First Habitable Exoplanet Orbits Red Dwarf Star

BY CASSIE RYAN
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French astrophysicists have determined that a rocky planet 20 light-years from Earth is the first planet outside our solar system—an exoplanet—that is in the habitable zone.

Gliese 581d is one of several exoplanets in a system orbiting a red dwarf star, Gliese 581, which has already received considerable attention since its discovery in 2007. Last September, Gliese 581g was controversially proposed as a Goldilocks planet, capable of supporting life. Since then, doubt has been cast on its existence.

Now, scientists from the Institut Pierre Simon Laplace in Paris have used new computer modeling techniques that can simulate exoplanet climates and surfaces in 3-D to predict that Gliese 581d, initially thought to be too cold to support life, may be warm and wet enough for Earth-like life to exist there.

Gliese 581d is approximately double Earth's size, with a mass at least seven times that of our planet. With a permanent day and night side, and less than one-third of the stellar energy that shines on Earth, the exoplanet seems unlikely to be habitable as an atmosphere thick enough for warming would probably freeze out on the night side.

However, the team's climate simulations demonstrate that Gliese 581d has "a stable atmosphere and surface liquid water for a wide range of plausible cases, making it the first confirmed super-Earth (exoplanet of 2–10 Earth masses) in the habitable zone," as stated in the abstract of the study, which is published in The Astrophysical Journal Letters.

According to a press release from France's National Center for Scientific Research (CNRS), if Gliese 581d is modeled to have a dense carbon dioxide atmosphere, which is a likely scenario, its climate is "not only stable against collapse, but warm enough to have oceans, clouds, and rainfall."

As the starlight from Gliese 581 is red, light can travel much further into the planet's carbon dioxide atmosphere, creating heat via the greenhouse effect. In our solar system, this would not be possible due to Rayleigh scattering whereby a thick atmosphere reflects the blue component of sunlight back into space, causing Earth's sky to be blue.

The modeling also shows that the atmosphere efficiently redistributes daylight heating around the planet through the atmosphere, preventing atmospheric collapse on the poles and the night side.

The institute's press release states that in the future, telescopes will be able to detect the exoplanet's atmosphere directly because it is relatively close to Earth. The team has devised several simple tests that will allow future observers to glean other information, such as whether Gliese 581d has retained some atmospheric hydrogen, like Uranus or Neptune.

As well as being bathed in red light, the planet's large mass means that its surface gravity would be approximately twice that of Earth's, suggesting that life-supporting planets may not need to be particularly Earth-like at all, according to the release.

ESO/L. CALÇADA

HABITABLE ZONE: An artist's impression of the Gliese 581 planetary system. New research suggests that the planet Gliese 581d could be warm and wet enough to support life.

Study: Does Guilt Promote Cooperative Behavior?

BY CASSIE RYAN
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Social decision-making behavior could be based on a compromise between personal gain and feelings of guilt, according to a new study published in the journal Neuron.

The notion of cooperation at personal cost is a problem that has vexed classical economics, which holds that people are solely motivated by self-interest. However, it cannot explain why people cooperate in spite of costs such as time, money, and stress.

Possible explanations could be that giving feels inherently good, or alternatively that being selfish makes people feel bad so they cooperate to avert their guilt.

A research team comprising cognitive neuroscientists and economists studied a group of 30 volunteers who played the trust game. In the game, player 1, the investor, had to decide how much money to award to player 2, the trustee.

This behavior, in turn, elicited expectations in the trustee about how much the investor expected to receive back. The trustees' brains were then scanned using functional magnetic resonance imaging (fMRI) to determine which areas of their brains were involved while they decided how much money to return to the investors, that is, whether or not to honor their partners' trust.

The results of the study fit a model wherein the decision maximized financial reward while minimizing anticipated guilt. When trustees matched investors' expectations, regions of the brain associated with negative effect and sympathy were active, whereas when they gave less than expected, the brain regions involved with value and monetary reward were in use.

"We believe these results are exciting because they provide support for the theory of moral sentiments, in which people appear to have competing motivations to, on the one hand, minimize the experience of future guilt, and on the other, to maximize the financial reward," said co-author Alan Sanfey from the Donders Institute for Brain, Mind & Behavior at Radboud University Nijmegen in the Netherlands, in a supplementary video accompanying the paper.

"This provides good evidence in our opinion that negative emotions such as guilt can also be responsible for cooperative behavior, and provide additional important clues as to why we often cooperate at a personal cost," he added.

The team concluded that a neural system associated with "expectation processing plays a critical role in assessing moral sentiments that in turn can sustain human cooperation in the face of temptation," according to the study's abstract.

Ants Give Insights Into Social Networks

BY CASSIE RYAN
EPOCH TIMES STAFF

ANT colonies may not be as organized as previously thought, according to a study published in the Public Library of Science on May 20.

In the past, social networks such as ant colonies were believed to have a unifying structure where self-directed interacting parts contribute to overall goals.

"Think of a city with many people or the Internet with many computers," said co-author Benjamin Blonder at the University of Arizona in a press release. "You have all these parts doing their own thing and somehow achieving some greater function."

The scientists relocated four different-sized wild colonies of the ant Temnothorax rugatulus to the lab, and recorded around 9,000 sensory interactions between 300 to 400 individuals using high-definition video.

Ants can see, but the majority of their sensory input is thought to be through chemosensory touch.

"To understand an interaction network, you need to know who all the individuals are," Blonder said. "You need to be able to tell any two individuals apart. We accomplished it by painting each ant with a unique color code."

Surprisingly, the researchers found that the ants do not spread information at all efficiently, and actually less so than if they were just bumping into each other at random.

"We were able to show that the real ants consistently had rates of information flow that were lower than even that expectation," Blonder said. "Not only are they not efficient, they're also slower than random. They're actually avoiding each other."

Blonder said the study raised a big question about why messages are not passed from one part of the colongy to another when there seem to be plenty of good reasons for this to be the optimal strategy.

Perhaps ants are responsible for various areas and only communicate with other individuals within that area. Alternatively, as Blonder said, "If you spend too much time interacting, then you're not actually getting anything done."

The study also emphasizes the importance of timing in network interactions.

"In some contexts it's clearly better not to spread information as quickly and then the question becomes understanding in what context it's good to be efficient and in what context it's not good to be efficient," Blonder said.

Dark Energy's Nature Further Revealed in Space Survey

BY CASSIE RYAN
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DARK energy is real and, counterposed by gravity, is causing runaway expansion of the universe, according to the results of a five-year survey of more than 200,000 galaxies across seven billion years of time.

Led by Chris Blake at Swinburne University of Technology in Melbourne, Australia, a team of 26 astronomers took part in the WiggleZ Dark Energy Survey, using NASA's Galaxy Evolution Explorer telescope in space and the Anglo-Australian Telescope in Australia to map galactic distribution across a vast expanse of the universe.

The scientists found that dark energy appears to be a constant force, uniformly driving the cosmos apart at ever-accelerating speeds.

Albert Einstein hypothesized that there is a constant force that opposes gravity and prevents the universe from collapsing. But he later called this his biggest blunder, and an alternative theory arose that gravity acts as this force.

However, studies of the brightness of distant supernovae or exploding stars in the late 1990s led astronomers to realize that the universe is expanding at an increasing rate, and the dark energy hypothesis regained credence.

"WiggleZ says dark energy is real," said Blake in a university press release. "Einstein remains untoppled."

"The action of dark energy is as if you threw a ball up in the air, and it kept speeding upward into the sky faster and faster," said Blake in a NASA press release.

"The results tell us that dark energy is a cosmological constant, as Einstein proposed. If gravity were the culprit, then we wouldn't be seeing these constant effects of dark energy throughout time."

The survey results were checked against two other kinds of observations—the pattern of galactic distribution in space, and how quickly galaxy clusters form over time.

"Although the exact physics required to explain dark energy still remains a mystery, knowing that dark energy exists has advanced astronomers' understanding of the origin, evolution and fate of the universe," said co-author Warrick Couch at Swinburne University, according to the university release.

The team's findings appear in two papers recently published in Monthly Notices of the Royal Astronomical Society.