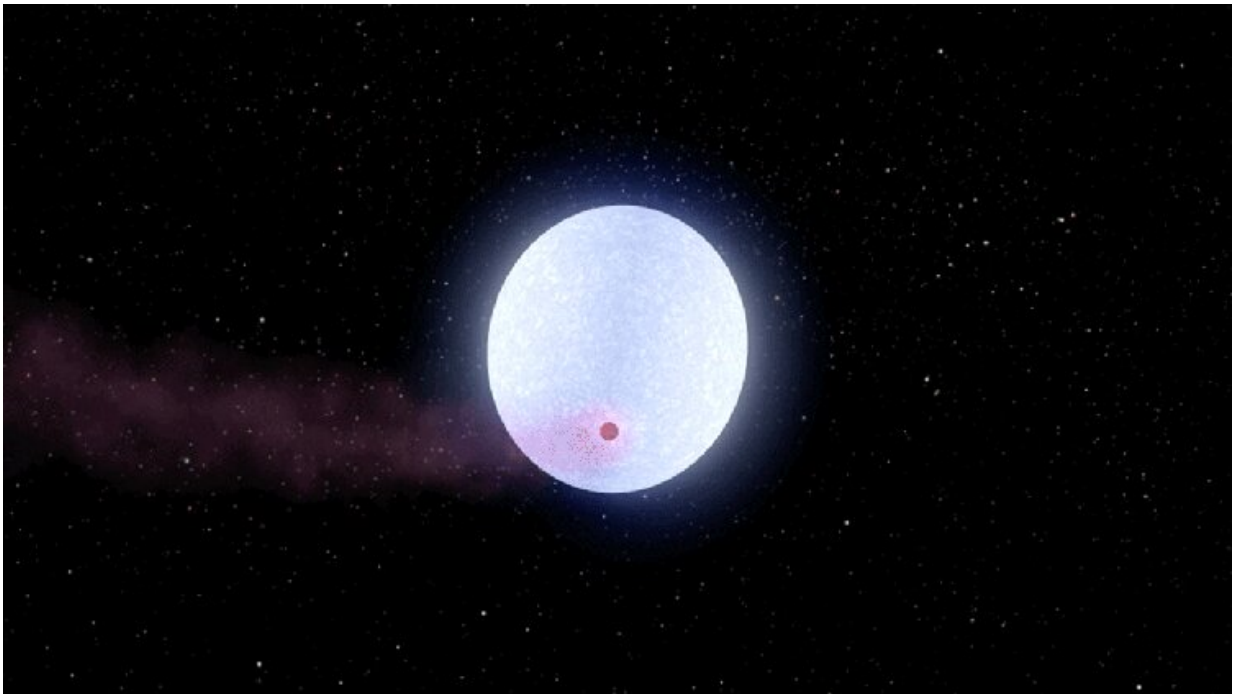


Researchers observe iron in exoplanetary atmosphere

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Artistic impression of exo planet KELT-9b orbiting its star KELT-9. Credit: NASA/JPL-Caltech

An international team of researchers, led by astronomers from the University of Amsterdam, has directly demonstrated the presence of iron in the atmosphere of an exoplanet for the first time. The researchers discovered emission lines of uncharged iron atoms in the light spectrum of KELT-9b. The observation was complicated as the exoplanet is

outshined by its bright host star.

The [exoplanet](#) KELT-9b orbits around its star KELT-9 in 36 hours. The star and planet are located at a distance of approximately 620 light-years from Earth in the Cygnus constellation. The star has a temperature of over 10,000 degrees, almost twice as hot as the sun. The planet KELT-9b is bigger than Jupiter. It is close to its star, around thirty times closer than the Earth to the sun.

The researchers already knew there had to be [iron](#) in the planetary atmosphere. A few years ago, they already saw signs of this when studying the starlight while the planet passed in front of its star

In the new observations, the researchers looked directly at the light of the planet. This is complicated, as the planet is outshined by the light of its star. Furthermore, due to its proximity to its host star, one year on the planet lasts about one day and a half. During half of this very short 'year,' the planet's night side is facing Earth, but that is too dark to be seen. Thus, the researchers picked up the light during a narrow 8 hours just before the planet disappeared behind the star, to observe its hotter, brighter day-side.

Lorenzo Pino (University of Amsterdam), lead author of the study, compares looking for the light from the exoplanet in the glare of its host star with looking at a firefly near a lamppost: "A few years ago we saw the shadow of the firefly, or in our case, the shadow of the exoplanet. We've now looked at the exoplanet directly."

Cross-correlation

The researchers made their observations on the Spanish island of La Palma on the night of July 22, 2018 using an Italian telescope, the Telescopio Nazionale Galileo. This telescope features HARPS-N, a

spectrograph that can split light and reveal the presence of specific atoms and molecules. The researchers extracted the emission lines of atoms using a technique called cross-correlation.

Pino compares cross-correlation with Photoshopping a series of film images: "The star is stationary, but the planet is moving. The cross-correlation is a kind of filter that moves with the planet. This allows us to isolate the planetary [light](#)."

Hubble Space Telescope

Based on the data, the researchers now think that the iron in the atmosphere of exoplanet KELT-9b heats the upper part of the atmosphere, making it warmer than the lower part. The idea is that the iron absorbs the starlight, thus heating the atmosphere. On Earth, a similar process takes place in the atmosphere. However, in this case it is not iron but ozone that heats up the top layers.

In the future, the researchers hope to carry out a deeper investigation by precisely measuring the iron content in the planetary [atmosphere](#). For example, this could take place using the Hubble Space Telescope on which Lorenzo Pino has been assigned observation time. Ultimately, the researchers hope to reveal how hot, gaseous giant exoplanets such as KELT-9b emerge and why there are no comparable examples in our own solar system.

More information: L. Pino et al. Neutral Iron Emission Lines From The Day-side Of KELT-9b—The GAPS Programme With HARPS-N At TNG XX. arXiv:2004.11335 [astro-ph.EP]. arxiv.org/abs/2004.11335

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