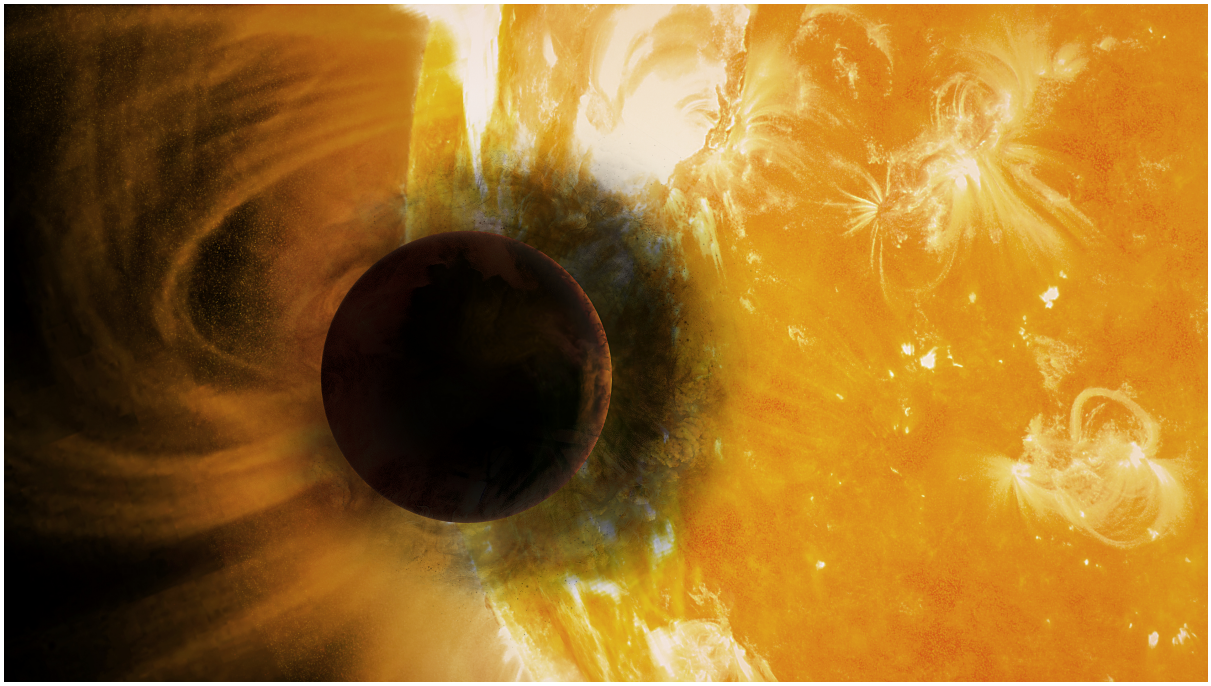
Hubble detects helium in the atmosphere of an exoplanet for the first time

Based on a European Space Agency (ESA) press release. Embargoed until May 02, 2018 at 12:00pm CDT.

March 2, 2018: **Astronomers using the Hubble Space Telescope have detected helium in the atmosphere of the extrasolar planet WASP-107b. This is the first time this element has been detected in the atmosphere of a planet outside the Solar System. The discovery demonstrates a new method of studying exoplanet atmospheres.**

An international team of astronomers, led by Jessica Spake at the University of Exeter and including Tennessee State University astronomers Gregory W. Henry and Michael H. Williamson, have discovered helium in the atmosphere of the exoplanet WASP-107b, which is the first detection of its kind. The discovery was made with the Wide Field Camera 3 on the ESA/NASA Hubble Space Telescope.



Artist's impression of the new planet WASP-107b in close orbit above the surface of its host star WASP-107. The helium escaping from the planet's atmosphere is shown as the green cloud surrounding the planet. Source: EngineHouseVFX.

“Helium is the second-most common element in the Universe after hydrogen,” explains Spake on the importance of the discovery. “It is also one of the main constituents of the planets Jupiter and Saturn in our Solar System. However, until now, helium had not been detected on any exoplanet - despite extensive searches for it.”

Using the Hubble Space Telescope, the team measured the infrared spectrum of the atmosphere of WASP-107b. Previous measurements of the upper atmospheres of exoplanets have primarily measured their spectra at ultraviolet wavelengths and, therefore, the presence of helium was missed.

“The strong signal we found from excited helium demonstrates that we have a new technique to study exoplanet atmospheres in a wider range of planets. Current methods, which use ultraviolet light, are limited to the closest exoplanets,” says Spake. “We know there is excited helium in the Earth’s upper atmosphere, and this new technique may help us to detect atmospheres around Earth-sized exoplanets – which is very difficult with current technology.”

Henry and Williamson used one of TSU's automated telescopes located in the mountains of southern Arizona to look for subtle brightness changes in the star that could compromise the Hubble observations. For over 25 years, the TSU telescopes have specialized in making very precise measurements of stellar brightness changes. “We found very low-amplitude stellar brightness variability of 0.5% in WASP-107,” said Henry. “This enables small corrections to the atmospheric spectrum of the planet and insures the accuracy of the helium detection.”

WASP-107b is one of the lowest density planets known: while the planet has about the same size as Jupiter it has only 12% of its mass. The exoplanet is about 200 light years from Earth, and it orbits its host star in less than six days. The amount of helium detected in the atmosphere of WASP-107b is so large that its upper atmosphere must extend tens of thousands of kilometers out into space. This is the first time an extended atmosphere has been discovered in infrared wavelengths. With such an extended atmosphere, the planet is losing a significant amount out into space. Intense radiation from its host star heats the upper atmosphere of the planet and puts the helium atoms in an excited state so the gas rapidly expands and escapes into space.

As co-author David Sing, also from the University of Exeter, explains “Back in the year 2000, it was predicted that helium would be one of the most readily-detectable gases in giant exoplanet atmospheres, but until now, searches for it have been unsuccessful. Our new method, along with future space telescopes, such as the giant James Webb Space Telescope, will allow us to analyze atmospheres of exoplanets in far greater detail than ever before.”

More information:

The measurement of an exoplanet's atmosphere is performed when the planet passes in front of its host star. A tiny portion of the star’s light passes through the exoplanet's atmosphere leaving detectable fingerprints in the spectrum of the star. The larger the amount of an element in the atmosphere, the easier the detection becomes.

The Hubble Space Telescope mission is the result of international cooperation between the European Space Agency (ESA) and NASA.

This study entitled “*Helium in the eroding atmosphere of an exoplanet*,” will be published in the May 3 issue of the journal *Nature*.

The international team of astronomers in this study consists of J. J. Spake (University of Exeter, UK), D. K. Sing (University of Exeter, UK; Johns Hopkins University, USA), T. M. Evans (University of Exeter, UK), A. Oklopčić (Harvard-Smithsonian Center for Astrophysics, USA), V. Bourrier (Observatoire de l'Université de Genève, Switzerland), L. Kreidberg (Harvard Society of Fellows, USA; Harvard-Smithsonian Center for Astrophysics, USA), B. V. Rackham (University of Arizona, USA), J. Irwin (Harvard-Smithsonian Center for Astrophysics, USA), D. Ehrenreich (Observatoire de l'Université de Genève, Switzerland), A. Wyttenbach (Observatoire de l'Université de Genève, Switzerland), H. R. Wakeford (Space Telescope Science Institute, USA), Y. Zhou (University of Arizona, USA), K. L. Chubb (University College London, UK), N. Nikolov (University of Exeter, UK), J. Goyal (University of Exeter, UK), G. W. Henry (Tennessee State University, USA), M. H. Williamson (Tennessee State University, USA), S. Blumenthal (Space Telescope Science Institute, USA), D. Anderson (Keele University, UK), C. Hellier (Keele University, UK), D. Charbonneau (Harvard-Smithsonian Center for Astrophysics, USA), S. Udry (Observatoire de l'Université de Genève, Switzerland), and N. Madhusudhan (University of Cambridge, UK).