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**SPACE**

**Signs of Alien Air Herald a New Era of Exoplanet Discoveries**

New efforts hint that nearby world GJ 1132 b may have an Earth-like atmosphere with water and methane

By Mara Johnson-Groh on January 23, 2017

This artist’s rendition shows the Earth-mass planet GJ 1132b circling its parent star. New observations suggest the planet’s thick atmosphere may harbor water or methane. *Credit: Dana Berry / Skyworks Digital / CfA*
For astronomers seeking Earth twins around other stars, the exoplanet GJ 1132 b probably isn’t an identical sibling—but it may be the closest cousin yet found. It weighs in at just over one Earth mass, but circles its star in a warm orbit that could make it more like Venus than our own world. Moreover, its diameter is nearly 50 percent larger than that of Earth, suggesting it possesses a thick atmosphere. Now, after taking the closest-ever look at GJ 1132 b, a European collaboration has confirmed the presence of its atmosphere and found hints it might contain water and methane. The results are currently under review for publication in *The Astrophysical Journal*.

As mere discoveries of exoplanets become routine, efforts to learn more about them—their compositions, climates and histories—are moving to the fore, with studies of their atmospheres occupying center stage. Although astronomers detected the first exoplanet atmosphere more than 15 years ago, they have only managed to observe a handful ever since, mostly for very hot worlds as big as Jupiter or even larger. With their first glimpse of GJ 1132 b’s alien air, astronomers are now entering a new frontier as they examine the atmospheres of smaller, more Earth-like worlds.

“We have shown that an Earth-mass planet is capable of sustaining a thick atmosphere,” says John Southworth, lecturer in astrophysics at Keele University in England and lead author on the discovery paper. “This is one step towards investigating whether a planet could host life.”

Finding the tenuous atmospheres around other worlds strains the limits of current technology. Luckily, GJ 1132 b has the advantage of being relatively easy to study, because it is only 39 light-years away—just a hop, skip and a jump across our cosmic neighborhood. It also orbits an M-dwarf, the smallest and coolest type of star, which allows astronomers to more readily probe the planet’s atmosphere.

“Detecting the atmosphere of Earth-sized planets around M-dwarfs is an essential step in the search for habitable exoplanets,” says astronomer Julien de Wit, postdoctoral researcher at Massachusetts Institute of Technology unaffiliated with the study. “The
concern, however, is that they may not always be able to sustain an atmosphere because of the potential history of strong activity of their star. Finding one with an atmosphere would provide us with hope.”

The team studied GJ 1132 b’s atmosphere using a variation on the “transit” planet-detection method, in which a world traverses the face of its star as seen from Earth. As the planet crosses its star, it blocks a small portion of the star’s total light and casts a planetary shadow toward our solar system. A planet’s atmosphere will absorb a tiny fraction of starlight around the shadow’s edges, filtering out certain wavelengths in accordance with its composition. Gathering enough light to discern this minuscule effect usually requires observing multiple transits using some of the world’s most powerful telescopes.

Using the MPG/ESO 2.2 meter telescope at the European Southern Observatory in Chile, the team monitored nine transits of GJ 1132 b across a wide range of wavelengths, from optical to near-infrared. The measurements allowed them to line up a simple spectrum, which shows the amount of light at each wavelength. Their results showed extra absorption at certain wavelengths—indicating the possibility of water and/or methane in GJ 1132 b’s atmosphere in approximately equal proportions as is found in Earth’s air.

Because astronomers have good measures for both the mass and the size of GJ 1132 b, they can estimate the planet’s density—and thus its possible composition. Given that the atmosphere may contain water vapor, one model suggests the planet could be a steamy space oasis with a substantial envelope of water surrounding a rocky core. Other models with rockier compositions are also possible, however, and the mass measurements are not detailed enough to wholly confirm the exact interior makeup. “Our own observations have shown that it has an atmosphere, but we have not been able to put many constraints on what the atmosphere is actually made of,” Southworth says. “The next step is to take observations with bigger telescopes, and space telescopes, covering a bigger wavelength range at a much better resolution.”

Given the limitations of current instruments, it will fall to the next generation of telescopes such as the James Webb Space Telescope (JWST) to glean more information about the nature of Earth-size exoplanet atmospheres. “The James Webb Space Telescope will be able to measure the spectra of exoplanets in great detail, and perhaps GJ 1132 b will be one of the more interesting exoplanets to be observed extensively” with the JWST, says Renyu Hu, a planetary scientist at the NASA Jet Propulsion Laboratory. “We will continue
to see astronomers pushing the limits, towards better spectra of smaller and perhaps more temperate exoplanets.”

Boasting a mirror some six times the size of the Hubble Space Telescope’s, JWST will be able to efficiently seek out signs of carbon dioxide and oxygen as well as water vapor and methane in some exoplanet atmospheres. Eager planet hunters, however, should not hold their breath for these breakthrough capabilities—JWST will not launch until October 2018, and the telescope has a full docket of other science objectives that will limit any time-consuming observations of exoplanets.

“This is a great start, but we need higher signal-to-noise data and spectral resolution,” Sara Seager, a professor of astrophysics at MIT, says of the results. “We need to await the JWST to make any real progress on small-planet atmospheres.”