

Kuiper Belt and Oort Cloud

In 1930, soon after the discovery of Pluto, astronomer Frederick C. Leonard suggested that Pluto was but one of many “ultra-Neptunian” or “trans-Neptunian” small bodies. In 1943, astronomer Kenneth Edgeworth hypothesized that many small, icy bodies exist in a disc in the region beyond Neptune, having condensed from widely spaced ancient material, and that from time to time one of them visits the inner solar system. Eight years later, Gerard Kuiper proposed the existence of such a disc, which formed early in the solar system’s evolution. In 1992, astronomers detected a faint speck of light from an object about 42 AU from the Sun — the first time a Kuiper Belt object (or KBO for short) had been sighted. (One astronomical unit, or AU, is the mean distance of Earth from the Sun: about 150 million kilometers or 93 million miles.) More than 1,300 KBOs have been identified since 1992. They are sometimes called Edgeworth–Kuiper Belt objects or transneptunian objects — TNOs for short.

The Kuiper Belt should not be confused with the Oort Cloud, which is a thousand times more distant. In 1950, astronomer Jan Oort proposed that certain comets come from a vast, extremely distant spherical shell of icy bodies surrounding the solar system. This giant swarm of objects, now named the Oort Cloud, occupies space at a distance between 5,000 and 100,000 astronomical units. No objects residing within the Oort Cloud have ever been directly observed. The outer extent of the Oort Cloud is where the Sun’s gravitational influence can be overpowered by that of other stars.

The Oort Cloud probably contains 0.1 to 2 trillion icy bodies in solar orbit. Occasionally, giant molecular clouds, stars passing nearby, or tidal interactions with the Milky Way’s disc disturb the orbit of one of these bodies in the outer region of the Oort Cloud, causing the object to streak into the inner solar system as a so-called long-period comet. These comets have very large, eccentric orbits and are observed in the inner solar system only once. In contrast, short-period comets take less than 200 years to orbit the Sun and they travel along the plane in which most of the planets orbit. They are thought to come from the Kuiper Belt or from the so-called scattered disc, a dynamic zone created by the outward motion of Neptune that contains many icy objects with eccentric orbits. The objects in the Oort Cloud and in the Kuiper Belt are presumed to be remnants from the formation of the solar system about 4.6 billion years ago.

The Kuiper Belt extends from about 30 to 55 AU and is probably populated with hundreds of thousands of icy bodies larger than 100 kilometers (62 miles) across and an estimated trillion or

more comets. Because KBOs are so distant, their sizes are difficult to measure. The calculated diameter of a KBO depends on assumptions about how brightness relates to size. With infrared observations by the Spitzer Space Telescope, most of the largest KBOs have known sizes.

One of the most unusual KBOs is Haumea, part of a collisional family orbiting the Sun, the first found in the Kuiper Belt. The parent body, Haumea, apparently collided with another object that was roughly half its size. The impact blasted large icy chunks away and sent Haumea reeling, causing it to spin end-over-end every four hours. It spins so fast that it has pulled itself into the shape of a squashed American football. Haumea and two small moons — Hi’iaka and Namaka — make up the family.

In March 2004, a team of astronomers announced the discovery of a planet-like transneptunian object orbiting the Sun at an extreme distance, in one of the coldest known regions of our solar system. The object (2003VB12), since named Sedna for an Inuit goddess who lives at the bottom of the frigid Arctic ocean, approaches the Sun only briefly during its 10,500-year solar orbit. It never enters the Kuiper Belt, whose outer boundary region lies at about 55 AU — instead, Sedna travels in a long, elliptical orbit between 76 and nearly 1,000 AU from the Sun. Since Sedna’s orbit takes it to such an extreme distance, its discoverers have suggested that it is the first observed body belonging to the inner Oort Cloud.

In July 2005, a team of scientists announced the discovery of a KBO that appeared to be slightly larger than Pluto. The object, temporarily designated 2003UB313 and later named Eris, orbits the Sun about every 560 years, its distance varying from about 38 to 98 AU. (For comparison, Pluto travels from 29 to 49 AU in its solar orbit.) Eris’s size is difficult to measure, owing to its extreme distance, but a 2011 estimate from a ground-based telescope suggested that Eris is about 27 percent more massive than Pluto. Eris has a small moon named Dysnomia.

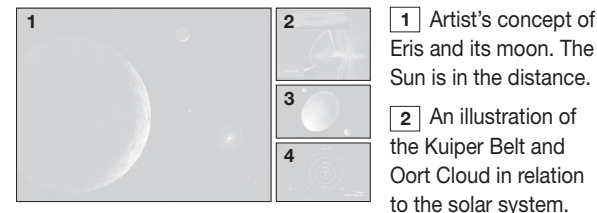
The discovery of Eris — orbiting the Sun and larger than Pluto (which was then designated the ninth planet) — forced astronomers to consider whether Eris should be classified as the tenth planet. Instead, in 2006, the International Astronomical Union created a new class of objects called *dwarf planet*, and placed Pluto, Eris, and the asteroid Ceres in this category. Subsequent discoveries added Haumea and Makemake to the dwarf planet family. Pluto, Eris, Haumea, and Makemake retain their classification as KBOs (or TNOs).

While no spacecraft has yet traveled to the Kuiper Belt, NASA’s New Horizons spacecraft, which is scheduled to arrive at Pluto in 2015, plans to study other KBOs after the Pluto mission is complete.

SIGNIFICANT DATES

1943 — Astronomer Kenneth Edgeworth suggests that a reservoir of comets and larger bodies resides beyond the planets.
 1950 — Astronomer Jan Oort theorizes that a vast population of comets may exist in a huge cloud surrounding our solar system.
 1951 — Astronomer Gerard Kuiper predicts the existence of a belt of icy objects just beyond the orbit of Neptune.
 1992 — After five years of searching, astronomers David Jewitt and Jane Luu discover the first KBO, 1992QB1.
 2002 — Scientists using the 48-inch Oschin telescope at Palomar Observatory find Quaoar, the first large KBO hundreds of kilometers in diameter. This object was photographed in 1980 but was not noticed in those images.
 2004 — Astronomers using the 48-inch Oschin telescope announce the discovery of Sedna.
 2005 — Astronomers announce the discovery of 2003UB313. This object, later named Eris, is slightly larger than Pluto.
 2008 — The Kuiper Belt object provisionally known as 2005FY9 was recognized in July as a dwarf planet and named Makemake (pronounced MAHkeh-MAHkeh) after the Polynesian (Rapa Nui) creation god. In September, 2003EL61 was designated a dwarf planet and given the name Haumea after the Hawaiian goddess of fertility and childbirth.

ABOUT THE IMAGES



1 Artist’s concept of Eris and its moon. The Sun is in the distance.

2 An illustration of the Kuiper Belt and Oort Cloud in relation to the solar system.

3 Artist’s concept of Haumea and its two small moons.

4 A diagram showing solar system orbits. The highly tilted orbit of Eris is in red.

FOR MORE INFORMATION

solarsystem.nasa.gov/kuiper