

After all of this time searching for aliens, are we stuck with the zoo hypothesis?

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The Karl Jansky Very Large Array at night, with the Milky Way visible in the sky. Credit: NRAO/AUI/NSF; J. Hellerman

In 1950, during a lunchtime conversation with colleagues at the Los Alamos National Laboratory, famed physicist Enrico Fermi asked the

question that launched a hundred (or more) proposed resolutions.
"Where is Everybody?"

In short, given the age of the universe (13.8 billion years), the fact that the solar system has only existed for the past 4.5 billion years, and the fact that the ingredients for life are everywhere in abundance, why haven't we found evidence of extraterrestrial intelligence by now? This came to be the basis of Fermi's Paradox, which remains unresolved to this day.

Interest in Fermi's question has been piqued in recent years thanks to the sheer number of "potentially habitable" exoplanets discovered in distant star systems. Despite that, all attempts to find signs of technological activity ("technosignatures") have come up empty. In a recent study, a team of astrobiologists considered the possible resolutions and concluded that only two possibilities exist. Either [extraterrestrial civilizations](#) (ETCs) are incredibly rare (or non-existent), or they are deliberately avoiding contact with us (aka, the "zoo hypothesis").

The paper, which was recently [published](#) in *Nature Astronomy*, was the work of Ian A. Crawford and Dirk Schulze-Makuch. Crawford is a Professor of Planetary Science and Astrobiology at the School of Natural Sciences and the Center for Planetary Sciences at UCL/Birbeck College, while Schulze-Makuch is a Professor of Planetary Habitability and Astrobiology at the Technical University of Berlin, the GFZ German Research Center for Geosciences, the Leibniz-Institute of Freshwater Ecology and Inland Fisheries, and Washington State University.

The big question

As we addressed in our series, "Beyond Fermi's Paradox," the paradox itself actually began with astronomer (and white nationalist) Michael Hart in 1975. In [a paper](#) titled "Explanation for the Absence of

Extraterrestrials on Earth," Hart argued that given the age of the universe and the relatively short time it would take for an advanced civilization to spread across the Milky Way galaxy (650,000 years, by Hart's estimate), Earth should have been visited by an extraterrestrial civilization (ETC) by now.

In 1980, mathematical physicist and cosmologist Frank J. Tipler built on and refined Hart's arguments with [his paper](#), "Extraterrestrial Intelligent Beings do not Exist." Based on the Copernican Principle, which states that neither humanity nor Earth are in a privileged position to observe the universe. Accordingly, Tipler theorized that an ETC would be assisted by self-replicating robotic explorers (von Neumann probes) that would spread from system to system, facilitating the arrival of settlers later. By Tipler's refined estimate, an ETC would be able to explore the entire galaxy in "less than 300 million years."

This came to be known as the Hart-Tipler Conjecture, which essentially states that the absence of evidence can only be explained by the absence of ETCs. In 1983, Carl Sagan and William Newman produced a [rebuttal paper](#) titled "The Solipsist Approach to Extraterrestrial Intelligence" (aka, "Sagan's Response") where they argued that "the absence of evidence is not the evidence of absence" and took the Hart-Tipler Conjecture to account for the many assumptions it made. They and countless other scientists have proposed potential resolutions for why we haven't seen any ETCs yet.

The great silence persists

Nevertheless, despite decades of observation and SETI surveys, there is still no definitive evidence that advanced extraterrestrial civilizations are out there. For the most part, these have consisted of radio SETI experiments that have observed distant stars and galaxies for indications of radio transmissions. However, other SETI experiments have focused

on anomalous infrared (heat) signatures that could indicate the presence of a megastructure designed to enclose an entire star system—otherwise known as a Dyson Sphere (or Dyson Structure).

Alas, these searches have found no compelling evidence of technosignatures within our galaxy or beyond. According to Crawford and Schulze-Makuch, the "great silence" we perceive when we look out into the universe can only mean one of two things. First, there's the possibility that the Hart-Tipler Conjecture is correct, and there are no advanced ETC out there. Similarly, it may be that intelligent life (or life in general) is rare in the universe due to the odds being stacked against its emergence or evolution (aka, the Great Filter).

If neither of these scenarios is true, we are left with only one answer: The zoo hypothesis is correct and advanced civilizations are keeping their distance to avoid being detected. As Crawford told Universe Today via email:

"There are only two possibilities; either ETI exists, or it does not. As several people have noted over the years, either answer would be astonishing, yet one must be true. All we know is that we see no evidence for ETI, despite the number of planets and the great [age of the universe](#) which would, naively, seem to imply that ETI should exist and perhaps be common. This is the FP. However, if ETI exists there are only two possibilities consistent with the fact that we don't observe them.

"Either we would never expect to observe them because space is so big, etc., [or] we don't observe them because they have taken steps to ensure that we don't (this is the ZH)."

Are we in a zoo?

The term was coined in 1973 by John A. Ball, a Harvard astrophysicist

and scientist with MIT's Haystack Observatory. In a study of the same name, Ball addressed various proposed resolutions to the Fermi Paradox and some common assumptions made by SETI researchers. Among them is the belief that intelligent species exist in our galaxy, that they are older and more advanced than we are, and that they want to make contact with other intelligent species (including us). In contrast, Ball argued that advanced species are "deliberately avoiding interaction and that they have set aside the area in which we live as a zoo."

In summary, the zoo hypothesis predicts that we shall never find them because they do not want to be found, and they have the technological ability to ensure this. This theory is similar to the planetarium hypothesis, which also posits that advanced civilizations have the means to elude detection from our instruments. Unlike the planetarium hypothesis, the zoo hypothesis assumes that the intentions of the ETCs are benign, which could include wanting to avoid interfering with our technological or social development (i.e., the "Prime Directive" from Star Trek).

As to which possibility is more likely to be true—i.e., [intelligent life](#) is non-existent (or extremely rare) vs. they are hiding from us—Crawford and Schulze-Makuch have somewhat opposite views. "For reasons given in the article, my own view is that life (and technological life especially) is likely to be so transformative that we really should see evidence of it if it exists and isn't hiding," said Crawford. "Therefore, I think if it does exist, then probably it must be hiding—aka the ZH. My own view is that it is more likely that ETI does not exist than that it is hiding."

"I think that the zoo hypothesis is more likely," Schulze-Makuch countered. "I believe so because (1) of the Copernican Principle. While I do think that humanity is something very special, being a technologically advanced life form, I can't fathom that we are truly unique or so rare in that capability that—for practical reasons—nothing is out there." The

second reason, said Schulze-Makuch, has to do with the recent release of the so-called UFO Report, which demonstrated that unidentified aerial phenomena (UAP) are far more common than previously known:

"While we can't make a true scientific argument based on these, given their speculative nature, there are so many cases by now, quite a few with multiple lines of evidence, that we cannot simply ignore it. And if some of them can actually be attributed to ETI, it would mean that they don't interfere with Earth matters or at least not to a large extent or clearly visible to us."

This perhaps raises another possible resolution: humanity has been looking for technosignatures in the wrong places. Perhaps, rather than simply observing distant stars for signs of transmissions or other technological activity, we should also look for evidence of advanced civilizations closer to home. This is the path being pursued by Professor Avi Loeb and his colleagues at the Galileo Project, which hopes to complement conventional SETI by searching for evidence of ETC technology and artifacts within our solar system.

What to do?

Regardless of which possibility could be true, there's the inevitable question: How do we find out? According to Crawford and Schulze-Makuch, the only thing we can do is to keep exploring the universe systematically. This includes SETI surveys and searches for ETC artifacts within the solar system because, as they write, "we can only assert an absence of evidence if we have searched for evidence sufficiently hard." In the meantime, exoplanet studies are transitioning from discovery to characterization, which will be aided considerably by next-generation telescopes like the James Webb Space Telescope.

The ability to determine the chemical composition of exoplanet

atmospheres could ultimately reveal indications of life or biological processes ("biosignatures"), thus putting tighter constraints on habitability. As they indicate, "such observations have the potential to constrain the prevalence of abiogenesis in the universe, and possibly also the prevalence of biological complexity and intelligence." Herein lies another difference between the Zoo and the planetarium hypothesis, which is that the former is more likely to be discoverable. As Schulze-Makuch summarized:

"If we are living in a simulation of some sort, we may never find out. But if the zoo hypothesis is correct, we would eventually. Our technology is getting more and more sophisticated, so we would catch up to ETI, and even if ETI could still hide their spacecraft, eventually, we would see their home worlds. But even hiding their spacecraft would get more and more difficult, and as sophisticated as they are, they would not be error-free, and accidents would happen. It is then tempting to attribute some of the UAP sightings as such... and this is still very speculative, but with more and more sensors coming online, we should be able to get a clearer picture soon."

"Given our technological progress (and assuming the zoo hypothesis is correct), I think we might get some proof of ETI within 15 years (and I have bet a bottle of whiskey with Ian on this). But the timeline is, of course, difficult to predict and depends to a large degree also on how fast the progress will be, and how attentive the 'Zoo keepers' are or what their aim is."

As always, all we can do is search in anticipation of what we may find. At this point, there are literally hundreds of scenarios of where ETCs may be and why they've eluded detection for this long. Being able to test these theories with greater and greater precision in the coming years is going to be mighty exciting, almost as exciting as the prospect of finding something someday.

More information: Ian A. Crawford et al, Is the apparent absence of extraterrestrial technological civilizations down to the zoo hypothesis or nothing?, *Nature Astronomy* (2023). [DOI: 10.1038/s41550-023-02134-2](https://doi.org/10.1038/s41550-023-02134-2)

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