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Magnetic properties of stars with close-in exoplanets

C. Moutou (1), R. Fares (2), J.-F. Donati (3) and the SPI team

(1) Laboratoire d'Astrophysique de Marseille, France, (2) St Andrews University, UK (3), Observatoire Midi Pyrénnées, France (claire.moutou@oamp.fr)

Abstract

We present spectropolarimetric results on a sample of stars hosting close-in massive exoplanets. The objective is to derive stellar properties and to explore the grounds of star-planet interactions.

1. Introduction

Some properties of extrasolar systems are critical to explore the interactions between the central star and its most nearby planetary companions, in hot-jupiter systems: the masses, the distance, the rotation velocity of the star, and the characteristics of its magnetic field. They influence the tidal and magnetospheric interactions that may take place when a planet orbits the star within its coronal field. These interactions may then induce enhanced stellar activity or impact the planet physics. We have thus observed a subsample of hot-jupiter systems using the spectropolarimeters TBL/NARVAL and CFHT/ESPaDOnS and characterized the magnetic field of their central stars, with various levels of detail.

2. Observations

NARVAL and ESPaDOnS are echelle spectrographs in the optical [1]; they allow to record the V polarised profile of stars, and to monitor it along the rotational and orbital cycles of the system. We have derived the detailed magnetic properties of three stars: HD 189733 [2,3], tau Boo [4,5] and HD 179949 [6] and explored the detection of a magnetic signature in six additional targets.

3. Discussion

Some of the main results are:

- The large-scale magnetic properties of stars with close-in planets does not strongly differ from the ones of stars without close-in planets.

- The magnetic cycle of tau Boo has been estimated to about 800 days by the observation of 2 polarity reversals; the potential role of the close-in giant planet in this short cycle is discussed.

- In none of the stars, a definitie evidence of planet-induced activity enhancement has been detected at a period related to the planetary orbit. In one case only, HD 179949, we found a marginal detection of an activity signal at the synodic period of the system.

- The magnetic flux at the distance of the planet can be quantified and used to estimate the radio flux emitted by the planet in case of plasma interactions [7]. This radio flux is not constant over the system's cycles, which may complicate its detection.

From this first exploration, it emerges that star-planet interactions do not present strong signatures, or that their intermittent behaviour [8] may hinder their detection over long timescales (typically a fraction of the stellar magnetic cycle). However, magnetic characterization remains a main piece of information to characterize the planetary environment and favors the accurate prediction of a radio emission by the planetary plasma. Understanding the stellar magnetic activity is also a key element in the search for low-mass planets with the radial-velocity method.

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