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Internal composition of planet host stars: the case of HD17051

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Abstract. Planet host stars present an average overmetallicity compared to stars without planets. This could be due to primordial overmetallicity or to accretion of hydrogen-poor matter during planetary formation (see Bazot and Vauclair, 2004) . Here, we study the solar-type star HD17051 for which a planet has been discovered. We compute overmetallic and accretion models to make predictions for future observations.

1. Introduction

HD17051 is a G0V star with an apparent magnitude V=5.40 and a parallax $\pi = 58(0.55)$ mas. A planet around this star has been discovered by Kürster et al.(2000). In this study, we compute stellar models with the Toulouse-Geneva code which uses the mixing length theory for convective zones. In a first part, we compute overmetallic models and in a second part, accretion models. Finally we study the effect of varying the mixing length parameter. For the effective temperature and metallicity, Santos et al.(2004) give $T_{eff} = 6252 \pm 53$ and $[Fe/H] = 0.26 \pm 0.06$, while Gonzalez et al. (2001) give $T_{eff} = 6136 \pm 34$ and $[Fe/H] = 0.19 \pm 0.03$. Both use spectroscopy with the analysis methods and linelist described by Gonzalez and Law (2001)). The luminosity is obtained using a bolometric correction BC from Flower (1996). We find: $\log L/L_{\odot} \in [0.194, 0.24]$.

2. Results

We first consider the error box of Santos et al. The models presented in Figure 1 are overmetallic and computed with $[Fe/H] = 0.26$, $\alpha = \alpha_{\odot} = 1.8$. We study two cases for the Y value: either Y follows the relation with Z found for galaxies (Izotov& Thuan, 2004) or Y has the solar value. As we can see in Figure 1, no model computed with this parameters enter the error box. Now we compute models with the accretion scenario: [Fe/H] is solar in the star except in the convective zone where we have the Santos et al [Fe/H]. Figure 2 displays evolutionary tracks for accretion models. Unlike the overmetallic models, they cross the Santos et al. error box, just at the beginning of the main-sequence: HD17051 is a very young star. We now change the mixing length parameter value for the overmetallic models to see whether it can help reconciling the evolutionary tracks with the spectroscopic observations. For models with $2.0 \leq \alpha \leq 2.2$, the evolutionary tracks cross the Santos et al. error box (Figure 3). The mixing length parameter is then an important element in our study. We consider now the error box of Gonzalez et al (Figure 4). Here $[Fe/H] = 0.18$ (smaller than the Santos et al. value). It is possible to find overmetallic models for HD17051 lying in this error box.

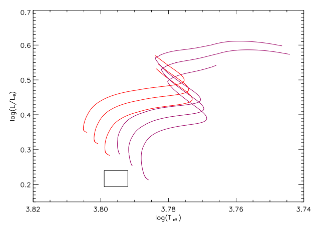

Fig. 1. Evolutionary tracks for overmetallic models (Santos et al. error box): $1.3M_{\odot}$ (up), $1.28M_{\odot}$, $1.26M_{\odot}$ (down) with $Y = 0.3$ (red) and $[Fe/H] = 0.26$. Magenta:same masses but with $Y = Y_{\odot}$ ($[Fe/H] = 0.26$). $\alpha = \alpha_{\odot}$

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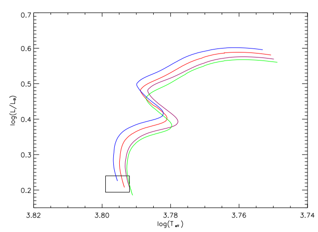

Fig. 2. Evolutionary tracks for accretion models:red: $1.18M_{\odot}$, $[Fe/H]_i = [Fe/H]_{\odot}$ (interior), $[Fe/H]_s = 0.2$ (surface), magenta: $1.19M_{\odot}$, $[Fe/H]_i = 0.10$, $[Fe/H]_s = 0.22$; green: $1.17M_{\odot}$, $[Fe/H]_i = 0.05$, $[Fe/H]_s = 0.2$, blue: $1.19M_{\odot}$, $[Fe/H]_i = [Fe/H]_{\odot}$, $[Fe/H]_s = 0.2$. For all $\alpha = \alpha_{\odot}$

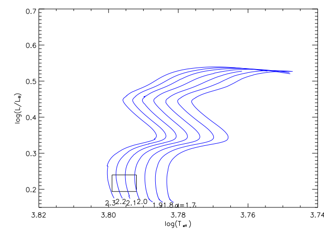

Fig. 3. Evolutionary tracks for overmetallic models for $1.19M_{\odot}$ stars with differents values of α and with $[Fe/H] = 0.26$

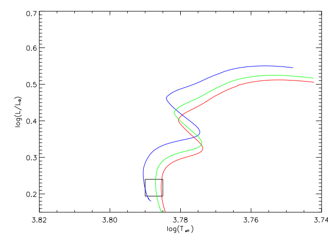

Fig. 4. evolutionary tracks for overmetallic models (Gonzalez et al. error box) $1.19M_{\odot}$ (blue),$1.17M_{\odot}$ (green) and $1.16M_{\odot}$ (red). Here $[Fe/H] = 0.18$ and $\alpha = \alpha_{\odot}$

3. Conclusions

In conclusion, HD17051 is a young G0V planet-host star. With a mixing length parameter $\alpha = \alpha_{\odot}$, no overmetallic models lie in the Santos et al. error box while only extremly young models cross the Gonzalez et al. one. On the other hand, models computed with accretion may cross the two boxes. With $\alpha = \alpha_{\odot}$, the accretion scenario is more adapted to the observed parameters. Overmetallic models can be reconcilied with the Santos et al. error box only if $\alpha > 2$. In the future, we will compute the oscillation frequencies of these models to provide asteroseismic predictions for this star.

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