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One planet is too hot for life, one may be just right

By Dennis Overbye
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So much for the Goldilocks planet.

Astronomers and ordinary people alike were cheered at the discovery in April of a new planet only five times the mass of the Earth circling a dim star in Libra. The planet, known as Gliese 581c, orbits at a distance of about 7 million miles, within the star's so-called habitable zone where it is neither too hot nor too cold for water to exist on its surface, making it the most promising spot for life yet found outside the solar system.

"On the treasure map of the universe, one would be tempted to mark this planet with an X," said one member of the discovery team, Xavier Delfosse of Grenoble University in France.

"Everybody got excited," said Manfred Cuntz, an astronomer at the University of Texas at Arlington.

Now, however, it seems that Gliese 581c is no paradise. A new analysis by German and Texas astronomers assuming Earthlike characteristics for its geology and atmosphere has concluded that the planet is probably a stifling greenhouse unsuitable for Life As We Know It.

"It's just too hot," said Cuntz, who was part of a team of theorists led by Werner von Bloh of the Potsdam Institute for Climate Impact Research, in Germany. He added, "I would not recommend mankind to move to that planet right now."

In a strange twist, however, the astronomers said another planet in the system, heavier at eight times the mass of Earth and farther from its star, had emerged from the calculations as possibly a pleasant abode, the new Goldilocks.

The planet, Gliese 581d, orbits at a distance of 23 million miles, which would normally make it too cold for liquid water, but the same greenhouse effect that would torch the smaller, closer planet would warm the larger outer one and make it livable.

"We cannot cool down an atmosphere of a planet," Cuntz explained, "but we can heat it up."

In a paper that has been submitted to the journal Astronomy and Astrophysics, he and his colleagues wrote about the outer planet, Gliese 581d, "Despite the adverse conditions of this planet, at least some primitive forms of life may be able to exist on its surface."

But other astronomers, while agreeing that there was an emerging consensus that 581c was too hot for life, described the new paper as speculative, resting on assumptions about how closely the Gliese planets resembled the Earth.

The main lesson, said Sara Seager, a planetary theorist at the Massachusetts Institute of Technology, is that the idea of habitability is much more complicated than just the locations of planetary orbits.

"The properties of the planet come into play," Seager said.

"Astronomers are going to realize just how complicated the idea of habitability is," she said. "The whole of astronomy is built on not knowing anything."

The Goldilocks planet was discovered by a group led by Stephane Udry of the Geneva Observatory, who said their initial estimates of its temperature and habitability had been based on its having only a thin atmosphere. He agreed that a thicker atmosphere would heat it up.

Dimitar D. Sasselov of the Harvard-Smithsonian Center for Astrophysics, who has also been studying the Gliese system, agreed that it was reasonable to expect that the greenhouse effect would warm the outer planet to comfortable temperatures. "I would trust that result because I am getting the same numbers," he said in an e-mail message from Greece.

But, as Seager emphasized, it remains to be seen which models of earthly geology and climate can be safely and appropriately extrapolated to the much more massive Gliese planets. All astronomers really know now about these planets are their masses and orbits.

Another complication is that the planets are so close to their star that they are almost certainly tidally locked, with the same side always facing the star, leading to constant heating on one side and cooling on the other. The resulting extreme weather, Cuntz said, made it likely that only simple forms of life could exist on Gliese 581d, the outer planet.

Astronomers are not likely to know more about these planets until space missions like NASA's Terrestrial Planet Finders and the European Space Agency's Darwin, designed to study terrestrial planets in the realms beyond our solar system, are in operation.

Cuntz said, "We really have to do more work." The Gliese planets, he said, are still the closest analogues to the Earth that have been found. "This is really to the credit of the Swiss group," he said.

"These two planets are really the best two cases we have."

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