A STUDY OF THE VARIABILITY OF THE DELTA SCUTI-STARS

IV: *Pulsational Modes in BD* $-6°4932$

GIANANTONIO GUERRERO and LUCIANO MANTEGAZZA

Osservatorio Astronomico, Merate, Como, Italia

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Abstract. A total of 321 observations of the Delta Scuti star BD $-6°4932$, obtained in 1968 by Hall and Mallama (1970), are analyzed. We find four frequencies which represent the light curves satisfactorily.

The three periods: $P_1 = 0\overset{d}{.}240$, $P_3 = 0\overset{d}{.}182$ and $P_4 = 0\overset{d}{.}114$ seem to correspond to the radial modes of pulsation with $K = 0$, 1, and 3, respectively. The last period $P_2 = 0\overset{d}{.}220$ can be related to a non-radial mode.

1. Introduction

The Delta Scuti star BD $-6°4932$ (HD 174553) was observed during a two week period (in all 321 observations) in 1968 by Hall and Mallama (1970, hereafter referred HM).

On the ground of a mere inspection of the lightcurves, without the use of more sophisticated analysis techniques, HM gave the following ephemeris: J.D. (max) = $2440393.709 + 0\overset{d}{.}223$ E. Nevertheless, they could assert that: "it is likely that the period is not constant or that we are observing the complicated interaction of two period".

In the framework of the observational program on Delta scuti stars, started some years ago at the Merate Observatory, we carefully analysed HM's data in order to throw light on the pulsational behaviour of this star.

2. Analysis of the Observations and Discussion

The observations (see Table I in the HM's paper) were analyzed with a method similar to that proposed by Vaníček (1971), and already applied by us in other works on Delta Scuti-stars (see for example, Guerrero *et al.*, 1979). Due to the favourable time distribution of the data there were not troubles with the aliases, so that four components were successively singled out with quite sure confidence. Moreover the probability that these components may be produced by random noise is less than 10^{-6} for all of them.

A least-squares solution was then obtained in the form

$$\Delta m(t) = \Delta m_0 + \sum_{i=1}^{4} A_i \sin\{2\pi f_i[(t - t_0) + \varphi_i]\}.$$

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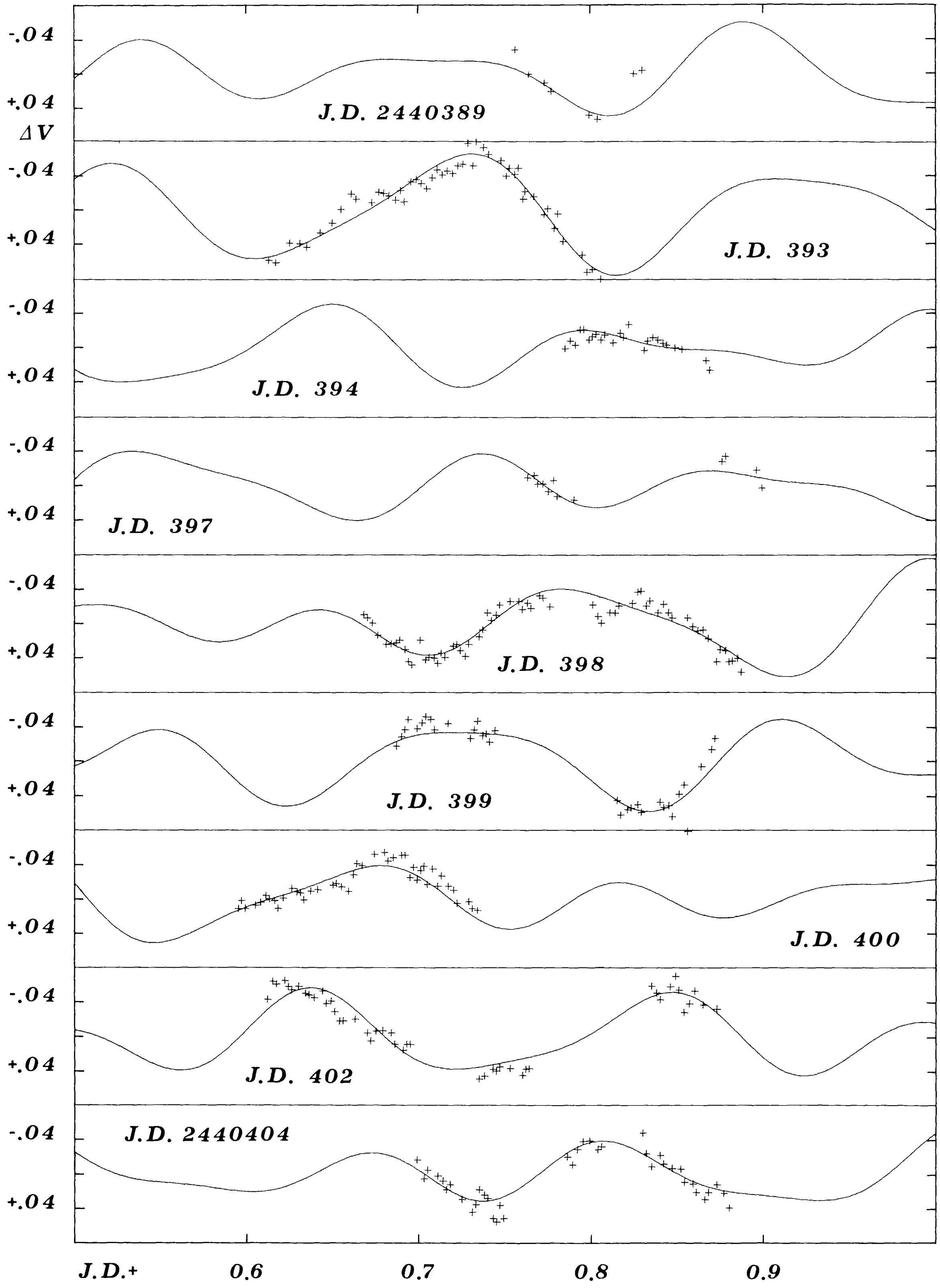

ΔV
-.04
+.04
J.D. 2440389
J.D. 393
J.D. 394
J.D. 397
J.D. 398
J.D. 399
J.D. 400
J.D. 402
J.D. 2440404
J.D.+
0.6
0.7
0.8
0.9

Fig. 1.

TABLE I

Periods $\left(\frac{1}{f_i}\right)$	Amplitudes (A_i)	Phases (φ_i)
$P_1 = 0\overset{d}{.}240$	$A_1 = 0\overset{m}{.}022 \pm 0\overset{m}{.}00016$	0.066
$P_2 = 0\overset{d}{.}220$	$A_2 = 0\overset{m}{.}010 \pm 0\overset{m}{.}00016$	−0.186
$P_3 = 0\overset{d}{.}182$	$A_3 = 0\overset{m}{.}034 \pm 0\overset{m}{.}00017$	−0.245
$P_4 = 0\overset{d}{.}114$	$A_4 = 0\overset{m}{.}014 \pm 0\overset{m}{.}00015$	−0.216

T_0 = JD(hel.) 400.644
$m_0 = 2\overset{m}{.}288$
Initial r.m.s. residual = $0\overset{m}{.}034$
Final r.m.s. residual = $0\overset{m}{.}013$

The coefficients are reported in Table I. In Figure 1 the synthesized curve, computed according to the above given equation, is compared with the observations. The total reduction of the variance due to this solution corresponds to 85%.

Because the *uvbyβ* photometry for BD −6°4932 doesn't exist, we cannot calculate the relative physical parameters, very useful for the discussion about the involved modes of pulsation, by means of these data.

We can consider reliable, on the ground of the discussion made in HM's paper, the following values: $(B-V)_0 = 0\overset{m}{.}38$, $M_v = 0\overset{m}{.}8$, spectral type F4 III. Starting from these data and using the relations between spectral type, bolometric corrections, effective temperatures and gravities given by Allen (1973), the following further parameters can be found:

$$T_{\text{eff}} \simeq 7000\text{ K}, \log g \simeq 3.5, BC \simeq -0.06.$$

Now we are able to calculate the pulsation constant Q for the two periods with the greatest amplitudes: $P_3 = 0\overset{d}{.}182$ and $P_1 = 0\overset{d}{.}240$. The corresponding values: $Q_3 = 0\overset{d}{.}030$ and $Q_1 = 0\overset{d}{.}040$, agree well enough with the theoretical ones calculated for the first overtone and the fundamental radial mode, respectively (Petersen, 1975). Furthermore, the reliability of these radial modes with $K = 0$ and $K = 1$ is confirmed by the ratio $P_3/P_1 = 0.76$, very similar to that theoretically determined.

The shortest period in Table I, $P_4 = 0\overset{d}{.}114$, gives $Q_4 = 0\overset{d}{.}017$ and can be related to the third radial overtone ($K = 3$). The ratios $P_4/P_3 = 0.626$ and $P_4/P_1 = 0.475$ strengthen this hypothesis (Petersen, 1975).

At last we have to consider $P_2 = 0\overset{d}{.}220$: its ratio with the period corresponding to the fundamental radial mode, $P_2/P_1 = 0.917$, could indicate the presence of a non-radial mode.

3. Conclusions

The Delta Scuti-star BD −6°4932 exhibits radial oscillations; the first overtone being more excited than the fundamental mode: this behaviour is similar to that found in 38 Cnc, another evolved Delta Scuti star intensively observed by our group (Guerrero *et al.*, 1979) and analyzed by Breger (1980).

The mixture of radial and non-radial modes of pulsation in the same object is not a strange phenomenon among Delta Scuti-stars: it is present also in other variables of this type, for example Delta Scuti itself and 1 Mon.

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