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Why the Pluto flyby will be a spectacular event for all of us

The New Horizons spacecraft will explore our solar system's outer limits as it continues its journey of more than 3 billion miles

BY RACHEL FELTMAN

It's a journey that has taken almost a decade, and it's going to pass in the blink of an eye. But it could unlock the secrets of the origin of the solar system.

On Tuesday, NASA's New Horizons spacecraft will zip past Pluto at more than 30,000 mph, having traveled more than 3 billion miles since its launch in 2006. The flyby, which will collect reams of data, will be humankind's first encounter with Pluto. And if you still consider Pluto a planet — which many do, even though in 2006 it was reclassified as a "dwarf planet" — then this seems like the last frontier of exploration in our cosmic neighborhood.

But Pluto isn't the last frontier. It's humankind's first foray into the Kuiper Belt, a thrilling region of space that starts just beyond Neptune's orbit.

"The reason why we're so excited about exploring Kuiper for the first time is that it gives us the best window into what the solar system was like just after forming 4.6 billion years ago," said Harold Weaver, New Horizons mission scientist at Johns Hopkins University's Applied Physics Laboratory.

The region, he said, has acted "almost like a cosmic refrigerator." The objects inside the belt have been kept incredibly cold since their formation near the beginning of the solar system.

"They're probably more pristine samples of the material that existed at the time of the solar system's formation than anything interior of them," Weaver said.

Scientists liken the encounter to an astronomical archaeological dig: a look at the building blocks on hand in the earliest days. These building blocks would come together to create our own planet and to make it habitable. And they would click into place to form the first life on Earth.

It is because of the discovery of the Kuiper Belt that Pluto is no longer a proper planet: The outermost region of our solar system, its existence was confirmed in 1992, about 60 years after Pluto — an object that resides in the innermost region of the belt — was discovered. Suddenly, Pluto wasn't the outer limit, the tiniest, coldest, most distant planet. It was just one of perhaps hundreds of similar objects orbiting at the fringes, surrounded by an estimated trillions of comets.

But getting into the Kuiper Belt isn't just about venturing to the outer limits of the solar system. The objects inside the Kuiper Belt are icy remnants of the formation of the solar system, so they hold clues to its very beginnings — and, by extension, to the origin of life as we know it.

The belt has upended some of what scientists thought they knew about the solar system. To explain the existence of the new bodies, models of the early solar system needed to be reevaluated. Scientists now think, for example, that the planets have moved significantly since their formation: Jupiter might have been as close to the sun as Mars is, and Uranus and Neptune might have flipped positions. All those findings were motivated by the need to explain this brand new zone of the solar system.

Joel Parker, director of the Southwest Research Institute's space science and engineering division, said that Pluto — while much simpler than our own planet and much more pristine — is very much alive.

"It's a living planet. There are a lot of processes going on, and in some ways Pluto has probably changed a lot in the past 4.6 billion years," said Parker, whose team is in charge of atmosphere-measuring instruments on the New Horizons mission and the European Space Agency's Rosetta mission, which is orbiting a comet moving toward the sun. That comet, Parker said, is in some ways more pristine than Pluto — it came from the Kuiper Belt, as many comets do, and it changes only when it makes a rare pass close to the sun's heat.

But when it comes to examining those building blocks, Pluto's moons might be more helpful than the dwarf planet itself. Charon, Kerberos, Nix, Styx, and Hydra probably haven't been very active in the past 4.6 billion years. And unlike the comet Rosetta is studying, they've never left the cosmic refrigerator they call home. Figuring out their compositions will help scientists understand how they formed and what the solar system was like back then.

Charon's craters are also expected to be helpful: They shouldn't have changed much since the early days of the solar system, so scientists can use them to calculate how many impacts the moon experienced back then — when some suspect the Kuiper Belt had 100 times as many objects as it does now.

This exploration need not end with Pluto and its moons. If NASA extends the New Horizons mission, its team can use the last of the probe's fuel to direct it toward one of several other objects they've detected in the Kuiper Belt.

So there is a lot more to the mission than Pluto itself, even if the dwarf planet is by far the most famous character featured.

"I have no doubt that when we look at Pluto up close and personal, we're going to see things that we never could have seen before from Earth," Parker said. "There are going to be things that make us have to revise our models, and that's why we do this. It's that next step in understanding the universe."

Parker is especially excited to find out more about Pluto's relationship with Charon, its largest moon. The two form an odd pair: At 750 miles across, Charon is half the size of Pluto, making it the largest known moon relative to its host planet. And instead of following the traditional courtship of a moon orbiting around its host, Pluto and Charon orbit in sync around a fixed point between them.

They act more like a binary planetary system, with Pluto's smaller moons struggling to stay stable around the pair's strange cosmic dance. But their compositions seem to be radically different, and pinning down what they're made of could help scien-

Perchè il passaggio presso Plutone sarà per tutti noi l'evento più spettacolare

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tists understand how they formed — and why they act so strangely.

Pluto's atmosphere is particularly interesting: Scientists already know that it escapes, seemingly evaporating into space. But it keeps coming back. Something on the surface of the planet must replenish that atmosphere, but they aren't sure what.

Christopher T. Russell, principal investigator of NASA's Dawn mission — which is orbiting Ceres, another dwarf planet located between Mars and Jupiter — pointed out that alien worlds can teach us a lot about things back home.

"On Earth, we have an environment that's wrapped up in the cycle of water freezing and evaporating, rain and ice, and it's all about the properties of water," Russell said. But on Pluto, temperatures as low as nearly minus-400 degrees make all water solid. Meanwhile, elements that are gases on Earth — such as carbon dioxide and nitrogen — are able to form liquids or even solids at those temperatures.

"If you look at water running down a hillside and compare it with, say, liquid nitrogen running down a hillside, you might learn something new about erosion for example, because the properties of the material are different, so just the basic process is the same," Russell said.

It's clear that Pluto's "demotion" hasn't tarnished it in scientists' eyes. Dwarf planet or planet, it's a strange new world ripe for exploration.

"Humans try to pigeonhole things and put them into categories, but we have to realize that you can't fit objects into clearly defined categories," Weaver said. "Nature just doesn't work that way, and Pluto is what it is independent of how we try to label it."

And what it is, he said, is a body with at least five moons around it — a perfect little system.

"My gosh, just think about the complexity of something like that," Weaver said. "How did it get to be like that? We just don't know."

On Tuesday and Wednesday, NASA is expected to release photos of Pluto that will turn the dwarf planet from a distant curiosity into a real, complex, beautiful world.

"From a philosophical point of view, it's the completion of humanity's first reconnaissance of all the planets in the original solar system, something we started just 50 years ago," Parker said. "To me, that's astounding. Maybe in today's fast-paced world that seems like a long time. But, you know. Space is big. Space is hard."

rachel.feltman@washpost.com