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MULTIPERIODICITY IN THE δ SCUTI VARIABLE GSC 2899-00521

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The variability of the star GSC 2899-00521 ($\alpha_{2000} = 05^{\text{h}}48^{\text{m}}45^{\text{s}}.1$; $\delta_{2000} = +40^{\circ}15'16''$) was suspected as a result of the STARE (STellar Astrophysics & Research on Exoplanets) project in Auriga. It received the preliminary designation aur0 5472 (STARE Home Page). An amplitude of 0.04 mag and a period of 0.15132 days were suggested. This makes the star a candidate Delta Scuti variable.

The star was observed at Beersel Hills Observatory during 9 nights between October 2001 and February 2002. A total of 1159 data points were obtained in V during 53.7 hours of photometry. During two nights, BVR photometry was acquired (114 data points in each colour). The instrument used was a 0.40-m telescope, equipped with a ST7E CCD camera and a filterset following Bessel's specifications. The exposure times varied between 50 and 90 seconds. In addition 27 data points were obtained in V during 2.7 hours of observations with the 1.0-m telescope and the HOLICAM CCD camera of the Hoher List Observatory (University of Bonn, Germany). The images were standard dark-framed and flatfielded and were reduced with the aperture photometry procedure of the Mira AP software package[†].

The brightness of the variable was measured with respect to GSC 2899-01786, while the stars GSC 2899-01257 and GSC 2899-02149 were used as check stars. The average instrumental magnitudes with respect to the comparison star are given in Table 1.

Table 1. Average instrumental magnitudes compared to GSC 2899-01786

Star	GSC 2899-	ΔB	ΔV	ΔR
var	00521	-0.54	-0.59	-0.62
check1	01257	-0.37	-0.53	-0.61
check2	02149	0.26	0.32	0.35

Standard deviations of the observations are of the order of 0.02 mag or smaller. The nightly standard deviation of the differences in V magnitude between the comparison and the first check star measured at BHO, ranged between 0^m006 and 0^m016, and between 0^m009 and 0^m024 for the second check star. In B and R , standard deviations were 0^m012

[†]The Mira AP software is produced by Axiom Research Inc.

and 0^m015 respectively, for both stars. At Hoher List this standard deviation amounted to 0^m005 for both check stars in V .

Our light curve clearly shows the multiperiodic behaviour typical of Delta Scuti stars. Fig. 1 shows B , V and R differential magnitudes for a particular night. The Fourier analysis program Period98 (Sperl, 1998) was used to detect the frequencies in the light curve. Fig. 2 shows the amplitude spectrum from the BHO V data. Two frequencies can easily be identified: at $6.610 \pm 0.005c/d$ (corresponding to the period given by STARE) and $13.356 \pm 0.005c/d$.

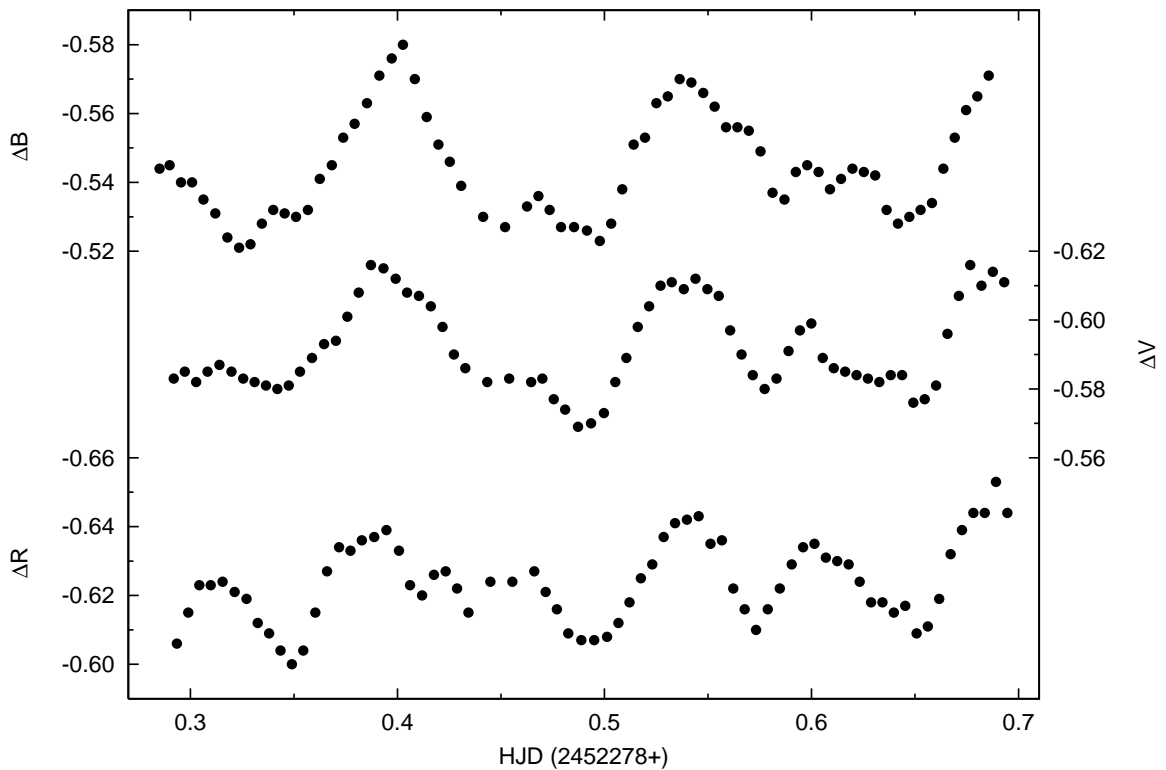


Figure 1. B (upper curve), V (middle curve) and R (lower curve) plots of the magnitude of GSC 2899-00521 compared to GSC 2899-01786, on the night of January 3rd, 2002.

After prewhitening for these two frequencies, a third frequency appears, with a signal-to-noise ratio of 5 (see Fig. 3). This frequency is located at $6.745 \pm 0.005c/d$, corresponding to the difference between the second and the first frequency. Due to the specific spectral window for the observations, there are strong aliases of this frequency which differ by $0.03 c/d$ and $1 c/d$. So there is still a possibility that the third frequency is not really a linear combination of the two other frequencies detected.

The same method was used to analyse the data from the STARE project (STARE Home Page). These data were obtained in 1997/8. The same three frequencies appear, with a much smaller amplitude (the wavelength of these observations resembles R). There

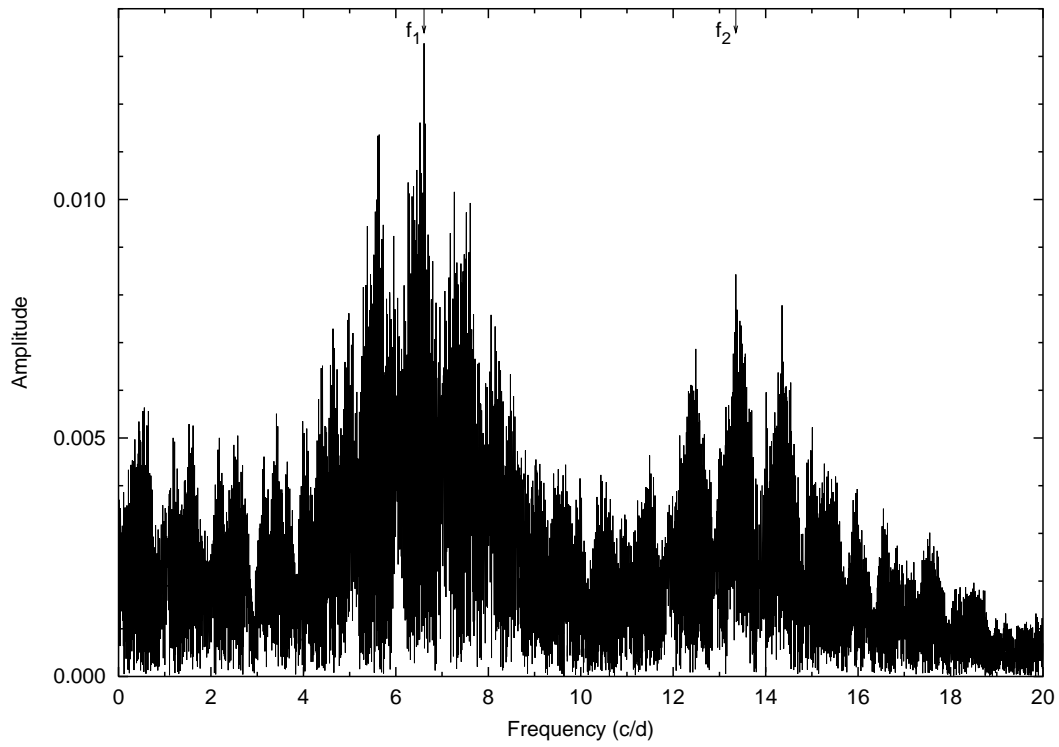


Figure 2. Amplitude spectrum of the V data.

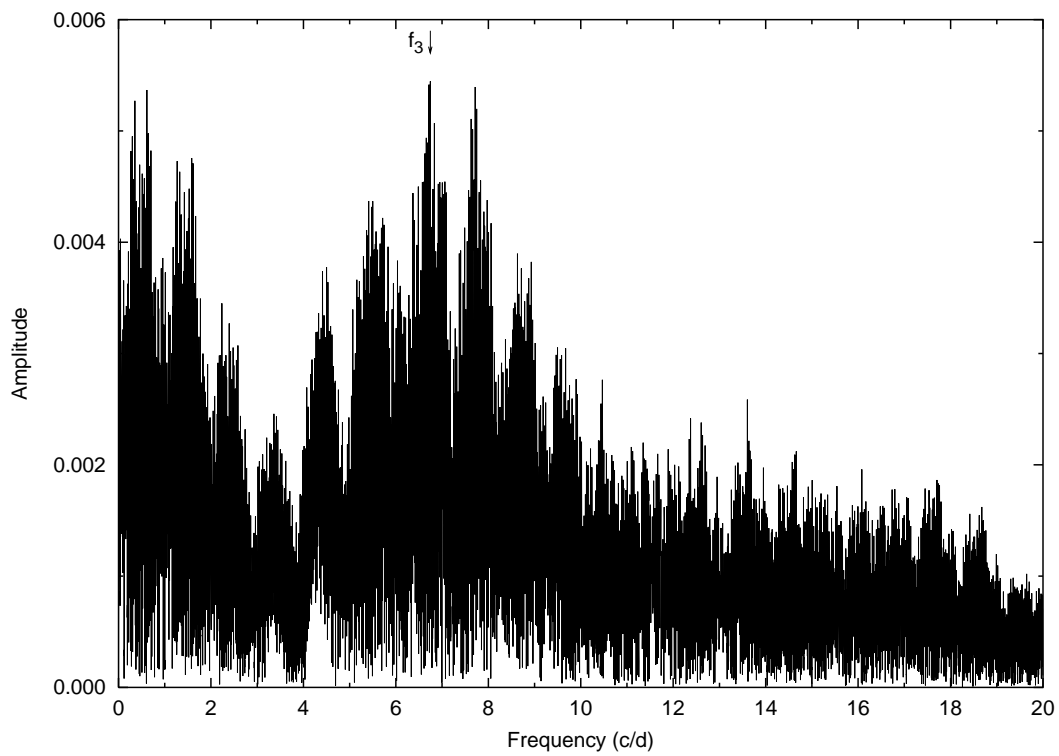


Figure 3. Amplitude spectrum after prewhitening for the two main frequencies.

is a 0.03 c/d alias of the third frequency as well, namely $6.711 \pm 0.010c/d$, which in this case has a higher amplitude. The S/N ratio is only 3 for this frequency, but since it is a combination of the other two frequencies, it is significant (Breger et.al., 1993).

The semi-amplitudes of the two main frequencies on the two nights with multi-colour photometry, obtained from a fit with these two frequencies only, are listed in Table 2 (in mmag). They are compared to the semi-amplitudes of our complete data set (in V) and the STARE data set, with all three frequencies fitted. While the amplitudes of the first two frequencies have a ratio 2 to 1 in B and V , they are equal in R . This may aid in the identification of the pulsation modes of this star.

Table 2. Semi-amplitudes of GSC 2899-00521 (in mmag)

Frequency	[c/d]	V (all data)	B	V	R	STARE
f_1	6.610	15	18	14	10	8
f_2	13.356	8	9	7	10	7
$f_2 - f_1$	6.745	6	—	—	—	4

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