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Confusion concerning the variability of HR 5492 (=DL Dra) and HR 5437

HR 5492 was observed by Percy (1973) using HR 5437 and HR 5608 as comparison stars. It was only suspected to be a variable star with an amplitude of $\sim$ 0.03 mag and a period of $\sim$ 3 or 7 hours based on five hours of photoelectric observations. Later, Guerrero et al.(1978) confirmed the light variation using HD 130173 as the comparison star. The check stars were HD 129226 and HD 129865. The data from three nights were analysed resulting in two periods (P_1 = 0.0825 days and P_2 = 0.0837 days) with a high period ratio suggesting non-radial pulsational modes. A more extensive study using the same comparison and check stars was performed by Bossi et al.(1981). According to their findings, HR 5492 does not show any light variation with an amplitude larger than $0\overset{\mathrm{m}}{.}01$ mag. In spite of the small light variation, two statistically significant periods, P_1 = 1.29 and P_2 = 0.044 days, were found. However, they are not sure that the period P_1 = 1.29 days is attributable to HR 5492. The second frequency is regarded as the radial fundamental mode. Comparing the amplitude of the light variation observed by Percy and by them, a possible variation in the pulsational amplitude on a very long time-scale is indicated.

In an effort to clarify the nature of HR 5492, photoelectric observations were carried out between 1986 and 1988 in Hungary and China. The following equipment was used:

(i) The 60 cm reflector of the Xinglong Station of Beijing Observatory. The photometer is a single-channel type working in the DC mode and controlled by microcomputer (Shi et al. 1987).

(ii) The 50 cm telescope of Piszkéstető, the mountain station of Konkoly Observatory. The telescope is equipped with a data acquisition system, phototube and filters (Patkós,1982) providing photoelectric data close to the Johnson UBV system.

All of the observations were obtained in the Johnson V band. In our study, almost all of the previously used comparison and check stars were observed in different combinations on different nights. The available photoelectric and spectroscopic data of the observed stars are listed in Table 1.

TABLE 1

	Star	V	B-V	U-B	R-I	Sp	ADS number
1	HR 5492	6.25	+0.41	-0.01	+0.20	F2V	9357
2	HR 5437	6.24R				FOIII	
3	HD 130173	6.60				F2	9371
4	HD 129865	8.0				F0	
5	HD 129226	8.4				F5	

The data are taken from The Bright Star Catalogue (Hoffleit and Jaschek 1982), the SAO Catalogue and the Index Catalogue of Visual Double Stars (Jeffers et al. 1963). HR 5492 is a very close binary system; the fainter component is 8.5 mag and the separation is 4".1. In the previous studies (Guerrero et al. 1978, Bossi et al. 1981) the systematically used comparison, HD 130173, is a visual triple system. The separation of the B component from A is 12".2 and the P component from A is 9".1. The fainter components are 8.3 and 10.4 mag, respectively. The application of the same diaphragm for this triple system as used for HR 5492 gives data with considerably higher scatter. The journal of the observations is shown in Table 2 containing the observed stars in the last column. The number of stars is taken from Table 1.

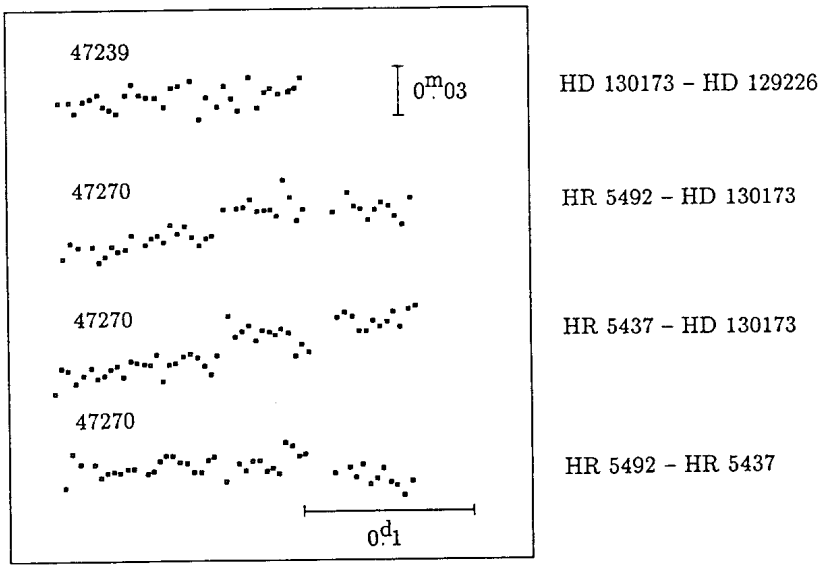

Figure 1.

TABLE 2

Date (UT)	2400000+	H.J.D. (days)	Length	Number	Site	Observed stars
March 17/18	1986	46507	.2367	85	H	1,3
March 18/19	1986	46508	.2524	61	H	1,2
Jan. 20/21	1987	46816	.1520	42	H	1,2
Febr. 5/6	1987	46832	.2188	62	H	1,2
Apr. 29/30	1987	46915	.2170	67	H	1,2
Apr.30/May 1	1987	46916	.2286	71	H	1,2
Febr. 1/2	1988	47193	.1570	54	CH	1,2,3,4,5
Febr. 2/3	1988	47194	.2063	81	CH	1,2,3,4,5
Febr. 3/4	1988	47195	.2462	77	H	1,2
Febr. 14/15	1988	47206	.1642	51	H	1,2
March 6/7	1988	47227	.1298	25	H	1,2,4
March 18/19	1988	47239	.1427	32	H	1,3,5
Apr. 13/14	1988	47265	.1364	33	CH	1,2,3,4,5
Apr. 18/19	1988	47270	.2084	49	H	1,2,3
Apr. 24/25	1988	47276	.2311	52	H	1,2,3
May 11/12	1988	47293	.1791	31	CH	1,2,3,4,5
June 11/12	1988	47324	.2163	38	CH	1,2,3,4,5
June 12/13	1988	47325	.1685	27	CH	1,2,3,4,5

As a result of the present study, the confusion concerning HD 130173, HR 5492 and HR 5437 seems to be resolved.

HD 130173: Because of the complexity of the system, unusual behaviour is to be expected making it unsuitable as a comparison star. In Figure 1. the light curves for HD 130173 obtained on two different nights are plotted. For the night of JD 2447239, in addition to the large scatter, it does not show any regular variation. However, for the night of JD 2447270 the light curves of HR 5492 and HR 5437 relative to HD 130173 have the same long term variation, while in the light variation of HR 5492 relative to HR 5437 no similar trend exists. The differential extinction correction was used in the same way on each night and for each light curve. The trend in the two middle curves in Figure 1. can be attributed to the (long term variation of) HD 130173. The period of 1.29 days found by Bossi et al.(1981) in the analysis of HR 5492 using HD 130173 as a comparison, is perhaps due to HD 130173.

HR 5492: Since HR 5437 was discovered by Jiang et al. (1988) to have a variable light curve, the observations in 1988 and the first night in 1986 can only be used to check the light variation of HR 5492. Some of the light curves are shown in Figure 2. According to our observations we may conclude, in agreement with Bossi et al. (1981), that if there is

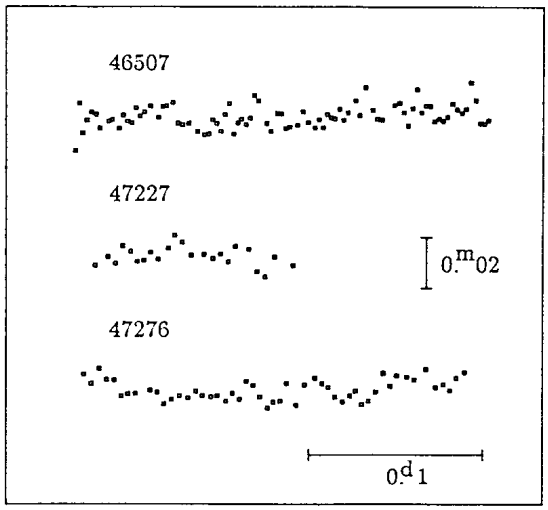

Figure 2.

any regular variation in HR 5492 it has an amplitude not larger than 0.01 mag. Moreover, the 0.03 mag light variation of HR 5492 in the survey done by Percy (1973) is questionable because HR 5437, used as a comparison, turned out to be variable and the other comparison, HR 5608, was observed with considerable scatter. HR 5492 was referred to in the literature (Bossi et al.1981) as an interesting object lying beyond the cold border of the instability strip and showing light variation. The uvbyβ photometric data (Hauck, 1980) and some physical parameters of HR 5437 after the calibration of Philip et al. (1976) are listed in Table 3.

TABLE 3

Star	b-y	m_1	c_1	β	M_v	Θ	log g	T_e
HR 5492	.266	.165	.461	-	2.3	-	-	-
HR 5437	.150	.180	.956	2.790	1.16	.65	3.78	7755

The absolute magnitude of HR 5492 is taken from Halprin & Moon's catalogue (1983). While HR 5492 is in fact situated beyond the cold border of the instability strip based on the published b-y and M_v data, HR 5437 can be located in the middle of the instability strip (Breger, 1979) according to the unreddened $(b - y)_0 = 0.136$ and $M_v = 1.16$ values. We conclude that HR 5492 is a normal F type star which lies beyond the instability strip and does not show any light variation.

HR 5437: turned out to have light variation of $\sim$ 0.03 mag amplitude. According to the spectral type and the pulsational period it seems to be a Delta Scuti

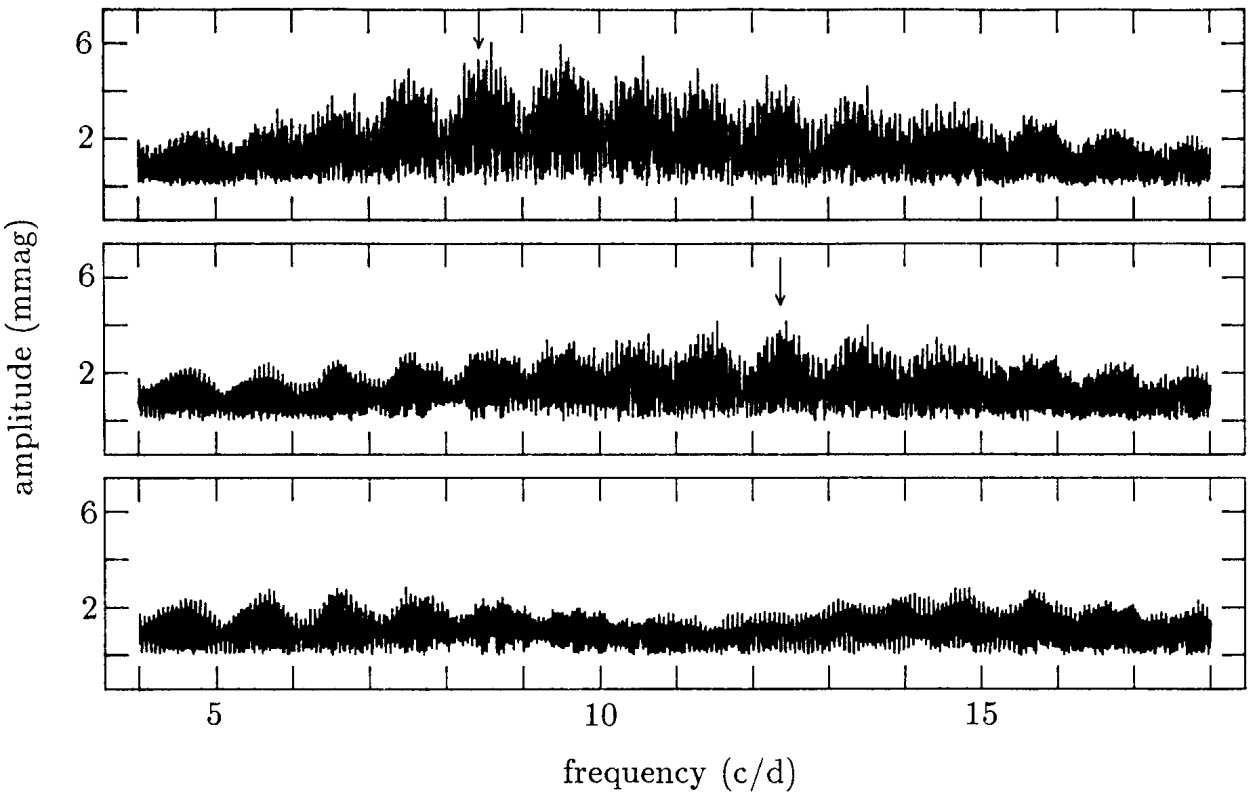

Figure 3.

type star. Eight tracks of observations were obtained for HR 5437 in 1988 covering a period of 130 days.(The data will be published elsewhere.) A frequency analysis was carried out keeping in mind the poor quality of the data distribution and the complex structure of the spectral window. Deeming's standard method (1975)

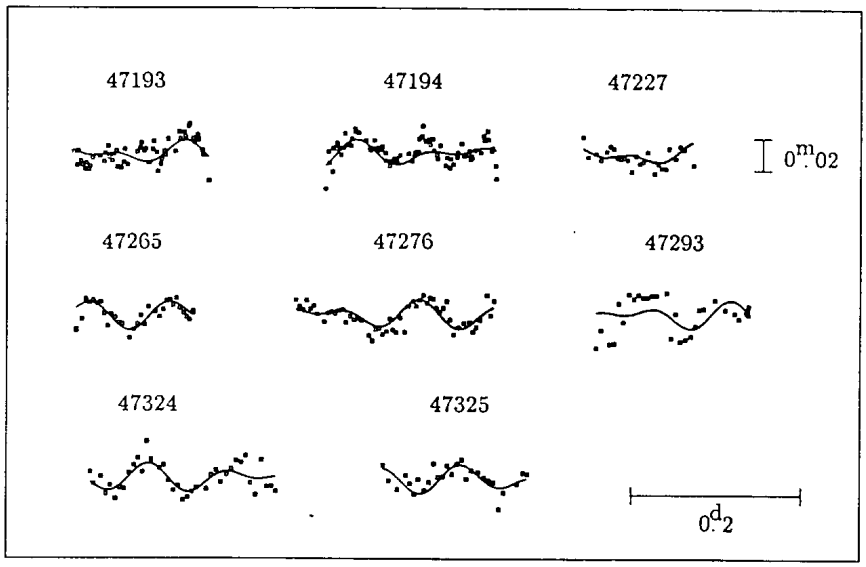

Figure 4.

was used to get the spectrum. In Figure 3. the original spectrum and the pre-whitened spectrum with one and two frequencies can be seen. The accepted values of the frequencies are listed in Table 4.

TABLE 4

The compact dataset in 1988			All of the data supposing HR 5492 is constant		
Freq. c/d	Ampl. (mag.)	Phase (deg.)	Freq. c/d	Ampl. (mag.)	Phase (deg.)
8.437	.00488	291	8.5367	.00335	206
12.362	.00449	186	11.3759	.00404	272

Because the least-squares method was used to determine the precise values of frequencies, the accepted frequencies may have smaller power values than the highest peak in the spectrum. After prewhitening with the first frequency some doubt appeared around the next frequency.

The 12.362 c/d frequency and its 1 c/d alias, 11.544 have almost the same power. On the basis of the smaller dispersion of the least-squares fit, the value 12.362 c/d was finally accepted, however, a better and longer data distribution may prove the 1 c/d alias to be correct frequency. The spectrum in the third panel prewhitened with two frequencies still has some structure suggesting the existence of several more frequencies or the incorrectness of our frequencies. The observed and the synthetic light curves with the accepted frequencies are plotted in Figure 4. Supposing that HR 5492 does not have regular variability, the observations of HR 5437 to HR 5492 in 1986 and 1987 were used to check the frequencies obtained from the dataset in 1988.

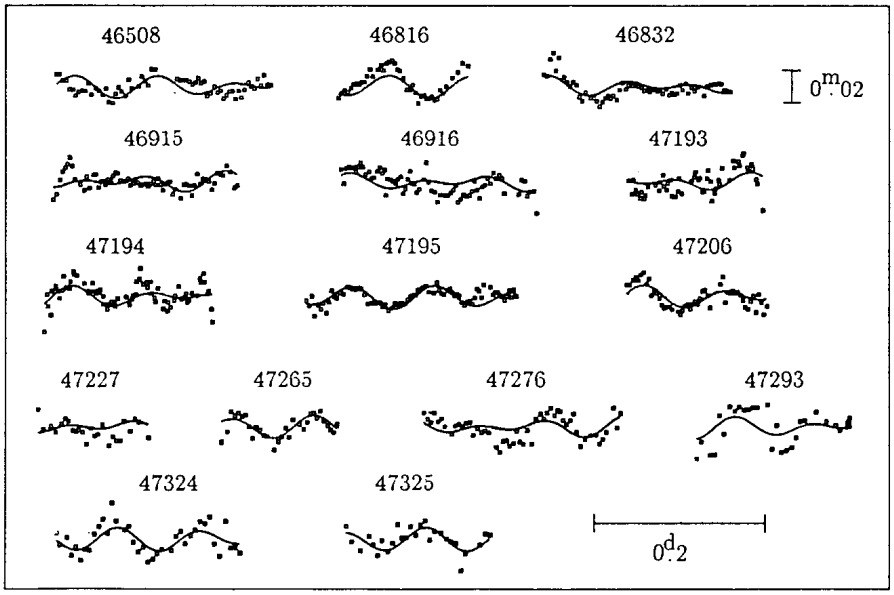

Figure 5.

Because of the long time-base the least-squares method was used near the accepted frequencies and their aliases. The finally accepted frequencies for the whole dataset of HR 5437 are listed in Table 4, too. The main features of the light curves obtained over three years can be fitted by these frequencies (Figure 5).Although the precise values of frequencies are not found, the frequencies seem to have remained stable for three seasons.

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