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Star-Planet Interactions: The Tidal and Magnetic Influence of Hot Jupiters

Evgenya Shkolnik
(shkolnik@dtm.ciw.edu)

The interacting processes taking place between a giant planet orbiting its star within 10 stellar radii (also known as a "hot Jupiter") have been getting increasing attention both observationally and theoretically. Our work has shown that such a short-period planet can induce activity on the upper atmosphere of its host star through both tidal and magnetic star-planet interactions (SPI).

Evidence for magnetic SPI includes a diverse array of photometric, spectroscopic and spectropolarimetric studies. Because of the small separation (< 0.1 AU), many of the hot Jupiters lie within the Alfven radius of their host stars, allowing direct magnetic interaction with the stellar surface. Models show both the stellar and planetary magnetic fields being strongly affected, possibly influencing the magnetic activity of both bodies, as well as modifying irradiation and non-thermal and dynamical processes.

In addition, a hot Jupiter's tidal influence on its star may increase the stellar rotation rate and thus also increase the global stellar activity level. Our recent work has shown that stars with hot Jupiters have twice the UV emission than stars with planets in wider orbits, which is also anti-correlated with the stellar synchronization time scales. Even though the stars with hot Jupiters are not fully synchronized (full synchronization in most cases will take longer than the age of the Universe), they have already undergone some increase in rotation rate, provided that the planets migrated early on in the system's history.

Studying both tidal and magnetic star-planet interactions aids our understanding of the formation, migration and evolution of hot Jupiters, and provides the best-available probe of exoplanetary magnetic fields.