

## Unearthing another Earth

By David Van Meter

UT Arlington Associate Professor of Physics Manfred Cuntz and fellow scientists working at the Potsdam Institute for Climate Impact Research in Germany recently made one giant-step closer to answering the question that has probably plagued man since he first looked up into the starry night sky: "Is anyone out there?"

With the help of a model for the evolution of Earth-like planets, coupled with a climate model, they were able to demonstrate habitable conditions on Gliese 581d, a planet in the constellation Libra, 20 light years away.

Last spring a European Space Agency team working in Chile had discovered two "Super Earths," far away from our solar system. Labeled Gliese 581c and Gliese 581d, these planets are called Super Earths, because they have masses of up to 10 times the size of Earth. They are different from most planets recently found outside the solar system, because they are much more similar to Saturn or Jupiter.

Those scientists thought that Gliese 581c—the smaller of the two planets at five times the size of Earth—contained the elements and an atmosphere that would enable "something" to survive. Turns out that is not the case, a fact established by Cuntz's mathematical analysis.

"Gliese 581c is just too hot for life to exist," said Cuntz, who collaborated with the team of Werner von Bloh at the Potsdam Institute. "Owing to the fact that the planet is too close to its host star, it is just like Venus. It is simply too close to its sun."

Along with the research team, Cuntz prepared a report on their findings for *Astronomy and Astrophysics*, one of the most prestigious journals in astrophysics. The report shows it is actually the larger, colder Gliese 581d that probably has a life support system in place. Eight times the size of Earth, this planet sits in a "tidally locked" state. That is, when moving along its orbit, it doesn't spin on its axis like Earth.

Cuntz said he had always been very interested in planets in the process of formation to be found around young stars. "I have always wanted to be a witness of newly formed planets."

And life on those planets?

"Typically, scientists like the idea of life on planets because that opens the possibility of more interesting studies," he said.

Cuntz and his colleagues, physics professor Zdzislaw Musielak and graduate student Jason Eberle, were aiming their studies at planets around many different stars, long before Gliese 581c proved it was not another Earth.

The trick to finding life on other planets is to think like Goldilocks: "not too hot, not too cold, but just right." That's what researchers like Cuntz call the zone where life has the chance to survive and to evolve. Orbiting at a distance of 23 million miles from its parent star, Gliese 581d is far too cold for liquid water, unless there was extra heating. But Gliese 581d is expected to have incredible amounts of greenhouse gases, Cuntz said. A bad sign for a planet like Earth, those gases are what make an unlivable planet like Gliese 581d livable.

Through months of investigations, he conducted extensive data verifications while other research team members studied climatology. The team studied how long Gliese 581d had been around (perhaps 2 billion years, but maybe as long as Earth), where its orbit takes it now and what its current surface climate is like.

Gliese 581c had proved unlivable because greenhouse gases keep temperatures intolerably hot, largely because the planet is three times closer to its parent star than Gliese 581d. That same carbon dioxide provides thermal insulation for Gliese 581d, stopping the temperature from being extremely freezing cold. Consequently, life has a chance to begin, if it hasn't already.

Harvard-Smithsonian astrophysicist Dimitar Sasselov agreed in *The New York Times* that greenhouse gases are good in this case.

"I would trust that result," he said of Cuntz's work, "because I'm getting the same numbers."

How good is the data? Good enough to turn once unrealistic missions into explorations whose plans and funding are now under way. Jane Platt, media relations specialist at Jet Propulsion Laboratories in California, said

plans have begun for NASA's Terrestrial Planet Finder and the European Space Agency's Darwin to study terrestrial planets beyond Earth's solar system. The mission will attempt to detect biomarkers, molecules that indicate if living organisms are or were present, in the atmospheres of planets like those around Gliese 581.

Steven Dick, NASA's chief historian, has long maintained that a biologically based (versus a machine-based intelligence) technological civilization is a brief phenomenon limited to a few thousand years and "exists in the universe in the proportion of one thousand to one billion, so that only one in a million civilizations are biological."

Cuntz, however, says that there is no way to be absolutely certain about those odds.

"We really have to do more work," he says with a smile, "but we may not be alone."

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