NEW HORIZONS GOES WHERE NO MAN HAS GONE BEFORE

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Space: The final frontier...exploring strange new worlds to go where no man has gone before...

These phrases from the opening sequence of the popular sci-fi series, Star Trek, evoke thrill and adventure, palpable to this day; for, humans are innately curious to explore what lies beyond the visible in search of new frontiers.

It is indeed interesting to be living in times where we, no longer confined to the earth alone, are expanding our horizons and reaching other worlds in the skies. Although we are yet in the infant stages of space travel, the past few years have witnessed quantum leaps in exploring our neighbourhood; we accosted the giant planets, even reached the stars with a solar probe and, gathered valuable data to give us an insight into the probability of extra-terrestrial life. Along with these stupendous records, we are also on an endeavour to build homes on nearby celestial bodies.

Amidst all the excitement, one mission stands out. Filled with adventure and enigma that could verily run parallel to that of the Star Trek franchise is the iconic crusader of the New Horizons. This spacecraft’s voyage is out to seek new worlds and go beyond our frontiers.
Exhibiting remarkable tenacity, NASA’s robotic probe to Pluto, *New Horizons*, travelled an arduous seven billion kilometres and nine years, going beyond the cold Neptune to reach the frigid Pluto and its moons. The notable achievement puts NASA in the elite position of being the only organisation to have visited all the planets of our solar system.

Having reached Pluto, the spacecraft was still bubbling with energy and not ready to call it quits. In robust health despite the sojourn, it outlived its tenure of a decade and was ready to explore further, prompting NASA to extend its mission by a few more years.

The piano-sized machine journeyed the abyss of deep space for a billion miles beyond Pluto in search of strange worlds at the farthest frontiers of our solar system. It survived the vagaries of space with aplomb, and on New Year’s Day 2019, the Earth received a gift of the stunning visuals of a 4.6-billion-year-old primordial space object.

By now, *New Horizons* had trekked non-stop for twelve years at tremendous speeds, regardless of which it was able to hunt down and engage with a tiny, 20-mile-long space resident — 486958 2014 MU₆₉ — adding another feather to its cap.

**The Kuiper Belt**

In the forties and fifties, astronomers predicted that our solar system could have a faraway suburb filled with tiny frozen objects. Jan Oort proposed that this region could be the source of the comets that strike the earth from time to time.

In 1951, Gerard Kuiper theorised that beyond the chilly Neptune lies a doughnut-shaped region filled with trillions of tiny, icy volatiles. This region now known as the Kuiper Belt and the objects as Kuiper Belt Objects (KBO), is the frigid zone of the solar system, a billion kilometres away from Neptune. In the elliptical, ring-shaped Kuiper Belt, spanning 4-7 billion kilometres, small space objects traverse in eccentric, ever-changing and unpredictable orbits. Pluto is one prominent denizen of this region.

For 76 years, Pluto enjoyed the status of a planet. However, in 2006, astronomers reassigned it as a dwarf planet, as it did not accurately fit into a planet’s definition.

Beyond Kuiper Belt lies the Oort cloud, a spherical plane of objects. These two regions have remnants from the early days of the solar system. Exploring them could provide valuable insights into the birth of the solar system.

**New Frontiers Program**

Compelled by the mysteries hidden
deep within our solar system, NASA devised the Integrated Exploration Strategy under the consensus of the planetary community to start the New Frontiers Program in 2002.

Along with Juno and the OSIRIS-Rex missions, New Horizons was a part of the New Frontiers program. In a daring, never-before-conceived mission, a 400-kilo human-made robotic probe set out to explore the frigid edge of the solar system and engage with Pluto on an illustrious odyssey.

The Mission
On 19 January 2006, New Horizons took to the skies toward the far-flung icy world of Pluto — 7.5 billion kilometres away. Launched from the Cape Canaveral Air Force Station, the principal makers and managers of this probe were Johns Hopkins University Applied Physics Laboratory (APL).

New Horizons was designed to operate on a single Radioisotope Thermoelectric Generator (RTG) to meet its power requirements. “New Horizons needs less power than a pair of 100-watt light bulbs to perform its mission,” quotes APL explaining the high-performance technology employed in the probe.

The team was in a hurry to reach the target as in 1989 astronomers found that Pluto was moving farther away from the Sun and turning colder; it was expected that the declining heat to the dwarf would freeze out its atmosphere. New Horizons had to arrive at Pluto when the atmosphere was thick enough to conduct better tests. Another reason to hasten the travel was that parts of Pluto and Charon have decades of night, further diminishing the chances of the probe to map its surface under the dim reflected light.

So, New Horizons — the fastest ever space probe — zoomed past Mars to reach Jupiter in one year. Taking the gravity assist of the giant planet, it hurled towards Pluto crossing Saturn in 2008, Uranus in 2011 and Neptune in 2014. During the seven years, New Horizons was covering a million miles a day in its course to Pluto, slashing its travel time by three years. Throughout the duration, the spacecraft was put in a hibernating mode to conserve its energy requirements.

Waking up briefly and at intervals to conduct essential checks and course corrections, New Horizons travelled at 50000 miles per hour to reach Pluto by 2015.
Arrival

*New Horizons* encountered Pluto on 14 July 2015 — a remarkable achievement, for it survived the harsh environs of deep space without a hitch and with only a few minor course corrections — arriving at the target as planned in good time.

The spacecraft whirred into action three months prior when it was about a hundred million kilometres away from the target and began taking pictures of Pluto. Though Pluto and Charon appeared as unresolved bright dots, spectrometric mapping was feasible. The science team were able to check for surface changes over two Pluto days (11-12 earth days) before the encounter.

*New Horizons* rendezvoused with Pluto at a close 12500km to map its surface. In the short span, it remained in the vicinity, spectral analysis for ultraviolet emissions, surface compositions and temperature signatures of the materials were gathered.

The spectacular imagery beamed by the probe was another milestone for the spacecraft which spoke of the excellent performance of its instruments: surface features as small as 200 ft across were visible.

Not content with this, *New Horizons* continued to take advantage of the dark side of Pluto: the view into the haze of the night-time side, the cameras checked for rings and surface irregularities. Moreover, as it passed the shadows of Pluto and Charon, it glimpsed the magnificent sight of the Sun and Earth behind. Not losing a moment it took the best atmospheric measurements in this mode.

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**The Seven Sisters**

*New Horizons*’ seven scientific systems (payload) display a remarkable miniaturisation: collectively drawing power as low as 28 watts, the instruments were specially designed for the frigid temperatures that the craft would encounter at Pluto and beyond.

- **Alice**: A highly sensitive imaging spectrometer, which is capable of not only separating the light into its constituent wavelengths (like a prism) but also capturing images of the target at each wavelength. Alice gave us some spectacular details of Pluto’s composition.
- **Ralph-LEISA**: Operates as the main “eyes” of the craft with a resolution ten times better than the human eye can see. It is made up of three black-and-white and four colour sensors encapsulated inside the Multispectral Visible Imaging Camera (MVIC), with LEISA operating as the infrared compositional mapping spectrometer. While MVIC beamed stunning images of Pluto and Ultima Thule at increasing wavelengths, LEISA analysed the chemical spectrum of Pluto and its moons.
- **REX**: The Radio Science Experiment consists of a small printed circuit board containing sophisticated signal-processing electronics integrated into the *New Horizons* telecommunications system. REX was indispensable to ground-based scientists in analysing Pluto’s atmosphere and determine its mass.
- **LORRI**: The Long-range reconnaissance Imager is a digital camera fitted with a large telephoto telescope. The high-res images from this camera gave scientists an unprecedented view of the details of Pluto’s surface. Some pictures even surpassed the quality beamed by the Hubble Telescope. What stands out is its robustness in the frigid environs of the Kuiper belt.
- **SWAP**: Solar Wind Around Pluto is a large aperture instrument designed to measure the interaction of solar winds on Pluto. Capable of minute energy measurements (up to 6 keV), the device can detect slight changes in solar wind energy around Pluto.
- **PEPSSI**: The Pluto Energetic Particle Spectrometer Science Investigation is a compact directional energetic particle spectrometer capable of detecting the particles that escape Pluto’s atmosphere. These particles pick up the solar energy and transform into charged ions which are carried by solar winds. Working in tandem with SWAP the two systems have provided tremendous inputs to scientists about the nature of Pluto’s atmosphere.
- **SDC**: Venetia Burney Student Dust Counter was designed by undergrads at the University of Colorado, Boulder. The instrument keeps a tab on the number of dust particles originating from collisions of space objects all along the long journey.
Pluto was discovered in 1930 and assigned as the ninth planet in our solar system. However, in 2006, the status was withdrawn and reassigned as a dwarf planet.

The name Pluto was proposed by Venetia Burney, an 11-year-old girl from England. The Student Dust Counter was named in her honour.

By the time we discovered and stripped Pluto of its planet status, the icy object had not completed an entire orbit around the Sun.

Pluto is the largest KBO and the second most massive.

One-third of Pluto is water ice — almost equal to three times the water in all our oceans put together. The remaining two-thirds is rock.

It takes 248 earth years for Pluto to orbit around the Sun.

The sunlight on Pluto is as intense as moonlight on Earth.

It takes five hours for the sunlight to reach Pluto (as against 8 mins to Earth).

Pluto has a retrograde rotation (opposite to that of the Earth). So, on Pluto the Sun rises in the west and sets in the east.

Pluto is a cold planet with an average temperature of about -230˚C.

The feeble light on Pluto makes the days appear dark, and one can see stars doing the day.

On Pluto, sunrise to sunset is about a week long.

Pluto has a thin atmosphere mostly of nitrogen ice, carbon monoxide and methane.

The surface is rocky and believed to be having cryovolcanoes and geysers.

Throughout the mission, New Horizons was in good communication with the Earth team reflecting its excellent communication systems which worked even at such far off distances.

In the coming months, the probe will continuously stream valuable data to its Earth team about its surroundings and discoveries. With the success of this mission, New Horizons challenges new frontiers in space, raising the bar for deep space navigation and communications.

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