Stellar winds may electrify exoplanets

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(Phys.org) —The strangest class of exoplanets found to date might be even stranger than astronomers have thought. A new model suggests that they are partially heated by electric currents linked to their host stars. Florida Gulf Coast University (FGCU) astronomer Dr. Derek Buzasi has proposed a model in which electric currents arising from the interaction between the planet's magnetic field and the hot charged wind from the star flow through the interior of the planet, heating it like an electric toaster.

Many of the planets found by the Kepler mission are of a type known as "hot Jupiters." While about the same size as Jupiter in our own solar system, these exoplanets are located much closer to their host stars than even Mercury is to our Sun, meaning that their atmospheres are heated to temperatures of thousands of degrees.

One problem scientists have had in understanding the hot Jupiters is that many are inflated to sizes even larger than expected for planets so close to their stars. Explanations for the "puffiness" of these exoplanets generally involve some kind of extra heating for the planet. Proposed sources for the extra heat have included tides and interactions between the high-speed winds and magnetic fields expected on these planets, but none of these models successfully explains the observation that more magnetically active stars tend to have puffier hot Jupiters orbiting around them.

"This kind of electric heating doesn't happen very effectively on planets in our solar system because their outer atmospheres are cold and don't

conduct electricity very well," says Buzasi. "But heat up the atmosphere by moving the planet closer to its star and now very large currents can flow, which delivers extra heat to the deep interior of the planet—just where we need it." More magnetically active stars have more energetic winds and would provide larger currents and more heat to their planets.

The currents start in the magnetosphere, the area where the stellar wind meets the planetary magnetic field, and enter the planet near its north and south poles. This so-called "global electric circuit" exists on Earth as well, but the currents involved are only a few thousand amps at 100,000 volts or less. On the hot Jupiters, currents can amount to billions of amps at voltages of millions of volts.

"It is believed that these hot Jupiter planets formed farther out and migrated inwards later, but we don't yet fully understand the details of the migration mechanism. The better we can model how these planets are built, the better we can understand how solar systems form. That in turn, would help astronomers understand why our solar system is different from most, and how it got that way."

This work is being presented today at the 222nd meeting of the American Astronomical Society in Indianapolis, Indiana.

Provided by Florida Gulf Coast University