Long-Term Datasets for the Understanding of Solar and Stellar Magnetic Cycles
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Influence of Planets on the Magnetic Activity of Sun-Like Stars

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Abstract. By considering the physical properties of Sun-like G stars and their exoplanets, present study examines whether presence of planets near the host stars enhances their stellar activity. In order to attain this goal, chromospheric R_{HK} index data-a proxy for the magnetic activity-for the stars with and without planets is considered. With the reasonable constraints on the exoplanetary data, we obtained a power law decay relationship between the magnetic activity of host stars and their ages, for stars with and without planets. Both these results strongly suggest that there is no difference in magnetic activity of the sun-like stars with and without presence of planets. In order to confirm this result, further we also examine an association between the host stars R_{HK} index that have exoplanets and their respective exoplanetary masses. We find that magnitude of R_{HK} (hence magnetic activity) of the host stars is independent of presence of planetary mass in its vicinity.

Keywords. stars: chromosperic activity, stars: planetary systems

1. Introduction

The magnetic field structures plays an important role in all the stellar evolutionary stages by affecting the physical and orbital characteristics of both central star as well as the near-by orbiting planet (Hiremath & Gokhale 1995). The companion (either a planet or brown dwarf) interacts with the central star through gravitation, tidal and/or magnetic fields (Charbonneau *et al.* 2004). Previously, many studies (McIvor *et al.* 2006; Scharf 2010) suggested that planets near by the host stars interact with their host stars by enhancing chromospheric activity, X-ray luminosity etc. Despite of many theories and observations which support enhancement in chromospheric activity due to presence of planets, there are also other studies which show that there is no correlation between the same two parameters (Miller *et al.* 2015). With these brief introductions, aim of present study is to check whether presence of planets influence and enhance the stellar magnetic or chromospheric activity of host star.

2. Data and Analysis

For the present investigation, physical and orbital characteristics of detected exoplanets of Sun-like G stars and physical properties of host stars such as mass, age are also considered from the Extrasolar Planets Encyclopedia (*http://exoplanet.eu/catalog/*). With reasonable constraints on exoplanetary data, we left with 120 exoplanets that belong to 86 host stars. Since the magnetic field structure of host stars are related with the chromospheric activity of host stars, in this study, we used chromospheric activity as a proxy for magnetic field structure. The data of stars with chromospheric activity and

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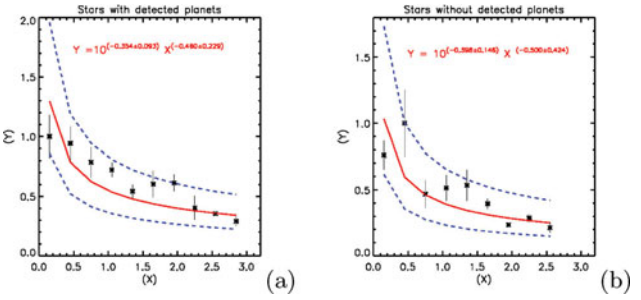

Figure 1. (a) & (b) Illustrate the power law variation of abs(R_{HK}) with stellar age for stars with and without detected exoplanet. Y-axis in (a) is normalized by value 1.056 × 10^{22} erg.s^{-1} cm^{-2} Hz^{-1} and (b) is normalized by value 1.544 × 10^{22} erg.s^{-1} cm^{-2} Hz^{-1}.

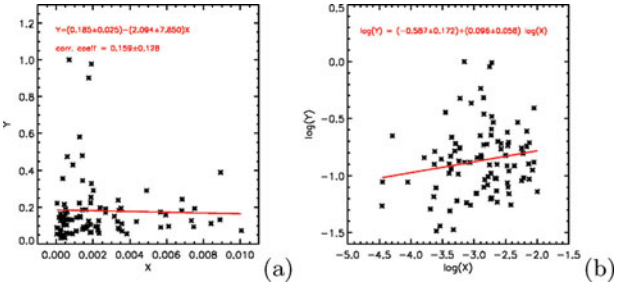

Figure 2. (a) & (b) Illustrate variation of abs(R_{HK}) with ratio of planetary mass with stellar mass in linear and non-linear space respectively.

other properties are considered from the BCool survey (Marsden *et al.* 2014; Mengel *et al.* 2017).

3. Results and Conclusions

From the exoplanetary data, a power law relationship between magnetic field structure of stars (with and without planets) and stellar age is obtained that suggests magnetic field structure decreases with stellar age. Since the exponents of power laws for case of stars with and without detected planets are almost similar, one can say that the presence of planets near the host star doesn't enhances the chromospheric activity of a star. Similarly, an investigation between magnetic activity and planetary mass shows that there is no linear or non-linear dependency between the magnetic activity and presence of planetary mass, which is illustrated in Figure 2 (a) and (b). Hence, this study suggests that the presence of planets do not affect the magnetic activity of host stars.

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