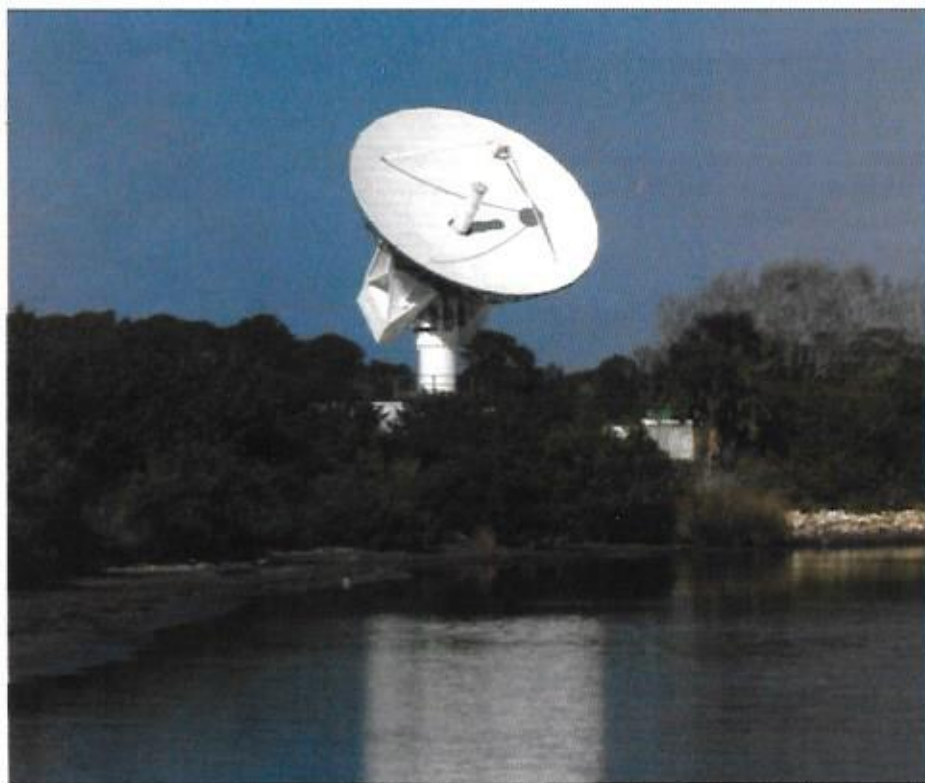


# DESTINATION: PLUTO

## *New Horizons* The First Mission to the Last Planet

*HENRY M. HOLDEN reports*

*Photos: Courtesy NASA*



**TOP:** This is the clearest view yet of the distant planet Pluto and one of its three known moons, Charon, as revealed by NASA's Hubble telescope. The image was taken by the European Space Agency's Faint Object Camera on February 21, 1994, when the planet was 2.6-billion miles from Earth; or nearly 30 times the separation between Earth and the sun.

**ABOVE:** This new C-band, 3 megawatt radar with a 50-foot dish antenna reflects on the marsh water nearby. The antenna has recently been installed on north Kennedy Space Centre. It is one of the largest of its kind in the world, providing higher definition imagery than has ever been available before. Working in concert with two new NASA-owned X-band radars mounted on the solid rocket booster retrieval ships, tracking the space shuttle and expendable launch vehicles with this new capability will provide more detail than NASA has ever observed by radar before.

6 World Airnews, March 2006.

**A**T 14h50 on Thursday, January 19, 2006, an Atlas 5 rocket on steroids, carrying NASA's Pluto-bound New Horizons probe, roared to life and flawlessly punched its way through Earth's gravity.

When it broke the surly bonds of Earth, it was travelling at 10 miles per second – 36 256 mph. It was off on a record-setting three-billion-mile voyage to the frigid edge of our solar system. This is the most compelling spaceflight since the launch of Voyager 2 almost 30 years ago.

The \$700-million mission will mark a milestone in the history of space exploration as New Horizons scientifically unmask the only planet in our solar system that has not been visited by humans or robotic spacecraft.

The 20-story rocket rolled to its launch pad at the Cape Canaveral Air Force Station, but after high winds, and a second attempt to launch which ended when storms knocked out power to the Johns Hopkins Applied Physics Laboratory spacecraft control centre, the mission finally launched three days late.

Racing ahead of its tail of flames, the Atlas 5 climbed above its launch gantry in less than six seconds – twice as fast as normal – and accelerated through the sound barrier about 45 seconds after lift-off. It quickly arced east over the Atlantic Ocean.

The solid rocket motors burned out about a minute and a half into the flight, falling back to Earth trailing white contrails, while the Atlas continued its ascent ahead of the tongues of orange flame



*Smoke and steam fill the launch pad as NASA's New Horizons spacecraft roars into the blue sky aboard an Atlas V rocket. Liftoff was on time at 14h00 EST from Complex 41 on Cape Canaveral Air Force Station, in Florida. This was the third launch attempt in as many days after scrubs due to weather concerns. The compact, 476 kg piano-sized probe will get a boost from a kick-stage solid propellant motor for its journey to Pluto. New Horizons will be the fastest spacecraft ever launched, reaching lunar orbit distance in just nine hours and passing Jupiter 13 months later.*

from its Russian-built RD-180 engines.

The nuclear-powered robotic spacecraft crossed the moon's orbit nine hours after lift-off, and will reach Jupiter for a velocity-boosting fly-by in February 2007.

The probe's seven instruments will be activated, and checked out in the next few months, and the Jupiter fly-by science campaign will begin its tasks around September.

The mission took years of planning, and it will rewrite the textbooks for interplanetary space travel for the 21<sup>st</sup> Century.

Ripping through space more than 100 times faster than a commercial jetliner, this one-way voyage, will still take New Horizons nine years to reach the Kuiper



**ABOVE:** At their consoles in the Atlas V Spaceflight Operations Centre on Cape Canaveral Air Force Station, members of the New Horizons team take part in a dress rehearsal for the launch. New Horizons carries seven scientific instruments that will characterise the global geology and geomorphology of Pluto and its moon Charon, map their surface compositions and temperatures, and examine Pluto's complex atmosphere. After that, fly-bys of Kuiper Belt objects from even further in the solar system may be undertaken in an extended mission.



**LEFT:** The fairing lifting fixture raises the fairing enclosing New Horizons to the top of a Lockheed Martin Atlas V launch vehicle in the Vertical Integration Facility at Complex 41 on Cape Canaveral Air Force Station.



Belt, a ring of icy debris left over from the birth of the solar system 4,6-billion years ago.

After 75 years of long distance study, we will finally see what Pluto, the Roman name for the Greek god Hadcs, looks like, but even that will have to wait until 2015. Pluto is so far away that even with the Hubble telescope all we have is a blurred view in the lens.

One scientist characterised it as looking at a walnut 30 miles away. Others speculate there may be a 10<sup>th</sup> planet beyond Pluto, and this mission may reveal if that is true.

Astronomer Clyde Tombaugh, who died in 1997 at age 90, discovered Pluto in 1930. Carrying some of the ashes of Tombaugh, New Horizons should race by the frozen planet on July 14, 2015, exactly 50 years after Mariner 4 became the first spacecraft to fly-by Mars.

New Horizons will pass within 5 500 miles of the icy, 1460-mile-wide planet at 31 300 mph. Fourteen minutes later, the spacecraft will pass by the planet's one of three known moons, Charon, at a distance of 16 800 miles.

#### KEYHOLE IN SPACE

To be successful, New Horizons must traverse some three-billion miles and then hit a keyhole in space just 186 miles wide, a target point at the far end of the launch trajectory that will allow the spacecraft to pass midway between Pluto and Charon.

Detailed observations will begin about March 2015, before the fly-by, collecting data that will help flight planners fine-tune the spacecraft's course. In May that year, at a distance of about 62-million miles, New Horizons will begin mapping Pluto and Charon. A few weeks later, the spacecraft's images will become sharper than those taken by the Hubble telescope. Daily observations will begin one month before the encounter.

New Horizons' close encounter with Pluto will last only a full day, 12 hours before and after. The spacecraft cannot enter orbit around the planet because no

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**LEFT:** *In the Payload Hazardous Servicing Facility, clean-suit garbed workers prepare the first fairing section (in the background) that will encapsulate the New Horizons spacecraft at left for flight. The fairing protects the spacecraft during launch and flight through the atmosphere. Once out of the atmosphere, the fairing is jettisoned.*

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 will perform a detailed reconnaissance of Pluto and its companion, Charon, and continue to fly past Pluto deep into the Kuiper Belt where temperatures are believed to be  $-228^{\circ}\text{C}$  just 35 degrees above absolute zero.

It is believed the Kuiper Belt contains the remnant objects from the formation of the solar system that never formed into planets, because they were simply too far out.

### DEBRIS CONCERN

There is concern that two recently discovered moons – and others that may be discovered between now and then – may contribute to any as-yet-unseen rings of debris around Pluto that could pose a threat to the spacecraft.

New Horizons should still have half a tank of hydrazine rocket fuel left, enough to change course if necessary to avoid any threats.

At Pluto's enormous distance from Earth – it will take light some 4,5 hours to cross the gulf – it will take days to transmit even a few high-priority images back to Earth. The spacecraft will need nine months to transmit the complete data set.

In 1937, Howard Hughes set a speed record from the East Coast to the West Coast of the United States in seven hours, 28 minutes. This spacecraft could fly from the East Coast to the West Coast in five minutes.

New Horizons is small compared to the school bus-sized Cassini currently in orbit around Saturn. It is roughly triangular, and about the size of a piano, measuring just 686 mm by 2,1 metres by 2,75 metres and weighed 478 kg at launch, of which 77 kg pounds is hydrazine manoeuvring fuel.

Operating more than 30 times further from the sun than Earth, New Horizons is built like a thermos bottle and insulated to retain the heat generated by its electrical systems. Internal temperatures between 10 and 30 degrees Celsius are expected throughout the mission, but small heaters are available if it gets colder than expected.

The probe is equipped with a single radioisotope thermoelectric generator or RTG – a "space battery" – that provides an uninterrupted and reliable source of heat and electricity in remote and harsh environments such as deep space. The RTG will power the seven state-of-the-art



*To get the kick needed to reach Jupiter and the outer solar system, New Horizons relied on a Star 48B solid-fuel motor that accelerated the small spacecraft to a departure velocity of some 10 miles per second, on course for a fly-by of Jupiter in late February 2007.*

science instruments, including a radio system that will be used to both communicate with Earth and collect valuable data about Pluto's tenuous atmosphere. The compact instruments typically operate on less power than a night light – two to 10 watts each.

### INSTRUMENTATION

The instruments on board are:

■ **Alice:** A 4,5 kg ultraviolet imaging spectrometer to study the structure and composition of Pluto's atmosphere. It also will be used to look for signs of a charged ionosphere around Pluto and any traces of an atmosphere around Charon.

■ **Ralph:** A 10,5 kg telescope/camera system that includes a multi-spectral visible-light camera with seven black-and-white and colour CCD detectors and a single infrared channel for spectroscopic studies.

Operating in light 1 000 times dimmer than on Earth, Ralph will photograph the

sunlit surfaces of Pluto and Charon, providing stereoscopic views, measuring the temperature and mapping abundances of nitrogen, methane, carbon monoxide and water ice.

In black-and-white mode, the camera will be able to discern surface features three-tenths of a mile across (0,9 miles across in colour mode and 4,3 miles in infrared mode).

■ **Radio Science Experiment (REX):** This is a 100-gram circuit board incorporated in the spacecraft's radio system. As the spacecraft flies behind Pluto and Charon, radio waves from Earth will be bent slightly as they pass through atmospheric gases. By characterising those subtle changes, scientists will be able to gain insights into atmospheric temperature and pressure.

■ **LORRI (long-range reconnaissance imager):** An 8,6 kg digital camera equipped with a 210 mm telescope serving as a telephoto lens that will be used for optical navigation on the way to Pluto. At close approach, LORRI should be capable of detecting surface features as small as 25 metres across.

Ninety days out from Pluto, LORRI's pictures will be 10 000 times sharper than current images taken by the Hubble telescope.

■ **SWAP (Solar Wind at Pluto)** will study how Pluto interacts with the solar wind. Scientists believe Pluto loses about 75 kg of its atmosphere every second. That material is then ionised by sunlight and carried away on the solar wind.

■ **PEPSSI (Pluto Energetic Particle Spectrometer Science Investigation):** A 1,5 kg spectrometer to study material escaping from Pluto's atmosphere as well as the atmosphere itself.

■ **SDC (Student Dust Counter):** The only instrument that will remain on for the duration of the new Horizons Mission, the SDC was developed by students at the University of Colorado, at Boulder, to measure microscopic dust grains in interplanetary space.

New Horizons is going to be going where no other mission has ever been, so it truly is a mission of exploration and discovery.

New Horizons, is the fastest thing ever built by the people of planet Earth, yet it will take almost a decade to reach Pluto and its moon Charon.

Maura, this author's granddaughter, is about to start kindergarten and will be starting high school by the time the spacecraft reaches its target. →