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**Discovery Made During Production of
Hayden Planetarium Space Show *Encounters in the Milky Way***

Surprising spiral structure made of billions of icy comets
found in our solar system's Oort cloud



New research resulting from a collaboration between science visualization artists and scientists at the American Museum of Natural History and the Southwest Research Institute suggests that our solar system's Oort cloud—a vast expanse of icy material left over from the birth of our Sun—might display a spiral structure resembling a miniature galaxy. The discovery was made serendipitously, as part of the production process for the Museum's new Hayden Planetarium Space Show [Encounters in the Milky Way](#), which opens to the public on June 9 and illuminates cosmic movements that shape our galactic neighborhood and our place in the universe. The new finding has been published in [The Astrophysical Journal](#).

“As a result of this unique assembly of people and technology, we were able to transform a flat screen simulation of a volume of abstract points into this beautiful theorized three-dimensional representation of our full solar system, which had a spiral structure that no one had ever seen before,” said Museum astrophysicist Jackie Faherty, curator of *Encounters in the Milky Way*. “When we first saw it, we were blown away at this structure that almost looks like a galaxy itself.”

Our Oort cloud is thought to be a shell of billions of icy bodies that surrounds the solar system and extends one-and-a-half light years in every direction, meaning light from our Sun takes a year and a half

to reach its edge. The Oort cloud's existence was first proposed in the 1950s, but its objects are too small and faint to be directly imaged by today's telescopes.

To investigate the Oort cloud, scientists track the trajectories of long-period comets that end up entering the inner solar system but are thought to originate in the Oort cloud region. These comets take a long time to orbit the Sun—millions of years for some—and occasionally enter the inner solar system, where they heat up and start releasing a halo and tail made of gas and dust.

During production for *Encounters in the Milky Way*, Southwest Research Institute scientist David Nesvorný and his colleagues provided a detailed simulation of millions of particles representing the Oort cloud so the Museum could visualize it for the first time in the new Space Show. As the production team experimented with the best way to show the data in this scene, they came across a bright, spiral-shaped structure.

“When I first explore a scientific dataset for our productions, there are often details and structures I find that I personally didn't know about beforehand,” said Jon Parker, the technical director for *Encounters in the Milky Way* and a visual effects artist, who was the first to spot the spiral. “The evident spiral galaxy-like S-shape in the Oort Cloud simulation was one of those details, but I assumed it was a known feature to the research team.”

But it turned out to be a new discovery. The Museum team flagged the finding for Nesvorný's research group, which used a powerful NASA supercomputer called the Pleiades to confirm and further explore the discovery.

The researchers found that the icy spiral is roughly 15,000 astronomical units (au) in length—one au is about 93 million miles. They also determined that this structure persists in the inner Oort cloud to the present day.

It is surprising to make a discovery of this significance,” Nesvorný said. “The math was there but we needed to step back and look at the big picture.”

The scientists suggest that the spiral is likely formed by the position of the solar system relative to a force called the galactic tide, the gravitational pull that comes from the Milky Way galaxy itself.

This is the first time in the 25-year history of Hayden Planetarium Space Shows that a discovery has been made in the production process. But it's not a surprising occurrence to the production team.

“The American Museum of Natural History has a long legacy of presenting the beauty of our planet and the universe in vivid and meticulously accurate ways,” said the Museum's Director of Astrovisualization Carter Emmart, who is also the director of *Encounters in the Milky Way*. “To do that, we foster deep collaborations between scientists, writers, artists, filmmakers, composers, and educators, and that's a perfect situation for the incubation of new ideas and discoveries.”

Encounters in the Milky Way is the seventh Space Show since the iconic Frederick Phineas and Sandra Priest Rose Center for Earth and Space opened at the Museum in 2000. In addition to the Southwest Research Institute, collaborators included more than 20 academic institutions, including the University of Surrey, NASA's Space Telescope Science Institute, the Center for Astrophysics/Harvard & Smithsonian, Technische Universität Berlin, Institute of Science and Technology Austria, and the European Space Agency, among others.

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Image:

While fine-tuning a simulation of the Oort cloud, a vast expanse of ice material left over from the birth of our Sun, the *Encounters in the Milky Way* production team noticed a very clear shape: a structure made of billions of comets and shaped like a spiral-armed galaxy, seen here in a scene from the final Space Show (curving, dusty S-shape behind the Sun).

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