X-Ray observations of an extrasolar planetary system

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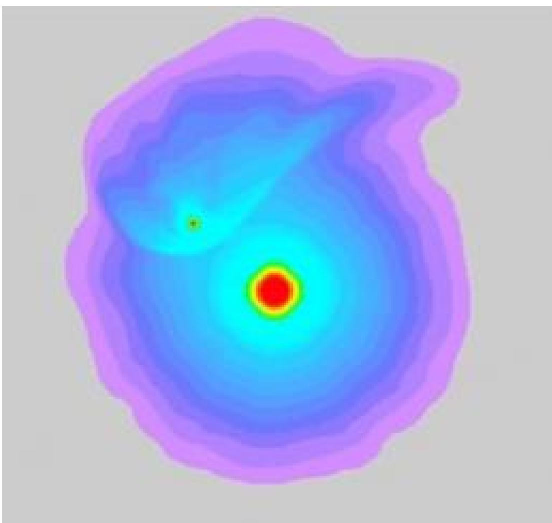

A computer simulation of the magnetic field strengths of a star that has been affected by the presence of a hot planetary companion orbiting nearby, as seen from above. Credit: Pillitteri et al. 2010

(PhysOrg.com) -- The majority of extra-solar planets (about 278 of them) are more massive than Jupiter. About 20% of this majority group orbit their stars at a distances of less than one-tenth of an astronomical unit (one AU is the average distance of the Earth from the sun, and in our solar system Mercury is four-tenths of an AU from the sun).

These giant planets are heated to atmospheric temperatures of thousands of degrees by the close proximity of the star, and so have been nicknamed "hot Jupiters." Astronomers are working to better understand hot Jupiters because they are so common, and because their formation and development are likely to shed light more generally on planetary processes.

Stars emit X-rays from their hot outer atmospheres (the "corona") as strong magnetic fields from the stellar surface heat the gas. SAO astronomers Ignazio Pillitteri, Scott Wolk, Ofer Cohen, Vinay Kashyap, and Heather Knutson, together with two colleagues, studied the possible effects of such an X-ray environment on a nearby hot Jupiter. The X-rays might, for example, significantly heat the planet's atmosphere, accelerate the loss of its gases, alter the chemistry, or otherwise influence its atmosphere's properties.

The scientists used the XMM-Newton satellite to observe a known hot Jupiter system located about sixty-three light-years away; the host star is slightly less massive and much younger than the sun. This particular hot Jupiter transits its star (that is, passes directly across our line-of-sight to the star). They monitored two episodes of the X-ray emission from the star, each during the planet's passage across its face and during its passage behind the star; during one episode they witnessed some flare activity on the star.

The team then modeled the possible magnetic interactions between the planet and star, finding generally good agreement between theory and observation. This enabled them to conclude that magnetic interactions between the planet and the star can distort the star's coronal structure, and also can enhance the magnetic field in the space between them. Additional observations are needed to probe some of the more complex questions, but the results so far provide new insight into the heating of hot Jupiters. They also caution that age estimates of stars based on their coronal activity could be suspect if hot Jupiters are present.

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