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GIRAFFE OBSERVATIONS OF COROT VARIABLE STARS

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Abstract. We present preliminary results from the ground-based ESO/GIRAFFE observational program set up for the spectroscopic study of variable stars observed in the CoRoT exoplanet fields. About 3000 variable stars have been identified in each CoRoT field by the CVC (CoRoT Variable Classifier). The multi-object GIRAFFE medium resolution spectroscopic observation of these fields allows us to accurately classify the variable stars in various types of pulsators, binaries, etc. In addition, our team identifies the Be stars to determine their fundamental parameters thanks to synthetic spectral fitting taking NLTE and rapid rotation effects into account. We will then test for correlations between the stellar parameters and pulsation properties of Be stars in a statistical way and study their instability strip. Moreover, knowing the fundamental parameters of the stars is necessary to perform seismic modeling.

1 Scientific Context

Stellar oscillations have been observed at almost all phases of stellar evolution. However, there exists a particular region in the HR diagram in which the density of pulsating stars is higher than elsewhere, called the classical instability strip. This strip includes classical Cepheids, RR Lyrae stars, δ Scuti stars and DB white dwarfs. On the blue hot side of the strip one can find high-mass pulsators such as β Cephei, Slowly Pulsating B (SPB) and Be stars. The goal of our program is to obtain one spectrum of each variable star detected by CoRoT (Auvergne et al. 2009) in its exo fields, in order to classify each star into a variable class according to its spectrum and determine its fundamental parameters. This information is needed for all the pulsating stars observed by CoRoT in order to perform their seismic modeling.

2 Spectral classification and fundamental parameters determination with GIRAFFE

We use the multi-object spectrograph FLAMES/GIRAFFE (Pasquini et al. 2004) mounted at UT2 to observe the variable stars detected in the exofields of CoRoT by the CVC (Debosscher et al. 2007). Data have already been acquired for parts of the IR1 and LRA1 fields and the whole LRC1 field. Observing time has been requested for further CoRoT runs. GIRAFFE allows the simultaneous observation of up to 132 targets (in a field of $25'$ in diameter). We use two setups: one at λ=4272 Å and R=6400 (LR2) and one at λ=6438 Å and R=8600 (LR6). Thanks to the GIRAFFE LR6 spectra, we are able to discriminate between the various pulsators observed by CoRoT. The LR2 spectra allow each team to determine the parameters of their class of stars. The LR2 domain contains important lines for all types of stars, in particular two H lines (H_γ and H_δ) and 6 HeI lines at 4009, 4026, 4144, 4388, 4438 and 4471, as well as the SiIII 4552 line. It also contains NII 3995, CII 4267, TiII 4501, FeII 4508 ... The reduced LR6+LR2 GIRAFFE data are then distributed to the various CoRoT teams according to the classification.

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3 Need for GIRAFFE spectroscopy

After each CoRoT run, the CoRoT Variable Classifier (CVC) identifies variable stars among all observed stars of the EXO program and tries to roughly classify them into categories of variables. However, the CVC cannot discriminate certain types of variables from photometry alone. For example there is strong confusion between SPB and Be stars (same pulsations but Be stars rotate faster and have a disk). To perform a seismic modeling of the variable stars and derive their internal structure, the fundamental parameters (temperature, gravity, vsini) as well as the abundances of the stars are needed. Only a spectrum allows to obtain a reliable classification and to perform an accurate determination of the parameters.

4 Discovery and confirmation of Be Stars

Be stars are defined as B stars that show or have shown at least once emission in their Balmer lines. This emission is due to the presence of a circumstellar disk built from matter ejected from the star through outbursts. For a complete review, see Porter & Rivinius (2003). We confirm the detection of 3 Be stars (CoRoT ID : 102766835, 102725623, 102719279), candidates according to their CoRoT lightcurves, and found 3 other Be stars (CoRoT ID : 102686433, 102672979, 102847615) thanks to the GIRAFFE spectra. Fig. 1 shows the easily recognizable H_α emission of the Be stars and the corresponding CoRoT lightcurve. Our team will determine the fundamental parameters of all Be stars observed by CoRoT thanks to the FASTROT/GIRFIT code (Frémat et al. 2005), which takes into account the effects of rapid rotation.

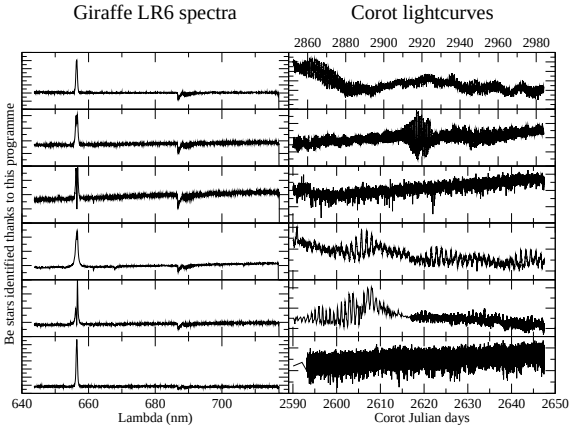

Fig. 1. Spectra and light curves of the confirmed and new Be stars

5 Conclusion

The spectroscopic GIRAFFE data allow us to improve the CVC classification of the variable stars detected in the exofields of CoRoT and distribute the CoRoT and GIRAFFE data to the appropriate thematic teams of CoRoT. They will then be able to determine the fundamental parameters of each variable star and use those to perform seismic modeling. In the case of Be stars our team will search for the possible correlation between these fundamental parameters, the pulsational properties and the outbursts of Be stars.

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