STUDY OF THE ECLIPSING SYSTEM V 388 Cyg

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ABSTRACT: Photoelectric observations of the eclipsing system V 388 Cyg were made at the Astronomical Observatory of Skalnaté Pleso in the blue region. Published epochs of minima and these new observations were used to study the changes in period of the system. Linear elements with a sudden change in period as well as non-liear elements were considered. The continuous decrease of the period agrees with the theory of mass transfer between the components of binaries. New light elements were calculated. It was proved that the changes of brightness in the primary minimum, discovered earlier, are of a periodic character with a frequency of 123 cycles per day and a halfamplitude of 11.9 millimagnitudes.

ИССЛЕДОВАНИЕ ЗАТМЕННОЙ СИСТЕМЫ V 388 Cyg.Были получены фотоэлектрические наблюдения затменной системы V 388 Cyg в Астрономической обсерватории Скалнате Плесо в синей области. Опубликованные эпохи минимумов вместе с новыми наблюдениями были использованы для исследования изменений периода системы. Рассуждались линейные элементы с внезапным изменением периода и нелинейные элементы. Непрерывное сокращение периода ссответствует теории переноса материи между компонентами двойных звезд. Были вычислены новые элементы. Было показано, что раньше найдены изменения яркости в первичном минимуме имеют периодический характер с частотой 123 цыклов в день с полуамплитудой 0.0119 звездной величины.

VÝSKUM ZÁKRYTOVEJ SÚSTAVY V 388 Cyg. Získali sa fotoelektrické pozorovania zákrytovej sústavy V 388 Cyg na Astronomickom observatóriu na Skalnatom Plese v modrej oblasti. Publikované epochy minima spolu s novými pozorovaniami sa použili na štúdium zmien periódy sústavy. Uvažovalo sa jednak s lineárnymi elementami s náhlou zmenou periódy a jednak s nelineárnymi elementami. Plynulé skracovanie periódy je v zhode s teóriou prenosu hmoty medzi zložkami dvojhviezd. Vypočítali sa nové svetelné elementy. Dokázalo sa, že predtým objavené zmeny jasnosti v primárnom minime majú periodický charakter s frekvenciou 123 cyklov/deň s poloamplitúdou 11.9 milimagnitúd.

1. INTRODUCTION

The variable star V 388 Cyg (BD +30°4051, HD 332329) was discovered by Morgenroth (1935). The nature of its changes in brightness was explained by Kwiek (1936) who classified the star as a binary system and calculated its period. The variable star was later studied by Piegza (1937) and Soloviev (1944). Its complete photographic light curve was obtained by Fedorovich (1948) who found that the light curve belonged to the light curves of the beta Lyrae type. Further photographic minima were published by Gaposchkin (1953) and Whitney (1959). During the decade 1962-1971, only one visual minimum epoch was determined by Carbol (Obůrka, 1965). Although the star is relatively bright, it has not drawn the attention of observers with photoelectric photometers, and there is still a relatively small number of its photoelectric observations. The hitherto only complete photoelectric curve was obtained by Cerruti-Sola et al. (1977). Photoelectric minimum epochs were observed by Niarchos (1983) and Agerer (1984).

The changes of period were analysed by Cerruti-Sola et al. (1977) and later by Milano and Russo (1983). Since it was found that the complete observational data on the minima were not available to these authors and that there were considerable differences in the values of the photometric elements (Cerruti-Sola, 1977; Giuricin and Mardirossian, 1981; Milano and Russo, 1983) it was decided to include the star in the observation program of the Astronomical Observatory at Skalnaté Pleso in order to obtain new minimum epochs, re-investigate the changes in period and other properties of this eclipsing system.

2. PHOTOELECTRIC OBSERVATIONS AND THEIR TREATMENT

The photoelectric observations were made in the Astronomical Observatory of the Slovak Academy of Sciences in Skalnaté Pleso with an 0.6/7.5 m mirror telescope. The telescope is fitted with a semi-automatic photoelectric photometer with an EMI 6256 B electron multiplier tube. Standard UBV filters and two sets of filters for medium-band and narrow-band photometry are built in-to the optical part. A detailed description of the optical and mechanical part and the properties of the photometric system can be found in (Horák et al., 1965). The electronic part, which is based on the integration method (Horák et al., 1965), has recently been replaced by a device operating on the basis of the pulse-counting method. The observation processes is controlled by a computer program stored in an EMG 666 B electronic calculator. A program is stored on magnetic tape for each observation mode in the one-filter or multi-filter mode. A new observation mode is introduced simply by changing the cassette in the calculator. The time of observation, with an accuracy of one second, is derived from the device's own clock. Besides the basic data, i.e. the time of observation and the number of pulses relating to the sky background and the star being observed, the printer of the EMG 666 B calculator also prints the alphanumerical data which provide the user with further information. A detailed description of the device will be published elsewhere.

V 388 Cyg was observed with a standard B filter. The length of the observation interval was taken to be 10 seconds. BD +30°4047 was used as the comparison star and BD +30°4048 as the check star. Bearing in mind that Cerruti-Sola (1977) found the brightness of the comparison star to be constant, we measured the check star only sporadically. The pulses for the sky backround, comparison star and check star were counted in two consecutive 10-second intervals, and 5 individual consecutive observations were made for the variable star, each with an integration period of 10 seconds. The averaging of the five observations of the variable star yielded mean points. The individual observations of the variable star are given in Tab. 1 and the mean points are plotted in Fig. 1. Since the angular distance between the stars is small, no correction for differential extinction was applied. The observation conditions were far from ideal. The observations were made one day after full Moon at a phase of 15 and a half days when the star was only 60° from the Moon. The light of the Moon interfered considerably the observations. The brightness of the sky in a diaphragm of 49 arcsec amounted to 40 000 pulses and the brightness of the variable star in the minimum was 25 000 pulses. The air humidity varied between 70 and 85%. The noise of the sky contributed $0^{m}.008$ to the scatter of the observations. The fact that the accuracy of the individual observations varied during the night from $0^{m}.003$ to $0^{m}.022$ is evidence of the changes in the observation conditions during the observations. Also the transparency of the sky changed during the night so that the mean square error of the mean point in Fig. 1 is $\pm 0^{m}.023$. A detailed analysis of the accuracy of our observations was made in order to detèrmine whether they were suitable for detecting microvariability as reported in the next section.

3. CHANGES OF PERIOD AND OSCILLATIONS OF THE LIGHT CURVE

Cerruti-Sola et al. (1977) discovered the changes in period. They found that the variations in light could not be approximated by a linear ephemeris and recommended that the observation intervals prior to and after J.D.2436905 should be interpreted separately, linear elements but with a different period applying to the two intervals. In this case, one must reckon with a sudden decrease in the period around J.D. 2636905 by 0.0000135 days.Milano and Russo

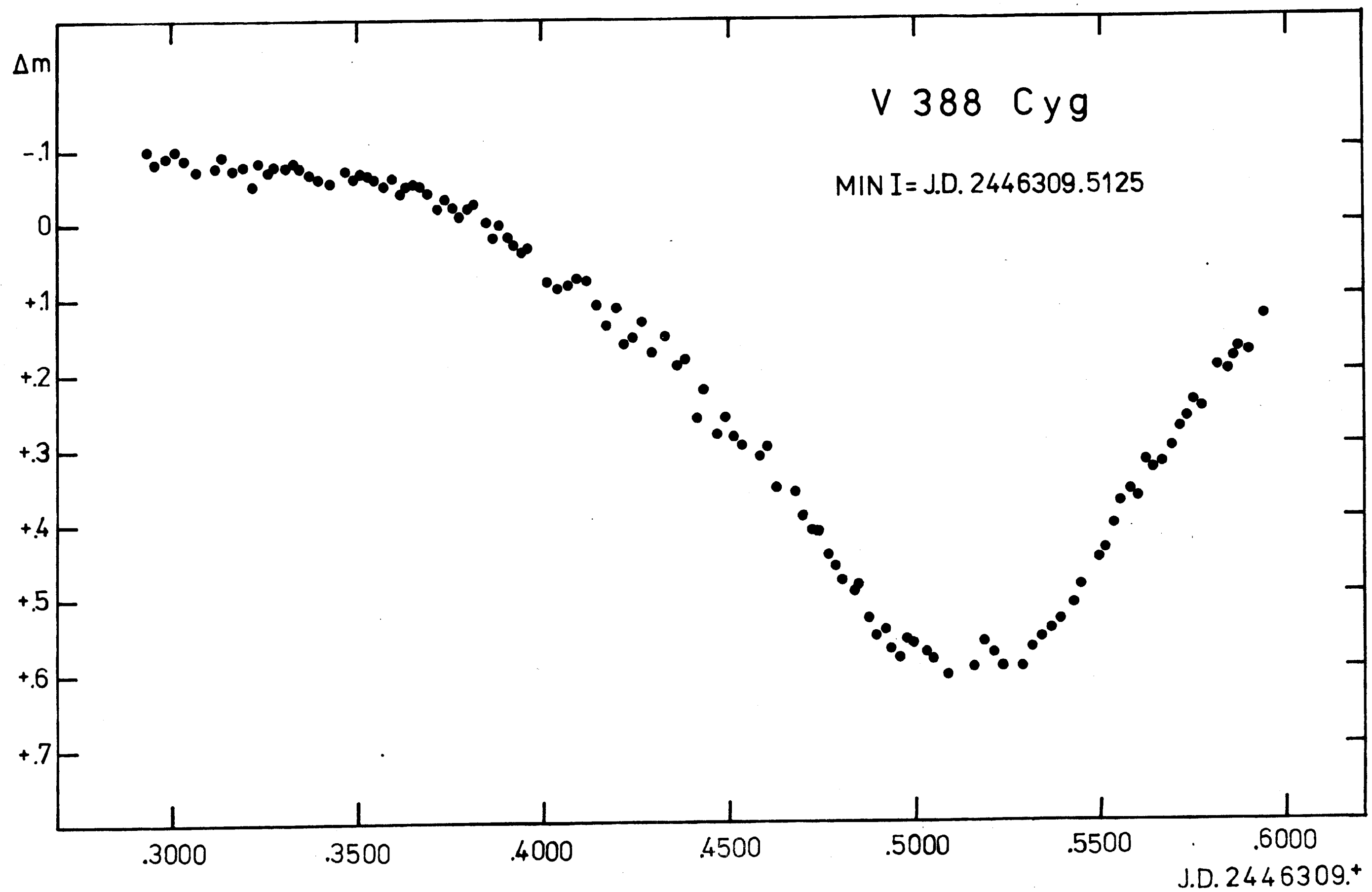

Fig. 1. Primary minimum obtained in B colour at the Skalnaté Pleso Observatory.
The individual observations were grouped into mean points.

(1983) consider the decrease of the period. However, there are only two minimum epochs in the critical part of the O-C curve.

To verify whether the interpretation of the changes in period of V 388 Cyg was correct, we accumulated three times as much observation material as Cerruti-Sola et al. (1977) and Milano and Russo (1983) over a longer time base, i.e. from 1934 to 1985. In interpreting the observation material, we not only considered the sudden change in period around J.D.2436095, but we also studied other possibilities. Calculations have shown that the light variations can be approximated very well by elements with a secular term over an interval of 50 years. The secular term has a minus sign and its value $a = -(4.55 \pm 0.18) \times 10^{-10}$, which indicates a continual decrease of the period. In the calculations, the weight $w = 3$ was assigned to the photoelectric minimum epochs and the weight $w = 1$ to the other observations. The sum $(O-C)^2$ values is slightly in favour of the interpretation with the sudden change of the period. The results of our computations are as follows:

$$\text{Min I} = \text{J.D. } 2433584.542 + 0.8590515 \times E \qquad (1)$$

The elements with the secular term:

$$\text{Min I} = \text{J.D. } 2433584.\underset{\pm 12}{5413} + 0.859\underset{\pm 20}{04743} \times E - \underset{\pm 18}{4.55} \times 10^{-10} \times E^2 \qquad (2)$$

The linear elements for the first period of observations $E < 5000$:

$$\text{Min I} = \text{J.D. } 2433584.\underset{\pm 15}{5375} + 0.859\underset{\pm 39}{04932} \times E \qquad (3)$$

The linear elements for the second period of observations $E > 5000$:

$$\text{Min I} = \text{J.D. } 2433584.\underset{\pm 29}{6005} + 0.859\underset{\pm 23}{03686} \times E \qquad (4)$$

The last linear ephemeris can be used as the actual ephemeris. Table 2 contains the corresponding O-C values for the whole set of the computations. In the case of the hypothesis of the sudden change of the period, it is necessary to suppose the decrease of the period by $\Delta P = -0^{d}.00001246$ around J.D. 2437880.

Table 2 shows the minimum epochs used in this study, the results of the calculations, references to the literature and further information. Where individual observations were published in the litarature, we calculated the errors in determining the minimum for the photoelectrically determined epochs. The O-C curve is shown in Fig. 2. The errors in determining the minimum epochs are represented by the vertical line bars. Since the sums of the deviations with the secular term and linear elements differ but little, we shall only be able to decide whether the interpretation is correct within the next decade, provided sufficiently accurate observation material will be available. However, it is our opinion that the interpretation with the continual decrease of the pe-

TABLE 1

J.D.$_{hel}$	Δm	J.D.$_{hel}$	Δm	J.D.$_{hel}$	Δm	J.D.$_{hel}$	Δm
2446309							
.2939	-0.094	.3169	-0.070	.3373	-0.068	.3574	-0.060
.2940	-0.094	.3170	-0.076	.3374	-0.068	.3575	-0.049
.2941	-0.104	.3172	-0.076	.3375	-0.058	.3592	-0.070
.2942	-0.102	.3191	-0.073	.3376	-0.053	.3593	-0.057
.2943	-0.095	.3192	-0.079	.3377	-0.073	.3594	-0.059
.2961	-0.085	.3193	-0.072	.3397	-0.062	.3595	-0.061
.2962	-0.079	.3194	-0.069	.3398	-0.062	.3596	-0.053
.2963	-0.090	.3196	-0.081	.3399	-0.052	.3613	-0.041
.2964	-0.071	.3215	-0.057	.3400	-0.048	.3614	-0.042
.2966	-0.076	.3216	-0.050	.3401	-0.069	.3615	-0.027
.2986	-0.088	.3217	-0.053	.3431	-0.034	.3616	-0.046
.2987	-0.090	.3218	-0.043	.3432	-0.063	.3617	-0.042
.2988	-0.086	.3220	-0.041	.3433	-0.061	.3632	-0.047
.2989	-0.090	.3237	-0.083	.3434	-0.052	.3633	-0.058
.2990	-0.090	.3238	-0.077	.3435	-0.053	.3634	-0.041
.3011	-0.100	.3239	-0.080	.3468	-0.065	.3635	-0.043
.3012	-0.098	.3240	-0.080	.3470	-0.078	.3636	-0.052
.3014	-0.102	.3241	-0.083	.3471	-0.072	.3650	-0.049
.3015	-0.100	.3260	-0.070	.3472	-0.069	.3651	-0.055
.3016	-0.091	.3261	-0.070	.3473	-0.062	.3652	-0.055
.3035	-0.082	.3262	-0.062	.3488	-0.060	.3653	-0.053
.3036	-0.082	.3263	-0.065	.3490	-0.060	.3654	-0.039
.3036	-0.078	.3265	-0.074	.3491	-0.058	.3670	-0.051
.3038	-0.089	.3280	-0.072	.3492	-0.066	.3671	-0.048
.3039	-0.093	.3281	-0.080	.3493	-0.062	.3672	-0.049
.3040	-0.079	.3283	-0.068	.3509	-0.062	.3673	-0.048
.3067	-0.067	.3284	-0.074	.3510	-0.057	.3674	-0.047
.3068	-0.076	.3285	-0.075	.3511	-0.053	.3689	-0.040
.3070	-0.067	.3306	-0.081	.3512	-0.072	.3690	-0.045
.3071	-0.071	.3307	-0.067	.3513	-0.071	.3692	-0.049
.3072	-0.070	.3308	-0.072	.3527	-0.060	.3693	-0.042
.3117	-0.059	.3310	-0.070	.3528	-0.056	.3694	-0.021
.3118	-0.065	.3311	-0.089	.3529	-0.057	.3713	-0.013
.3119	-0.088	.3329	-0.080	.3530	-0.069	.3714	-0.020
.3120	-0.072	.3331	-0.082	.3531	-0.073	.3715	-0.011
.3122	-0.085	.3332	-0.073	.3551	-0.050	.3716	-0.026
.3139	-0.093	.3333	-0.079	.3553	-0.063	.3732	-0.035
.3140	-0.076	.3334	-0.078	.3554	-0.070	.3734	-0.024
.3142	-0.094	.3352	-0.079	.3555	-0.054	.3735	-0.023
.3143	-0.088	.3353	-0.079	.3556	-0.050	.3736	-0.040
.3144	-0.092	.3354	-0.074	.3570	-0.048	.3737	-0.033
.3167	-0.061	.3355	-0.076	.3572	-0.041	.3752	-0.040
.3168	-0.073	.3357	-0.059	.3573	-0.042	.3753	-0.031

TABLE 1 cont.

$J.D._{hel}$	Δm	$J.D._{hel}$	Δm	$J.D._{hel}$	Δm	$J.D._{hel}$	Δm
.3755	−0.013	.3940	+0.036	.4199	+0.116	.4433	+0.225
.3756	−0.014	.3955	+0.037	.4201	+0.099	.4435	+0.218
.3757	−0.013	.3956	+0.017	.4202	+0.112	.4436	+0.222
.3772	−0.012	.3957	+0.029	.4218	+0.169	.4437	+0.227
.3773	−0.005	.3958	+0.047	.4219	+0.162	.4438	+0.230
.3775	−0.009	.3959	+0.047	.4221	+0.169	.4461	+0.296
.3776	−0.009	.4011	+0.082	.4222	+0.165	.4462	+0.275
.3777	−0.007	.4012	+0.077	.4223	+0.155	.4464	+0.288
.3795	−0.020	.4013	+0.081	.4239	+0.159	.4465	+0.288
.3796	−0.018	.4014	+0.072	.4241	+0.159	.4466	+0.271
.3811	−0.027	.4015	+0.083	.4242	+0.142	.4484	+0.273
.3812	−0.026	.4036	+0.083	.4243	+0.161	.4486	+0.261
.3813	−0.021	.4037	+0.095	.4244	+0.152	.4488	+0.247
.3814	−0.021	.4038	+0.084	.4267	+0.115	.4489	+0.263
.3842	+0.005	.4039	+0.092	.4268	+0.140	.4506	+0.274
.3843	−0.007	.4040	+0.092	.4269	+0.120	.4508	+0.274
.3844	−0.006	.4067	+0.081	.4270	+0.137	.4509	+0.280
.3845	+0.010	.4068	+0.085	.4271	+0.164	.4510	+0.302
.3846	+0.001	.4069	+0.086	.4291	+0.189	.4511	+0.314
.3860	+0.013	.4070	+0.088	.4292	+0.177	.4529	+0.288
.3861	+0.032	.4071	+0.083	.4293	+0.164	.4530	+0.295
.3862	+0.024	.4093	+0.082	.4295	+0.167	.4532	+0.306
.3864	+0.022	.4095	+0.079	.4296	+0.175	.4533	+0.305
.3865	+0.015	.4096	+0.077	.4331	+0.158	.4534	+0.313
.3880	+0.009	.4097	+0.071	.4333	+0.157	.4579	+0.289
.3881	+0.003	.4098	+0.075	.4334	+0.152	.4580	+0.307
.3882	+0.005	.4118	+0.089	.4335	+0.156	.4581	+0.316
.3883	+0.012	.4120	+0.068	.4336	+0.145	.4582	+0.346
.3884	−0.002	.4121	+0.078	.4357	+0.192	.4599	+0.292
.3899	+0.017	.4122	+0.082	.4359	+0.188	.4600	+0.312
.3900	+0.011	.4123	+0.080	.4360	+0.183	.4601	+0.304
.3902	+0.033	.4144	+0.098	.4361	+0.207	.4603	+0.298
.3903	+0.013	.4145	+0.126	.4362	+0.191	.4604	+0.298
.3904	+0.026	.4146	+0.117	.4379	+0.179	.4622	+0.343
.3917	+0.027	.4147	+0.111	.4380	+0.180	.4623	+0.354
.3918	+0.027	.4148	+0.105	.4381	+0.175	.4624	+0.367
.3919	+0.016	.4166	+0.126	.4383	+0.184	.4625	+0.356
.3920	+0.035	.4167	+0.140	.4384	+0.193	.4626	+0.366
.3921	+0.043	.4168	+0.136	.4403	+0.263	.4671	+0.366
.3935	+0.027	.4169	+0.147	.4404	+0.249	.4672	+0.349
.3937	+0.041	.4171	+0.152	.4405	+0.271	.4674	+0.368
.3938	+0.051	.4197	+0.133	.4406	+0.260	.4675	+0.378
.3939	+0.036	.4198	+0.115	.4407	+0.273	.4676	+0.350

TABLE 1 cont.

J.D.$_{hel}$	Δm	J.D.$_{hel}$	Δm	J.D.$_{hel}$	Δm	J.D.$_{hel}$	Δm
.4694	+0.408	.4889	+0.534	.5158	+0.589	.5392	+0.551
.4695	+0.390	.4890	+0.552	.5159	+0.591	.5393	+0.529
.4697	+0.368	.4892	+0.565	.5160	+0.598	.5422	+0.530
.4699	+0.414	.4893	+0.565	.5161	+0.595	.5423	+0.501
.4717	+0.412	.4894	+0.547	.5163	+0.585	.5424	+0.493
.4718	+0.430	.4911	+0.555	.5182	+0.561	.5426	+0.515
.4719	+0.417	.4912	+0.553	.5184	+0.546	.5427	+0.515
.4720	+0.396	.4913	+0.539	.5185	+0.568	.5445	+0.511
.4722	+0.415	.4914	+0.533	.5186	+0.560	.5447	+0.479
.4737	+0.406	.4915	+0.559	.5187	+0.585	.5448	+0.499
.4739	+0.417	.4931	+0.578	.5207	+0.565	.5449	+0.480
.4740	+0.410	.4933	+0.581	.5209	+0.589	.5450	+0.454
.4741	+0.428	.4934	+0.572	.5210	+0.591	.5493	+0.447
.4757	+0.436	.4935	+0.558	.5211	+0.595	.5495	+0.452
.4758	+0.453	.4936	+0.583	.5212	+0.555	.5496	+0.461
.4759	+0.447	.4952	+0.574	.5236	+0.598	.5497	+0.456
.4761	+0.446	.4953	+0.575	.5237	+0.603	.5498	+0.445
.4762	+0.454	.4954	+0.590	.5238	+0.602	.5513	+0.444
.4778	+0.456	.4956	+0.604	.5239	+0.591	.5514	+0.447
.4779	+0.468	.4957	+0.570	.5240	+0.585	.5515	+0.427
.4780	+0.469	.4975	+0.571	.5286	+0.589	.5517	+0.430
.4782	+0.474	.4976	+0.564	.5287	+0.607	.5518	+0.436
.4783	+0.462	.4977	+0.544	.5289	+0.580	.5534	+0.411
.4800	+0.479	.4995	+0.583	.5290	+0.607	.5535	+0.407
.4801	+0.488	.4996	+0.579	.5291	+0.602	.5536	+0.414
.4802	+0.479	.4998	+0.553	.5313	+0.583	.5537	+0.403
.4804	+0.482	.4999	+0.546	.5314	+0.584	.5538	+0.383
.4805	+0.483	.5000	+0.562	.5315	+0.561	.5554	+0.378
.4826	+0.487	.5022	+0.598	.5316	+0.554	.5556	+0.388
.4828	+0.495	.5023	+0.573	.5318	+0.556	.5557	+0.371
.4829	+0.507	.5025	+0.571	.5336	+0.540	.5558	+0.367
.4830	+0.488	.5026	+0.580	.5337	+0.564	.5559	+0.372
.4831	+0.496	.5027	+0.565	.5338	+0.570	.5575	+0.357
.4848	+0.485	.5043	+0.588	.5339	+0.532	.5577	+0.368
.4849	+0.474	.5045	+0.586	.5340	+0.577	.5578	+0.362
.4851	+0.476	.5046	+0.585	.5363	+0.565	.5579	+0.362
.4852	+0.497	.5047	+0.591	.5365	+0.535	.5580	+0.345
.4853	+0.496	.5048	+0.585	.5366	+0.540	.5597	+0.379
.4869	+0.534	.5086	+0.631	.5367	+0.534	.5598	+0.379
.4870	+0.540	.5087	+0.591	.5368	+0.545	.5600	+0.367
.4871	+0.533	.5089	+0.601	.5389	+0.518	.5601	+0.354
.4872	+0.523	.5090	+0.598	.5390	+0.532	.5602	+0.357
.4873	+0.539	.5091	+0.614	.5391	+0.532	.5620	+0.330

TABLE 1 cont.

$J.D._{hel}$	Δm	$J.D._{hel}$	Δm	$J.D._{hel}$	Δm	$J.D._{hel}$	Δm
.5621	+0.324	.5692	+0.306	.5767	+0.235	.5857	+0.179
.5622	+0.315	.5707	+0.262	.5768	+0.237	.5858	+0.165
.5623	+0.306	.5708	+0.280	.5769	+0.244	.5875	+0.187
.5624	+0.330	.5709	+0.285	.5770	+0.266	.5876	+0.163
.5640	+0.347	.5710	+0.274	.5811	+0.190	.5877	+0.185
.5641	+0.323	.5711	+0.278	.5812	+0.205	.5878	+0.158
.5642	+0.339	.5725	+0.265	.5814	+0.209	.5879	+0.159
.5643	+0.327	.5727	+0.255	.5815	+0.181	.5894	+0.152
.5644	+0.310	.5728	+0.257	.5816	+0.189	.5895	+0.188
.5659	+0.340	.5729	+0.257	.5831	+0.202	.5897	+0.165
.5660	+0.323	.5730	+0.275	.5832	+0.206	.5898	+0.190
.5661	+0.330	.5746	+0.241	.5834	+0.194	.5899	+0.169
.5662	+0.296	.5747	+0.231	.5835	+0.203	.5939	+0.120
.5663	+0.323	.5748	+0.248	.5836	+0.192	.5940	+0.116
.5687	+0.311	.5750	+0.239	.5853	+0.184	.5941	+0.128
.5688	+0.286	.5751	+0.251	.5854	+0.204	.5942	+0.126
.5689	+0.296	.5766	+0.251	.5856	+0.180	.5943	+0.131
.5690	+0.301						

TABLE 2

MINIMA OF V 388 CYGNI

No	J.D.$_{hel}$	Error	Note	W	E	O-C$_1$	O-C$_2$	O-C$_3$	O-C$_4$	References
1	2427624.452		p	1	- 6938	+0.009	+0.004	-0.001		Morgenroth (1935)
2	7710.356		p	1	- 6838	+0.008	+0.002	-0.002		Morgenroth (1935)
3	8070.283		p	0	-06419	-0.007	-0.014	-0.017		Fedorovich (1948)
4	8070.302		v	1	- 6419	+0.012	+0.005	+0.002		Piegza (1937)
5	8351.222		p	0	- 6092	+0.022	+0.015	+0.013		Gaposchkin (1953)
6	8404.464		v	1	- 6030	+0.002	-0.005	-0.006		Kwiek (1936)
7	8428.530	±0.006	v	1	- 6002	+0.015	+0.008	+0.007		Piegza (1938)
8	2430532.330		p	1	- 3553	-0.002	-0.010	-0.005		Soloviev (1944)
9	0898.287		p	1	- 3127	-0.001	-0.009	-0.003		Soloviev (1944)
10	2296.827		p	1	- 1499	+0.003	-0.001	+0.004		Whitney (1959)
11	2821.710		p	1	- 888	+0.006	+0.003	+0.008		Whitney (1959)
12	3218.578		p	1	- 426	-0.008	-0.009	-0.004		Whitney (1959)
13	3483.165		p	1	- 118	-0.009	-0.009	-0.005		Kaho (1952)
14	3584.542		p	1	0	0	-0.001	+0.005		Whitney (1959)
15	3919.576		p	1	+ 390	+0.004	+0.006	+0.009		Whitney (1959)
16	4223.667		p	1	+ 744	-0.009	-0.005	-0.003		Whitney (1959)
17	5089.597		p	1	+ 1752	-0.003	+0.006	+0.005		Whitney (1959)
18	6821.430		p	1	+ 3768	-0.018	+0.004	-0.005		Busch (1964)
19	6895.308		p	1	+ 3854	-0.018	+0.005	-0.006		Busch (1964)
20	7199.429		p	0	+ 4208	-0.002	+0.024	+0.012		Busch (1964)
21	8290.403	±0.004	v	1	+ 5478	-0.023	+0.014		-0.001	Oburka (1965)
22	2441928.4241	±0.0021	e	3	+ 9713	-0.0851	-0.0020		-0.0014	Cerruti-Sola et al. (1977)
23	1953.3375	±0.0014	e	3	+ 9742	-0.0842	-0.0007		-0.0001	Cerruti-Sola et al. (1977)

Table 2 cont.

No	J.D.$_{hel}$	Error	Note	W	E	O-C$_1$	O-C$_2$	O-C$_3$	O-C$_4$	References
24	2567.5492	±0.0007	e	3	+10457	-0.0943	-0.0013		+0.0003	Cerruti-Sola et al. (1977)
25	2595.469	±0.003 sec	e	3	+10489.5	-0.0937	-0.0003		+0.0014	Cerruti-Sola et al. (1977)
26	4445.409		e	3	+12643	-0.121	+0.004		+0.006	Diethelm (1980)
27	4853.441		v	1	+13118	-0.139	-0.006		-0.005	Braune, Mundry (1982)
28	4853.451		v	1	+13118	-0.129	+0.004		+0.005	Braune, Mundry (1982)
29	4853.470		v	0	+13118	-0.110	+0.023		+0.024	Braune, Mundry (1982)
30	5228.4142	sec	e	3	+13554.5	-0.1414	-0.0019		-0.0014	Niarchos (1983)
31	5231.4186		e	3	+13558	-0.1436	-0.0041		-0.0036	Niarchos (1983)
32	5232.2786		e	3	+13559	-0.1427	-0.0032		-0.0027	Niarchos (1983)
33	5566.449		p	1	+13948	-0.143	+0.003		+0.002	Frank (1984)
34	5597.3757		e	3	+13984	-0.1425	+0.0041		+0.0037	Agerer (1984)
35	5603.383		v	1	+13991	-0.148	-0.002		-0.002	Wils (1983)
36	6309.5125	±0.0015	e	3	+14813	-0.1594	+0.0015		-0.0010	This paper

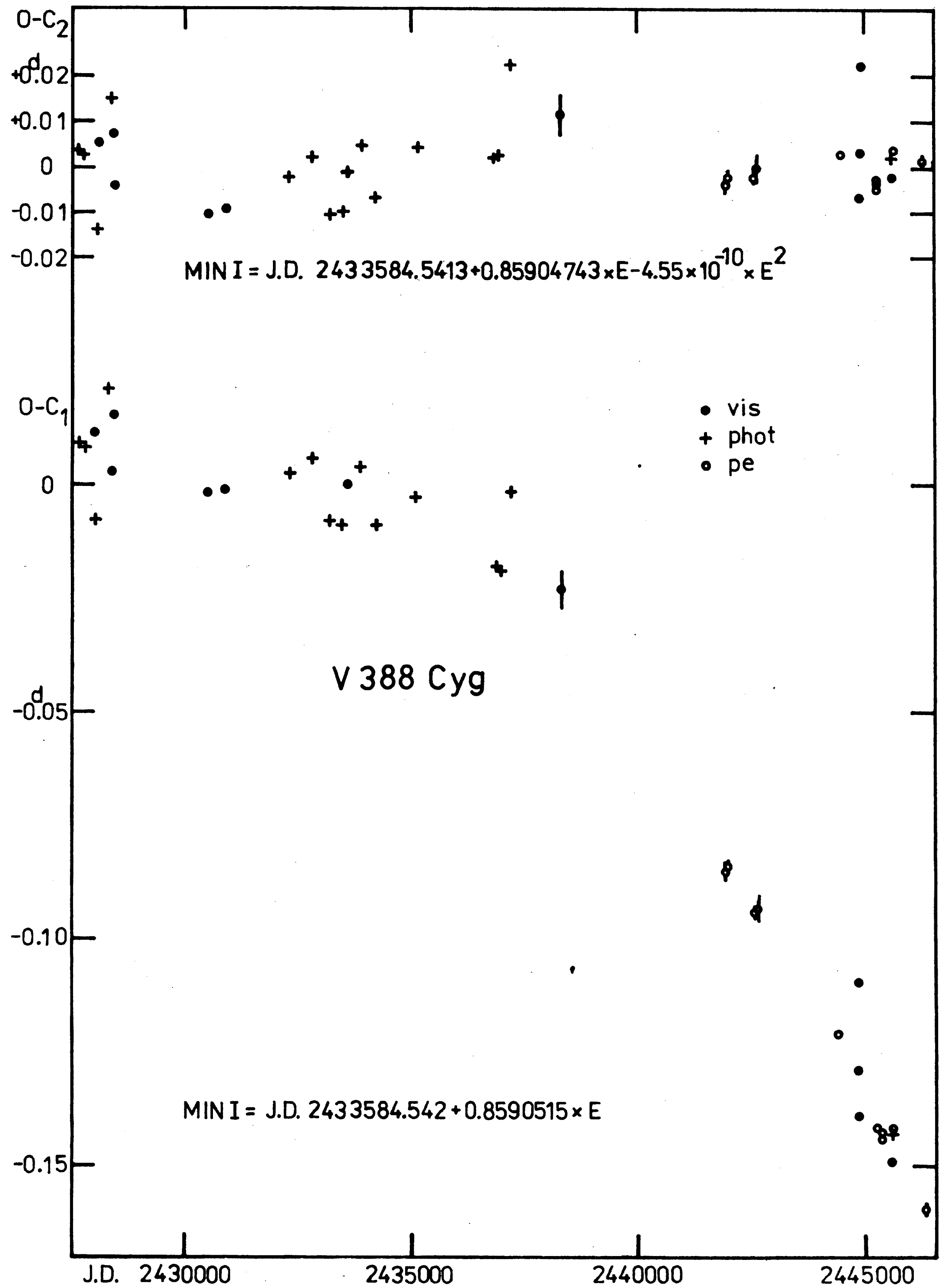

Fig. 2. O-C curve when linear and non-linear elements are applied.

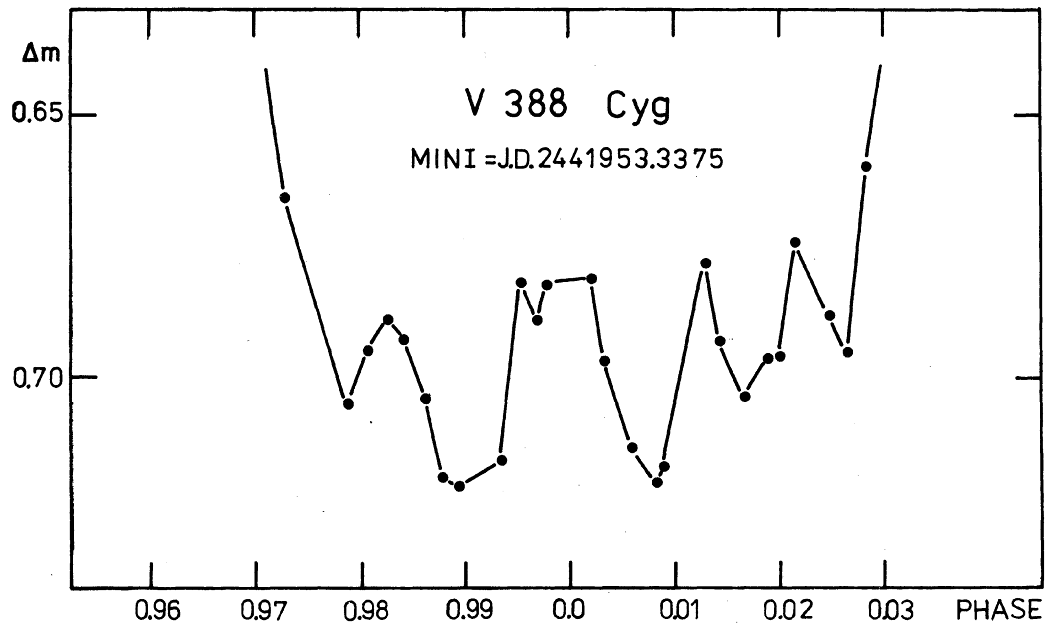

Fig. 3. The quasiperiodic variations of the brightness during the primary minimum.

riod is more acceptable. Also the results of studying the light curve, reported earlier by Cerruti-Sola et al. (1977), and analysed by Giuricin and Mardirossian (1981) and Milano and Russo (1983), speak in favour of this interpretation. Their analysis indicates that V 388 Cyg is a detached or semi-detached system. The primary has a larger radius than the main sequence stars of the same spectral class. The secondary displays a clearly larger luminosity than the stars of the same spectral class and mass. It should be pointed out that the elements, derived by Cerruti-Sola et al. (1977) from the same observation material, differ considerably and, e.g., in the dimension of the secondary by as much as 50%, the system being detached. The analysis of Giuricin and Mardirossian (1981) indicates a contact system and that of Milano and Russo (1983) a semi-detached system. Once again let it be emphasized that the same observation material was interpreted. V 388 Cyg should be in a later stage of development. The physical nature of the system, the mass ratio of its components and evolutionary status can only be assessed after the radial velocity curve has been determined. Regardless of whether the interpretation with the sudden change in period or our interpretation, which considers a continuous decrease of period, is correct, one has to assume that a sudden mass transfer has occurred, or that a continuous mass transfer from the component with the larger mass to that with the smaller mass is taking place.

Cerruti-Sola et al. (1977) observed the following peculiarities of the light curve: a difference (of approximately $0\overset{m}{.}01$) in the amplitude of the maxima, a peculiar shape of the maxima, a peculiar shape of the maxima and of the secondary minimum, totality and a large scatter in the observations (approximately $0\overset{m}{.}05$) during totality. We devoted attention to the irregularities of the light curve. A cursory visual inspection of the brightness in the primary minimum alone disclosed that the changes have a periodic character with a period of about 12 minutes (Fig. 3). We, therefore, decided to Fourier analyse the brightness variations of the photoelectric observations made earlier by Cerruti-Sola et al. (1977). The frequency analysis was carried out on the SM 4-20 computer of the Astronomical Institute of the Slovak Academy of Sciences in Tatranská Lomnica using the program of Fourier analysis for unequally spaced data, written by Dr. J. Zverko, CSc. The program structure is based on Deeming's mathematical procedure (1975). The frequency analysis was carried out for the observations in the primary minima, the secondary minima and in both brightness maxima in the neighbourhood of phases 0.25 and 0.75. In the primary minimum, a distinct maximum (Fig. 4) was observed at frequency 123.674 cycles per day with a halfamplitude of 11.9 millimagnitudes in the frequency interval of 100 - 160 cycles per day. The power spectrum curve in Fig. 4 has a flatter maximum with a certain of asymetry in favour of the higher frequencies. Therefore, another analysis was made by subtracting the frequency 123.674 cycles per day, which yielded a frequency of 133.729 cycles per day with a halfamplitude of 8.1 millimagnitudes. After the power spectra of both frequencies had been subtracted, the resultant power spectrum was plotted in Fig. 5 in the same interval of frequencies. This figure shows that no further frequency of the rapid changes in brightness is present in the observation

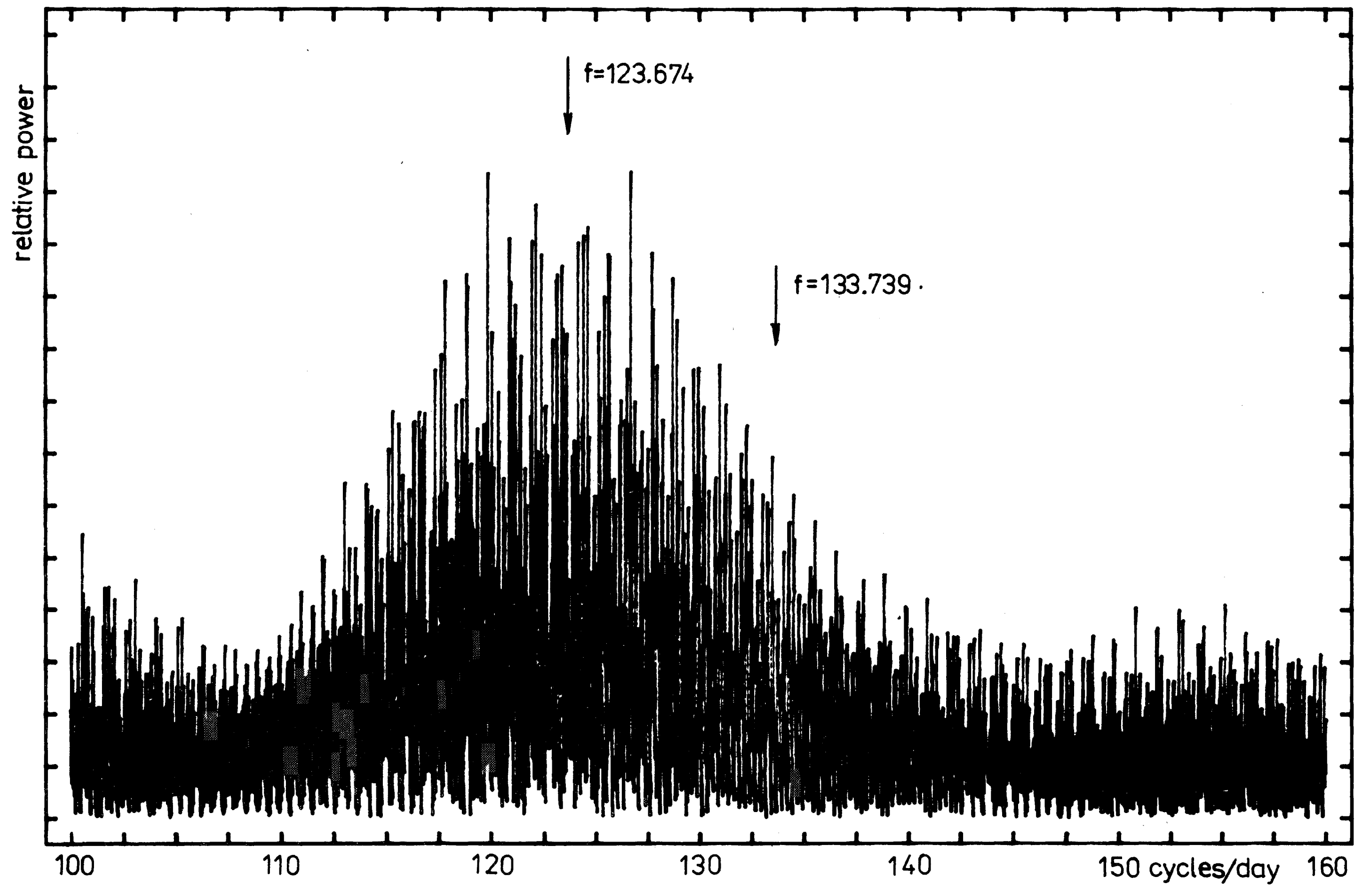

Fig. 4. Fourier analysis of the light variations of V 388 Cyg during the primary minima.

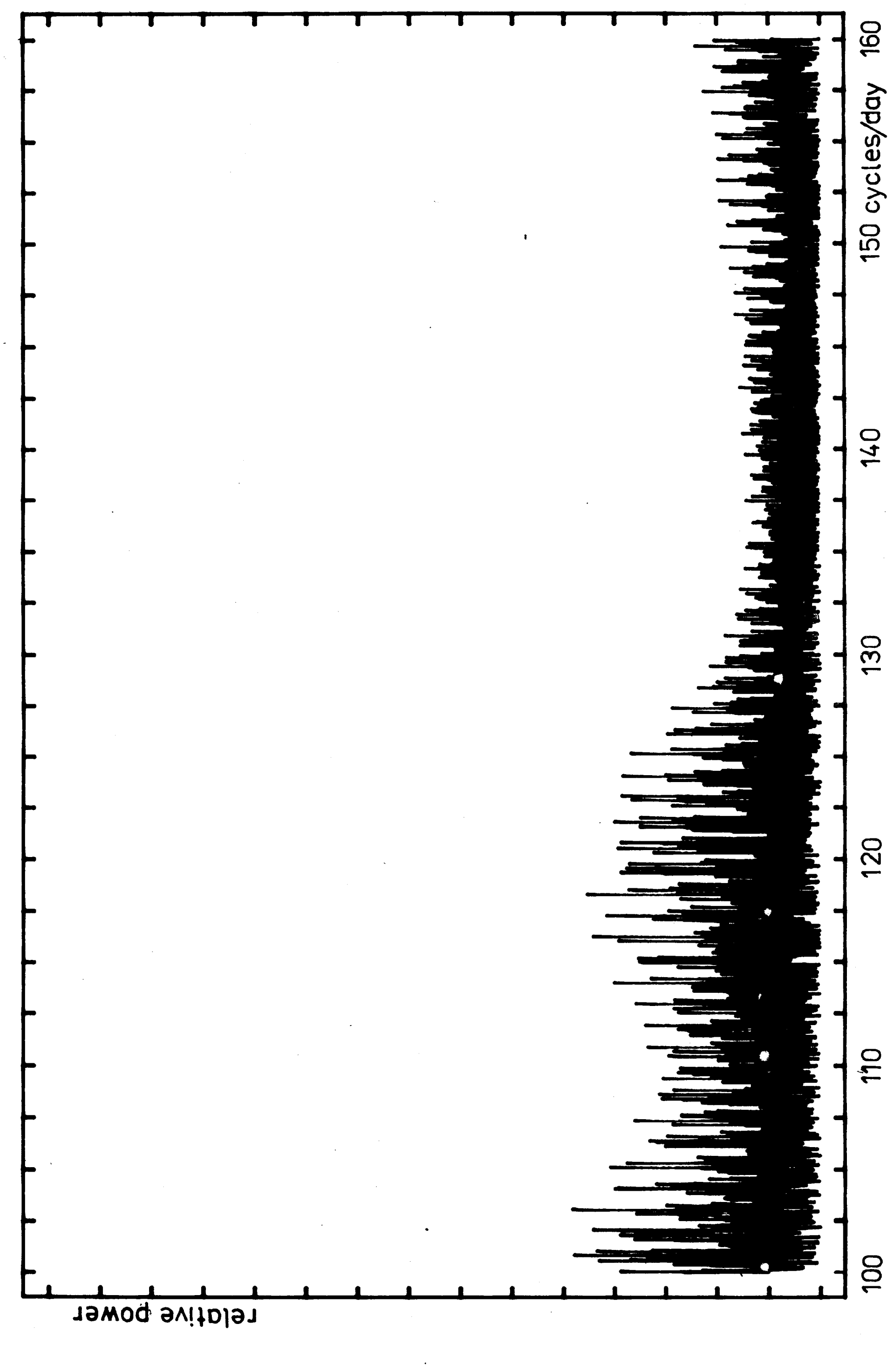

Fig. 5. The power spectrum after subtracting the two frequencies shown in Fig. 4.
The scales in Figs. 4. and 5. are the same.

data. These frequencies were not found in the secondary minimum or the maxima of the light curve. Although the observations are affected by noise due to the small amplitude of the periodic change, it is remarkable that the phase of the light variations remains unchanged. However, in the analysis one must bear in mind that the number of minima is small, the duration of totality is about one hour and the interval between the first and last minimum is over 600 days. The observations we made, as already mentioned in detail in the preceding section, display a higher dispersion due to variable transparency during observations, the largest dispersion being in the phase interval of 0.92 - 0.96 and in the primary minimum. The search for periodic changes with such a small amplitude in our observations has no hope of succes.

Since the data were not numerous, we consider the problem of periodic changes in the primary minimum to be open. Further accurate observations would be required to determine whether the periodic changes of brightness persist. If the observed changes are not simulated by some instrumental effects (the observations were made with just one instrument), or to a temporary microvariability of the comparison star, the rapid changes in brightness have to be attributed to the secondary component with the smaller mass, or to the envelope. Non-radial pulsations of the secondary component, or the instability of the envelope in the neinghbourhood of the secondary component could be the most probable explanations.

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