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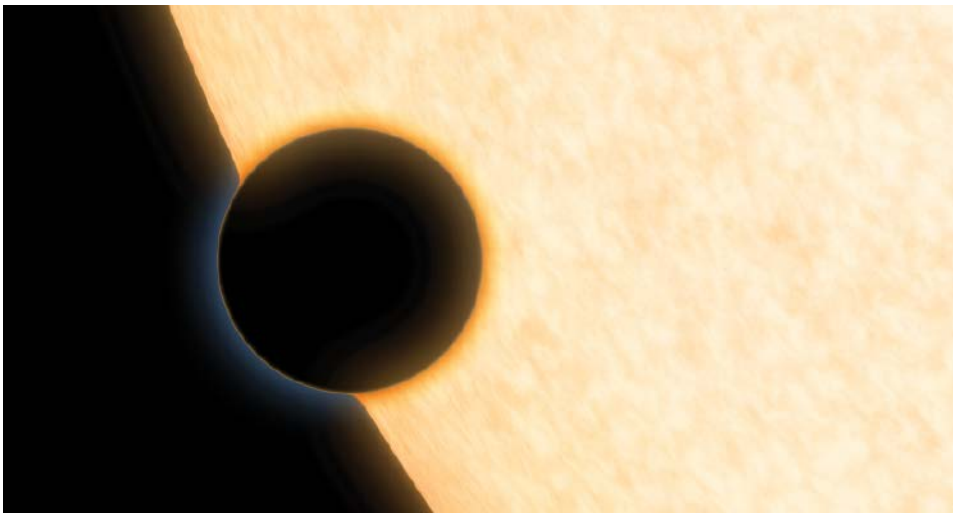
Ten Earth-Sized Planets Found by Exoplanet-Hunting Telescope



An artist's rendering of a Neptune-sized exoplanet. New research using Kepler data finds that the majority of exoplanets fall into two distinct size categories: similar to Earth or similar to Neptune but not in between. Credit: NASA/JPL-Caltech

NASA introduced 219 exoplanet candidates to the world this June. Ten of these are roughly Earth sized and orbit their stars in the so-called habitable zone, a distance from the star at which temperatures could be ripe for liquid water.

The candidate exoplanets appear in the eighth and newest catalog from the agency's exoplanet-hunting Kepler space telescope and the final catalog from Kepler's observations of the Cygnus constellation. The new catalog includes 4034 exoplanet candidates overall (http://bit.ly/exoplanet-archive).

Past "Kepler catalogs have shown us that small exoplanets are common," Susan Thompson, lead author on the catalog study and a research scientist at the SETI Institute in Mountain View, Calif., told *Eos*. "With this [latest] catalog, we can show whether this is also true for exoplanets that are in orbital periods similar to those of the Earth."

Accompanying research also reveals that the majority of known exoplanets fall into two distinct sizes: rocky exoplanets up to 1.75 times the radius of Earth and Neptune-sized gassy exoplanets. The finding, which was accepted in The Astronomical Journal (http://bit.ly/ExoplanetClass), deepens scientists' understanding of exoplanet diversity.

> "These Kepler catalogs have shown us that small exoplanets are common."

Building Exoplanet Catalogs

In previous exoplanet catalogs, researchers focused on rocky planets with orbits like Mercury's, or less than about 100 Earth days, Thompson noted. In contrast, the new catalog is the first to feature enough potential near-Earth-sized planets orbiting in their habitable zones that scientists can start to fully understand just how abundant these bodies are in the galaxy, she continued.

Scientists build exoplanet catalogs by reprocessing the entirety of Kepler's data from the first 4 years of its mission, which ran from 2009 to 2013 until an onboard mechanical failure ended its campaign to observe more than 150,000 stars. Since then, researchers have combed through the data, finding more and more exoplanet candidates as their models became more accurate.

The analysis of Kepler data has revealed several types of exoplanets, including gassy "hot Jupiters" (bodies hotter than Jupiter) and smaller planets (from Neptune-sized gassy planets to rocky planets roughly the size of Earth). The majority of confirmed Kepler exoplanets have fallen into this smaller planet category.

New Branches of the Exoplanet Family Tree

The predominance of two distinct sizes in the new data add to our understanding of the exoplanet family tree, Kepler researchers noted. The differences observed are akin to the biological differences between reptiles and mammals, Benjamin Fulton said. Fulton is a graduate student and lead author on the soon-to-be-published paper. He splits his time between the California Institute of Technology (Caltech) in Pasadena and the University of Hawaii at Mānoa.

To better understand the size distribution of smaller exoplanets, Fulton and his colleagues turned to the W. M. Keck Observatory in Hawaii to take a closer look at 1300 stars hosting more than 2000 exoplanets. The researchers collected data about the stars' light, which dims periodically as their planets pass between them and Earth. The team used the observations of light from the stars—and how the planets affected that light—to determine the planets' sizes.

The team found that smaller exoplanets fall into two distinct size categories: rocky planets up to 1.75 times the radius of Earth and gassy planets 2–3.5 times the radius of Earth (or a touch shy of Neptune's size).

"Astronomers like to put things in buckets," Fulton said. "In this case, we have found two very distinct buckets for the majority of the Kepler planets."

These gassy mini-Neptunes could have rocky cores buried "beneath the crushing weight of a thick atmosphere" or no solid core at all, said Fulton, rendering them inhospitable to life as we know it. Few exoplanets exist between those two sizes.

The researchers speculate that these two categories could stem from the bodies' hydrogen and helium compositions when they first formed. Just enough gas, and the planet could balloon in size and "jump the gap" to become a mini-Neptune, said Andrew Howard, an astronomer at Caltech and principal investigator on the new research. But a small amount of gas would get blown away by radiation from the planet's host star.

The newly discovered size differences will help researchers home in on the more Earth-like exoplanets. "Our result sharpens up the dividing line between potentially habitable planets and those that are inhospitable to life as we know it," Fulton said.

By **JoAnna Wendel** (@JoAnnaScience), Staff Writer