Starring Intelligent Aliens

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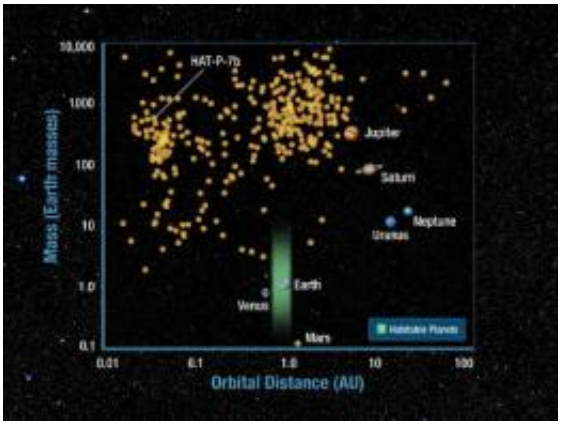

Distributions of mass and orbit size for the extrasolar planets so far discovered. The habitable zone is marked in green. Credit: NASA

The most probable place to find intelligent life in the galaxy is around stars very similar to our sun, a new study has found.

When scientists search the heavens for habitable worlds beyond Earth, they don't necessarily know what to look for. A new study has found that the most probable place to find intelligent life in the galaxy is around stars with roughly the mass of the sun, and surface temperatures between 5,300 and 6,000 Kelvin (9,100 and 10,300 degrees Fahrenheit) - in fact, stars very similar to our own sun.

Learning that sun-like stars are good candidates for life may not sound surprising, but it isn't always what scientists have thought.

"The principle of mediocrity says that, barring any evidence to the contrary, our observations should be typical among those of all intelligent observers," said researcher Daniel Whitmire, a physicist at the University of Louisiana at Lafayette. "But the typical star is not like the sun - the typical star is a low mass star. We don't find ourselves around a typical star and we show the reason why in this paper. Our results confirm the principle of mediocrity as applied to the sun."

Sun-like stars are actually a minority in the galaxy - 93 percent of stars in the Milky Way are less massive, less luminous and cooler than the sun. Though the typical star in the galaxy weighs between one-tenth and half the mass of the sun, life is more likely to be found around the more unusual variety of stars like our own, the researchers found.

To make their calculation, Whitmire and colleague John Matese combined models of how planets form with data on the distribution of stars in the galaxy as a function of mass. The planet models show when worlds are most likely to form in the habitable zone - a Goldilocks region around a star in which a planet would be just right for life - not too close that its surface would be boiling, and not too far that it would be frigid either. Planets in the habitable zone are the best candidates for having liquid water, which is thought to be a prerequisite of life. In general, the planet-formation theories predict that more massive stars are the most likely to have planets in the habitable zone. So the larger a parent star is, the more likely its planets will have environments conducive to life.

But this advantage of larger stars is counteracted by the fact that more massive stars are less abundant - there are fewer big stars out there. In addition, the more massive a star is, the shorter its lifetime. That makes it hard to find very massive stars that have lived long enough for complex life to develop.

The researchers weighed these factors against each other to calculate the distribution of stars most likely to host thinking, living creatures. "It's a tradeoff between the numbers of stars out there and the probability of habitable planet formation increasing with mass." Whitmire said. "We show it's no accident we find ourselves around a star like the sun." The distinction between habitable planets and planets harboring intelligent life is based on the fact that intelligent life requires stars with lifetimes greater than the time required for intelligence to evolve. For example, in the case of this solar system, we could not find ourselves around a star with a lifetime less than 4.5 billion years.

Indeed, sun-like stars seem to have the right balance: They are of high enough mass that they are more likely to host habitable planets, but they are of low enough mass that they live long enough for intelligent life to develop, and are not extremely scarce. Whitmire estimates that 10 percent of the Milky Way's stars might fall into the category they've outlined. This would still leave over 10 billion candidate stars in the Milky Way alone.

The results mitigate the most commonly used argument that intelligent life must be extremely rare, Whitmire said. This idea, based on the anthropic principle, was outlined by astrophysicist Brandon Carter. There is an approximate coincidence between the time it took intelligence to evolve on Earth and the lifetime of the sun. Assuming these two timescales are independent, this coincidence makes sense if intelligent life is extremely improbable, Carter argued. In most cases, he claimed, the time it takes for intelligent life to emerge is much longer than the portion of a star's existence that is conducive to such life.

"In the paper we explain one number in the coincidence - why the lifetime of the sun is what it is," Whitmire said. "The additional assumption necessary to counter the Carter argument is that intelligent life requires at least a few billion years to evolve, as expected if we are

typical."

The study is detailed in the September 2009 issue of the *Astrobiology Journal.*

Source: by Clara Moskowitz, Astrobio.net