

Nonterrestrial artifacts hard to pin down

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(PhysOrg.com) -- Two Pioneer probes left our solar system carrying plaques about humankind, and two Voyager probes will soon join them to gather information about places far out in our galaxy. We can and will send more autonomous probes into outer space, but why have we never found evidence of other civilizations doing the same? A pair of postdoctoral researchers at Penn State, approaching the problem mathematically, shows that we have not looked in enough places to ensure that no extraterrestrial artifacts exist in our solar system.

"The vastness of space, combined with our limited searches to date, implies that any remote unpiloted exploratory probes of [extraterrestrial origin](#) would likely remain unnoticed," report Jacob Haqq-Misra, Rock Ethics Institute, and Ravi Kumar Kopparapu, Earth and Environmental Systems Institute, in a paper accepted by *Acta Astronautica* and posted online on ArXiv.

So far, we have not found any nonterrestrial artifacts in our solar system. The [Fermi paradox](#), originally formulated by [Enrico Fermi](#), asks, if [intelligent life](#) is common, why have no technological civilizations been observed. Answers to this question could include life is rare, intelligent cultures inevitably destroy themselves, intelligent beings have not gotten here yet or they are here but not revealing themselves. Even without actual contact, like us, other civilizations could be sending unpiloted probes to quietly peek at our civilization.

These probes, like ours, would be small and might be hidden in a variety of places. In the [asteroid belt](#) they would probably go unnoticed,

especially if these nonterrestrial objects are only 3 to 33 feet in size, weighing little more than a ton.

"Extraterrestrial artifacts may exist in the solar system without our knowledge simply because we have not yet searched sufficiently," said Haqq-Misra and Kopparapu. "Few if any of the attempts would be capable of detecting a 1 to 10 meter (3 to 33 foot) probe."

Haqq-Misra and Kopparapu use a probabilistic method to determine if we have looked closely enough anywhere in the solar system to definitively say there are no nonterrestrial objects here. The analysis is based on answering the question, how sure can we be that we should have already found any nonterrestrial objects lurking in the solar system.

They view the solar system as a fixed volume and figure out the percentages of that volume that would need to be thoroughly searched using a discovery capability small enough to detect these probes, assuming that the probes are not consciously camouflaged. The researchers note that most searches to date have not been fine enough to locate such small probes or to totally rule out anywhere.

After taking into account a variety of potential biases, such as "the universe is teeming with life" or "life is rare," the team developed an equation that can be applied to a portion of the volume of the solar system and determine whether sufficient searching has been done to ensure that we can say there are no nonterrestrial objects within that volume.

The researchers found that it is, at this point, difficult to say that there are not nonterrestrial objects in our solar system.

"The surface of the Earth is one of the few places in the solar system that has been almost completely examined at a spatial resolution of less

than 3 feet," said Haqq-Misra and Kopparapu.

But even as humans have spread across the solid surfaces of the Earth, there are still caves, jungles and deserts as well as the ocean floor and subsurface areas that have not been explored. Even with this, the Earth does have a high confidence that no nonterrestrial artifacts exist.

The moon and Mars have been searched to a small extent. An ongoing mapping project, the Lunar Reconnaissance Orbiter, is looking at the moon at a resolution of about 20 inches, so we may eventually be able to determine if there are no nonterrestrial objects on the moon. The researchers caution that surface maps may not be sufficient to distinguish between a space probe and a rock.

The surface of Mars is still mostly unsurveyed and the researchers' confidence in the probability of no nonterrestrial artifacts is low. Similarly, locations like the Earth-moon Lagrange points, the asteroid belt and the Kuiper belt might also shelter extra solar system probes, but the vast majority of the solar system's volume is uninvestigated.

"Searches to date of the [solar system](#) are sufficiently incomplete that we cannot rule out the possibility that nonterrestrial artifacts are present and may even be observing us," said Haqq-Misra and Kopparapu. They add that "the completeness of our search for nonterrestrial objects will inevitably increase as we continue to explore the moon, Mars and other nearby regions of space."

Provided by Pennsylvania State University

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