COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 5162

Konkoly Observatory
Budapest
29 August 2001

HU ISSN 0374 – 0676

GSC 8527-373: A MULTIMODE DELTA SCUTI STAR

PÓCS, M.D.[1]; REA, R.D.[2]; SZEIDL, B.[1]

[1] Konkoly Observatory, H-1025 Budapest, P.O. Box 67, Hungary, e-mail: pocs@konkoly.hu, szeidl@konkoly.hu

[2] Regent Lane Observatory, Nelson, New Zealand, e-mail: reamarsh@ihu.co.nz

The variability of GSC 8527-373, an approx. 12.5-mag star was discovered by Rea (2001) while monitoring the near-by CV star TW Pictoris. On the basis of the period ($0\overset{d}{.}080$) and amplitude ($0\overset{m}{.}2$) of the star's light variation the object was classified as a probable δ Scuti star. Since the variable has been thoroughly observed, it prompted us to rediscuss the observations and to look for further frequencies.

The original observations were made with an 0.35-m Schmidt–Cassegrain telescope and a CCD detector without using any filter, thus no colour information was obtained and no utilizable information was available from other sources either for this object. On the other hand the lack of filters may result in severe zero point shifts from night to night because of the colour dependence of atmospheric transparency. The observations have been obtained on 14 nights during two months: December 6, 7, 9, 12, 13, 21, 26, 2000, January 3, 13, 17, 26, 29, 31 and February 1, 2001.

Before the analysis heliocentric corrections were applied to the "raw" data and then, in order to decrease the scatter, the observations were binned in groups of three. Multifrequency analysis was performed with the MUFRAN (MUltiFRequency ANalysis) program package (Kolláth, 1990). MUFRAN is a collection of methods for period determination, sine fitting for observational data and graphics routines for visualization of the results.

The first, rather superficial frequency analysis clearly showed a high peak at $f_1 = 12.5521$ c/d, the main frequency of the star. After prewhitening with the frequencies f_1, $f_2 = 2f_1$ and $f_3 = 3f_1$ the residual spectrum seemed to be very noisy. Our suspicion was that it might be the result of the defectiveness of the data. Therefore the data sets of different nights were carefully scrutinized and it turned out that the scatter of the observations were excessively large on the nights 12, 13 December, 2000 and 29 January, 2001. These observations were left out of consideration in the final analysis. (If we took into account the less noisy data of these nights our final results did not change.)

Fig. 1 shows the spectral window and Fig. 2 presents the Fourier amplitude spectrum of the data of 11 nights. The frequency 12.5521 c/d and its multiples are present, and after prewhitening with them (Fig. 3), a further frequency $f_4 = 18.87660$ can be deduced. The results of the least-squares solution with these frequencies are given in Table 1. The residual is $0\overset{m}{.}013$ which seems to be slightly high since the error of the binned observations is around $0\overset{m}{.}005$.

After removing the frequencies f_1, $f_2 = 2f_1$, $f_3 = 3f_1$ and f_4, the remaining spectrum is shown in Fig. 4. The high peaks at the short frequency end refer to serious zero point shifts

from night to night. Although real frequencies may exist on the short frequency ($f \leq 1$ c/d) domain (see e.g. Paparó et al. 1996), in the present case the previous explanation seems to be valid. Probably other frequencies ($f_5 = 10.3658$ c/d, $a_5 = 0\overset{\mathrm{m}}{.}003$; $f_6 = 18.6727$ c/d, $a_6 = 0\overset{\mathrm{m}}{.}003$) are also present, but the available observational material does not allow further discussion and conclusion.

The asymmetric light-curve ($f_2 = 2f_1$ and $f_3 = 3f_1$ are also present) and the low amplitude ratio $a_4/a_1 = 0.072$ make the object a very interesting δ Scuti star. The high amplitude oscillation (with the frequency f_1) may be identified as the fundamental radial mode, and the frequency f_4 (and possible other frequencies) as non-radial mode(s).

According to its behaviour the star resembles the unique high-amplitude δ Scuti star AN Lyncis (Rodríguez et al. 1997) in many respects (e.g. the amplitude ratio of the non-radial and radial oscillation or the frequency distribution).

The star is certainly a good target for further investigation.

Table 1: Least-squares solution

	frequency (d^{-1})	amplitude (mag)	phase (rad)
f_1	12.55213	0.069	0.56
$f_2 = 2f_1$	25.10426	0.010	2.71
$f_3 = 3f_1$	37.65639	0.002	0.76
f_4	18.87660	0.005	5.63

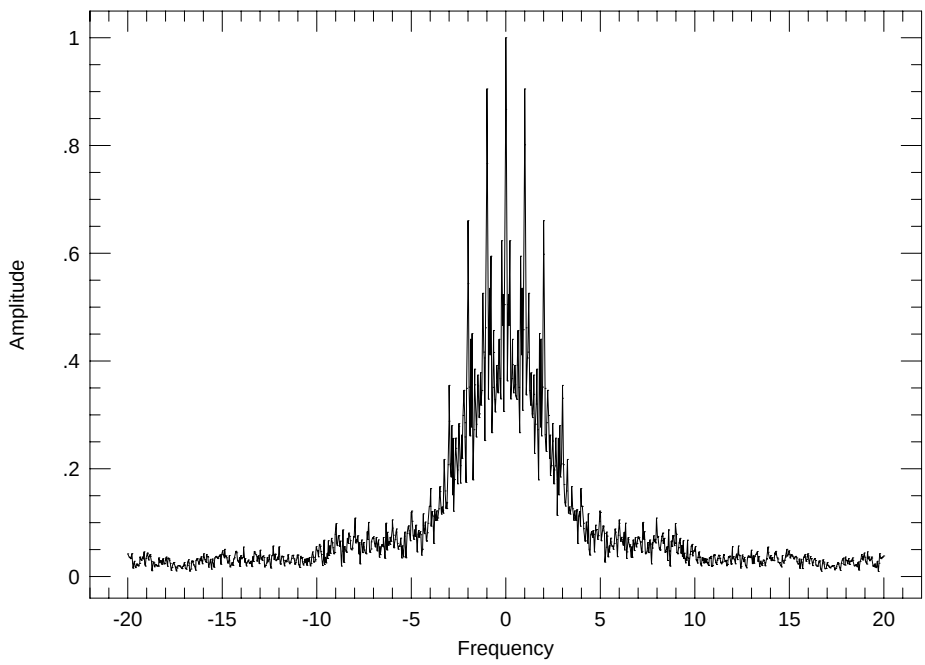

Figure 1. Spectral window

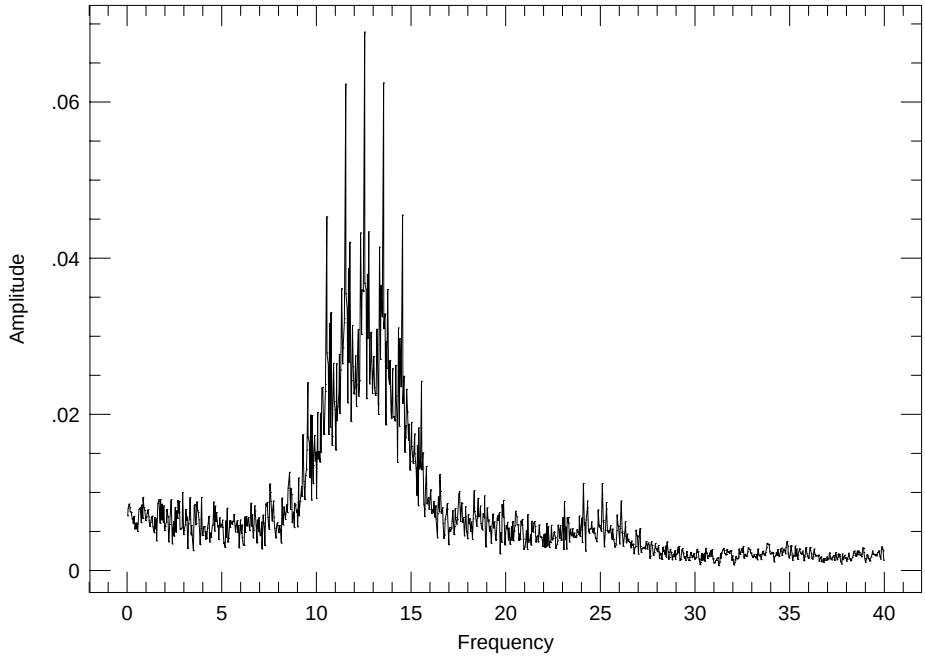

Figure 2. Amplitude spectrum of the binned observations of 11 nights

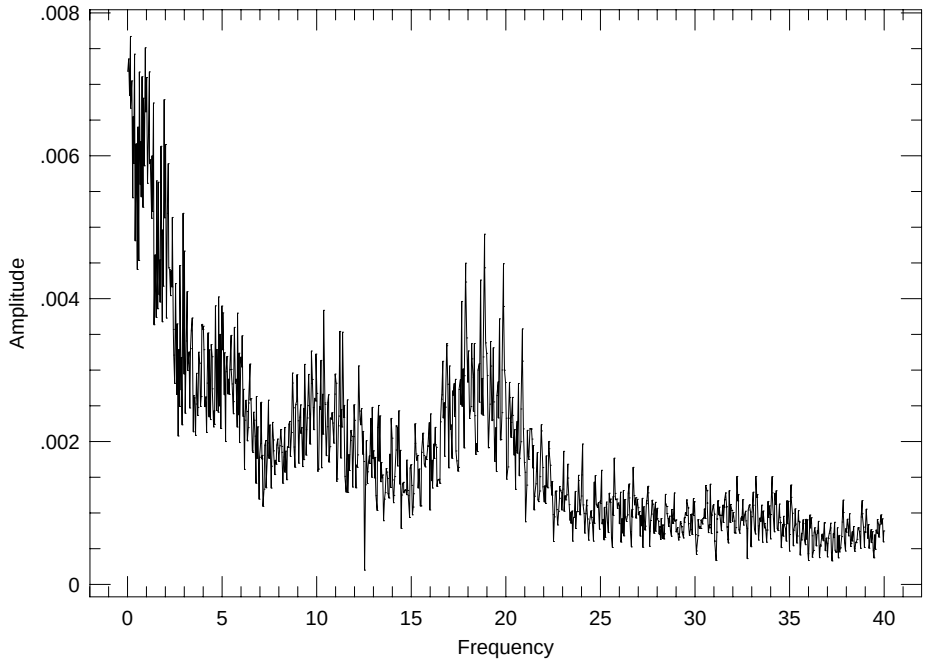

Figure 3. Amplitude spectrum of the binned observations of 11 nights after removing the frequencies f_1, $f_2 = 2f_1$, $f_3 = 3f_1$

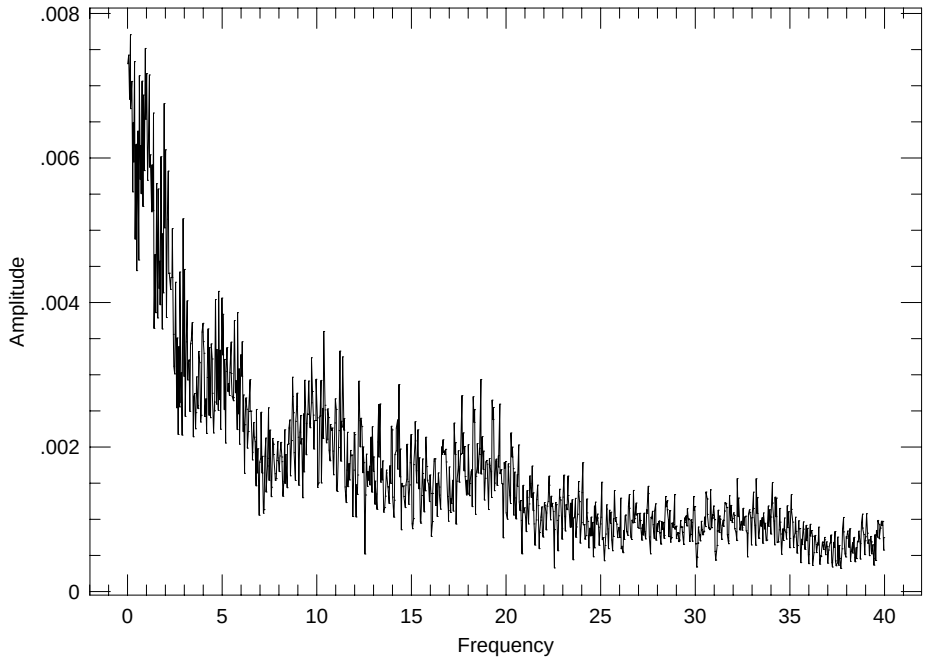

Figure 4. Amplitude spectrum after removing the frequencies f_1, $f_2 = 2f_1$, $f_3 = 3f_1$ and f_4

Acknowledgement. This work was supported by the Hungarian Research Grant OTKA T-030955.

References:

Kolláth, Z., 1990, *Occasional Technical Notes, Konkoly Obs.*, No. 1
Paparó, M., Sterken, C., Spoon, H.W.W., & Birch, P.V., 1996, *A&A*, **315**, 400
Rea, R.D., 2001, *IBVS*, No. 5064
Rodríguez, E., González-Bedolla, S.F., Rolland, A., Costa, V., López-González, M.J., & López de Coca, P., 1997, *A&A*, **328**, 235