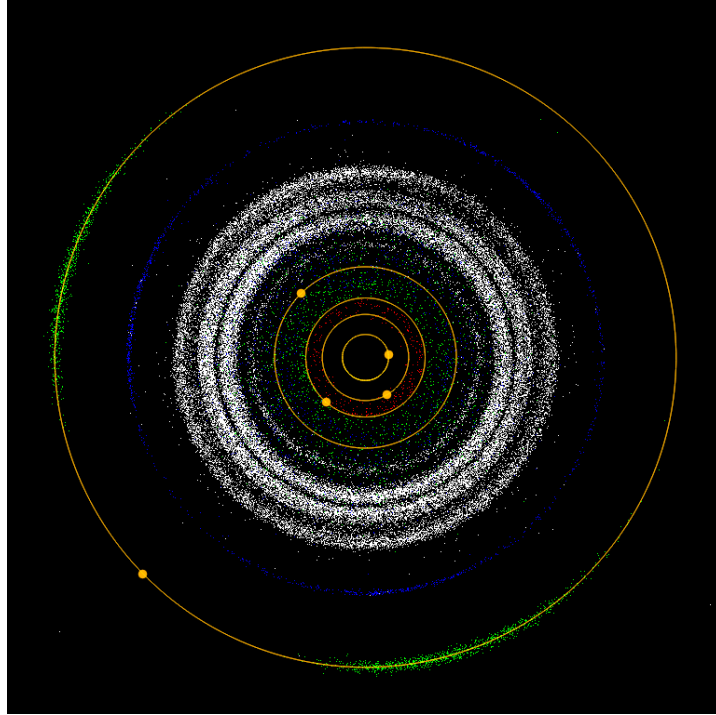


LEARN - What are Kirkwood Gaps?



Learning Objective:

Learn why and where there are gaps in the distribution of asteroids.

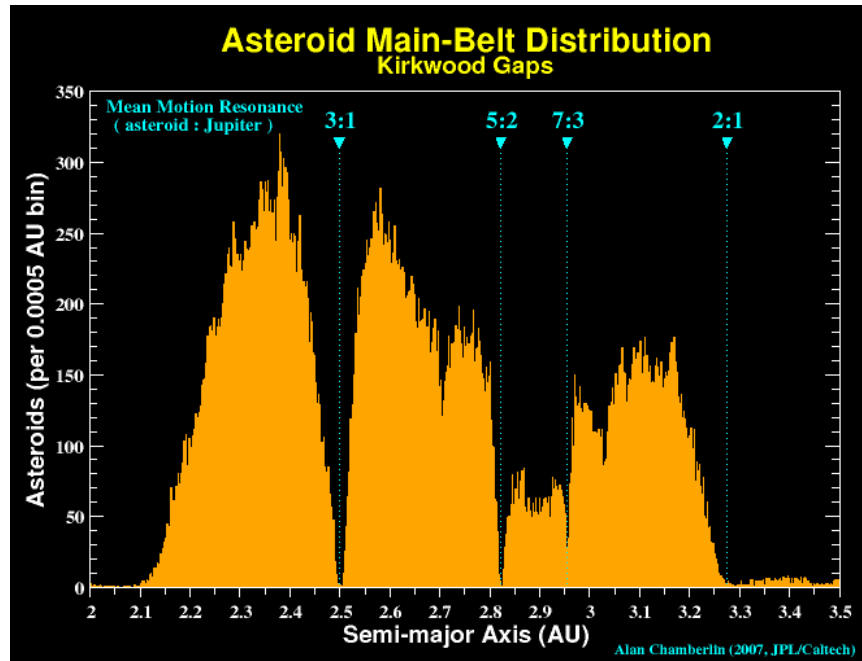
Overview:

Kirkwood Gaps are a feature of main belt asteroids' orbit, where there are gaps in the distribution of asteroids associated with certain semimajor axes (one-half of the longest dimension of an ellipse). These gaps are a result of orbital resonances with Jupiter.

Specifics:

In general, the orbit of celestial bodies is elliptical. One-half of the longest dimension of this ellipse, or orbit, is what we call the semimajor axis. The asteroid main belt is the region located between the orbits of planets Mars and Jupiter, where most of the asteroids are found.

Jupiter, being the biggest planet in our solar system and thus having dominant gravitational pull, exerts a strong influence on main belt asteroids, which American astronomer, Daniel Kirkwood, first noticed in 1866. He examined the orbital periods of asteroids relative to their semimajor axes and realised that there were spaces at certain semimajor axes, where only very few asteroids exist.



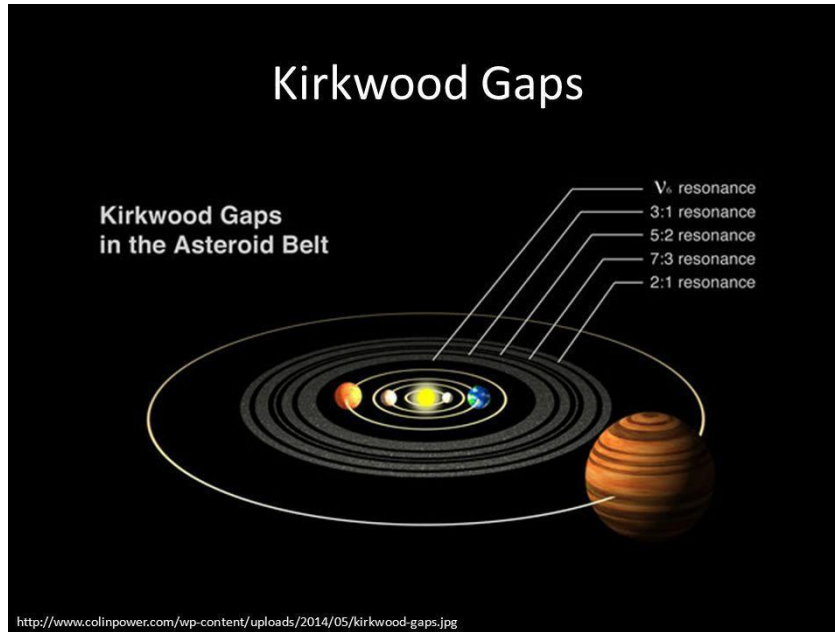
Mathematically, these gaps occur when the asteroids' orbital periods are a simple fraction of Jupiter's orbital period. This is an example of [orbital resonance](#), where the orbital periods of two bodies are in a simple ratio (e.g. 1:2) while orbiting a third object.

For example, an asteroid is said to be in a 2:1 resonance if its orbital period is half of Jupiter's and so while Jupiter orbits our Sun once, the asteroid completes two whole orbits.

Key Kirkwood Gaps occur at 2:1, 3:1, 5:2, and 7:3 orbital resonances. Trojan asteroids are usually found at the 3:2 and 1:1 orbital resonances.

The most prominent Kirkwood Gaps are found at mean orbital radii (measured in AU - astronomical units - which is the mean distance of the centre of Earth from the centre of Sun, i.e. about 149.6 million km) of:

- 2.06 AU – 4:1 resonance
- 2.5 AU – 3:1 resonance, this is where the Alinda asteroid group is found
- 2.82 AU – 5:2 resonance
- 2.95 AU – 7:3 resonance
- 3.27 AU – 2:1 resonance, where the Griqua asteroids are located.



Some weaker Kirkwood Gaps are found at:

- 1.9 AU – 9:2 resonance
- 2.25 AU – 7:2 resonance
- 2.33 AU – 10:3 resonance
- 2.71 AU – 8:3 resonance
- 3.03 AU – 9:4 resonance
- 3.075 AU – 11:5 resonance
- 3.47 AU – 11:6 resonance
- 3.7 AU – 5:3 resonance

The main asteroid belt is divided into the inner and outer zones, while the outer zone may be further divided into middle and outer zones, separated by the following Kirkwood Gaps:

- 2.06 AU – 4:1 resonance, zone I population, inner zone
- 2.5 AU – 3:1 resonance, zone II population, middle zone
- 2.82 AU – 5:2 resonance, zone III population, outer zone.

The largest asteroid found in the inner zone is 4 Vesta, with a diameter of 525.4 km. Ceres and 2 Pallas are found in the middle zone, with diameters of 950 km and 545 km, respectively. The most massive asteroid in the outer zone is 10 Hygiea with a diameter of 444 km.

Kirkwood Gaps are also the main sources of Near Earth Asteroids (NEAs).

Learn more about this subject by visiting these websites:

- [Kirkwood Gap Facts & Information](#)
- [Asteroid Main-Belt Distribution](#)
- [Asteroids](#)