

'Super Earth' discovered near one of our galaxy's oldest stars

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Artist's rendition of TOI-561, one of the oldest, most metal-poor planetary systems discovered yet in the Milky Way galaxy. Credit: W. M. Keck Observatory/Adam Makarenko

A hot, rocky "super Earth," near one of the oldest stars in the galaxy has taken a team of planet-hunting scientists by surprise.

The planet is about 50% larger than Earth but requires less than half a day to orbit its star.

"For every day you're on Earth, this planet orbits its star twice," said UC Riverside planetary astrophysicist and team member Stephen Kane.

Part of the reason for the short orbit is the planet's proximity to its star, which also creates incredible heat. Its estimated [average surface temperature](#) is over 2,000 degrees Kelvin—much too toasty to host life as we know it today, though it may once have been possible.

In addition, Kane said that although the planet has roughly three times the mass of Earth, the team calculated its density to be the same as our planet.

"This is surprising because you'd expect the density to be higher," Kane said. "This is consistent with the notion that the planet is extremely old."

The older a planet is, the less dense it's likely to be because not as many [heavy elements](#) were available when it formed, explained Kane. Heavy elements are produced by fusion reactions in stars as they age. Eventually stars explode, dispersing these elements from which new stars and planets will form.

Discovery of planet TOI-561b, and additional observations the team made about its composition, have been accepted for publication in the *Astronomical Journal* and are being presented Jan. 11 at the 2021 meeting of the American Astronomical Society.

"TOI-561b is one of the oldest rocky planets yet discovered," said University of Hawaii postdoctoral fellow and team lead Lauren Weiss. "Its existence shows that the universe has been forming rocky planets almost since its inception 14 billion years ago."

Named for NASA's Transiting Exoplanet Survey Satellite, TESS Object of Interest (TOI) 561 belongs to a rare population of [stars](#) called the galactic thick disk. Stars in this region are chemically distinct, with fewer heavy elements such as iron or magnesium that are associated with planet building.

The TESS Mission team used the University of California's access to the W.M. Keck Observatory in Hawaii—home to some of the most scientifically productive telescopes on Earth—to confirm the presence of planet TOI-561b. The observatory's equipment also helped the team calculate the planet's mass, density and radius.

Astronomers are continually trying to understand the relationship between the mass and radius of the planets they find. This information yields insight about the interior structure of [planets](#) that with today's technology are too far away to visit and sample.

"Information about a planet's interior gives us a sense of whether the surface of the planet is habitable by life as we know it," Kane said. "Though this particular planet is unlikely to be inhabited today, it may be a harbinger of a many rocky worlds yet to be discovered around our galaxy's [oldest stars](#)."

More information: The TESS-Keck Survey II: An Ultra-Short Period Rocky Planet and its Siblings Transiting the Galactic Thick-Disk Star TOI-561. arxiv.org/abs/2009.03071 arXiv:2009.03071v2 [astro-ph.EP]

Provided by University of California - Riverside

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