A Journey to the Furthest Planet Pluto

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Pluto was discovered in 1930 by Clyde Tombaugh and was originally considered the ninth planet from the Sun. It was the first Kuiper belt object to be discovered. After 1992, its status as a planet fell into question following the discovery of several objects of similar size in the Kuiper belt. In 2005, Eris, which is 27% more massive than Pluto, was discovered, which led the International Astronomical Union (IAU) to define the term "planet" formally for the first time. According to IAU, there are three main conditions for an object to be considered a "planet":

1. The object must be in orbit around the Sun.
2. The object must be massive enough to be rounded by its own gravity.
3. It must have cleared the neighborhood around its orbit.

Pluto fails to meet the third condition, because its mass is only 0.07 times that of the mass of the other objects in its orbit. The IAU further decided that bodies like Pluto that do not meet criterion 3 would be called 'dwarf planets'.

Some facts about Pluto:

- Distance from the Sun: 5.9 billion kms at an average.
- Plutonian day : 153 hrs or 6.39 Earth days
- Plutonian year : 248 Earth years
- Orbit: Highly elliptic and due to the eccentricity the distance of the planet from the Sun varies considerably (Perihelion – 4.44 billion kms and Aphelion- 7.38 billion kms). Pluto becomes closer to the Sun than Neptune for 20 yrs of its period of revolution (248 yrs).
- Core: Rocky core surrounded by the mantle of water ice with other ice (Methane, Nitrogen and Carbon monoxide).
- Atmosphere: A thin, tenuous atmosphere consisting mostly of nitrogen and some methane that expands when it comes closer to the sun and collapses as it moves farther away.
- Surface temperature: -375^{o}F or -225^{o} C
- Moons: Five known moons – Charon, Styx, Nix, Kerberos and Hydra.

Pluto's distance from Earth makes its in-depth study and exploration difficult. The earliest maps of Pluto, made in the late 1980s, were brightness maps created from close observations of eclipses by its largest moon, Charon. Better maps were produced from images taken by the Hubble Space Telescope (HST), which offered higher resolution, and showed considerably more detail. The New Horizons inter-planetary space probe is the first and so far only attempt to explore Pluto directly which was launched on 19 Jan, 2006 as a part of NASA's New Frontier Programme. The spacecraft,

engineered by the Johns Hopkins University Applied Physics Laboratory (APL) and the Southwest Research Institute (SwRI), with a team led by S. Alan Stern, flew by Pluto in July 2015.

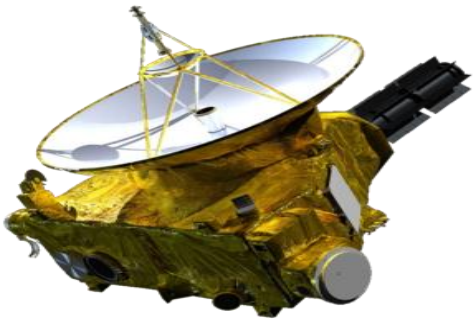
Objectives of the mission:

- map the surface composition of Pluto and its biggest moon Charon
- characterize the geology and morphology of Pluto and Charon
- characterize the neutral atmosphere of Pluto and its escape rate
- search for an atmosphere around Charon
- map surface temperatures on Pluto and Charon
- search for rings and additional satellites around Pluto
- conduct similar investigations of one or more Kuiper belt objects

The Spacecraft:

New Horizons' body forms a triangle, almost 0.76 m thick. A 7075 aluminium alloy tube forms the main structural column, between the launch vehicle at the "rear," and the 2.1 m radio dish antenna affixed to the "front" flat side. The titanium fuel tank is in this tube. Titanium provides strength and thermal isolation. A cylindrical radioisotope thermoelectric generator (RTG) protrudes in the plane of the triangle from one vertex of the triangle. The RTG is to provide about 250 W, 30 V DC at launch, and is predicted to drop approximately 5% every 4 years, decaying to 200 W by the time of its encounter with the Plutonian system in 2015. The RTG contains 10.9 kg of radiative plutonium 238 oxide palletes. Each pallete is clad in iridium and encased in graphite shell.

The interior structure is painted black to equalize temperature by radiative heat transfer. Overall, the spacecraft is thoroughly blanketed to retain heat. The heat from the RTG adds warmth to the spacecraft while it is in the outer Solar System. While in the inner Solar System, the spacecraft must prevent overheating, hence electronic activity is limited, power is diverted to shunts with attached radiators, and louvers are opened to radiate excess heat. While the spacecraft is cruising inactively in the cold outer Solar System, the louvers are closed, and the shunt regulator reroutes power to electric heaters.



New Horizons space probe

So far as the propulsion is concerned, the space craft has both spin stabilized and 3-axis stabilized modes controlled entirely with hydrazine monopropellant. Additional velocity gain is provided by internal tank. Helium is used as pressurant.

The spacecraft carries two computer systems: the Command and Data Handling system and the Guidance and Control processor. Communication with the spacecraft is via X band. The craft had a communication rate of 38 kbit/s at Jupiter.

It has 16 thrusters – 4 larger ones for trajectory correction and 12 smaller ones for attitude controls and spin-up or spin-down maneuvers. Two star cameras are there to measure the attitude.

New Horizons carries seven instruments:

- Three optical instruments (the Long-Range Reconnaissance Imager (LORRI), an ultraviolet imaging spectrometer (Alice) and Ralph telescope)
- Two plasma instruments(SWAP and PEPSSI)
- A dust sensor (VBSDC—Venetia Burney Student Dust Counter) and
- A radio science receiver/radiometer (REX).

The instruments are to be used to investigate the global geology, surface composition, surface temperature, atmospheric pressure, atmospheric temperature and escape rate of Pluto and its moons.

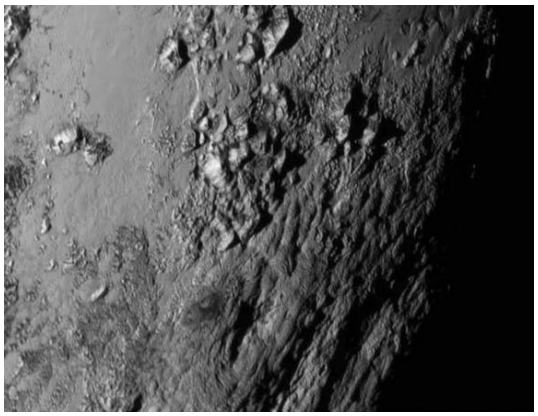
Launch and Journey:

New Horizons was launched from Cape Canaveral directly into an Earth-and-solar-escape trajectory with an Earth-relative speed of about 16.26 kilometers per second (58,536 km/h; 36,373 mph); it set the record for the highest launch speed of a human-made object from Earth. After a brief encounter with asteroid 132524 APL, New Horizons proceeded to Jupiter, making its closest approach on February 28, 2007, at a distance of 2.3 million kilometers . New Horizons received a gravity assist from Jupiter which increased its speed by 4 km/s (14,000 km/h), accelerating the probe to a velocity of 23 km/s (83,000 km/h) and shortening its voyage to Pluto by three years.

On January 15, 2015, the spacecraft began its approach phase to Pluto. On the morning of July 14, 2015, it flew 12,500 km above the surface of Pluto and thirteen hours later NASA received the first communication from the probe.

Observations:

Observations of Pluto's surface by the New Horizons spacecraft revealed a variety of surface features, including mountainous region, unofficially named as Norgay Montes after Tenzing Norgay, that reaches as high as 11,000 feet (3,500 meters), comparable to the Rocky Mountains on Earth. While methane and nitrogen ice cover much of the surface of Pluto, these materials are not strong enough to support such enormous peaks, so scientists suspect that the mountains are formed on bedrock of water ice. New Horizons photographs show the reflection of light from the planet's surface which is different from the light reflection from the solely methane ice which suggests the presence of other ices also.



A close-up view of the surface of Pluto, taken by the New Horizons space probe in July, 2015, revealed the presence of icy mountains on the dwarf planet's surface. Credit: NASA-JHUAPL-SwRI

A New Horizons photograph showing the heart shaped region Tombaugh Reggio. Credit: NASA-JHUAPL-SwRI

Another distinct feature on Pluto's surface is a large heart-shaped region known unofficially as Tombaugh Reggio . The left side of the heart is covered in carbon monoxide ice. In the center left of Tombaugh Reggio is a very smooth region unofficially known by the New Horizons team as 'Sputnik Planum'. This region of Pluto's surface lacks craters caused by meteorite impacts, suggesting that the area is, on a geologic timescale, very young — no more than 100 million years old. These icy plains also display dark streaks that are a few miles long, and aligned in the same direction. It is possible the lines are created by harsh winds blowing across the dwarf planet's surface.

Observations of Charon by New Horizons have revealed the presence of canyons on the moon's surface. A section of the moon's surface near one pole is covered in a much darker material than the rest of the planet. Similar to regions of Pluto, much of Charon's surface is free of craters — suggesting the surface is quite young and geologically active.

New Horizons shows the evidence of Pluto's leaking nitrogen atmosphere. It estimates that 500 tons of nitrogen is slipping into space every year. Atmospheric scientists are working to find the answer of how Pluto regenerates its atmosphere if the rate of leaking is so high.

The first details of the encounter were received, but the download of the complete data during the nine day fly by will take about 16 months, and analysis of the data will take longer. After passing Pluto, New Horizons will continue on through the Kuiper belt, making a flyby of a Kuiper belt object (KBO) and hope to send new information and continue the journey of exploring space.

References:

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