Spreading life throughout the universe

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This is the "South Pillar" region of the star-forming region called the Carina Nebula. Like cracking open a watermelon and finding its seeds, the infrared telescope "busted open" this murky cloud to reveal star embryos tucked inside finger-like pillars of thick dust. Credit: NASA

Panspermia hypothesis proposes that life travels between stars and planets, surviving the effects of interstellar journeys and finally settling down on a planetary surface, beginning new evolutionary processes. The microorganisms can be transported to random destinations by asteroids, comets or meteoroids or distributed intentionally by some intelligent alien civilization. But with Earth as the only example of a life-bearing planet, the essential question is: If panspermia really occurs, how could we detect it?

"It is possible for life to be carried by rocks which are ejected from one planet, after an impact by an asteroid, and land on another planet. This can happen by chance if the two planets are in the same planetary system or, with smaller likelihood, if they are in different systems. Although this process is possible, we have no evidence for it," said Abraham Loeb, chair of the Department of Astronomy at the Harvard University, in an interview with Phys.org.

Loeb is the co-author of a paper published in *Astrophysical Journal Letters* suggesting that if life spreads via panspermia, it does it in a characteristic pattern that we could identify.

His research shows that this pattern would be similar to the outbreak of an epidemic. Loeb compares spreading microbial organisms to an infection with pockets of life. He states that there is a biological similarity between panspermia and disease spread: Any species that evolves panspermia abilities would have enormous fitness advantages. Just as viruses evolved to brave the harsh environment of "inter-host" space to harness the energy of multiple biological hosts, perhaps evolution has or will drive a class of organisms to brave the harsh environment of interstellar space to harness the energy of multiple stellar hosts.

The panspermia theory and the model introduced by Loeb and his colleagues may be the keystone in the search for extraterrestrial life for future generations. Moreover, Loeb believes that we will soon find traces of alien microorganisms.

"In my view, it is likely we will detect evidence for primitive life within the coming decade or two. This first fingerprints of life will probably be identified in the atmospheres of extra-solar planets through spectrographs on the next generation of telescopes," Loeb said.

Researchers look forward to such future instruments as NASA's Transiting Exoplanet Survey Satellite (TESS), which would come in handy when searching for signs of extraterrestrial life. TESS, a space telescope to be launched in August 2017, is designed to be capable of detecting hundreds of Earth-like exoplanets. Ground-based and space-based follow-up observations characterizing exoplanet atmospheres could look for biosignatures such as oxygen in combination with a reducing gas.

But according to Loeb, it is likely that only a few Earth-like exoplanets will be close enough to be biologically characterized with new instruments in the future. Eventually, surveys could test for more specific spectral signatures such as the "red edge" of chlorophyll or even industrial pollution. It is also possible that searches for extraterrestrial intelligence in the radio or optical wavelengths could yield signals that could be tested for clustering.

"Intelligent life can spread intentionally with a higher probability. We have no evidence for that, either. The lack of evidence for the spread of alien civilizations despite the large number of stars in our galaxy is known as the Fermi Paradox," Loeb noted.

The famous question, "Where is everybody?" remains unanswered, even though we are developing more tools enabling increasingly detailed searches for alien life forms. With Loeb's words in mind, it may be that if we are successful in finding extraterrestrial life, it is highly probable that the seeds of life sent intentionally by an advanced intelligent civilization will be found first.

More information: Statistical Signatures of Panspermia in Exoplanet

Surveys, arXiv:1507.05614 [astro-ph.EP] arxiv.org/abs/1507.05614

Abstract
A fundamental astrobiological question is whether life can be transported between extrasolar systems. We propose a new strategy to answer this question based on the principle that life which arose via spreading will exhibit more clustering than life which arose spontaneously. We develop simple statistical models of panspermia to illustrate observable consequences of these excess correlations. Future searches for biosignatures in the atmospheres of exoplanets could test these predictions: a smoking gun signature of panspermia would be the detection of large regions in the Milky Way where life saturates its environment interspersed with voids where life is very uncommon. In a favorable scenario, detection of as few as ~25 biologically active exoplanets could yield a 5σ detection of panspermia. Detectability of position-space correlations is possible unless the timescale for life to become observable once seeded is longer than the timescale for stars to redistribute in the Milky Way.