Missing planets attest to destructive power of stars' tides

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During the last two decades, astronomers have found hundreds of planets orbiting stars outside our solar system. New research indicates they might have found even more except for one thing - some planets have fallen into their stars and simply no longer exist.

The idea that gravitational forces might pull a planet into its parent star has been predicted by computer models only in the last year or so, and this is the first evidence that such planet destruction has already occurred, said University of Washington astronomer Rory Barnes.

"When we look at the observed properties of extrasolar planets, we can see that this has already happened - some extrasolar planets have already fallen into their stars," he said.

Computer models can show where planets should line up in a particular star system, but direct observations show that some systems are missing planets close to the stars where models say they should be.

Barnes, a postdoctoral astronomy researcher with the Virtual Planet Laboratory at the UW, is a co-author of a paper describing the findings that was accepted this month for publication in Astrophysical Journal. Lead author Brian Jackson and co-author Richard Greenberg are with the Lunar and Planetary Laboratory at the University of Arizona.

The research involves planets that are close to their parent stars. Such planets can be detected relatively easily by changes in brightness as their orbits pass in front of the stars.

But because they are so close to each other, the planet and star begin pulling on each other with increasingly strong gravitational force, misshaping the star's surface with rising tides from its gaseous surface.

"Tides distort the shape of a star. The bigger the tidal distortion, the more quickly the tide will pull the planet in," Jackson said.

Most of the planets discovered outside of our solar system are gas giants like Jupiter except that they are much more massive. However, earlier this year astronomers detected an extrasolar planet called CoRoT-7 B that, while significantly larger than our planet, is more like Earth than any other extrasolar planet found so far.

However, that planet orbits only about 1.5 million miles from its star, much closer than Mercury is to our sun, a distance that puts it in the category of a planet that will fall into its star. Its surface temperature is around 2,500 degrees Fahrenheit "so it's not a pleasant environment," Barnes said, and in a short time cosmically - a billion years or so - CoRoT-7 B will be consumed.

The destruction is slow but inevitable, Jackson said.

"The orbits of these tidally evolving planets change very slowly, over timescales of tens of millions of years," Jackson said. "Eventually the planet's orbit brings it close enough to the star that the star's gravity begins tearing the planet apart.

"So either the planet will be torn apart before it ever reaches the surface of the star, or in the process of being torn apart its orbit eventually will intersect the star's atmosphere and the heat from the star will obliterate the planet."

The researchers hope the work leads to better understanding of how stars destroy planets and how that process might affect a planet's orbit, Jackson said.

The scientists also say their research will have to be updated as more extrasolar planets are discovered. NASA, which funded the research, recently launched the Kepler telescope, which is designed specifically to look for extrasolar planets that are closer in size to Earth.

Jackson hopes new observations will provide new lines of evidence to investigate how a star's tides can destroy planets.

"For example, the rotation rates of stars tend to drop, so older stars tend to spin more slowly than younger stars," he said. "However, if a star has recently consumed a planet, the addition of the planet's orbital angular momentum will cause the star to rapidly increase its spin rate. So we would like to look for stars that are spinning too fast for their age."

More information: The paper is available at lanl.arxiv.org/abs/0904.1170

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