After Pluto, New Horizons mission nears an object 'beyond the known world'

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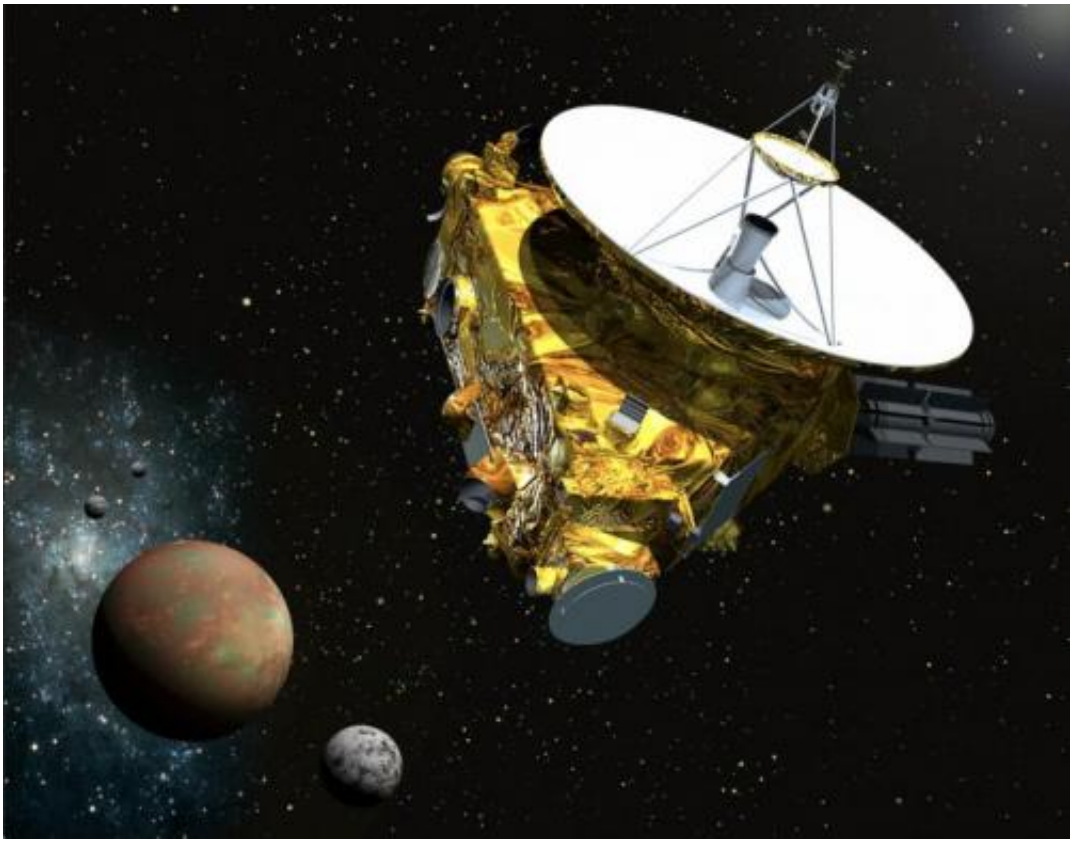

An artist's illustration of New Horizon at Pluto. Credit: NASA.

Three and a half years after giving humanity its first close-up view of Pluto, and almost 13 years after launching from Earth, the New Horizons spacecraft will explore another new frontier: a reddish hunk of rock and ice known as Ultima Thule.

The object—or, perhaps, pair of objects (it's so far away astronomers aren't sure) - is thought to be a pristine remnant of the early solar system, untouched for billions of years. Its nickname conveys its significance, meaning "beyond the known world."

Ultima Thule is 4 billion miles from Earth. New Horizons will reach it as the new year arrives on Jan. 1, with a mission to collect as many images and as much data as possible while speeding past at 32,000 miles per hour.

"This is pure exploration," said Alan Stern, the mission's principal investigator. "We are really flying toward something completely unknown, unlike any other object we've studied in the past."

The Ultima Thule fly-by is an encore for the New Horizons mission, led by the Johns Hopkins Applied Physics Laboratory. The baby grand piano-sized spacecraft designed and managed for NASA on the lab's Laurel, Md., campus zipped past Pluto—its primary mission—in July 2015, revealing craggy, icy surfaces and a wisp of an atmosphere around the dwarf planet.

It will capture similar images and data as it passes even closer to Ultima Thule, itself just about 20 miles across.

But even though it's technically an add-on phase of a mission whose main focus was Pluto, the examination of Ultima Thule could prove even more revelatory.

"It could potentially be the most primitive object ever encountered by a spacecraft," said Hal Weaver, the mission's project scientist. "By examining what it looks like now, we are looking back at the time of planetary formation."

Ultima Thule is in a region at the edge of the solar system known as the Kuiper Belt. Scientists suspect the region is home to hundreds of thousands of asteroid- or cometlike objects at least as big as Ultima Thule—which is officially known as 2014 MU69.

At such a distance, the sun provides barely a glint of light, yet its influence is still felt—Ultima Thule is among a group of Kuiper Belt objects that orbit the distant star in almost a perfect circle, instead of an ellipse like most planetary objects. That suggests it has avoided any major collisions in the 4.6 billion years since the solar system formed.

New Horizons makes historic fly-by of Pluto

While Pluto and its moons are also part of the Kuiper Belt, Ultima Thule is about a billion miles farther from Earth. It took New Horizons nearly a decade to reach Pluto, even though it rocketed from Earth at up to 36,000 mph, faster than any mission before it.

Nearly 3 { years more will have passed by the time the spacecraft makes it to Ultima Thule.

As dramatic and illuminating as the Pluto fly-by was, scientists know even less about what to expect from Ultima Thule. Because it's so far away and so dim, they aren't even sure if it's a single mass. They suspect it is made up of two lobes, but it also could be two separate objects orbiting around each other.

"We were already getting hints of what Pluto was going to be looking like well in advance of the day of closest approach," Weaver said. "This time, everything is going to be pretty much a mystery, we think, until the last hour or so."

That hour is expected to come around midnight Jan. 1, when scientists

predict New Horizons will begin observing Ultima Thule in earnest. The spacecraft's moment of closest approach to the object is expected around 12:30 a.m.

The fly-by itself is a complicated and extremely risky process, but one that is run completely on auto-pilot. Scientists have spent more than a year fine-tuning a flurry of commands New Horizons will follow to capture images and spectroscopic data, which together will show both what Ultima Thule looks like and what it's made of.

Scientists faced the same sort of challenge when observing Pluto, but it's even more difficult this time because Ultima Thule is so much smaller and farther away. It takes an hour and a half longer to send and receive messages to and from New Horizons than it did in 2015—a six-hour wait, each way.

New Horizons' speed, coupled with Ultima Thule's size, also poses problems. If the spacecraft weren't flying so fast, it wouldn't reach its target in any reasonable time. But because of that speed, the scientists must perfectly time the pre-programmed sequence of observations to ensure Ultima Thule is literally in the frame of New Horizons' cameras.

"The object's so small that if you're off, you could miss the whole thing," said Alice Bowman, the New Horizons mission operations manager.

The scientists hope to fly the spacecraft within about 2,200 miles of Ultima Thule, four times closer than its encounter with Pluto, to capture images and other data with as much resolution as possible. But that could depend on what, if anything, New Horizons spots in its path as Ultima Thule gets closer and brighter.

Mission engineers were preparing for the possibility they would have to steer the speeding spacecraft as far as 6,200 miles from its target, if that

means avoiding any bits of debris in space.

"A rice-sized pellet hitting the spacecraft in the wrong place could destroy it," Weaver said.

The first signal back from New Horizons is expected about 10 a.m. New Year's Day, with the best images and data from Ultima Thule expected to come down later that day and on Jan. 2, the scientists said.

Any good data would be the first collected from a planetary object so far from Earth.

Only the Voyager and Pioneer missions have traveled farther than New Horizons, but they were taking relatively more crude observations of plasma and particles in space. When they launched in the 1970s, Weaver said, scientists "didn't even know what existed out there."

Stern, who is based at the Southwest Research Institute in Colorado, credited the scientists at the Hopkins lab for their pioneering planetary research. The institution previously managed only one planetary mission, to a near-Earth asteroid known as Eros in the 1990s. Now, its team has taken New Horizons 100 times farther.

And Ultima Thule may not be the end of the mission. While the primary goal of New Horizons was to explore Pluto, NASA always intended the mission to go on to explore more of the Kuiper Belt. Stern said the scientists' attention will turn to finding a new target for exploration in 2020. The spacecraft is estimated to have enough power to keep running into the mid-2030s.

"We'll see what we find," he said. "We have a long way to go."

In the meantime, the horizons keep expanding. This month, researchers

confirmed discovery of the farthest object in the solar system to be observed by humans, more than 3 { times farther from the sun than Pluto.

Its name is "Farout."