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Race Against Time: Long Road to Pluto and Why We're Going

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Alan Stern is 45 years old. He was 32 when serious planning began for a mission to Pluto, which he just learned has been [quietly and formally approved](#). He'll be 57 when the spacecraft he and others have been promoting finally gets there.

Will the long road to Pluto, a popular planet with both children and scientists and the only one never visited by a spacecraft, be worth the quarter-century wait?

"Past experience in planet exploration has consistently proved the value of reconnaissance missions for revolutionizing our view," Stern, principal investigator for the New Horizons mission, told *SPACE.com*. "Yes it'll be worth the wait, and then some."

Stern calls New Horizons "the first exploration of the third zone of the solar system," the region beyond both the terrestrial planets and the giant planets.

Deep freeze

As the mission heads toward launch in 2006, Pluto is headed for a deep freeze, moving farther from the Sun each day on its 248-year, elliptical orbit. So Stern and his colleagues at the Southwest Research Institute (SwRI) are now in a race against time to design and build a craft, launch it, and gather precious data and pictures before the planet's atmosphere freezes out for two centuries.

New Horizons is set to arrive in 2015.

Since 1989, Pluto has been moving away from the Sun. In 1999, it crossed the orbital path of Neptune, repeating an age-old exchange that once again made Pluto the most distant planet in our solar system. On average, Pluto is 39.5 times farther from the Sun than is Earth.

It is a world upon which little solar energy lands and about which even less is known.

No telescope or spacecraft has ever snapped a good picture of Pluto. Even the venerable Hubble Space Telescope sees no more than a blur. Pluto's atmosphere is therefore an enigma, its surface only vaguely understood. Astronomers don't know how or even under what circumstances Pluto formed.

As planets go, Pluto is small and strange. As icy rocks go, however, Pluto appears to be large but otherwise common in a region of space littered with them.

Planet or just a rock?

The inner solar system contains four rocky, so-called terrestrial planets, Mars being the outermost. Pluto, a world of rock and ice, resides at the edge of a region of the solar system noted for giant planets made not of rock but of gas or ice. More specifically, Pluto roams a region riddled with thousands of rocky, icy objects that resemble both asteroids and comets.

These Kuiper Belt Objects, or KBOs, as they are called, were first suggested to exist by Gerard Kuiper about five decades ago. The first KBO was discovered in 1992. They are now known to populate a [vast swath of space](#) beyond the orbit of Neptune. There may be 100,000 of them bigger than 62-miles (100 kilometers) across, researchers say.

Stern calls the Kuiper Belt the big brother to the Asteroid Belt, which is positioned between Mars and Jupiter.

Pluto, found by Clyde Tombaugh in 1930, would have been classified as a KBO [instead of a planet](#) were it discovered today, most astronomers agree. Here are some of the supporting reasons:

Pluto's orbit is not at all circular. Its distance from the Sun, called orbital eccentricity, varies by 25 percent. The 1,430-mile-wide (2,300-kilometer) rocky world also zooms high above and below the plane along which Earth and the other planets orbit. Astronomers refer to this as orbital inclination, and Pluto's is a whopping 17.1 degrees.

The oddities don't stop there. Pluto is the only planet whose moon is big enough -- Charon is roughly half the size of Pluto -- to draw the planet into a visibly significant binary orbit: The two objects orbit around a midpoint that is in the space between them. Some scientists refer to this as a double-planet system.

Pluto and Charon complete an orbit every 6.4 Earth days. Each also spins on its own axis in exactly that same amount of time.

Scientists don't know how Pluto and Charon, which appear compositionally very different, came to be gravitationally bound. Like Earth's Moon, Charon might have been [carved viciously](#) from its host planet by the impact of another large object. That's the leading theory, but it's also possible Charon was simply captured by Pluto.

Finally, astronomers speculate that the Pluto-Charon system might contain other satellites, smaller moons that either developed with the system or that are KBOs that were captured later. A [search is set](#) for this year to find any possible additional moons.

Up close

Because Pluto so resembles KBOs, and because it travels with them in space, New Horizons will study both. In fact some scientists have suggested that examining the Kuiper Belt in general is the greater reason for going. Yet while the study of KBOs excites scientists, it is the close-up views of Pluto that are most likely to enthrall the public.

Here's how the heart of the mission will proceed:

About a year before the encounter, in 2014, New Horizons will start snapping pictures of Pluto and Charon, which will appear only as bright dots. About three months before encounter, the craft's cameras will generate the first useful maps of Pluto.

If Pluto's atmosphere is indeed freezing out (there are actually inexplicable signs of [global warming](#) right now), the craft will have an opportunity to watch seasonal change during these months of approach. Scientists speculate that all the stuff wafting above Pluto -- mostly nitrogen, carbon monoxide, methane and some water ice -- might fall out as snow as the protracted winter sets in.

Pluto may have the most dramatic seasonal patterns of any planet, Stern has said.

Finally, New Horizons will fly within 6,000 miles (9,600 kilometers) of Pluto in 2015. The busiest part of the mission, officials say, will be a 24-hour period centered around this close approach. The craft will look for ultraviolet emissions from Pluto's atmosphere. It will generate high-resolution global maps of both Pluto and Charon. And it will analyze the surface composition and temperature.

For about a half-hour at closest approach, the probe will make visible and near-infrared pictures of Pluto, resolving surface features down to 200 feet (60 meters). It will do the same with Charon at a different point in the flyby.

Some of the best science is likely to be done just after the close approach, however, when the robot will look over its

The Odd Planet Out

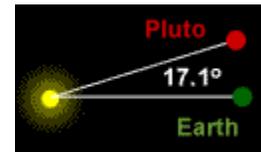


Eccentricity

Pluto's distance from the Sun varies by 25 percent. In 1999, Pluto crossed the orbital path of Neptune to become, once again, the most distant planet in the solar system.

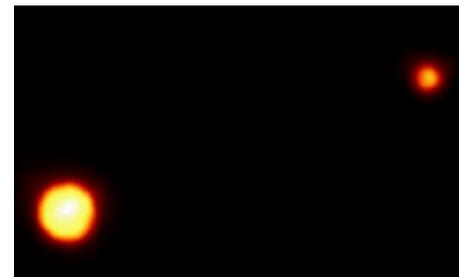
Inclination

Pluto's orbit is inclined 17.1 degrees to the plane through which Earth goes around the Sun.



Pluto Data

Diameter: 1,430 miles (2,300 km)
 Time to rotate: 6.4 Earth days
 Orbit: 248 Earth years
 Mass: 0.2% of Earth's
 Diameter: 18% of Earth's
 Distance from Sun: 39.5 times as far as Earth, on average



Pluto, left, and its satellite Charon, as seen by the Hubble telescope.

*Pluto was Hades,
 Roman god of the underworld.*

shoulder at the dark side of Pluto in an effort to spot atmospheric haze and search for possible rings. Silhouette views, provided as the craft actually passes through the shadows of Pluto and Charon, should help researchers learn how rough or smooth the two worlds are.

Once the flyby is complete, a whole other phase of the mission begins. This phase is not yet fully planned. The target will be a KBO, one that astronomers still have to find. Mission planners expect to fly past a KBO that's roughly 30-60 miles wide (50-100 kilometers). New Horizons will perform similar examinations of the rock to those that had been done at Pluto.

Stern expects much to be learned about Pluto and the Kuiper Belt between now and 2015, and the new information will be used to maximize the science return of the mission.

The Kuiper Belt is full of leftovers from the formation of the Sun and solar system.

Stern has said the distant belt probably contained enough material when the solar system initially developed to have created another Neptune-sized planet. For some reason, most of that mass is gone. And the "10th planet" never formed, though it pops up routinely in computer simulations.

So what happened? Something must have disrupted the Kuiper Belt, way back more than 4 billion years ago, Stern figures. Perhaps the formation of Neptune caused a gravitational shift that tore the other fledgling planet apart. Or maybe several large planetary wannabes were ejected out of the solar system by Neptune and, along the way, swept parts of the Kuiper Belt clean. Possibly something else is to blame.

Studying the Pluto-Charon system, as well as one or more other KBOs, could answer this question of the "missing" planet.

First, a big boost

The path to Pluto won't be direct. As with other spacecraft heading beyond Mars, a natural boost provided by the gravity of a planet will save fuel and cut mission costs.

The probe will first head to Jupiter, where early plans call for some investigation of the Jovian moons. Otherwise, New Horizons will slumber during much of its journey. Arriving at Jupiter more than a year after launch, the craft will zip around the giant planet and steal a little of its orbital energy, using it like a slingshot to set a new and faster course toward Pluto.

Under the direction of the Southwest Research Institute, serious design of the craft begins now that funding has been committed. The robotic probe will be put together, beginning next summer, by the Johns Hopkins University Applied Physics Laboratory (APL). Some of the instrumentation will be built by Ball Aerospace, Stanford University and NASA's Goddard Space Flight Center.

New Horizons will carry four instrument packages. The probe will see light emitted in the visible, ultraviolet and infrared wavelengths. A radio detector will probe Pluto's atmosphere and surface temperatures. Particle detectors will aim to sample material escaping the atmosphere into space.

The spacecraft will feature an 8-foot (2.5-meter) dish antenna, needed to communicate with Earth from as far away as 4.7 billion miles (7.5 billion kilometers).

No mission is without bumps, but the upcoming trip to Pluto may well be smoother than the path traveled so far.

The public's mission

During the 1990s, NASA considered various types of spacecraft, from the very large to very small, for a Pluto mission. Cost estimates soared, and a proposed Pluto-Kuiper Express mission was cancelled in the fall of 2000. Reaction from scientists and even school children compelled NASA to reconsider, and the agency put out a request for proposals that could stay under a \$500 million cap.

New Horizons, proposed by Stern and his colleagues, was chosen in late 2001. But as recently as late last year, NASA and even President Bush tried to keep the mission on the shelf. Scientists and the public continued to fight for the mission, in part because they feared an opportunity would be lost once Pluto entered the deep freeze.

Louis Friedman, executive director of the Planetary Society, which has lobbied heavily for the New Horizons mission, was thrilled when he learned yesterday of the funding decision.

Friedman noted the quiet approval of the New Horizons budget (*SPACE.com* was [first to report the approval](#), late Tuesday, five days after it had occurred). Friedman supposes the governmental downplay resulted from the event being politically lost in larger space issues of the moment, from the shuttle [Columbia disaster](#) to NASA's [2004 budget request](#), which was released earlier this month and calls for ambitious spending on nuclear propulsion initiatives that will culminate in a [new mission to Jupiter's moons](#) late in the decade.

"Maybe it is a minor story," Friedman said of the New Horizons approval, "but it's a major victory that we've fought long and hard for."

Congress is responsible for writing the mission into NASA's 2003 budget. Bush signed the legislation on Feb. 20. It guarantees an initial \$110 million for the project in 2003. Additional funding is already in NASA's 2004 budget request.

The Planetary Society had lobbied hard for the mission, gathering thousands of signatures from the public to send to Congress.

"People really wanted this mission," Friedman said in a telephone interview, adding that Pluto strikes an uncommon chord in peoples' imaginations. "The fact that the public willed a mission into existence is great."

Stern, for his part, never figured to play such a prominent role in the exploration of the outer solar system. "I never intended in 1989 to have it turn out this way," said the New Horizon's team leader. "I figured we'd sell the mission in a few years, launch about 1996-2001, and I'd play some modest role," possibly as the principal investigator for one of the craft's many instruments.

Instead, Stern is poised to be the public face of the first mission to Pluto, the peoples' choice. Yet he credits the teamwork of the planetary community for getting New Horizons positioned for liftoff.

"This is not my mission," he said. "It's something many, many hundreds of people at NASA, APL, SwRI, Ball Aerospace, the Department of Energy, and in the science community are involved in. Many dozens of folks in the science community and NASA have worked 10 years or more to get it on the books and under way."