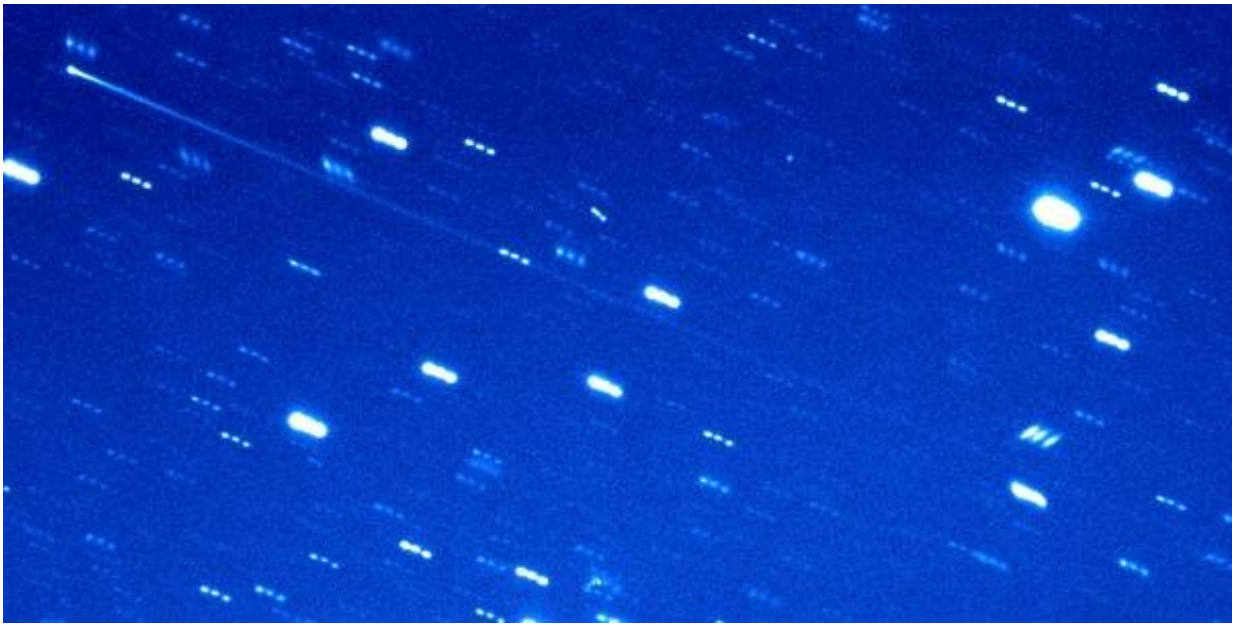
Is new finding an asteroid or a comet? It's both

October 4 2021



Composite image of (248370) 2005 QN173 taken with Palomar Observatory's Hale Telescope in California on July 12, 2021. The head, or nucleus, of the comet is in the upper left corner, with the tail stretching down and to the right, getting progressively fainter farther from the nucleus. Stars in the field of view appear as short dotted lines due to the apparent motion of Solar System objects against background stars and the process of adding together multiple images to increase the visibility of the tail. Credit: Henry H. Hsieh (PSI), Jana Pittichová (NASA/JPL-Caltech).

The newest known example of a rare type of object in the Solar

System—a comet hidden among the main-belt asteroids—has been found and studied, according to a new paper by Planetary Science Institute Senior Scientist Henry Hsieh.

Discovered to be active on July 7, 2021, by the Asteroid Terrestrial-Impact Last Alert System (ATLAS) survey, asteroid (248370) 2005 QN137 is just the eighth main-belt asteroid, out of more than half a million known main-belt asteroids, confirmed to not only be active, but to have been active on more than one occasion. "This behavior strongly indicates that its activity is due to the sublimation of icy material," said Hsieh, lead author of the paper "Physical Characterization of Main-Belt Comet (248370) 2005 QN173" that he presented at a press conference today at the 53rd annual meeting of the American Astronomical Society's Division for Planetary Sciences. "As such, it is considered a so-called main-belt comet, and is one of just about 20 objects that have currently been confirmed or are suspected to be main-belt comets, including some that have only been observed to be active once so far.

"248370 can be thought of as both an asteroid and a comet, or more specifically, a main-belt asteroid that has just recently been recognized to also be a comet. It fits the physical definitions of a comet, in that it is likely icy and is ejecting dust into space, even though it also has the orbit of an asteroid," Hsieh said. "This duality and blurring of the boundary between what were previously thought to be two completely separate types of objects—asteroids and comets—is a key part of what makes these objects so interesting."

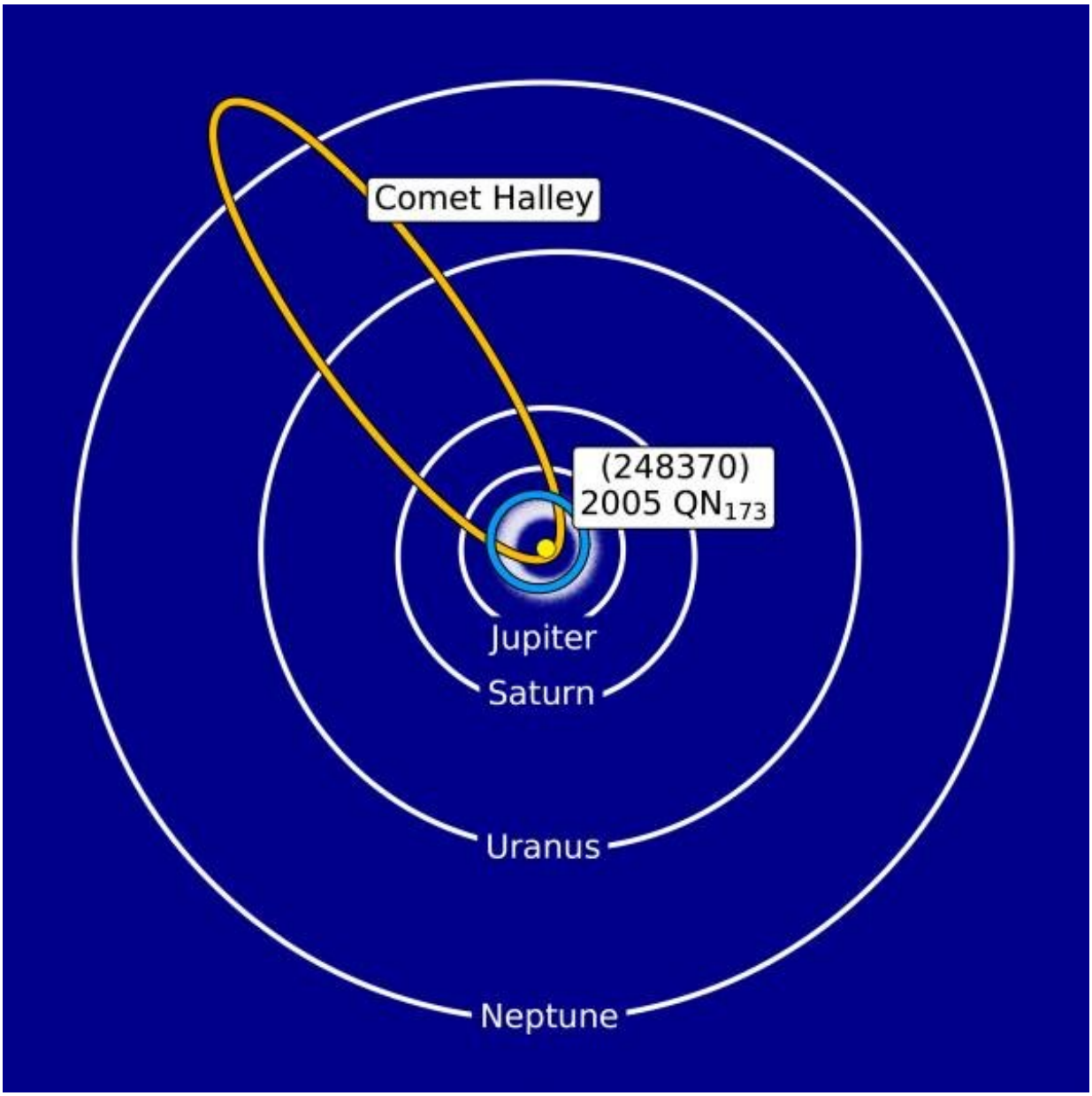


Diagram showing the orbit of (248370) 2005 QN173 along with the main asteroid belt and the orbits of Jupiter, Saturn, Uranus, and Neptune, and Comet Halley for comparison, showing how "traditional" comets like Comet Halley spend much more time far from the Sun in the cold outer Solar System than (248370) 2005 QN173, whose orbit keeps it much closer to the Sun and therefore in a much warmer environment all the time. Credit: Henry H. Hsieh (PSI).

Hsieh found that size of the nucleus, the solid object at the "head" of the comet that is surrounded by a dust cloud, is 3.2 kilometers (2 miles) across, the length of the tail in July 2021 was more than 720,000 kilometers (450,000 miles) long, or three times the distance from the Earth to the Moon, and the tail at that time was just 1,400 kilometers (900 miles) wide. These dimensions mean that if the length of the tail was scaled to the length of a football field, the tail would be just 7 inches wide and the nucleus would be half a millimeter across.

"This extremely narrow tail tells us that dust particles are barely floating off of the nucleus at extremely slow speeds and that the flow of gas escaping from the comet that normally lifts dust off into space from a comet is extremely weak. Such slow speeds would normally make it difficult for dust to escape from the gravity of the nucleus itself, so this suggests that something else might be helping the dust to escape. For example, the nucleus might be spinning fast enough that it's helping to fling dust off into space that has been partially lifted by escaping gas. Further observations will be needed to confirm the rotation speed of the nucleus though," Hsieh said.

"Cometary activity is generally thought to be caused by sublimation—the transformation from ice to gas—of icy material in a Solar System object, which means that most comets are found to come from the cold outer Solar System, beyond the orbit of Neptune, and spend most of their time there, with their highly elongated orbits only bringing them close to the Sun and the Earth for short periods at a time," Hsieh said. "During those times when they are close enough to the Sun, they heat up and release gas and dust as a result of ice sublimation, producing the fuzzy appearance and often spectacular tails associated with comets."

By contrast, main-belt asteroids, which orbit between the orbits of Mars and Jupiter, are thought to have been in the warm inner Solar System where we see them today (inside the orbit of Jupiter) for the last 4.6

billion years. Any ice in these objects was expected to be long gone from being so close to the Sun for so long, meaning that cometary activity was not expected to be possible from any of these objects. However, a few rare objects that challenge this expectation called main-belt comets, first discovered as a new class of comets by Hsieh and David Jewitt in 2006, have been found over the last several years. These objects are interesting because a substantial part of Earth's water is thought to have been delivered via impacts by asteroids from the main asteroid belt when the Earth was being formed. Given that the activity observed for these objects means they are likely to still contain ice, they offer a potential way to test that hypothesis and learn more about the origin of life on Earth by learning more about the abundance, distribution, and physical properties of icy objects in the inner Solar System.

Provided by Planetary Science Institute