Photometric campaign on massive stars in the open cluster NGC 5617

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Abstract

A campaign on the open cluster NGC 5617 was organized in order to characterize the pulsations and to better understand the internal structure of its stars. The variability of the cluster members was never studied before. We present the observations taken and an up-to-date analysis of the obtained time series, especially of several SPB candidates we discovered.

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Introduction

Since 2003, we are monitoring a set of selected southern open clusters with the aim of detecting and characterizing their variable stars. This program is conducted at Euler, the 1.2-m Swiss telescope at La Silla Observatory, Chile, with the C2 CCD camera. The large time span of the observations, typically a few years, makes it possible to study long-period variables, while repeated observations during a given run allow us to detect short-term variations as well.

The majority of the clusters is still in the process of being observed, and the obtained data are being reduced and analyzed. In these proceedings we present the first results of this survey by showing light curves of massive stars, like SPBs, but also δ Scuti and γ Dor stars, as well as eclipsing or ellipsoidal binaries.

Observations and reductions

Over a period of 5.5 years, we took 4400 measurements in the V-band and 750 in each of the Geneva U- and B-bands. The fluxes were extracted using a personal revised version of DAOPHOT (Stetson 1987) using combined PSF and aperture photometry. Then the effects of airmass, atmospheric extinction, . . . , were corrected using multi-differential photometry. The data presented here are the V-band observations and are still not detrended. Their accuracy currently reaches 2.5 mmag for the brightest non-variable stars, over a period of more than 5 years. We plan to use the software SysRem (Tamuz et al. 2005) to correct the remaining systematic effects.
Variable stars in NGC 5617

We found a total of 218 stars displaying variability in the V-band with periods shorter than 50 days. The stars with longer periods have to be taken with caution (possible instrumental drifts) and will be analyzed later. Our automated classification software (Debosscher et al. 2007) found amongst others about 35 SPB, 30 δ Scuti and 20 γ Dor candidates, and 40 eclipsing and 15 ellipsoidal binaries, but the method does not take spectral information into account (known thanks to the membership to the cluster). The variability of these stars is thus doubtless but the classification has to be verified. Hereafter we present some of the candidate pulsators.

Two SPB candidates

In the top panels of Fig. 1, we show the amplitude spectra in different stages of prewhitening of two SPB star candidates. For one of the candidates, seven significant frequencies, with values between 0.495 d$^{-1}$ and 0.784 d$^{-1}$, were detected. Peaks near 0.58 d$^{-1}$ could belong to a quintuplet ℓ = 2. The amplitudes range from 16.3 to 4.0 mmag. For the other candidate SPB pulsator, three modes were found: $f_1$=0.677 d$^{-1}$, $f_2$=0.574 d$^{-1}$, $f_3$=0.768 d$^{-1}$. The amplitudes are 6.3, 3.6 and 2.7 mmag respectively.

A δ Scuti and γ Dor candidate

In the middle panels of Fig. 1, we plot the amplitude spectra in different stages of prewhitening of a δ Scuti and a γ Dor candidate. We determined seven significant frequencies in this δ Scuti candidate, all between 17.995 and 35.228 d$^{-1}$. The amplitudes vary from 3.2 to 0.8 mmag. For the γ Dor candidate we could identify three frequencies: $f_1$=1.746 d$^{-1}$, $f_2$=1.912 d$^{-1}$, $f_3$=1.710 d$^{-1}$. Their amplitudes measure 14.0, 5.1 and 3.3 mmag.

Some eclipsing binaries

Several eclipsing binaries were identified in NGC 5617. In the lower panels of Fig. 1, we show the phase plots for two of them: one with a short period of P=0.296d and another one with a longer period of P=2.178d.

Future work

The first variability results in NGC 5617 encourage a more in depth analysis of the observations. We will search in detail for oscillating stars and try to identify their main modes by means of the multi-colour photometry. With the absolute photometry we have at our disposal, we will select some interesting oscillating cluster members and finally attempt to model them.

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References

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Figure 1: Some example pulsator candidates and eclipsing binaries in NGC 5617.