Superhot Planet Likely Possesses Comet-like Tail

July 15 2010

This artist's illustration shows a view of the gas giant planet HD 209458b, as seen from the surface of a hypothetical nearby companion object. The planet is orbiting so close to its sunlike star that its heated atmosphere is escaping into space. Spectroscopic observations by the new Cosmic Origins Spectrograph (COS) aboard the Hubble Space Telescope suggest that powerful stellar winds are sweeping the castoff material behind the scorched planet and shaping it into a comet-like tail. Artwork Credit: NASA, ESA, and G. Bacon (STScI)

(PhysOrg.com) -- As if the debate over what is and what is not a planet hasn't gotten confusing enough, Hubble Space Telescope astronomers have now confirmed the existence of a tortured, baked object that could be called a "cometary planet."

The gas giant planet, dubbed HD 209458b, is orbiting so close to its star

that its heated atmosphere is escaping away into space. Now, observations by the new Cosmic Origins Spectrograph (COS) aboard NASA's Hubble suggest that powerful stellar winds are sweeping the castoff material behind the scorched planet and shaping it into a comet-like tail.

"Since 2003 scientists have theorized that the lost mass is being pushed back into a tail and have even calculated what the tail looks like," says astronomer Jeffrey Linsky of the University of Colorado in Boulder, leader of the COS study. "We think we have the best observational evidence to support that theory. We have measured gas coming off the planet at specific speeds, some coming toward Earth. The most likely interpretation is that we have measured the velocity of material in a tail."

HD 209458b weighs slightly less than Jupiter, but it orbits 100 times closer to its star than Jupiter does. The roasted planet zips around in a mere 3.5 days. (In contrast, our solar system's speedster, Mercury, orbits the Sun in a leisurely 88 days.) The planet is one of the most intensely scrutinized extrasolar planets because it is one of the few known alien worlds that can be seen passing in front of, or transiting, its star. The transit causes the starlight to dim slightly. In fact, the gas giant is the first alien world discovered to transit its parent star. It orbits the star HD 209458, located 153 light-years from Earth.

Linsky and his team used COS to analyze the planet's atmosphere during transiting events. During a transit, astronomers can study the structure and chemical makeup of a planet's atmosphere by sampling the starlight that passes through it. The dip in starlight due to the planet's passage, excluding the planet's atmosphere, is very small, only 1.5 percent. When the atmosphere is added, the dip jumps to 8 percent, indicating a bloated atmosphere.

COS detected the heavy elements carbon and silicon in the planet's super-

hot (2,000-degree-Fahrenheit) atmosphere. This detection reveals that the parent star is heating the entire atmosphere, dredging up the heavier elements and allowing them to escape the planet.

The COS data also showed that the material leaving the planet was not all traveling at the same velocity. "We found gas escaping at high velocities, with a large amount of this gas flowing toward us at 22,000 miles per hour," Linsky explains. "This large gas flow is likely gas swept up by the stellar wind to form the comet-like tail trailing the planet."

Hubble's newest spectrograph, with its ability to probe a planet's chemistry at ultraviolet wavelengths that are not accessible to ground-based telescopes, is proving to be an important instrument for probing the atmospheres of "hot Jupiters" like HD 209458b. Astronomers have also used COS to sample the atmosphere of another baked planet, WASP-12b, whose puffy atmosphere is spilling onto its star.

Another Hubble instrument, the Space Telescope Imaging Spectrograph (STIS), observed HD 209458b in 2003. The STIS data showed an active, evaporating atmosphere, and a comet-tail-like structure was suggested as a possibility. But STIS wasn't able to obtain the spectroscopic detail necessary to show an earthward-moving component of the gas during transits. Because of COS's unique combination of very high ultraviolet sensitivity and good spectral resolution, the earthward moving component of the gas — the tail — could be directly detected for the first time.

Although this "extreme" planet is getting roasted by its star, it won't be destroyed anytime soon. "It will take about a trillion years for the planet to evaporate," Linsky says.

The results appeared in the July 10 issue of *The Astrophysical Journal.*

Provided by ESA/Hubble Information Centre