Exoplanet with Wild Temperature Swings

Talk about hot flashes! NASA's Spitzer Space Telescope has observed a planet that heats up to extreme temperatures in a matter of hours before quickly cooling back down. Hello, I'm Daniel Brennan.

This Spitzer Space Telescope podcast is part of a series highlighting recent discoveries in infrared astronomy. It's produced by NASA's Spitzer Science Center at the California Institute of Technology in Pasadena. The Spitzer mission is managed by NASA's Jet Propulsion Laboratory.

The "hot-headed" planet in question is called HD 80606b. It's a gas giant that orbits a star 200 light-years away. It was already known to be quite unusual, with an elliptical orbit swinging nearly as far away from its star as Earth is from our Sun, and then much closer in than Mercury. Since infrared light emission is an excellent way to measure temperature, astronomers used the Spitzer Space Telescope to measure heat from the planet as it whipped behind and close to its star. In just six hours, the planet's temperature rose from 800 to 1,500 Kelvin -- that's 980 to 2,240 degrees Fahrenheit!

According to Greg Laughlin of the Lick Observatory at the University of California at Santa Cruz, who is the lead author of the study, this is the first time weather changes have been detected in real time on a planet outside our solar system. The team was able to observe the development of one of the fiercest storms in the galaxy.

HD 80606b's eccentric orbit means its speed changes dramatically over its 111-day orbit. Kepler's Second Law of Planetary Motion states that planets sweep out an equal area in equal time -- which simply means that when it is farther away from its star it moves more slowly, and when it is close to its star it moves very quickly.

The Spitzer observations of HD 80606b covered a period of time before, during, and just after its closest passage to the star, as it sizzled under the star's heat. When Laughlin and his colleagues planned the observation, they did not know whether the planet would disappear completely behind the star -- an event called a secondary eclipse -- or whether it would remain in view. A secondary eclipse is very beneficial for infrared observations of an exoplanet, because during the secondary eclipse, the planet is not visible at all, allowing the scientists to measure the infrared emissions from the star alone. By subtracting the light of the star from the light of the star plus the planet, an accurate assessment of the light from the planet alone is possible. Luckily for the team, the planet did indeed temporarily disappear from view, providing the planet's initial and final temperatures.

The extreme temperature swing observed by Spitzer indicates that the atmosphere near the planet's gaseous surface must quickly absorb and lose heat. This type of information reveals how a planet responds to sudden changes in heating -- an extreme version of seasonal change.

Laughlin and his colleagues say that a key factor in being able to make these observations is the planet's eccentric orbit. Unlike so-called Hot Jupiter planets that remain in tight orbits around their stars, HD 80606b rotates around its axis roughly every 34 hours. Hot Jupiters, on the other hand, are thought to be tidally locked, so one side always faces their stars. Because HD 80606b is spinning around independently from its motion around its star, the astronomers were able to measure how its atmosphere responds to being baked by the star, giving us detailed information about atmospheric heating and cooling for the first time. For the Spitzer Science Center, I'm Daniel Brennan.

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