



CLOSE ENCOUNTER WITH PLUTO

By Henry M. Holden

ON THURSDAY, January 19, 2006, an Atlas V551 along with five solid rocket motors, attached to the Atlas booster powered by Russian RD-180 engines, carrying NASA's Pluto-bound New Horizons probe, roared to life.

As it punched its way through Earth's gravity and broke the "surly bonds of earth", it was travelling at 10 miles per second or 36 256 miles per hour.

It was off on a record-setting, three billion-mile, more than 9.5-year voyage to the frigid edge of our solar system. This would be the most compelling spaceflight since the launch of Voyager 2 almost 30 years earlier. On July 14, 2015 the spacecraft made the first historic fly-by of the dwarf planet, Pluto.

After 75 years of long-distance study, we finally were able to see what Pluto, the Roman name for the Greek god Hades, looks like. Pluto is so far away that even with the Hubble telescope scientists only had a blurred view in a lens. One scientist characterised it as looking at a walnut 30 miles away.

The purpose of the Pluto New Horizons mission is to understand the formation of the Pluto system, the Kuiper Belt and the transformation of the early Solar System. The spacecraft will study the atmospheres, surfaces, interiors and environments of Pluto and its moons. It will also study other objects in the Kuiper Belt.

Reaching the closest approach point to Pluto took about only one minute less than predicted when the craft was launched in 2006. The spacecraft threaded the needle through a 36-by-57

Above: New images of Pluto and its large moon Charon highlight their compositional diversity. These are not actual colour images of Pluto and Charon — they are shown here in exaggerated colours that make it easy to note the differences in surface material and features on each planetary body. The images were obtained using three of the colour filters of the "Ralph" instrument on July 13 at 3:38 am EDT.

(Image Credit: NASA/APL/SwRI)

This photo: Smoke and steam filled the launch pad as NASA's New Horizons spacecraft roared into the blue sky aboard the Atlas V551 rocket on January 19, 2006 on the start of its 3.6-billion mile journey to Pluto. The 551 configuration includes the Russian-built RD-180 engines. (Image: NASA).



Pluto

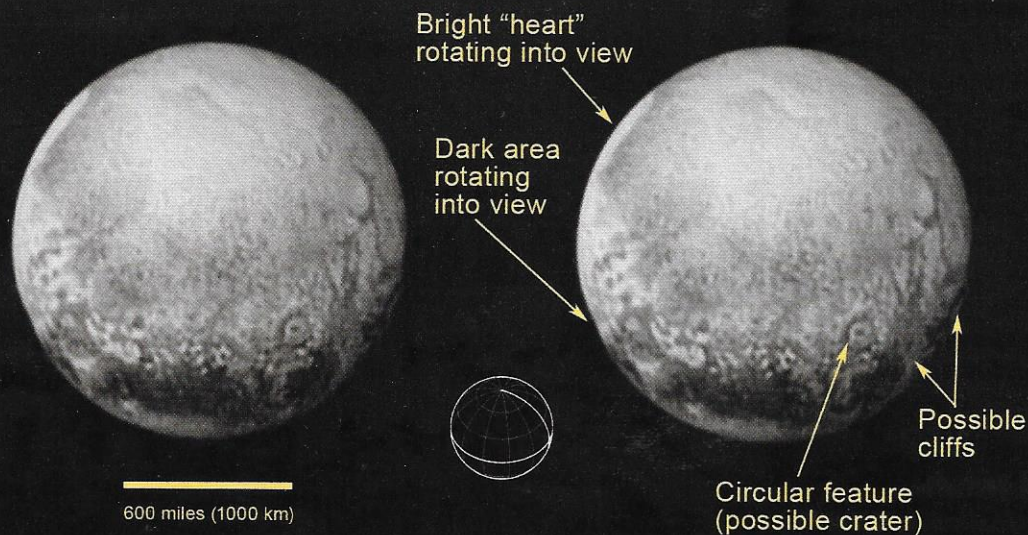


Image: NASA/JHUAPL/S

This photograph taken by Pluto on July 11, shows how New Horizons captured a world that is growing more fascinating by the day. For the first time on Pluto, this view reveals linear features that may be cliffs, as well as a circular feature that could be an impact crater. Rotating into view is the bright heart-shaped feature that was seen in more detail during New Horizons' closest approach on July 14.

mile window in space — the equivalent of a commercial airliner arriving no more off target than the width of a tennis ball.

The target point at the far end of the launch trajectory allowed the spacecraft to pass midway between Pluto and its moon Charon. New Horizons made its closest approach to Pluto on July 14, about 7 750 miles above the surface — roughly the same distance from New York to Mumbai, India — making it the first space mission to explore a world so far from Earth.

Others characterised reaching it so precisely as sinking a hole-in-one on a golf shot from New York City to Los Angeles.

In a coincidence of cosmic proportions, the closest approach fell on the 50th anniversary of the first fly-by of Mars, which NASA's Mariner 4 accomplished on July 14, 1965.

The spacecraft was at its busiest during the time of closest approach during which time it turned from target to target as it flew past Pluto at over 34 000 miles per hour.

New Horizons' closest encounter with Pluto lasted only a full day, 12 hours before, and 12 hours after. The spacecraft could not enter orbit around the planet because no current rocket can launch a

probe carrying enough fuel to arrest the velocity needed to get it there in a reasonable amount of time.

New Horizons is now studying the Pluto system up close with seven different science instruments, including cameras capable of picking out features on the dwarf planet's surface as small as the ponds in New York City's Central Park.

At Pluto's enormous distance from

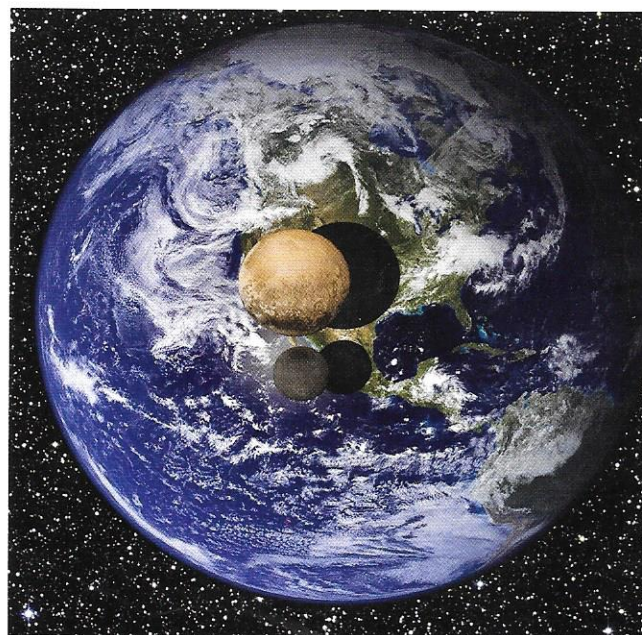
Earth, it will take light 4,5 hours to close the distance. It will take days to transmit even the few high-priority images back to Earth.

New Horizons operated in a nine-day-long "close encounter mode" that ran through to July 16. There will probably not be a huge data dump any time soon. It will take New Horizons up to 16 months to beam all its observations back to Earth.

The colossal distance Pluto is from us meant team members did not know if the flyby was successful until about 13 hours later when the probe's handlers received a "check-in message." (Since late Monday, July 13, the probe was incommunicado and flying on autopilot because it cannot make its pre-programmed observations and transmit to Earth at the same time).

As a fail-safe measure, mission control retrieved all the information gathered by the probe's instruments in the days prior to the radio blackout beginning, including a detailed colour image of Pluto taken about 16 hours before the probe's closest approach.

That status update calmed the nervousness among the team members, because New Horizons is travelling so fast —



This graphic presents a view of Pluto and Charon as they would appear if placed slightly above Earth's surface and viewed from a great distance. Recent measurements obtained by New Horizons indicate that Pluto has a diameter of 2 370 km, 18,5% that of Earth's, while Charon has a diameter of 1 208 km, 9,5% that of Earth's. (NASA)

debris as small as a grain of rice could be fatal. It is travelling at twice the speed of the Space Shuttle, which makes it the fastest spacecraft ever made. It could fly across continental United States from New York to Los Angeles in four minutes.

The velocity has some potentially deadly side effects. Impacts by even very small particles can compromise the mission. But beneath the gold-coloured blanket of insulation is a Kevlar vest designed to resist penetration of small particles into the electronics and fuel on board.

HOW BIG IS PLUTO?

A new close-up image of an equatorial region near the base of Pluto's bright heart-shaped feature, shows a mountain range with peaks jutting as high as 11 000 feet (3 500 metres) above the surface of the icy body.

The mountains on Pluto likely formed no more than 100-million years ago — mere youngsters in a 4,56-billion-year-old solar system. This suggests the close-up region, which covers about one percent of Pluto's surface, may still be geologically active today.

"This is one of the youngest surfaces we've ever seen in the solar system," said Jeff Moore of the New Horizons Geology, Geophysics and Imaging Team (GGI) at NASA's Ames Research Centre, in Moffett Field, California.

Unlike the icy moons of giant planets, Pluto cannot be heated by gravitational interactions with a much larger planetary body. Some other process must be generating the mountainous landscape.

"This may cause us to rethink what powers geological activity on many other icy worlds," says GGI deputy team leader, John Spencer, at SwRI.

The new view of Charon, Pluto's largest moon, reveals a youthful and varied terrain. Scientists are surprised by the apparent lack of craters. A swath of cliffs and troughs stretching about 600 miles (1 000 kilometres) suggests widespread fracturing of Charon's crust, likely the result of internal geological processes.

The image also shows a canyon estimated to be four to six miles (seven to nine kilometres) deep. In Charon's North Polar region, the dark surface markings have a diffuse boundary, suggesting a thin deposit or stain on the surface.

New Horizons also observed the smaller members of the Pluto system, which includes four other moons: Nix, Hydra, Styx and Kerberos. A new sneak-



New details of Pluto's largest moon Charon are revealed in this image as New Horizons approached Pluto. Taken on July 13, 2015, from a distance of 289 000 miles (466 000 kilometers). A swath of cliffs and troughs stretches about 600 miles (1 000 kilometers) from left to right, suggesting widespread fracturing of Charon's crust, likely a result of internal processes. At upper right, along the moon's curving edge, is a canyon estimated to be 4 to 6 miles (7 to 9 kilometers) deep. (Image: NASA-JHU/APL-SwRI)

peak image of Hydra is the first to reveal its apparent irregular shape and its size, estimated to be about 27 by 20 miles (43 by 33 kilometres).

New Horizons answers a basic question about Pluto. Mission scientists have found Pluto is 1 473 miles (2 370 kilometres) in diameter, larger than prior estimates. Images acquired with the Long Range Reconnaissance Imager (LORRI) were used to make this determination.

This result confirms what was already suspected: Pluto is larger than all other known solar system objects beyond the orbit of Neptune.

"The size of Pluto has been debated since its discovery in 1930," said mission scientist, Bill McKinnon, of the Washington University, St. Louis. "We are excited to finally lay this question to rest."

Pluto's newly estimated size means that its density is slightly lower than previously thought, and the fraction of ice in its interior is slightly higher. Also, the lowest layer of Pluto's atmosphere, called the troposphere, is shallower than previously believed.

Measuring Pluto's size has been a decades-long challenge due to complicating factors from its atmosphere. Its largest moon, Charon, lacks a substantial atmosphere, and its diameter was easier to determine using ground-based

telescopes. New Horizons observations of Charon confirm previous estimates of 751 miles (1 208 km) kilometres across.

THE FUTURE

The implications of New Horizons' discoveries should extend beyond the Pluto system, mission team members have said. Pluto is just one of thousands of objects — albeit the largest and most famous one — in the Kuiper Belt, the largely unexplored ring of icy bodies beyond Neptune's orbit.

"From the science perspective, we're entering this whole new realm of the solar system," former astronaut John Grunsfeld, associate administrator of NASA's Science Mission Directorate, said during a post-fly-by briefing.

The spacecraft will study the atmospheres, surfaces, interiors and environments of Pluto and its moons. It will also study other objects in the Kuiper Belt.

Mission team members plan to propose a fly-by of another, much smaller body. That second fly-by would take place in 2019, assuming NASA gives the green light.

New Horizons' handlers have identified two possible targets for the second fly-by, but have not announced which one they would go after). →