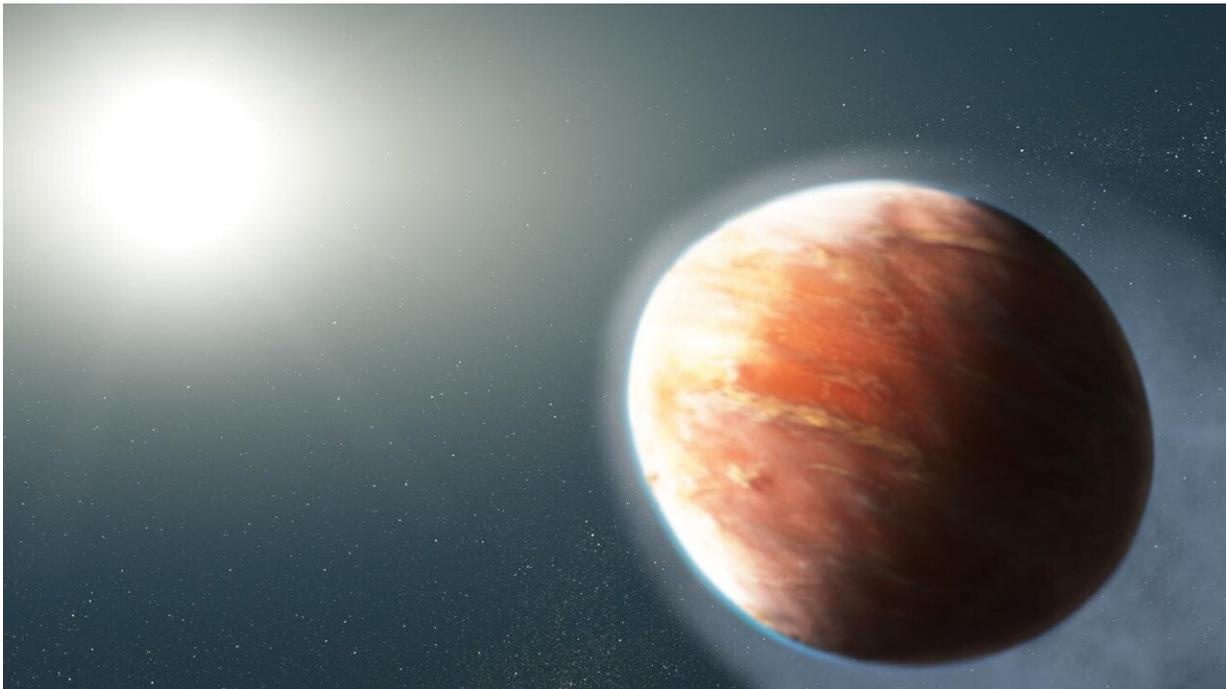


Distant 'heavy metal' gas planet is shaped like a football

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This artist's illustration shows WASP-121b, a distant world that is losing magnesium and iron gas from its atmosphere. The observations represent the first time that heavy metals have been detected escaping from a "hot Jupiter," which is a large, gaseous exoplanet that orbits very close to its host star. WASP-121b's orbit is so close that the star's gravity is nearly ripping the planet apart, giving the planet an oblique football shape. Credit: NASA, ESA, and J. Olmsted (STScI)

The scorching hot exoplanet WASP-121b may not be shredding any heavy metal guitar riffs, but it is sending heavy metals such as iron and magnesium into space. The distant planet's atmosphere is so hot that metal is vaporizing and escaping the planet's gravitational pull. The intense gravity of the planet's host star has also deformed the sizzling planet into a football shape.

The new observations, made by an international team of astronomers using NASA's Hubble Space Telescope, describe the first known instance of heavy metal gas streaming away from a "hot Jupiter," which is a nickname for large, gaseous exoplanets that orbit very close to their host stars. A [research paper](#) describing the results, co-authored by University of Maryland Astronomy Professor Drake Deming, was published in the August 1, 2019 issue of the *Astronomical Journal*.

"This planet is a prototype for ultra-hot Jupiters. These [planets](#) are so heavily irradiated by their host stars, they're almost like [stars](#) themselves," Deming said. "The planet is being evaporated by its host star to the point that we can see metal atoms escaping the [upper atmosphere](#) where they can interact with the planet's magnetic field. This presents an opportunity to observe and understand some very interesting physics."

Normally, hot Jupiter planets are still cool enough inside to condense [heavier elements](#) such as magnesium and iron into clouds that remain in the planet's [atmosphere](#). But that's not the case with WASP-121b, which is orbiting so close to its host star that the planet's upper atmosphere reaches a blazing 4,600 degrees Fahrenheit. The planet is so close, in fact, that it is being ripped apart by the star's gravity, giving the planet an oblique football shape. The WASP-121 star system resides about 900 light-years from Earth.

"Heavy metals have been seen in other hot Jupiters before, but only in

the lower atmosphere," explained lead researcher David Sing of Johns Hopkins University. "With WASP-121b, we see magnesium and iron gas so far away from the planet that they're not gravitationally bound. The [heavy metals](#) are escaping partly because the planet is so big and puffy that its gravity is relatively weak. This is a planet being actively stripped of its atmosphere."

The researchers used Hubble's Space Telescope Imaging Spectrograph to search for ultraviolet light signatures of magnesium and iron. These signatures can be observed in starlight filtering through WASP-121b's atmosphere, as the planet passes in front of its host star.

The observations of WASP-121b add to the developing story of how planets lose their primordial atmospheres. When planets form, they gather an atmosphere made of gas from the disk that gave rise to both the planet and its host star. These young atmospheres consist mostly of hydrogen and helium, the most plentiful elements in the universe. As the planet moves closer to its star, much of this early atmosphere burns off and escapes to space.

"The hot Jupiters are mostly made of hydrogen, and Hubble is very sensitive to hydrogen, so we know these planets can lose the gas relatively easily," Sing said. "But in the case of WASP-121b, the hydrogen and helium gas is outflowing, almost like a river, and is dragging these metals with them. It's a very efficient mechanism for mass loss."

According to the researchers, WASP-121b will be a perfect target for NASA's James Webb Space Telescope, scheduled for launch in 2021. The Webb telescope will enable researchers to search for water and carbon dioxide, which can be detected at longer, redder wavelengths of infrared light. The combination of Hubble and Webb observations should give astronomers a more complete inventory of the chemical

elements that make up the planet's atmosphere.

"Hot Jupiters this close to their [host star](#) are very rare. Ones that are this hot are even rarer still," Deming added. "Although they're rare, they really stand out once you've found them. We look forward to learning even more about this strange planet."

The research paper, "The HST PanCET Program: Exospheric Mg II and Fe II in the Near-UV transmission spectrum of WASP-121b using Jitter Decorrelation," David Sing, Panayotis Lavvas, Gilda Ballester, Alain Lecavelier des Etangs, Mark Marley, Nikolay Nikolov, Lotfi Ben-Jaffel, Vincent Bourrier, Lars Buchhave, Drake Deming, David Ehrenreich, Thomas Evans, Tiffany Kataria, Nikole Lewis, Mercedes López-Morales, Antonio García Muñoz, Gregory Henry, Jorge Sanz-Forcada, Jessica Spake, and Hannah Wakeford, was published in the *Astronomical Journal* on August 1, 2019.

More information: The Hubble Space Telescope PanCET Program: Exospheric Mg ii and Fe ii in the Near-ultraviolet Transmission Spectrum of WASP-121b Using Jitter Decorrelation, *Astronomical Journal* (2019). iopscience.iop.org/article/10.1088/1538-3881/ab2986

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