New Horizons completes flyby of Ultima Thule

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NASA's New Horizons spacecraft successfully completed its flyby of the Kuiper Belt object, informally known as Ultima Thule, in the early hours of New Year's Day 2019. The probe broke off contact with Earth in the 24 hours before closest approach in order to perform its primary scientific investigations and reestablished communications 10 hours afterwards, to the jubilation of its controllers and people worldwide.

Ultima Thule is 6.4 billion kilometers from Earth (about 2 billion kilometers more distant than Pluto), the most distant astronomical body ever explored up close by a vehicle launched from our planet. This record was previously set when New Horizons flew past Pluto in July 2016 and one that will hopefully be broken by further New Horizons missions in this remote part of the Solar System. It is also the smallest asteroid to be visited by one of humanity's robotic explorers.

All data received by the spacecraft so far indicates that every instrument performed as expected and that every system is healthy. Downloads from the spacecraft are currently paused as it passes behind the Sun as seen from Earth. On January 10 it will begin beaming back the full set of data collected and continue for a further 20 months as the data is slowly and steadily beamed back to scientists on the ground. The most high-resolution images will be sent first, followed by other data, including particle and magnetic field densities far away from the Sun.

Unlike virtually every other target for a close encounter with a manmade spacecraft, Ultima Thule was only selected for a flyby after New Horizons was launched. In the years preceding the spacecraft's Pluto encounter, the Hubble Space Telescope was used to search for other objects in the Kuiper Belt that might be encountered by New Horizons. After an extensive search using Hubble and ground-based observations, Ultima Thule was selected. It took four course-correction maneuvers to ensure that the probe would get close enough to collect meaningful data.

The images New Horizons has already sent have already increased our understanding of Ultima Thule itself and the Kuiper Belt as a whole. Initial analyses show that the 35 km x 15 km asteroid rotates once every 15 hours, has no atmosphere and has no rings or natural satellites larger than two kilometers in diameter. Its color is similar to that of Pluto's moon Charon, one which is likely shared by other objects in the Kuiper Belt, as determined by ground-based and space-based telescope measurements.

The few images New Horizons has sent so far were collected while it was approaching Ultima Thule, and show no shadows, as the Sun was directly behind it. Later photos taken during close approach will show more details and reveal the topography more clearly. The spacecraft has two cameras: a low-resolution color-sensitive Multispectral Visible Imaging Camera, and a high-resolution but color-blind Long-Range Reconnaissance Imager. The NASA color releases combine images from these two cameras to produce syntheses that possess both sharpness and color.

The initial photos were also able to determine that Ultima Thule is likely a contact binary asteroid, one which at some point in its history was two separate objects that eventually merged into one. Other similar objects have been found through radar imaging, such as asteroid 1999 JD6, recorded four years ago in a close approach to Earth, but this is the first time such an object has been directly imaged with visible light rather than with radio waves.

Much closer imagery, which was taken minutes later, has not yet been sent back. New Horizons passed

Ultima Thule, which is only 20 miles long, at a distance of 3,500 kilometers—and at a speed of 14 kilometers per second. At that close approach, the spacecraft saw its target as only the size of the full moon in its sky (despite prevalence of artistic images making it appear much closer). And at such an encounter distance and speed, “close-up” views were only to be had for about 10 minutes, a real challenge given the faint light in these far distant regions of the Solar System.

In order to operate so far from the Sun, New Horizons is powered by the radiation produced by 11 kilograms of plutonium-238 dioxide, which in turn is used to generate 200 watts (a third of that needed to power a microwave) to operate the spacecraft’s scientific instruments and communications suite. This is expected to last until sometime into the 2030s, when the plutonium decay will not be enough to sustain the craft.

New Horizons is expected to have enough power, however, to send data back on at least one more Kuiper Belt object. It also still has enough fuel for limited changes to its course. Whether or not the spacecraft will perform any more scientific experiments is dependent on observations from Earth similar to the effort to find Ultima Thule, locating other Kuiper Belt objects in the probe’s potential flight path.

Beyond the technical challenges of more New Horizons missions, the political hurdles will be at least as difficult. Even as New Horizons flew past Ultima Thule, NASA employees have been furloughed as a result of a broader US government shutdown.