2. A line from a planet to the sun sweeps over equal areas in equal intervals of time.
3. A planet's orbital period (P) squared is proportional to its average distance from the sun (a) cubed: $P^2 \sim a^3$ (P_y = period in years; a_{AU} = distance in AU)
 - IOW: The farther away, the slower the orbit.



Kepler's Laws DEMONSTRATION: <http://astro.unl.edu/classaction/animations/renaissance/kepler.html>

<http://astro.unl.edu/classaction/animations/extrasolarplanets/radialvelocitysimulator.html>

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Kepler's Laws

Summary

Kepler's laws were derived through very precise observations that were then used to model our Solar System.

From the models, Kepler was able to describe the behaviors of the planets.

NOTE: His descriptions were not mathematical. Newton later converted these into the language of Math.

Kepler's Laws apply to all orbiting bodies, not just our Solar System bodies.



Kepler's Laws

Questions?