

# ON PLUTO'S DOORSTEP

By Henry M. Holden

**I**N JANUARY 2006, a NASA space probe called "New Horizons" took off on a very long journey, to the doorstep of Pluto, 4,6-billion miles (7,5-billion kilometres) from Earth.

This coming July 14, it will virtually knock on Pluto's door soaring close to the planet, inside the orbits of its five known moons, with its cameras ready. It is the longest journey any craft has flown from Earth to reach its primary target.

To put it in perspective, it would take 25 years to get there in the Space Shuttle. If you could somehow fly an airliner to Pluto, the trip would take more than 800 years. And if you're a radio wave, it takes seven hours to get there. The temperature on Pluto is minus 387 degrees Fahrenheit (minus 233 degrees Celsius).

"NASA's first mission to distant Pluto will also be humankind's first close up view of this cold, unexplored world in our solar system," said Jim Green, director of NASA's Planetary Science Division at NASA's headquarters, Washington.

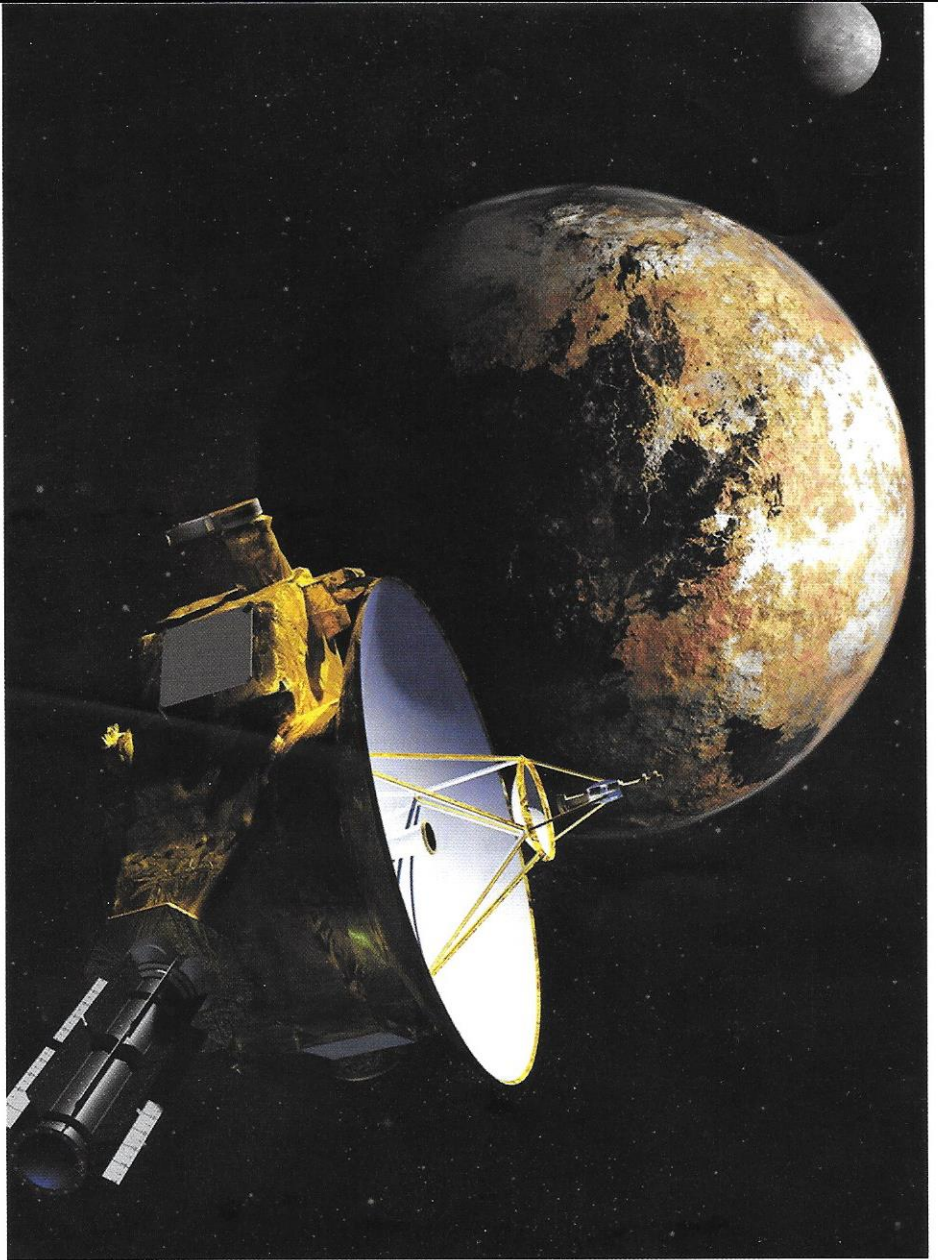
New Horizons represents humanity's closest virtual approach to the icy body which lies so far out that it takes some 248 years just to make one orbit around our Sun.

The probe spent 373 days in hibernation – about two-thirds of its flight time – spread over 18 separate hibernation periods from mid-2007, to late 2014, that ranged from 36 days to 202 days long. New Horizons awoke from its final hibernation period on December 6, 2014, and began making history, nine years after its launch.

In the hibernation mode, much of the spacecraft is unpowered; the onboard flight computer monitors system health and broadcasts a weekly beacon-status tone back to Earth.

On average, operators woke New Horizons just over twice each year to check out critical systems, calibrate instruments, gather scientific data, rehearse Pluto-encounter activities and perform course corrections when necessary.

New Horizons is the fastest spacecraft



**Above:** An artist's concept of NASA's New Horizons spacecraft as it passes Pluto and Pluto's largest moon, Charon, in July 2015. (Image: NASA/JHU APL/SwRI/Steve Gribben).

ever to leave the Earth — reaching the orbit of the moon in just nine hours, about 10 times more quickly than the Apollo spacecraft did. Now, after travelling for nine years at an average speed of 39 000 mph (59 000 km/h), equivalent to Los Angeles to New York in four minutes, it is at last approaching its historic rendezvous.

## CRITICAL NAVIGATION

The closer the probe gets to Pluto the more critical becomes the navigation. New Horizons' telescopic long-range reconnaissance imager, (LORRI), will send photos back to give mission scientists a constantly updated look at the dynamics of Pluto's moons.

The photos will play a critical role in navigating the spacecraft as it covers the remaining 135-million miles (220-million kilometres) to Pluto.

Over the next few months, LORRI will snap hundreds of photos of Pluto against

star fields to refine the team's estimates of New Horizons' distance to Pluto. The Pluto system will resemble little more than bright dots in the camera's view until May. Mission navigators will use those data to design course-correction manoeuvres that aim the spacecraft toward its fly-by target point. The first such manoeuvre could occur as early as this month.

Spacecraft operators are also tracking New Horizons using radio signals from NASA's Deep Space Network. But the "optical navigation" campaign that began in January marks the first time pictures from New Horizons will be used to help pinpoint Pluto's location.

At its closest approach, New Horizons will pass Pluto at a distance of just 6 000 miles (9 700 km). It will send back images at resolutions so high that if it were flying over New York City at the same altitude, it could count ponds in Central Park, and the number of vehicles on a street.

## SO MANY QUESTIONS TO ANSWER

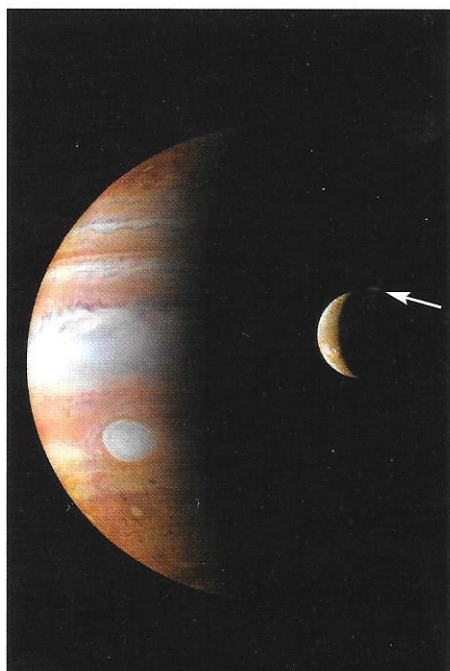
We know very little about Pluto except that its interior is primarily made of rock, it is covered in ice and wrapped in an atmosphere made chiefly of nitrogen, like Earth's. Does it have mountain ranges? Is its surface young or old? Are there polar caps? Is there water or other liquids on its surface or oceans in its interior? Are there cloud decks in its atmosphere or erupting geysers? Does it have more moons yet to be discovered? We don't know the answers to any of these questions — but we should know soon.

"We need to refine our knowledge of where Pluto will be when New Horizons flies past it," said Mark Holdridge, the New Horizons encounter mission manager from the John Hopkins University Applied Physics Laboratory. "The fly-by timing also has to be exact, because the computer commands that will orient the spacecraft and point the science instruments are based on precisely knowing the time we pass Pluto — which these images will help us determine."

Given the fact that it takes seven hours for the spacecraft to receive a signal from Earth, and seven hours for it to transmit the results of a manoeuvre back to Earth, it will be a long day for the scientists.

## THE KUIPER BELT

And that matters. In 2003, the National Academy of Sciences ranked visiting the Pluto system at the very top of NASA's exploration priorities. Why? Because in the 1990s, planetary astronomers discovered a vast structure in our solar system, a previously unknown disk of comets and small planets out beyond Neptune, called the Kuiper Belt.



Pluto was the first of many small planets discovered out there, and it is still both the brightest and the largest one known.

The debate about whether Pluto is a planet was generated by recent detections of hundreds of planetary objects in the outer solar system. The International Astronomical Union classifies Pluto as a dwarf planet.

Most people call Pluto a planet because it orbits the Sun, and it is large enough that its own gravity has pulled it into a spherical shape.

Technically, Pluto — which spans slightly less than 1 500 miles in diameter, or not even two-thirds the diameter of our own Moon — is a member of the Kuiper Belt, a giant reservoir of planetary debris believed to be left over from the solar system's formation some 4,6-billion years ago.

The Kuiper Belt is the largest mapped structure in our planetary system, three times larger than all the territory from the sun out to Neptune's orbit. The comets and small planets that make it up are valuable because they represent the astronomical equivalent of an archeological dig, reaching back to the era of planet formation, 4,6-billion years ago.

## EXPLORING THE UNKNOWN

More intensive Pluto studies begin late this month, when the cameras and spectrometers aboard the probe can provide resolutions better than the most powerful telescopes on Earth.

Eventually, New Horizons will obtain images good enough to map Pluto and its moons better than has ever been achieved by any previous first planetary reconnaissance mission.

Once New Horizons completes its Pluto mission it will continue deeper into the Kuiper Belt exploring the interplanetary environment where the Pluto system orbits, with its two charged-particle sensors. These sensors will measure the high-energy particles streaming from the Sun, with its dust counter tallying dust-particle

*This image shows Jupiter and its volcanic moon Io. It was taken during the spacecraft's Jupiter fly-by in early 2007. The image shows a major eruption in progress on Io's night side (arrowed), at the northern volcano Tvashtar. Incandescent lava glows red beneath a volcanic plume, whose uppermost portions are illuminated by sunlight.*

*The plume appears blue due to scattering of light by small particles within it.*

*(Image: NASA/JHU APL SwRI Goddard Space Flight Centre)*



*In the Payload Hazardous Servicing Facility on December 13, 2005, the two fairing sections are ready to be moved in place around the New Horizons spacecraft (in centre) for encapsulation. The fairing protected the spacecraft during launch and flight through the atmosphere. Once out of the atmosphere, the fairing was jettisoned.*

*(Photo: NASA)*

concentrations in the inner reaches of the Kuiper Belt and the unexplored outer region of the solar system that includes potentially thousands of similar icy, rocky small planets.

Clyde Tombaugh, who discovered Pluto in 1930, is on board the New Horizons spacecraft.

Although he died on January 17, 1997, some of his ashes were placed on board as a fitting tribute to the man who discovered our ninth planet.

Nothing like the exploration that New Horizons is making has happened in a generation, and nothing like it is planned or even anticipated to happen again. It is likely the last time in our lifetimes that a new planet will be explored. While this is scientifically important, it is also a reminder of what human kind can do with technology and vision.