Stellar eclipse gives glimpse of exoplanet

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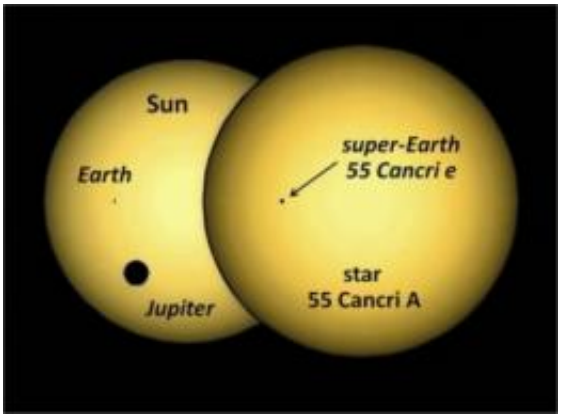

A rendering of the silhouette of 55 Cancri e transiting its parent star, compared to the Earth and Jupiter transiting our sun. Image: Jason Rowe, NASA/Ames; Jaymie Matthews, UBC

A group of astronomers led by an MIT professor has spotted an exoplanetary eclipse of a star only 40 light years away — right around the corner, astronomically speaking — revealing a "super-Earth."

The far-out planet, named *55 Cancri e*, is twice as big as Earth and nearly nine times more massive. It is most likely composed of rocky material, similar to Earth, supplemented with light elements such as water and hydrogen gas. Scientists estimate the planet's surface is much hotter than ours: close to 2,700 degrees Celsius.

Exoplanets — planets outside our own solar system — have captivated astronomers in recent years as interest in finding life on other Earth-like

planets has intensified.

But Josh Winn, the Class of 1942 Career Development Assistant Professor of Physics at MIT, says exobiologists should probably not flock to *55 Cancri e* looking for signs of life: The temperatures are just too high to sustain living organisms. But he suspects the exoplanet will attract the telescopes of many astronomers, mainly for reasons of visibility: *55 Cancri e* is relatively close to Earth compared to other known exoplanets, and, as a result, the star around which the planet orbits appears roughly 100 times brighter than any other star with an eclipsing planet.

“Everything we do in astronomy is starving for more light,” Winn says. “The more light a star gives you, the more chances you have of learning something interesting … and everyone’s been waiting for a system like this that you can study in great detail.”

An 18-hour year

Winn and his colleagues collected starlight data continuously for two weeks from Canada’s Microvariability and Oscillations of Stars space telescope, called “MOST” for short. They directed the satellite scope toward *55 Cancri e* based on a tip from doctoral student Rebekah Dawson of the Harvard-Smithsonian Center for Astrophysics. Last year, Dawson published a mathematical analysis of existing data on *55 Cancri e*, and found it took the planet 18 hours to orbit its star.

Her results suggested *55 Cancri e* was much closer to its star than previously thought, and Winn immediately saw an opportunity to catch sight of an eclipse.

“If [a planet] is just hugging the star, there’s a greater chance of an eclipse, versus if the planet is really far out, in which case you have to be

luckier to see it right in front of the star," he says.

An eclipse has the potential to unlock many mysteries about an exoplanet. For example, astronomers can identify a planet's diameter, mass, composition and atmospheric conditions by measuring the differences in light as a planet passes in front of, or "transits," its star. However, only a handful of rocky exoplanets have been known to transit, and every one of them eclipses a faint star.

'A firefly across a searchlight'

For two weeks, Winn and his colleagues tracked the brightness of *55 Cancri e*'s super-bright star, discovering tiny dips in the data that occurred every 18 hours, a finding that confirmed Dawson's original theory by suggesting the occurrence of an exoplanetary eclipse.

Andrew Howard, a research astronomer at the University of California at Berkeley who was not involved in this study, said spotting such a miniature eclipse in deep space is no small feat.

"This is like looking for a firefly crawling across a searchlight [by] looking for the decreasing brightness of that searchlight from 1,000 kilometers away," Howard says, adding that planet hunters now have plenty of high-quality data to play with in learning more about *55 Cancri e*'s atmosphere and composition. "This is just a new world," Howard says.

The results of the study have been accepted for publication in *The Astrophysical Journal Letters*. Winn hopes the study will prompt astronomers to explore *55 Cancri e* with their own tools and telescopes.

Dawson's findings prompted another group at MIT to investigate the rocky exoplanet. Sara Seager, the Ellen Swallow Richards Professor of

Extrasolar Planets at MIT, and Brice-Olivier Demory, a postdoc in the Department of Earth, Atmospheric and Planetary Sciences, detected a transit of *55 Cancri e* using NASA's Warm Spitzer, a powerful infrared space telescope. From the spectral data they collected, the group calculated the planet's dimensions, confirming Winn's calculations.

Demory and Seager plan to commandeer the telescope again next year to catch the planet, this time behind its star. By measuring the difference between the light given off from the planet in front of and behind its star, the group could determine exactly how much light the planet itself gives off, which could in turn give researchers clues about the planet's atmospheric composition.

"It's still going to be hard to learn everything about this planet," Winn says. "But at least we have what might be the best system in the sky to study it."

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