SOLAR SYSTEM STEALS ALIEN COMETS

Halley's, Hale-Bopp and McNaught are some of the most famous comets in our solar system. But as it turns out, they might have come from somewhere else. Rather than forming in our solar system at the same time as our planets, as previously thought, recent research suggests that many comets formed in other solar systems and were captured by ours. This finding could change how scientists study the origins of life and our solar system.

Most of the brightest comets in our solar system come from the Oort cloud — a spherical distribution of comets that extends halfway from the sun to the next nearest star. There are as many comets in the Oort cloud as there are stars in the Milky Way, says planetary scientist Harold Levison of the Southwest Research Institute in Boulder, Colo.

Until now, astronomers thought that the Oort cloud's comets developed in the solar system's protoplanetary disk at the same time as the formation of the outer planets like Uranus and Neptune, which consist largely of ice, much like comets. As the comets orbited the sun, at the far edge of the solar system known as the scattered disk, they got caught in the gravitational pull of one of the outer planets, which then slingshot them out beyond the planetary system, farther away from the sun's gravity, into the Oort cloud.

But the Oort cloud is home to too many comets to be explained by this process, Levison says. There should be about 10 times as many objects in the Oort cloud as there are in the scattered disk in which the comets were thought to have been created. Yet these calculations are off by a factor of up to 100. For there to be so many comets in the Oort cloud, scientists would expect to see many more left behind in the scattered disk than there are, Levison says. "These are huge inconsistencies."

After trying and failing to find a way to rework this model to reflect the low number of comets seen in the scattered disk, Levison says, "we decided that we needed to come up with another source of these Oort cloud comets, and resurrected an idea that came up in the '70s — that these things were captured from other stars."

When this idea came up three decades ago, computing power was not strong enough to correctly calculate the model, Levison says. Approximations were made, the model didn't work, and the idea was rejected. At a loss for any other explanation of the Oort cloud's population, Levison and his team revisited the idea, this time equipped with far more powerful computers. And this time, the model worked, Levison and his colleagues reported in Science. The findings suggest that roughly 90 percent of the comets in the Oort cloud came from the protoplanetary disks of other stars. McNaught, Hale-Bopp and Halley's may be among the alien comets, although Levison is less sure about Halley's.

"I think it's a neat idea. It's plausible," says Michael A'Hearn, an astronomer at the University of Maryland in College Park, who was not involved in the new research. But this idea is very difficult to verify observationally, he says. If the comets were ejected from stars of a similar size to the sun, then they would have been formed in the same way as the comets in our solar system; therefore, our solar system comets and alien comets would look the same. "Basically, you'd be exchanging identical comets," A'Hearn says. And if they aren't identical, he says, it's difficult to know whether that's because they came from another star, or because they formed at different locations within our solar system.

Researchers are trying everything to figure out where comets came from, including crashing scientific instruments into one, as NASA did in 2005 when Deep Impact crashed into comet Tempel 1.

Artwork by Pat Rawlings, courtesy of NASA/JPL/UMD

Aside from shedding light on the origins of comets like Hale-Bopp, this hypothesis could change how scientists study the origins of the solar system. "Most of us who study comets want to use them to constrain what the physical conditions were 4.5 billion years ago in the protoplanetary disk where Earth formed and all the other planets formed. This has implications for how water arrived on Earth, where the organics from which we're made came from — all of this happened in the [protoplanetary] disk," A'Hearn says. "If Hal [Levison] is right, and most of the Oort cloud comets are from other stars, then we cannot make that direct connection."

Bernard Langer