A Study of δ Scuti stars in open clusters NGC 1817 and NGC 7062

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Abstract

We report spectroscopic and photometric observations of ten δ Scuti stars and one eclipsing binary from the open cluster NGC 1817, and three δ Scuti stars from the open cluster NGC 7062. For each target, we measure the projected rotational velocity, v sin i, the radial velocity, RV, the effective temperature, T_{eff}, and the surface gravity, log g. All stars are found to be moderate or fast rotators. We classify three targets as new single-lined spectroscopic binaries and one target as a double-lined spectroscopic binary.

Individual Objects: NGC 1817, NGC 7062

Observations

The observations were carried out at the Nordic Optical Telescope (La Palma, Canary Islands, Spain). We used the Andalucía Faint Object Spectrograph and Camera, ALFOSC, for spectroscopy, and the ALFOSC/FASU setup with a set of uvbyβ Strömgren filters for photometry.

Analysis and Results

We derived T_{eff} and log g for each target using the calibration of Napiwotzki et al. (1993) and the Strömgren indices of Balaguer-Núñez et al. (2004) and Peniche et al. (1990) for stars in NGC 1817 and NGC 7062, respectively. We used these T_{eff} and log g, and the ATLAS9 and SYNTHETE software (Sbordone 2005, Sbordone et al. 2004) to compute the model atmosphere and the synthetic spectrum for each target.

We measured v sin i of the stars by comparing the observed spectrum with the synthetic one. We used mainly strong hydrogen lines and, whenever possible, several metallic lines from Table 3 of Rasmussen et al. (2002). We found that all our targets are moderate or fast rotators and therefore difficult targets for asteroseismic analysis.

The radial velocities were computed in two ways: with the cross-correlation method and the fxcor task provided by IRAF, and with the method described by Ruciński (1999). In both cases we used synthetic spectra as templates.

Several stars show indications of variable radial velocity. NGC 1817-V1, -V18 and NGC 7062-V1, we classify as new SB1 systems. In NGC 1817-V4, in the profile of the broadening function we see the evidence of the presence of a secondary component, see Fig. 1, and classify this star as a new SB2 system. The identification numbers of stars in NGC 1817 and NGC 7062 are from Arentoft et al. (2005) and Freyhammer et al. (2001), respectively.
Figure 1: The broadening function of NGC 1817–V04, observed on HJD 2 453 332.566. The two components plotted with dashed lines are clearly visible. The combined fit consists of an instrumental broadening convolved with a rotational broadening profile.

We note that in some cases it was difficult to see the difference between a binary and a fast rotator with the spectroscopic resolution of ALFOSC. Also the observed high spread in RV is partially due to the difficulty of measuring precise values of RV for fast rotating stars.

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