Sustainable Energy

An advanced civilization could resist the accelerating expansion of the universe

And Earth-bound astronomers should be able to tell if someone is out there doing it, a physicist says.

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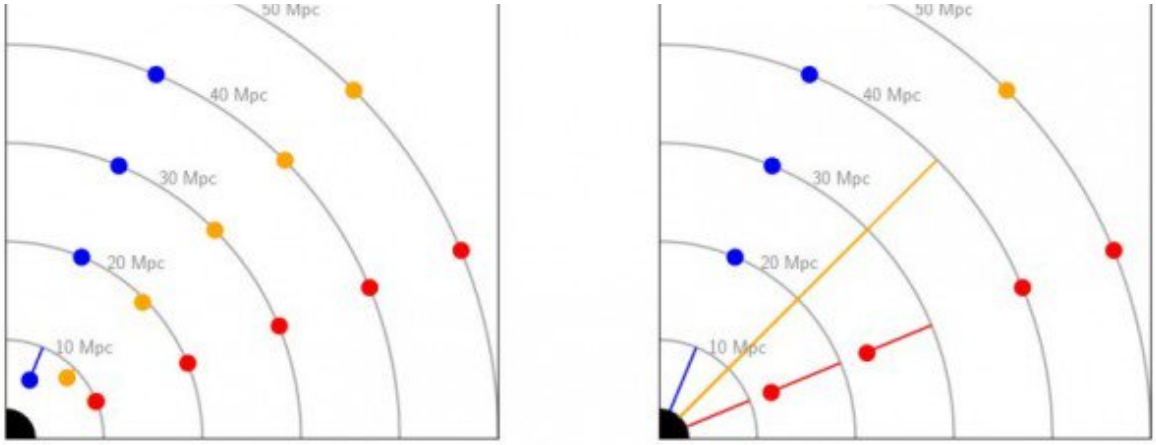
When it comes to existential threats to humanity, some problems are more urgent than others. Disease, nuclear war, famine, asteroid impact: all have a well-studied likelihood of damaging society in the current age. These threats rightly instill a modicum of fear in the hearts and minds of many.

But one threat that is near the bottom of the list is the accelerating expansion of the universe. Indeed, it hasn't been considered a clear threat at all until now.

Today that changes, at least a little, thanks to the work of Dan Hooper, a particle physicist at the Fermi National Accelerator Laboratory in Batavia, Illinois. Hooper points out that we are unable to study, communicate, or influence things beyond the cosmic horizon, which is the maximum distance that light can travel to us within the age of the universe.



There may be plenty of things beyond the cosmic horizon—stars, galaxies, even civilizations. But since light from them can never reach us, we cannot contact or see them.

But the cosmic horizon is changing. Hooper has worked out how this will affect our neighborhood in the universe, which astronomers call the Local Group. This is the set of about 50 nearby galaxies that are gravitationally bound to the Milky Way and on course to collide sometime within the next trillion years to form a single supergalaxy.

Consequently, the Local Group will be humanity's home for the foreseeable future. Over billions of years, we might even colonize it, hopping from one star system to another and exploiting each sun's energy along the way.

However, the accelerating expansion of the universe is sending galaxies over the horizon at a rate that is increasing. "As a result, over the next approximately 100 billion years, all stars residing beyond the Local Group will fall beyond the cosmic horizon and become not only unobservable, but entirely inaccessible," says Hooper.

That's a problem for an advanced civilization because it limits the

So the question that Hooper investigates is whether there is anything an advanced civilization can do to mitigate the effects of this accelerating expansion. And it turns out there is.

First, some background. Back in the 1960s, the legendary physicist Freeman Dyson speculated that advanced civilizations would attempt to gather as much energy from their suns as possible. He suggested that the obvious way to do this was to entirely encircle each star with a sphere that captures all the light produced. This energy can then be exploited and the waste heat radiated into space as sub-millimeter waves or infrared light.

So-called Dyson spheres have achieved cult status. Science fiction writers have penned volumes about them. More important, astronomers have searched for the distinctive radiation signature they must produce, so far unsuccessfully.

Hooper's work adds a new twist to the tale. His idea is that an advanced civilization could build a sphere that emits waste radiation in a specific direction. This radiation would accelerate the sphere—and the star it contains—in the opposite direction.

Over time, an advanced civilization could use this technique to gather stars as a source of energy and thereby keep them inside the cosmic horizon as the universe expands.

An important question is what kind of stars would be suitable for this endeavor. Hooper says that large stars tend to be older and so would run out of juice while being maneuvered. On the other hand, very small stars produce less energy and cannot accelerate quickly. These

horizon.

Hooper's conclusion is that stars of about the same mass as the sun would be best suited to this kind of galactic transport. He says that concentrating stars in this way would increase the amount of energy available to civilizations by a factor of several thousand. And that could keep them going much longer than would otherwise be possible.

There is a measurable prediction from Hooper's work. If advanced civilizations have already begun this star-gathering process, it should be observable to astronomers. "Such a civilization could appear as a region up to tens of megaparsecs in radius in which most or all of the stars lighter than [two solar masses] are surrounded by Dyson Spheres," he concludes.

No doubt astronomers will eagerly search for such a signature.

However, Hooper's work relies on two assumptions. The first is that an advanced civilization will attempt to maximize its energy consumption. That's by no means certain. Perhaps such civilizations will learn how to make do with what they've got. Earth certainly needs to.

The second assumption is that cosmologists are correct in thinking the expansion of the universe is accelerating. Once again, this is no slam dunk.

Many researchers are uncomfortable with the idea that the universe will expand forever, and even more unhappy with the idea that this expansion is accelerating. Perhaps the biggest concern is that this acceleration violates the principle of conservation of energy—a

Advanced civilizations are more likely to have solved this conundrum. So the absence of Dyson spheres in the groups Hooper imagines may just be evidence that our cosmologists have got it wrong.

Ref: arxiv.org/abs/1806.05203 : Life Versus Dark Energy: How An Advanced Civilization Could Resist the Accelerating Expansion of the Universe

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