Mem. S.A.It. Vol. 77, 342

Memorie della

β Cephei stars in the inner part of the Galaxy

A. Narwid, Z. Kołaczkowski, A. Pigulski, and T. Ramza

Instytut Astronomiczny Uniwersytetu Wrocławskiego, Kopernika 11, 51-622 Wrocław, Poland, e-mail: narwid@astro.uni.wroc.pl

Abstract. From the Fourier analysis of the catalogue of ~200,000 variable candidates in the OGLE-II Galactic fields, we found a sample of about 230 short-period low-amplitude variable stars. From their position in the colour-magnitude diagram and the observed periods (multiple in most cases), we identify the stars as a mixture of β Cephei and δ Scuti stars. β Cephei stars from this sample are located in the Galactic disk at distances from 3 to 6 kpc. Many of them shows large range of the excited periods, an indication of high metallicity. We estimate that even a half of the sample of 230 short-period variables we found, can be β Cephei stars. The periods alone, however, are rarely sufficient to distinguish between both types of pulsators. We point out, how this can be done observationally.

Key words. Stars: δ Scuti, Stars: pulsations

1. Introduction

The analysis of the OGLE-II observations by means of the image subtraction method resulted in a catalogue of over 200,000 variable star candidates published by Woźniak et al. (2002). The observations were carried out in the years 1997–2000 in 49 Galactic fields covering ~11 square degrees in the sky. In the search for short-period pulsators in the Galaxy, we analyzed the data from this catalogue. The analysis yielded a lot of candidates for β Cephei, δ Scuti, SPB and γ Doradus stars. In this paper, we present global properties of a sample of ~230 stars with shortest periods (exluding high-amplitude δ Scuti stars, see Pigulski et al., these proceedings). This sample consists mainly of a mixture of β Cephei and low-amplitude δ Scuti stars.

Send offprint requests to: A. Narwid

2. Analysis

The analysis consisted of an automatic extraction of up to five periodic terms for all stars in the catalogue with consecutive prewhitening followed by an automatic classification based upon the periods, amplitudes, and Fourier coefficients (for stars with detected harmonics or subharmonic). Then, for stars selected in this way, a detailed analysis was performed in an interactive way. As a result, we selected about 230 short-period stars that are good candidates for β Cephei and low-amplitude δ Scuti stars. For these stars, we searched for the photometry from the MACHO survey. It turned out that 94 stars from this sample have the MACHO photometry available. However, it is of low quality for some stars, so that we combined OGLE-II and MACHO photometry for only 67 stars in our sample. The analysis of the combined photometry results in a better resolution, lower detection threshold and practically removes the

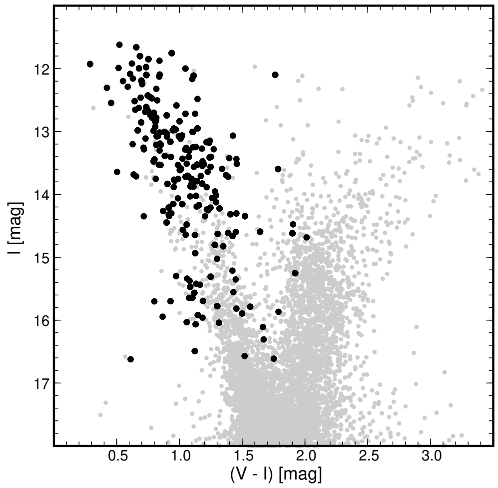

Fig. 1. Colour-magnitude diagram for over 5000 stars from the OGLE-II SC11 field (gray dots) and a sample of ~230 short-period stars (filled circles) found in the OGLE-II catalogue of Woźniak et al. (2002). The latter are mainly β Cephei and low-amplitude δ Scuti stars.

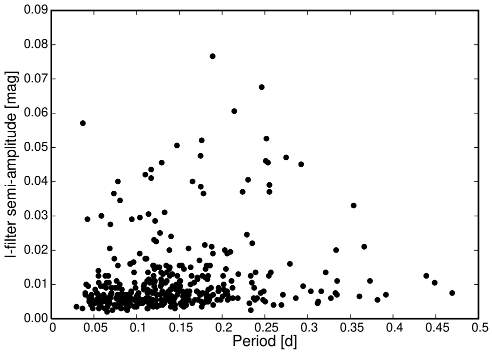

Fig. 2. I-filter semi-amplitudes plotted against the period for all modes detected in the sample of 230 stars shown in Fig.1.

ambiguity in the frequencies of the extracted terms.

3. Results

The main results of our study can be summarized as follows:

1. In the OGLE-II catalogue of variable star candidates (Woźniak et al. 2002) we found about 230 low-amplitude stars with periods shorter than 0.5 d that are good candidates for β Cephei and low-amplitude δ Scuti stars. In the colour-magnitude diagram (Fig. 1), they populate the branch of main-sequence stars. Their I magnitudes range from the OGLE-II saturation limit of $I \sim 11.5$ down to magnitude 16.5.
2. The periods of the bulk of stars in our sample range between 0.04 and 0.2 d (Fig. 2). Since the periods of modes excited in both β Cephei and δ Scuti stars cover this range, the two types of pulsators cannot be distinguished merely from their periods. We are going to carry out the UBV photometry or/and low-resolution spectroscopy of stars from our sample. This will allow us to classify definitely these stars.
3. Almost all other variable stars with periods shorter than 0.5 d were excluded in the process of automatic classification. However, a small-amplitude RR Lyrae and W UMa stars may contaminate our sample, especially for periods longer than ~0.25 d. We estimate, however, that this contribution does not exceed 10%.
4. Half of the stars from our sample (114) shows more than one period of variability. Up to eight modes in a single star were found in the combined OGLE-II and MACHO data.
5. In some stars, equidistant in frequency triplets, an indication of rotational splitting, were found. For many stars, the range of periods of the excited modes is very wide. This may be an indication of the larger-than-average metallicity expected in young population of stars in the inner regions of our Galaxy.
6. All the information given above shows clearly that our sample includes many β Cephei stars located 3–6 kpc away.

Acknowledgements. This work has been supported by the KBN grant No. 1 P03D 016 27.

References

Woźniak, P.R. et al. 2002, AcA, 52, 129