

# New Horizons spacecraft prepares for Pluto flyby

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Six days from now, the spacecraft New Horizons will make its closest approach to the dwarf planet Pluto. During a 36-hour window, the probe will perform the first close range study of the distant, icy world and its five attendant moons before continuing its journey deeper into the outer solar system.

While the probe did cause a momentary panic on Saturday after going into an unscheduled “safe-mode” caused by a hard-to-detect timing flaw, NASA reported the problem diagnosed and solved. Science operations resumed Tuesday, and there has been no effect on the mission’s primary objectives.

Compared to the planets and even the larger asteroids, very little has been learned about Pluto from ground-based observations. Its great distance from Earth and small size (about two-thirds that of the Moon) mean even images from the Hubble Space Telescope have only given very basic information about the distant, icy ball.

What is known was largely gathered using long exposures by Hubble alongside periodic analyses of its infrared spectra. These have determined that its surface is mostly nitrogen ice, with traces of methane, carbon monoxide and possibly hydrocarbons. In addition, we can see the brightness of Pluto varying greatly over a period of decades, although without detailed imaging of its surface features, which is part of the primary mission of New Horizons, the causes are unclear.

From average density calculations, it is suspected that Pluto’s interior consists of a large, rocky core surrounded by a mantle of water ice. It is even possible that radioactivity in Pluto’s interior creates a thin layer of liquid water between the core and mantle.

The system’s moons are even more unknown. There are five: Charon, Styx, Nix, Kerberos and Hydra. Charon was first observed in ground-based photos by

James Christy in 1978. Nix, Kerberos and Hydra were all discovered with careful observations by Hubble. Styx was found during a search for hazards that might endanger New Horizons. Little is known about these moons outside of their interesting orbital interactions with Pluto, diameter estimates and possible ice particle geysers on Charon. Part of New Horizon’s mission is to probe deeper into the composition of these worlds.

Other significant Kuiper Belt objects that have been discovered and studied include Quaoar, Makemake, Haumea, Ixion, Varuna, Sedna, Orcus and Eris. The largest of these, Eris, is approximately the size of Pluto and likely more massive. It is thought that Neptune’s largest moon Triton (also more massive than Pluto) is a former Kuiper Belt object captured by Neptune’s gravity, because it has a similar composition to Pluto and is the only large moon in the solar system that orbits in the direction opposite to its planet’s rotation.

Pluto’s discovery was somewhat coincidental. During the second half of the 19th century and early parts of the 20th, there was an ongoing search for a “Planet X,” a massive body beyond the orbit of Neptune hypothesized to explain perturbations in the orbit of Uranus. Clyde Tombaugh was working at the Lowell Observatory comparing pairs of photographs taken days apart in an attempt to find the theorized planet. He found what he thought was Planet X, soon after dubbed Pluto, in 1930.

However, in the decades to come, it became apparent this was not a large planet, but some small icy, rocky world at the edge of the solar system. Measurements of Pluto initially placed its mass as equal to Earth’s, but this figure was slowly revised downward, especially when Pluto’s moon Charon was discovered, allowing a precise measurement of Pluto’s mass: roughly 0.2 percent of Earth’s. It was only in 1992 that data from

the Voyager 2 spacecraft led astronomers to realize that the supposed necessity for Planet X was a fiction caused by incorrectly measuring the mass of Neptune by half a percent.

Though Pluto was not what astronomers originally thought it to be, it was the first object to be observed in a region of the solar system we now call the Kuiper Belt. This ring of small icy planetoids extends out from the orbit of Neptune to about 7.5 billion kilometers from the Sun and is 20 to 200 times as massive as the more famous asteroid belt.

Speculation about other objects as distant as Pluto began soon after it was discovered. Later in 1930, astronomers Frederick Leonard and Armin Leuschner independently hypothesized that it was unlikely that Pluto was the only body beyond Neptune's orbit. In 1943, Kenneth Edgeworth demonstrated that there was insufficient gravity from the Sun in the region of Pluto's orbit for the primordial nebula of the solar system to have condensed into a planet. He contended that what was out there would have to be a vast number of smaller bodies.

Edgeworth's view was contested in 1951 by Gerard Kuiper (after whom the belt is named), who argued that the gravitational interactions between Pluto (then believed to be as massive as Earth) and these objects would eject them from the solar system or collect them, similar to many of the moons of Jupiter.

Experimental evidence proved to be the deciding factor. While a consensus had emerged in the astronomical community that there were objects similar in composition and orbit to Pluto, the first non-Pluto Kuiper Belt object was only discovered in 1992, after a five-year search done by a team led by David Jewitt and Jane Luu. Since then, many hundreds of tiny worlds have been discovered and many thousands more are expected to be found by the Pan-STARRS survey as it steadily scans the sky, looking for changes from previous observations of the same areas of the sky.

The Kuiper Belt is also believed to be the origin of a class of comets with orbits of hundreds of years. While these objects are bound in stable orbits by Neptune, a different set of planetoids called the scattered disc exists among them, which are occasionally forced into the inner solar system by Neptune's gravity.

When New Horizons makes its closest approach, it will answer a great many questions about the far off

world and ask a great many more. As with previous firsts in planetary exploration—Mariner, Venera, Pioneer, Voyager, Dawn, Rosetta—the discoveries New Horizons makes will only spur further curiosity into the origins of the solar system, including the Earth, life and human beings.



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