Stars and their variability observed from space
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THE EXISTENCE OF HOT γ DORADUS AND A–F-TYPE HYBRID STARS

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Abstract. The γ Dor-type pulsations are thought to be driven by a convective blocking mechanism within a convective envelope in a sufficient depth. However, there are several hot γ Dor and hybrid star candidates in which there should not be an adequate convective envelope to excite the γ Dor-type oscillations. In this study we presented the result of examinong these hot variables by spectroscopic and photometric analyses.

Keywords: stars: general, abundances, atmospheres, variables, individual: γ Doradus

1 Introduction

The existence of the hot γ Dor stars was first discussed by Balona (2014); Balona et al. (2016). These stars have been thought to be either binary systems, or rapidly rotating and slowly pulsating B (SPB) stars seen equator-on. In an attempt to sort out these problems we carried out detailed spectroscopic and photometric studies. Twenty-four hot γ Dor and hybrid candidates were selected from the study of Uytterhoeven et al. (2011); they have $T_{\rm eff}$ values higher than 7500 K in the Huber et al. (2014) catalogue, and have no high-resolution spectroscopy. Our spectroscopic observations were carried out with the FIES spectrograph at medium resolution (R=46000). To examine the binary nature of the targets, we took at least two spectra per star on different nights. The average S/N ratio of the spectra was 70.

2 Spectroscopic and photometric analyses

In our spectroscopic analyses we used ATLAS9 model atmospheres (Kurucz 1993) and the SYNTHE code (Kurucz & Avrett 1981), and carried out spectral synthesis. The atmospheric parameters ($T_{\rm eff}$, $\log g$, ξ) were determined by comparing the strengths of Fe lines having a range of excitation and ionization potentials. The resulting atmospheric parameters were adopted as input for determining the chemical abundances of the stars. Values of $v \sin i$ were also derived. Photometric analyses were carried out using the long- and short-cadence *Kepler* data. Through these analyses we identified 2 non-pulsating, 9 δ Sct, 8 γ Dor and 5 hybrid stars in our sample.

3 Conclusions

In this study we found 5 hot γ Dor and 2 hot hybrid stars in our sample but no binary systems amojng them. If hot γ Dor stars are SPB variables, they should show high rotational velocities. However, the average $v \sin i$ value for these systems was 126 km s^{-1}, while an average $v \sin i$ value for stars having the spectral types similar to the SPB stars is 144 km s^{-1} (Balona et al. 2016; Głebocki & Gnaciński 2005).

We could not confirm any SPB properties in these hot objects. If the hot γ Dor stars are rapidly rotating SPB systems, they should show B-type spectral features. However, no such features were seen, though this

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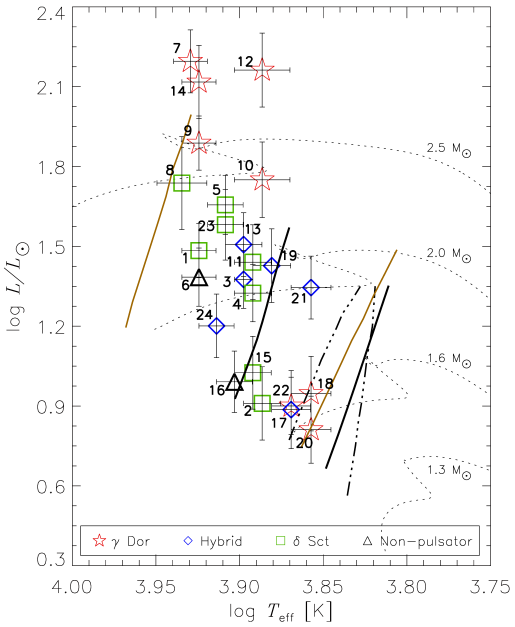

Fig. 1. Positions of the stars in the H–R diagram. The theoretical instability strips of the γ Dor (dashedlines) and δ Sct (solid black lines) stars were taken from Dupret et al. (2005). The recently suggested δ Sct instability strip (Murphy et al. 2019), which had recently been defined, is shown by solid brown lines. The evolutionary tracks (Z=0.02) were adopted from Kahraman Aliçavuş et al. (2016).

result should be checked with higher S/N spectra. The positions of the stars in the Hertzsprung-Russell (H–R) diagram (Fig. 1) use Gaia paralaxes (Gaia Collaboration et al. 2018). As can be seen from that figure, all hot γ Dor stars show higher luminosity values, and imply larger radii. We also calculated the luminosities of the other hot γ Dor stars given in Balona et al. (2016). It turned out that 70% of these stars also have higher luminosities, and consequently larger radii, compared to the theoretically calculated values for their range of spectral types.

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