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MULTIPLE PERIODICITY OF δ DELPHINI

Delta Scuti stars are pulsating, short period variables characterized by small amplitude in their light curves. Known stars in this group have A or F type spectra with small color indices.

δ Delphini was noticed as a variable by Eggen (1956) with a period of $0^d.13505$ after 3 nights of observations. Eggen defined the star as a member of δ Scuti group and spectral type was given as A7 III by Slettebak (1955). Bidelman (1966) has also defined a new spectral type using δ Del as a prototype.

Table 1. Coordinates of variable and comparison stars.

	α_{1950}	δ_{1950}	Sp	m
δ Del	$20^h\ 41^m\ 07^s.4$	$+14^\circ\ 53'.6$	FO IV	4.49 - 4.38 v
ζ Del	$20^h\ 32^m\ 58^s.2$	$+14^\circ\ 30'$	A3 V	4.68

In this paper, we present new photometry of δ Del obtained using 0.4 m reflector at the observatory of METU, which was established at the end of 1990. Observations of δ Del (HD 197461) were performed in blue and visual regions and ζ Del (HD 196180) was chosen as comparison star. Differential star-star method was followed and magnitude differences $\Delta m = m(\delta) - m(\zeta)$ corrected for extinction in both filters were then plotted against time (heliocentric julian days). We have also included the previous observations obtained by one of us (Uyanıker, 1989) with a telescope of 20 cm. aperture using SSP-3 photometer. A multiperiod analysis was applied to all available data using the program PERIOD of Breger (1990). Light curves are given in figure 1 and the amplitude spectra for two nights are shown in figure 2. Periods obtained from the frequency analysis are displayed in table 2. Amplitude variations between maxima and minima in the light curves have been detected. It can be seen from figure 1 that δ Del is bluer at maximum than at minimum. The fundamental period obtained from old observations is 0.157 days while new observations resulted in a period of 0.148 days, both in the visual range.

We have also detected, roughly, a second and a third period of 0.057 and 0.042 days, in v filter, respectively (see also table 2). Thus we have tried to represent the light curve as the sum of three Fourier terms. However, the light curves of JD 2447405 and 2448449 are affected with a fourth frequency corresponding to a range of 0.33 to 0.40 days, and are inconsistent with the periods of δ Scuti type stars. These values may be results of the tidal influence of the component star as indicated by Fullerton (1967); who also noticed a 40 day binary period, while Fitch (1975) indicated 40.58 days. Baglin et al. (1973) also put δ Del in the class of binary stars in δ Scuti variables. Observations of JD 2448438 are of poor quality, so this night was excluded from the frequency analysis.

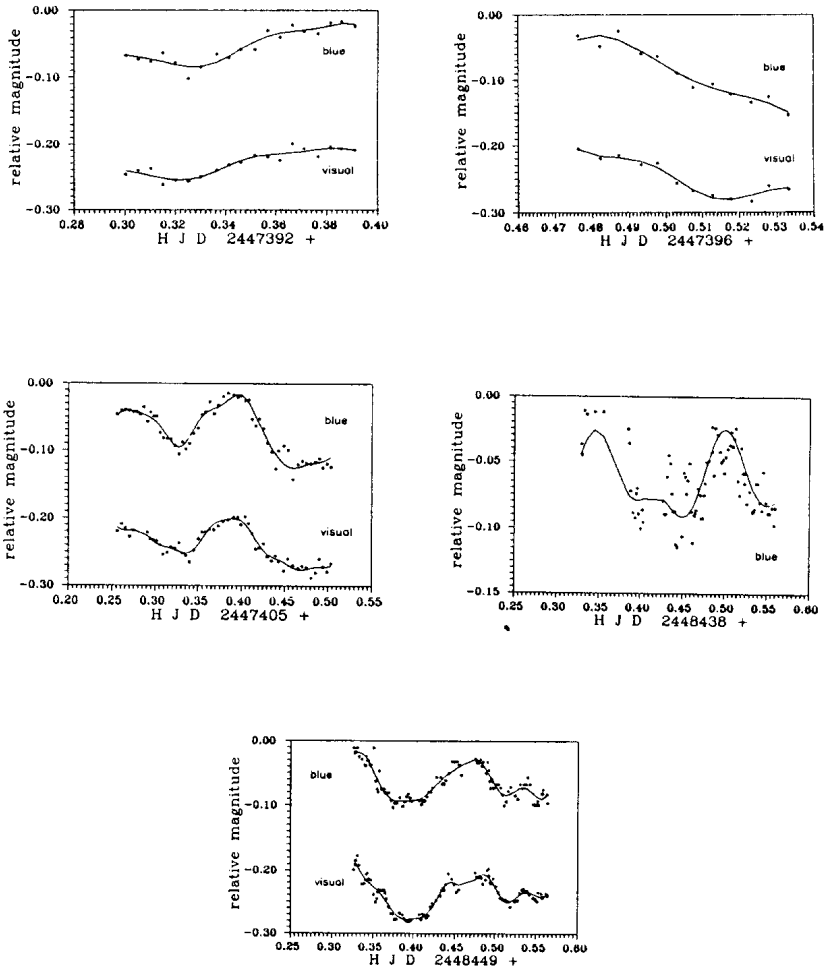

Figure 1. Light curves of HD 197461 in both blue and visual filters. Note that solid curves indicate the fit.

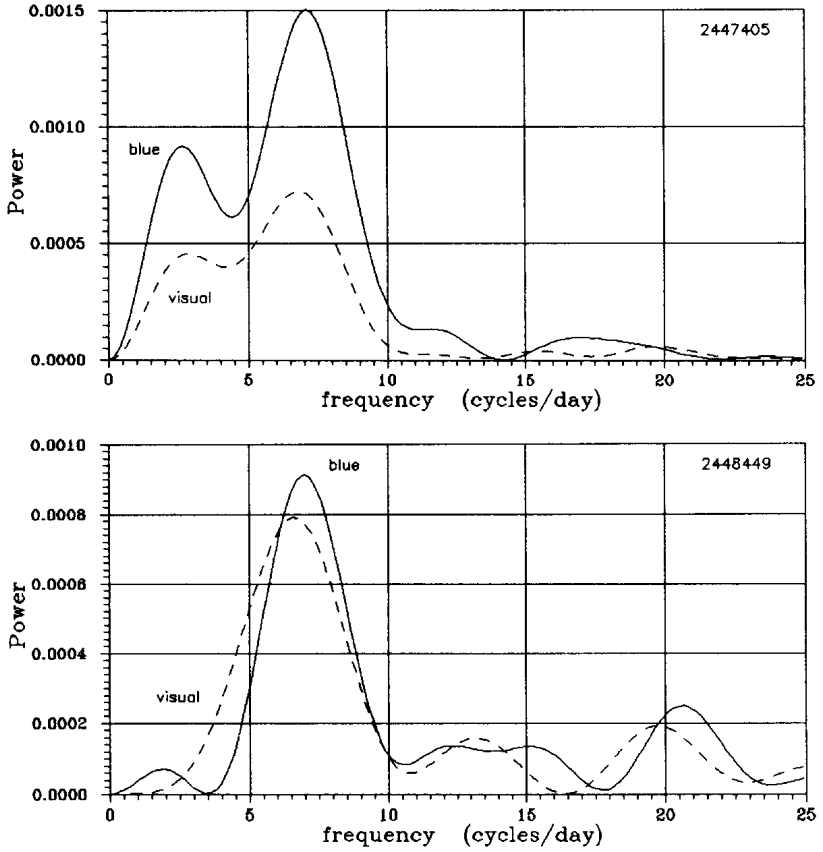

Figure 2. Power spectrum analysis of the data in two filters. Corresponding dates are also labeled.

Fundamental period and its harmonics indicate that P_1/P_0 ratio is about 0.4 to 0.5 for all data available. This result implies that δ Del does not hold the $P_1/P_0 \approx 0.75$ criterion for the radial oscillations (Breger and Bregman, 1975).

Table 2. Frequency fit parameters

HJD	*filter*	F_1	F_2	F_3	F_4	*Residual*
2447392	b	8.40	-	24.21	-	0.0078
	v	8.47	-	23.41	-	0.0061
2447396	b	6.73	12.36	-	-	0.0085
	v	5.16	-	27.00	-	0.0048
2447405	b	7.80	17.75	22.99	1.31	0.0094
	v	6.36	11.59	24.34	3.03	0.0069
2448449	b	6.87	17.35	18.60	2.46	0.0094
	v	6.73	17.82	22.74	5.43	0.0074

Thus we conclude that, the preliminary period range obtained above is too small to be the binary period. However this is because of the binary nature of the star. Further work is required and a detailed frequency analysis must be carried out in order to understand the reason of these variations. Continuous observations are also needed to resolve the binary period.

Bülent UYANIKER and Altan BAYKAL
Physics Department
Middle East Technical University,
06531 Ankara, Turkey
e-mail: A10380 @ TRMETU.BITNET
ABAY @ TRMETU.BITNET

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