Gamma ray telescopes could detect starships powered by black hole

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Researchers at WSU have created a fluid with a negative effective mass for the first time, which could open the door to studying the deeper mysteries of the Universe. Credit: ESA/Hubble, ESO, M. Kornmesse

In the course of looking for possible signs of extra-terrestrial intelligence

(ETI), scientists have had to do some really outside-of-the-box thinking. Since it is a foregone conclusion that many ETIs would be older and more technologically advanced than humanity, those engaged in the Search for Extra-Terrestrial Intelligence (SETI) have to consider what a more advanced species would be doing.

A particularly radical idea is that spacefaring civilizations could harness radiation emitted from black holes (Hawking radiation) to generate power. Building on this, Louis Crane, a mathematician from Kansas State University (KSU), recently authored a study that suggests how surveys using gamma telescopes could find evidence of spacecraft powered by tiny artificial black holes.

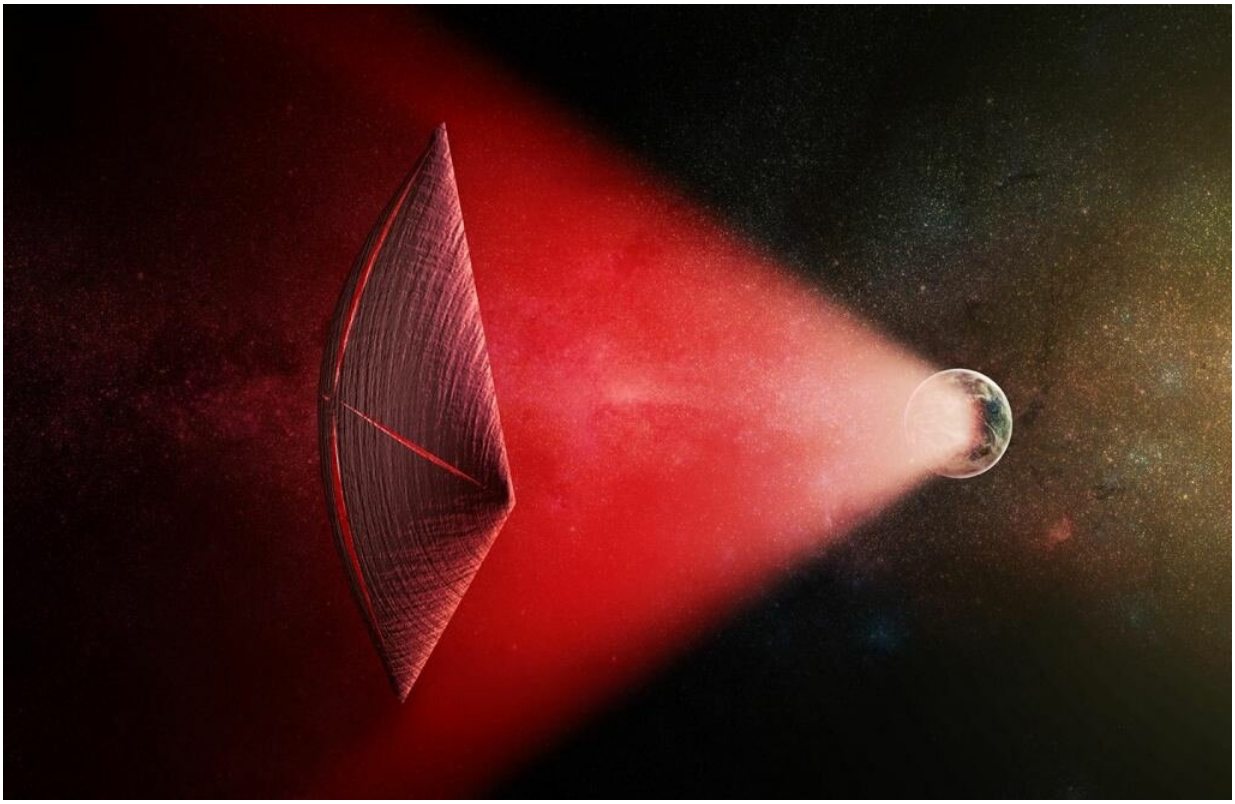
The study, "Searching for Extraterrestrial Civilizations Using gamma Ray Telescopes," recently appeared online. This is the second paper published by Dr. Crane on the subject, the first of which was co-authored by Shawn Moreland (a physics grad student with KSU) and published in 2009 – titled "Are Black Hole Spacecraft Possible?"

In the first paper, Crane and Westmoreland explored the possibility of using Hawking radiation from an artificial black hole. They concluded that it was at the edge of possibility, but that quantum gravity effects (which are currently unknown) could be an issue. In her most recent paper, Crane took things a step further by describing how the resulting gamma-rays such a system would produce could aid in the search for ETIs.

The concept of a black hole-powered spacecraft was first introduced by famed science fiction author Arthur C. Clarke in his 1975 novel *Imperial Earth*. A similar idea was presented by Charles Sheffield in his 1978 short story "Killing Vector." In both cases, Clarke and Sheffield describe how advanced civilizations could extract energy from rotating black holes to meet their energy needs.

Aside from being pure science-fiction gold, the ability to harness a black hole to generate power would offer some pretty hefty advantages. As Dr. Crane described to Universe Today via email: "An advanced civilization would want to harness a microscopic black hole because it could throw in matter and get out energy. It would be the ultimate energy source. In particular, it could propel a starship large enough to be shielded to relativistic velocities. None of the starship concepts NASA studied turned out to be viable… It might be the only possibility."

In addition, the signatures associated with this sort of technological activity (aka "technosignatures") would indicate a very high level of advancement. Given the sheer energy requirements for creating an artificial black hole, plus the technical challenges associated with harnessing it, the process would be beyond anything less than a Type II civilization on the Kardashev Scale.

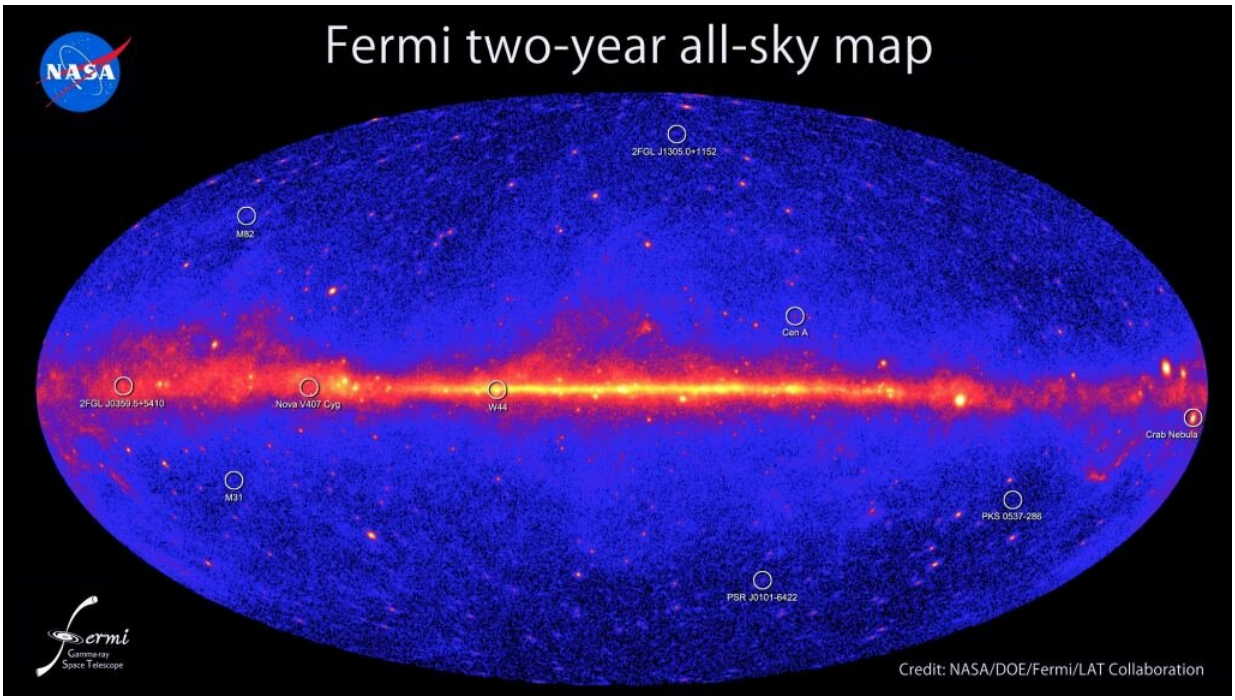


An artist's illustration of a light-sail powered by a directed-energy beam (red) generated on the surface of a planet. The leakage from such beams as they sweep across the sky would appear as errant flashes and indicating the possible existence of an ETI. Credit: M. Weiss/CfA

"To produce an artificial black hole, we would need to focus a billion-ton gamma ray laser to nuclear dimensions," said Dr. Crane. "It's like making as many high-tech nuclear bombs as there are automobiles on Earth. Just the scale of it is beyond the current world economy. A civilization which fully utilized the solar system would have the resources."

That's not even the least of the technical challenges, most of which well are beyond what humanity is capable of. These include the sheer amount of power it would take to power the gamma-ray laser, where this energy would be stored, and how these emissions would be focused onto an atom-sized space. As Crane indicated, there are suggestions for how this could be done, but they remain highly speculative.

Aside from the concept itself, the idea of a black hole-powered civilization is also interesting because of the possibilities that it presents for SETI research. As with other signs of technological activity (a.k.a. "technosignatures"), a civilization harnessing tiny, artificial black holes created with gamma ray lasers could be detectable thanks to a little thing known as "spillover."



Fermi Second catalog of Gamma Ray Sources, constructed over two years and released in 2011. Credit: NASA/DOE/Fermi LAT Collaboration

This concept was described by Prof. Philip Lubin in a 2016 study, where he suggested that evidence of ETIs could be found by searching for signs of directed energy. Consistent with Lubin's own research involving lasers for planetary defense and laser propulsion (for NASA and as part of Breakthrough Starshot), Lubin suggested that errant flashes of laser energy (aka "spillover") could indicate a technologically advanced civilization.

In the same way, SETI researchers could rely on gamma-ray telescopes to search for signs of spillover from gamma ray lasers. Dr. Crane said, "If some advanced civilization already had such starships, current VHE gamma ray telescopes could detect it out to 100 to 1000 light years if we were in its beam. They could be distinguished from natural sources by

their steadily changing redshift over a period of years to decades. To investigate this, astronomers would need to keep time series of frequency curves of the point-like gamma ray sources. This does not seem to be something they currently do."

What is perhaps most exciting, though, is the fact that astronomers may have already found signs of some Type II Kardashev civilizations that use this type of method for energy production. As Dr. Crane explained, several point-like gamma ray sources have been detected in the universe for which no natural explanation has been given.

Future observations using space-based telescopes like the Fermi Gamma-ray Space Telescope (FGST), and ground-based facilities like the High Energy Stereoscopic System (HESS) and the Very Energetic Radiation Imaging Telescope Array System (VERITAS), could reveal whether these sources could actually be artificial in nature.

Coupled with next-generation instruments that have greater resolution and imaging capabilities, gamma-ray laser spillover and other potential technosignatures could be out there, just waiting to be identified. In the meantime, humanity still has a long way to go before it can begin to contemplate building this kind of technology.

Much like Dyson spheres, Alderson disks, space elevators, and the ability to move stars, this kind of Type II megaproject is just going to have to wait humanity can tackle a few smaller challenges. Something more our speed, like finding ways to settle on other planets in our solar system, or learning how to use Earth's resources sustainably.

More information: Searching for Extraterrestrial Civilizations Using gamma Ray Telescopes: arXiv:1902.09985 [gr-qc]
arxiv.org/abs/1902.09985

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