1996 multisite photometric and spectral campaign on the λ Boo star 29 Cyg

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1. Introduction

29 Cyg is the first among λ Boo-type stars for which definite evidence of pulsations has been found (Gies & Percy, 1977). Since the discovery of variabilty, 29 Cyg has been studied photometrically by Cooper & Walker (1994), Kusakin & Mkrtichian (1996), Paunzen & Handler (1996).

The 1996 multisite two-stage photometric and spectral campaign on 29 Cyg was organized by the CAN group (see Mkrtichian et al., 1998) between 5–17 August and 15–25 September against the background of continuous monitoring of the star from the CAN site TSAO between 27 July and 30 September. This campaign was a natural resumption of the 1995 photometric investigation of 29 Cyg (Kusakin & Mkrtichian, 1996).

2. Photometry

A total of 48 photometric and 2 spectroscopic nights at observatories in Ukraine, Kazakhstan, Turkey, Hungary, Canada and USA were acquired during the campaign. 29 Cyg is known as a star with variable amplitudes of modes (Kusakin & Mkrtichian, 1996). In this note, we focus on the search for a solution with a stationary frequency for the interval JD 2450292 - JD 2450357. The steps of the

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preliminary DFT analysis of combined V-filter data of 45 selected nights, made using the pre-whitening technique, are shown in Figure 1; the frequencies found are given in Table 1.

Table 1. Frequency solution for JD 2450292 - 2450357 V-data set

	Frequency d^{-1}	Semi-ampl. (V) mag
f_1	37.425	0.0102
f_2	34.721	0.0038
f_3	29.774	0.0030
f_4	28.160	0.0023
f_5	25.189	0.0021
f_6	33.629	0.0023

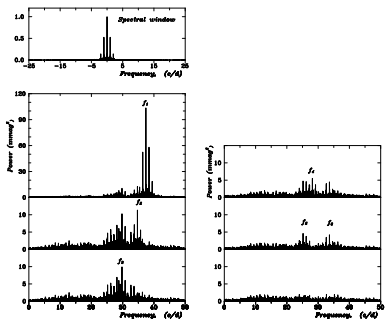

Figure 1.

Comparison with the yet unpublished analysis of our 1995 V data shows conspicious peculiarities:

- In 1996 the main mode of pulsation, with the frequency 37.425 d^{-1} (ΔV=0.020), did not change its amplitude, in comparison with the 1995 V-band observation ($\Delta V = 0.020$) obtained at TSAO.
- The second main mode, with $\nu = 29.77\ d^{-1}$, decreases its amplitude from $\Delta V = 0.012$ to $\Delta V = 0.006$, i.e. by a factor of two.
- Evidence of additional low-amplitude modes in the power spectrum can be suspected in the range $10 - 40\ d^{-1}$.

3. Spectroscopy:

When our work on 29 Cyg started, only one λBoo-type star, HD 111604, was investigated spectroscopically for pulsations (Bohlender et al., 1996). The new spectral observations of 29 Cyg were carried out at the coudé focus of the 2.6-m telescope of the Crimean Astrophysical Observatory during two consecutive nights, August 11/12 and 12/13 1996. We present in Figure 2a,b the radial

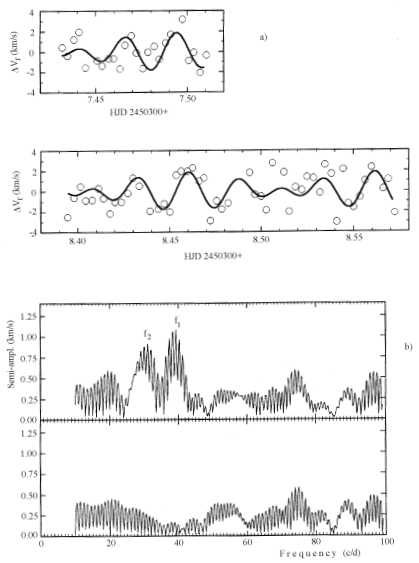

Figure 2.

velocity (RV) variations of the H_α line (the dots) for two nights, JD 2450307 and JD 2450308 and two steps of DFT frequency analysis in combination with prewhitening technique. RV variations with peak-to-peak amplitudes of about 4 $\mathrm{km\,s^{-1}}$ are clearly seen in the figure. The main peak at 39.3 $\mathrm{d^{-1}}$ with a semi-amplitude of 1.0 $\mathrm{km\,s^{-1}}$ in amplitude spectra, corresponds, within the uncertainties, to the 37.425 $\mathrm{d^{-1}}$ frequency of photometric variability having the highest amplitude. The velocity-to-amplitude ratio for 37.425 $\mathrm{d^{-1}}$ is $2K/\Delta V = 100\ \mathrm{km\,s^{-1}\,mag^{-1}}$. The second frequency $f_2 = 30.0\ \mathrm{d^{-1}}$ with a semi-amplitude of 0.8 $\mathrm{km\,s^{-1}}$ is more probably an unresolved combination of the two known photometric frequencies, 34.72 $\mathrm{d^{-1}}$ and 29.77 $\mathrm{d^{-1}}$.

4. Further work and prospect:

We plan to do analysis of the simultaneous multicolor W,B,V,R TSAO observations for the mode-identification of the highest-amplitude modes. A joint fine analysis of photometry and spectroscopy is planned. In July-October 1997 the second multisite photometric and simultaneous spectral campaign on 29 Cyg was undertaken by CAN and the observatories in Arizona and Turkey. Data were acquired during more than 82 photometric and 2 spectroscopic nights. The combined analysis of 1995/1996/1997 data will allow the investigation of the amplitude variability of modes over 3 years, a reduction of the noise level in the power spectrum and the extraction of small amplitude modes suspected in the 10-40 $\mathrm{d^{-1}}$ range.

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