Hubble Finds Carbon Dioxide on an Extrasolar Planet

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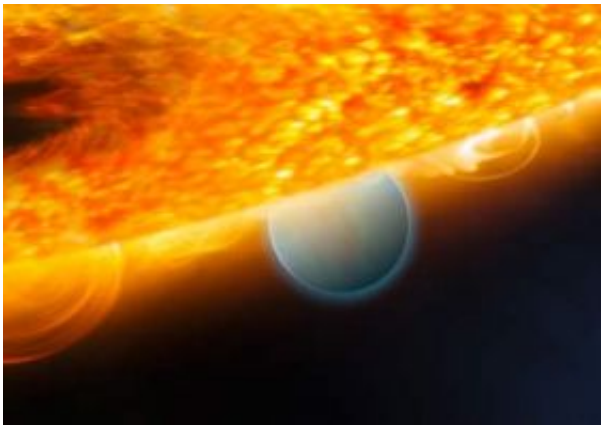

This is an artist's impression of the Jupiter-size extrasolar planet, HD 189733b, being eclipsed by its parent star. Astronomers using the Hubble Space Telescope have measured carbon dioxide and carbon monoxide in the planet's atmosphere. The planet is a "hot Jupiter," which is so close to its star that it completes an orbit in only 2.2 days. Credit: ESA, NASA, M. Kornmesser (ESA/Hubble), and STScI

(PhysOrg.com) -- NASA's Hubble Space Telescope has discovered carbon dioxide in the atmosphere of a planet orbiting another star. This is an important step along the trail of finding the chemical biotracers of extraterrestrial life as we know it.

The Jupiter-sized planet, called HD 189733b, is too hot for life. But the Hubble observations are a proof-of-concept demonstration that the basic

chemistry for life can be measured on planets orbiting other stars. Organic compounds can also be a by-product of life processes, and their detection on an Earth-like planet may someday provide the first evidence of life beyond Earth.

Previous observations of HD 189733b by Hubble and the Spitzer Space Telescope found water vapor. Earlier this year, Hubble astronomers reported that they found methane in the planet's atmosphere.

"This is exciting because Hubble is allowing us to see molecules that probe the conditions, chemistry, and composition of atmospheres on other planets," says Mark Swain of NASA's Jet Propulsion Laboratory in Pasadena, Calif. "Thanks to Hubble we're entering an era where we are rapidly going to expand the number of molecules we know about on other planets."

Swain used Hubble's Near Infrared Camera and Multi-Object Spectrometer (NICMOS) to study infrared light emitted from the planet, which lies 63 light-years away. Gases in the planet's atmosphere absorb certain wavelengths of light from the planet's hot glowing interior. Swain identified not only carbon dioxide, but also carbon monoxide. The molecules leave their own unique spectral fingerprint on the radiation from the planet that reaches Earth. This is the first time a near-infrared emission spectrum has been obtained for an exoplanet.

"The carbon dioxide is kind of the main focus of the excitement, because that is a molecule that under the right circumstances could have a connection to biological activity as it does on Earth," Swain says. "The very fact that we're able to detect it, and estimate its abundance, is significant for the long-term effort of characterizing planets both to find out what they're made of and to find out if they could be a possible host for life."

This type of observation is best done for planets with orbits tilted edge-on to Earth. They routinely pass in front of and then behind their parent stars, phenomena known as eclipses. The planet HD 189733b passes behind its companion star once every 2.2 days. This allows an opportunity to subtract the light of the star alone (when the planet is blocked) from that of the star and planet together prior to eclipse, thus isolating the emission of the planet alone and making possible a chemical analysis of its "day-side" atmosphere.

In this way, Swain explains that he's using the eclipse of the planet behind the star to probe the planet's day side, which contains the hottest portions of its atmosphere. "We're starting to find the molecules and to figure out how many of them there are to see the changes between the day side and the night side," Swain says.

This successful demonstration of looking at near-infrared light emitted from a planet is very encouraging for astronomers planning to use NASA's James Webb Space Telescope when it is launched in 2013. These biomarkers are best seen at near-infrared wavelengths.

Astronomers look forward to using Webb to spectroscopically look for biomarkers on a terrestrial planet the size of Earth, or a "super-Earth" several times our planet's mass. "The Webb telescope should be able to make much more sensitive measurements of these primary and secondary eclipse events," Swain says.

Swain next plans to search for molecules in the atmospheres of other exoplanets, as well as trying to increase the number of molecules detected in exoplanet atmospheres. He also plans to use molecules to study changes that may be present in exoplanet atmospheres to learn something about the weather on these distant worlds.

Provided by Hubble Centre