New Horizons spacecraft completes Pluto flyby

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Celebrations broke out at the Johns Hopkins Applied Physics Laboratory and other operation centers around the world when the New Horizons spacecraft re-established communications at 8:52:37 pm Eastern Daylight Time (EDT) last night after its successful flyby of Pluto, the most distant object in the solar system to be visited by a space probe.

After the first dazzling close-up photograph sent Tuesday morning, as the spacecraft began its closest approach to the dwarf planet, New Horizons was silent, its instruments turned to Pluto, gathering more and better data in a few hours than in the entire previous history of astronomical observation of that body. Once the spacecraft resumed communications to Earth, it began relaying that data home. Initial imagery from the close approach is expected to be released in the coming days.

In 1962, the spacecraft Mariner 2 performed the first successful planetary encounter as it flew past Venus, marking the beginning of planetary exploration. In the subsequent 27 years, a series of robotic probes were sent to every planet in the solar system, from Mercury to Neptune, revealing worlds of unimagined complexity, character and beauty. More than a quarter century later, New Horizons has continued that journey with the exploration of fundamentally new terrain: Pluto and its system of moons.

New Horizons was launched nine and half years ago and has an estimated cost of $650 million (less than a single B-2 stealth bomber). To get to Pluto as fast as possible, the spacecraft was launched aboard an Atlas V rocket directly into a solar system escape trajectory, going at approximately 16.5 kilometers per second relative to Earth. To further shorten the journey, it used Jupiter's gravity to slingshot it, increasing the velocity by 4 kilometers per second and shortening the voyage to Pluto by three years.

While New Horizons was the fastest spacecraft at launching, it is not the fastest spacecraft leaving the solar system. That record is still held by Voyager 1, which gained a gravity assist from both Jupiter and Saturn.

New Horizons is powered by radiation collected from on-board pellets of plutonium-238, similar to other outer solar system missions such as Cassini, because the Sun is too faint at those distances to deliver adequate energy to solar panels. The probe is expected to have power to conduct major science operations until 2026.

The spacecraft's closest approach to Pluto occurred at 7:49 am EDT. It was just 12,500 kilometers above the dwarf planet's surface, moving at just under 13.8 kilometers per second (49,600 kilometers per hour) relative to Pluto. At their best resolution, the instruments revealed features as small as New York City's Central Park.

However, as a result of the great distance between Earth and Pluto—nearly three billion miles—and the resulting low bandwidth between the spacecraft and radio receivers on Earth, it will take sixteen months for New Horizons to transmit all the data it has collected back to Earth. Despite this, the brief connection last night indicated that all the mission's primary objectives and most of its secondary and tertiary objectives have been achieved.

The spacecraft carries a suite of seven instruments used to conduct science operations, the most advanced instruments ever to perform a first encounter with an extraterrestrial object. Collectively, these collected data on Pluto's geological history, the composition and temperature of the dwarf planet's surface and atmosphere and the escape rate of matter from Pluto

and its moons. There are also sensors that are still being used to analyze the amount of charged particles in and around the Pluto system, as part of a broader study on the nature of the solar wind so far from the Sun.

Information gathered before and during closest approach—only one percent of the vast quantity that will eventually be returned—has already begun to refine our knowledge of the distant world. The uncertainty in measuring Pluto's radius has been drastically reduced, with the accepted figure slightly increased, re-affirming its status as the largest known object in the Kuiper Belt. Since Pluto is slightly larger in volume than previously known, with the same mass, the estimate of its density has gone down slightly, indicating that it has a higher proportion of ice to rock than previously thought. The new measurement also means that Pluto's atmosphere is thinner than expected, changing the existing models of its composition.

Some clues to Pluto's geological history have also been uncovered. The last image sent to Earth on July 13 gave the highest-resolution photo yet of a heart-shaped feature on Pluto's surface, what looks to be a relatively smooth area that contrasts to the rest of the cratered world. This means that Pluto was once geologically active and possibly remains so today. This is supported by other features seen on Pluto's surface, including a series of linear fractures to the left of the heart. None of these complexities were expected prior to arrival at Pluto and are already being studied for their implications.

In the days approaching Pluto, the Long Range Reconnaissance Instrument was also able to determine that Pluto has a polar ice cap made of methane and nitrogen. This was suspected from images taken previously, but it was not until now that the resolution was significant enough to separate out features from the polar and equatorial regions. There has also been a detection of ionized nitrogen nearly six million kilometers away from Pluto, more than five times what was expected to be escaping from the dwarf planet. The implications for Pluto's atmosphere will be investigated in the coming months.

While New Horizons has collected the best data it is going to get on Pluto, the spacecraft's useful life is not over. Pluto is only one of many objects orbiting outside of Neptune's orbit, all of which are suspected to be rocky, icy remnants of the early solar system. A study of any one of these would provide further insight into the nature of the solar system and its evolution. In 2011, a search began for suitable secondary flyby targets. The list of choices has been narrowed down to two, with flybys in either 2018 or 2019. The final decision will be made next month.

Currently, there are no plans for a follow-up mission. While there have been proposals for Pluto missions since 1989, it took 12 years and five cancelled projects (one of which cost $1.1 billion) before New Horizons was finally given the green light in 2001. Even then, it was almost quashed by Bush-appointed NASA Administrator Sean O'Keefe. It was only through the concerted efforts of the entire astronomical community that funding was finally restored for the spacecraft in 2003. Combined with the ongoing poverty in funding in basic science inflicted by Democratic and Republican administrations alike over the past quarter century, a second mission to Pluto has not been seriously considered.

The contradictions surrounding New Horizons—the existence of wars, exploitation, hunger and death on the planet that launched this scientific tour de force—do not diminish what has been accomplished: humanity has now explored worlds farther from Earth than ever before. The impediments to further scientific discovery are not so much the technical challenges, but the reactionary obstacles created by the decay of the profit system and conflicting interests of rival capitalist nation-states. Reaching and studying Pluto is one small indication of what will be achieved when science is freed from those shackles.