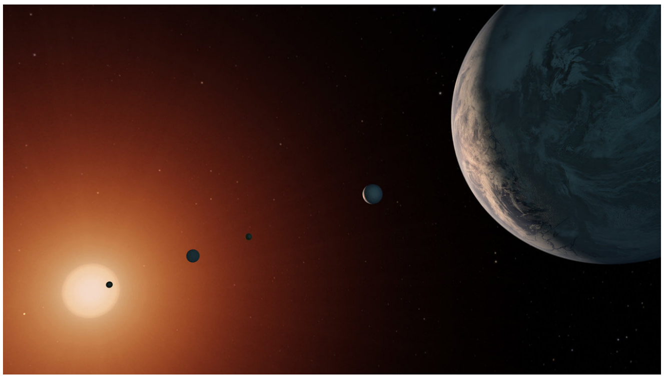
Sharing life with the planets next door

30 October 2018, by Starre Vartan



An artist's impression of the TRAPPIST-1 planetary system. Credit: SETI Institute

How life could be shared between planets in close proximity to one another has received a greater insight thanks to new analytics based on previously known and new calculations. The findings are allowing researchers to understand how likely life might be on a given planet in such tight-knit systems if that world shows signs of habitability.

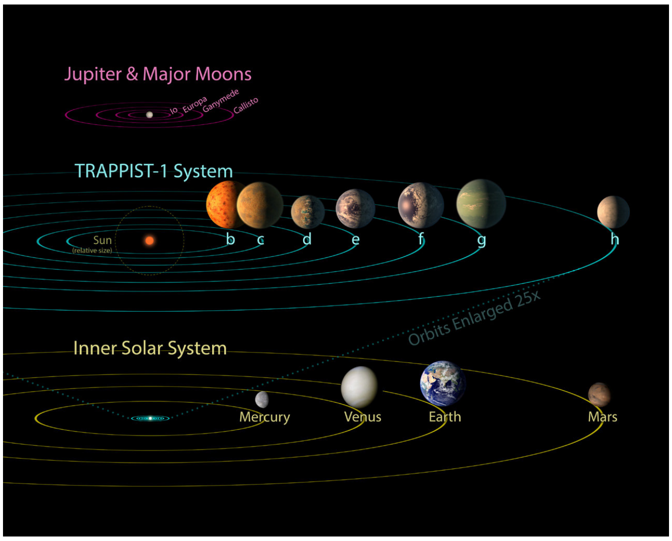
It began with a blasphemous-at-the-time idea: that life exists throughout the universe, and it can travel without supernatural interference. Anaxagoras, a 5th-century BC Greek philosopher, called this concept 'panspermia'. Kelvin, Helmholtz and Arrhenius advanced the idea in the 19th and 20th centuries by examining how life could be carried to and from Earth. In 2009, Stephen Hawking went beyond our solar system with the idea when he suggested that "Life could spread from planet to planet or from stellar system to stellar system, carried on meteors."

Dr. Dimitri Veras, an astrophysicist at the University of Warwick in the UK, and lead author of a new paper on the subject, says that, "Within the last century, [panspermia] has been focused on life transport within the solar system, including Earth."

The TRAPPIST-1 system, which is 41 light years away and includes seven planets packed into an orbit smaller than Mercury's, changes this Earth-centric idea. The TRAPPIST-1 sun is an ultra-cool red dwarf, so even though the seven nearby planets orbit closely, they are possibly all still in the habitable zone for life, to varying degrees depending upon the make-up of their atmospheres. That makes them a perfect model for exploring the idea of panspermia, per Hawking, anywhere in the universe.

Three stages

But back to our solar system, where the "foundation for panspermia-related processes has been established," according to Veras' paper. That includes evidence that life can survive the three stages of traveling from one planet to another: initial ejection, the journey through space between planets, and impact onto a new planet. Each stage presents challenges to the survival of life, of course.



The orbits of the planets of the TRAPPIST-1 system are tightly arranged, especially when compared to our Solar System or even the moons of Jupiter, increasing the chances that life could be shared between them. Credit: NASA/JPL–Caltech

Veras wanted to create an analytical system to quantify each of these parts to create a better understanding of the probability of the whole.

He had some information to start with: Microbes can possibly survive ejection from a planet with life on it, as per previous studies, and even a voyage through interplanetary space, if shielded from the radiation and cold. Less is known about how well a microbe that endured space travel could survive impact on a new planet, which would be necessary for life to complete the voyage from one planet to another.

Since impact includes more unknowns than ejection and transit between planets, Veras had less-detailed information to work with in this area of his calculations. "The physics of re-entry features complexities that are not present with the ejection and voyage phases through space," he says. "For example, frictional heating during re-entry can lead to the formation of a fusion crust [the outer layer of the meteorite that melts and ablates during atmospheric entry] on the surface of the meteorite."

When it came to figuring out how to calculate the tricky physics of atmospheric entry onto a new planet, Veras tells Astrobiology Magazine that, "Equations regarding the physics of impact have already been established and used for solar system applications [so] we converted those for use in a general extra-solar system."

To understand the probability of ejected material traveling from one planet to another, Veras combined his equations into analytics as a way to figure out the whole system of panspermia, not just parts of it.

"Usually, the dynamics of panspermia is studied with numerical simulations, however, these can be slow to run and must be tailored to an individual system," says Veras. "Alternatively, analytics are much faster to use and are general enough to be applicable to a wide variety of systems."

Sharing life

Now that there's an observable multi-planet system – TRAPPIST-1 – with more than one world in the habitable zone, astrobiologists can use these analytics to understand the probability of life being shared between planets in these extra-solar locales. The closeness of the planets in this new system means that the chance they can share material is high. Can Veras' analytics guarantee that, if life began on one of the planets, that life may then existor not exist thanks to panspermia on a given planet? His equations are not meant to do that – Veras admits that they are "not exact," but "provide a sufficiently good approximation," – but rather their aim is to give astrobiologists another tool with which to assess new planetary systems.

Amaya Moro-Martin, an astronomer at the Space Telescope Science Institute in Maryland, who has previously published a paper on the probability of panspermia between different planetary systems, says Veras' analytics are "An impressive piece of work that takes into account a wide range of physical processes that are involved in panspermia."

Looking forward, Moro-Martin thinks Veras' work will be useful for when new planetary systems are discovered. "The framework that it establishes will help others assess whether, from the dynamical point of view, panspermia could have been feasible, given the system characteristics," she says.

Astrobiologists need to ensure that they are not limiting life to what's already known; aliens could look very different from what we expect. ""The difficulty here is that the experiments that test survival against the hazards of outer space and atmospheric entry will be based on the organisms we are familiar with, and we have no clue what extra-solar organisms might be like," says Moro-Martin, "which opens a fascinating world of possibilities."

More information: Dimitri Veras et al. Dynamical and Biological Panspermia Constraints Within Multiplanet Exosystems, *Astrobiology* (2018). DOI: 10.1089/ast.2017.1786

beyond at www.astrobio.net .

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