## $BD-18^{\circ}$ 3437. A NEW SHORT PERIOD ECLIPSING BINARY

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BD  $-18^{\circ}$  3437 has been found to be a short period variable and from the nature of its light and colour variation we conclude that it is an eclipsing binary of W UMa type with depths of minima of 0 $^{\circ}$ 20 and 0 $^{\circ}$ 18 and a period of 0.3166386 days. After rectification the depths of the minima were found to be too shallow indicating that the light variation of this system is mainly due to the ellipticity and reflection effects. There are night to night variations in the light curves and the system became fainter by about 0 $^{\circ}$ 06 in 1972 compared to 1971. These complications in the light curves may be associated with the intrinsic variation of one or both the components or they may be due to a change in the envelope surrounding the system.

Key words: Short-period eclipsing variable.

#### 1. INTRODUCTION

The star BD  $-18^{\circ}3437$  (HD 110139, F8) was observed by us as a comparison star for photoelectric observations of the eclipsing binary system RV CrV. The plots of magnitude versus airmass for this star observed on two nights showed a periodic variation about the mean relation, indicating the possibility of a short period variation. Further observations of this star were made by us to test the suspected variability and it was found that BD  $-18^{\circ}3437$  undergoes light variations with two minima of nearly equal depth of roughly  $0^{\text{m}}20$  and  $0^{\text{m}}18$  in a period of about 6.5 hours. The possibility of this star being an intrinsic variable with a period of 3.25 hours was considered, but because of the difference in the shapes and depths of the two minima and due to the small amplitude of colour variation we feel that the new variable is an eclipsing binary of W UMa type.

### 2. OBSERVATIONS

The new variable has been observed by us through the standard U, B and V filters on 14 nights during 1971 and 1972, with a photoelectric photometer attached to the 1.2 m reflecting telescope of Rangapur Observatory. An unrefrigerated EMI 6256B photomultiplier tube was used as the detector, and the photocurrent was recorded by means of a GR 1230A dc-amplifier and a Honeywell Brown recorder. We have used  $BD - 17^{\circ}3680$  and  $BD - 18^{\circ}3438$  as the comparison and check stars respectively. The extinction coefficient for each filter was determined from the comparison star observations on each night and all the observations were corrected for atmospheric extinction. The data was then transformed to the UBV system by applying the transformation relations obtained from the observations of the standard stars.

The magnitude and colours of the comparison and check stars in the standard system observed on JD 2441429 are given in Table 1a. The magnitude differences  $\Delta V$ ,  $\Delta B$  and  $\Delta U$  between the comparison and check stars show considerable scatter particularly for 1971 observations. This scatter can probably be attributed

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to the poor observing conditions prevailing at the time of these observations, although the possibility of small variations in the light of the comparison or the check star cannot be totally ruled out. The mean values of  $\Delta V$ ,  $\Delta B$ , and  $\Delta U$  between the comparison and check stars are listed in table 1b along with the number of observations and the estimated probable error of a single observation. From this table it is apparent that there is no significant change in  $\Delta m$  (comparison – check) between 1971 and 1972.

The magnitude differences  $\Delta V$ ,  $\Delta B$  and  $\Delta U$  between the variable and BD  $-17^{\circ}3680$  are listed in table 2a, 2b and 2c respectively, along with the corresponding heliocentric Julian day of observation. Observations of the variable star made on the night of JD 2441034 have been excluded from these tables due to their consistently poor quality, although they have been used for estimating the time of minimum on that night.

#### 3. PERIOD AND LIGHT CURVE

The times of minima were determined by the method of bisection from the plot of light curves for individual nights. No significant difference was found between the times of minima determined from the V, B and U light curves. The average values of times of minima determined from the V and B light curves are listed in table 3 along with the weights assigned to them. In this table the primary and secondary minima are identified by 'p' and 's' respectively. As the secondary minima were found to occur halfway between the times of primary minima, a least squares solution of all the times of minima listed in table 3 was made and yield the following ephemeris:

$$T_{\min}$$
 (Primary)=JD<sub>e</sub> 2441017.4557 + 0.3166386 E  
 $\pm$  5  $\pm$  10

The residuals (O-C) between the observed and computed times of minima are given in the third column of table 3. A least squares solution of the times of maxima yielded a period of  $0^{4}3166372 \pm 0^{4}0000028$ , and the larger error of this result is attributed to the fact that the maxima following the secondary are not located halfway between the maxima following the primary minima and show a systematic trend in this respect. We have, therefore, adopted the period determined from the minima for further discussion.

Normal light curves obtained by using the ephemeris given above are shown in figures 1 and 2 for 1971 and 1972, respectively. From a comparison of the two figures it is easily noticed that there is a systematic shift of about  $0^m.06$  between the 1971 and 1972 light curves. This shift stands out clearly inspite of the fact that the observations of 1971 as well as those of 1972 have an internal scatter of the order of  $0^m.04$ . The possibility that this change in the light curves may be due to an increase in the brightness of the comparison star can be ruled out because, as noted earlier, the mean values of  $\Delta m$  (comparison-check) given in table 1b for 1971 and 1972 do not show much difference. We are therefore inclined to believe that the observed change in the light curves must be due to a decrease in the brightness of the eclipsing binary system itself. Additional evidence for the change being associated with the variable star is found from the fact that the decrease in the brightness is not the same at all phases of the light curve – indicating a variation in its shape. Further it is noted that for both the 1971 and 1972 data there are systematic shifts of the light curve and changes in its shape from night to night, which again leads us to believe that in this system some kind of intrinsic variation is superposed on the variation due to the eclipse.

The observed depths of the primary and secondary minima are listed in table 5a; we note that although the whole light curve is fainter in 1972 by 0 \(^m\)06 relative to 1971 there is relatively small change in the depth of the two minima. Therefore, the observed changes in the light curve must be attributed to long period effects either due to intrinsic variation in one or both the components or due to a change in the envelope surrounding the whole binary system. Pronounced changes in the light curve have also been reported in several other binary systems (e.g. SW Lac, EM Cep, etc.) and have generally been attributed to mass transfer between the components.

#### 4. RECTIFICATION

In view of the above complications we have not attempted to combine the 1971 and 1972 data and they were treated separately for analysing the light variations outside the eclipses. From a preliminary investigation the phase angle at the start of external tangency was estimated to be about  $50^{\circ}$ , and the light variations outside the eclipses defined by this limit were represented by a Fourier series including both the sine and cosine terms. Separate least squares solutions were made terminating the series at  $2\theta$ ,  $3\theta$  and  $4\theta$  terms, but the coefficient of  $3\theta$  and  $4\theta$  terms were found to be negligible or comparable to their probable errors. Therefore, the light variation outside the eclipses was finally represented by

$$l = A_0 + A_1 \cos \theta + A_2 \cos 2\theta + B_1 \sin \theta + B_2 \sin 2\theta$$

The coefficients  $A_0$ ,  $A_1$ ,  $A_2$ ,  $B_1$ , and  $B_2$  determined from the least squares solution are listed in table 4 along with their probable errors. The values of these coefficients for different filters are consistent with each other, but significant changes are noticed in the values of  $A_1$ ,  $B_1$  and  $B_2$  for 1971 and 1972 data. The perturbation terms which were negligible for 1971 data have become significant in 1972 observations, and the reflection coefficient  $A_1$  has become less negative in 1972 compared to its value in 1971. The changes in the values of these coefficients again indicate the complex nature of the light variations in this system.

The rectification of the light curves in V, B and U was carried out using the method of Russell and Merrill (1952) after substracting out the sine terms which were treated as perturbations. The coefficients  $C_0$  and  $C_2$  needed for the rectification were estimated using the approximation  $C_0 = 3C_2 = 0.090 \sin^2 \theta_e$ , where we have used  $\theta_e = 50^\circ$ . For the rectification of the phase for ellipticity the oblateness coefficient z = 0.13 has been used.

The depths of the primary and secondary minima in the rectified light curves are given in table 5b which should be compared with the unrectified depths given in table 5a. It is found that after the rectification the depths of both the primary and secondary minima are considerably reduced indicating that most of the light variation observed in this system is due to the ellipticity and reflection effects. In the rectified light curves the primary eclipse has smaller depth compared to the depth of the secondary minimum. Since the two minima in the observed light curves are of nearly equal depth we might consider the possibility that a mistake has been made in the identification of the primary minimum; but in that case the values of the reflection coefficient  $A_1$  will become positive both for the 1971 and 1972 data and this would be in contradiction to the sign expected from the theory.

Owing to the very shallow depths of the eclipses left after rectification and due to the scatter in the observations introduced by the intrinsic variations present in the system, we have not carried out any solution for the orbital elements. We feel that for a better understanding of this system more thorough coverage of the light curves over long period will be needed to disentangle the nature of intrinsic variations present in the system. Spectroscopic observations of this system would be particularly useful to decide whether observed changes in the light curves are due to intrinsic variations in the components or whether they are related to the changes caused by a possible mass transfer between the components of the system.

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Table 1a Magnitude and colours of comparison and check stars

BD.No.	V	B-V	U-B	
rison -17 <sup>0</sup> 3680	0 8.78	+0.31	+0.04	
-18 <sup>0</sup> 3438	8 9.60	+0.69	+0.34	
	rison -17 <sup>0</sup> 368	rison -17 <sup>0</sup> 3680 8.78	rison -17°3680 8.78 +0.31	rison -17°3680 8.78 +0.31 +0.04

Table 1b Magnitude difference (Check star – Comparison star)

Year	ΔΥ	n	p.e.	ΔΒ	n	p.e.	ΔŪ	n	p.e.	
1971	0.828	10	<u>+</u> 0.017	1.182	10	<u>+</u> 0.022	1.484	7	± 0.017	
1972	0.815	9	<u>+</u> 0.009	1.181	9	<u>+</u> 0.009	1.475	1	-	
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1,000	441000+  46.526		3	7.0.791	na ⊲	Hel.J.D.	9	нет. о.р.	<b>Q</b>
0.556         0.77.2461         0.6531         0.42.3833         0.937         411.2863         0.9564           557         2.8557         5.98         4,487         5.56         2.8569           558         2.8577         4,487         5.75         2.8569           553         2.8562         4,487         5.75         2.8569           553         2.8562         4,487         5.75         2.8569           553         2.8562         4,487         5.76         2.8569           553         3.722         4,487         5.76         2.8569           553         3.222         4,482         1.701         5.76         3.8569           553         3.222         4,482         1.701         5.76         3.8569           554         3.222         4,482         1.701         5.76         3.8569           554         3.222         4,682         3.8569         4,75         3.8669           554         4.234         5.71         4.77         3.766         3.8669           554         4.234         5.71         4.77         3.766         3.8669           554         4.234         5.72         3.8669	0.528         0.97.2461         0.653         0.42.3833           556         3.8675         598         4.427           623         3.877         4.62         4.427           618         3.172         4.62         4.427           618         3.172         4.62         3.173           618         3.172         4.62         3.173           618         3.173         4.62         3.173           623         3.172         4.62         3.173           623         3.172         4.62         3.173           624         627         4.427         4.427           625         3.282         4.62         3.173           626         627         4.427         4.427           627         3.174         4.62         3.174           628         3.140         4.62         3.174           629         4.284         5.73         3.128           620         4.284         5.73         3.140           623         4.284         5.73         3.140           623         4.284         5.74         3.140           624         5.22         3.22 <tr< td=""><td>2441000+</td><td></td><td>5441000+</td><td></td><td>2441000+</td><td></td><td>2441000+</td><td></td></tr<>	2441000+		5441000+		2441000+		2441000+	
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652         2862         1445         044,1661         1475         3436           6118         3174         423         1933         549         3873           611         3174         423         1933         549         3873           553         3423         462         2177         616         3873           553         3420         462         2177         616         3873           553         3420         462         2189         546         3873           553         3420         462         2180         3873         3873           554         3420         464         3905         3873         3873         3873           558         346         477         477         3873 <t< td=""><td>652         2962         .445         044.1661           618         3174         .423         .1771           611         31923         .453         .1771           553         .4223         .1772         .524           554         .4223         .1772         .524           558         .4046         .665         .5260           503         .4046         .665         .5280           504         .4046         .665         .5280           505         .4046         .665         .5280           506         .4046         .665         .5280           506         .4046         .665         .5890           506         .406         .667         .3890           506         .4381         .573         .3100           606         .2877         .573         .3100           607         .2878         .560         .3466           608         .2878         .560         .3466           608         .2878         .573         .3466           609         .2878         .578         .3466           609         .2878         .3466</td><td>.2858</td><td>.627 .639</td><td>.2900 .2917</td><td>.503 503</td><td>.4427</td><td>.556</td><td>.2849 2849</td><td>523</td></t<>	652         2962         .445         044.1661           618         3174         .423         .1771           611         31923         .453         .1771           553         .4223         .1772         .524           554         .4223         .1772         .524           558         .4046         .665         .5260           503         .4046         .665         .5280           504         .4046         .665         .5280           505         .4046         .665         .5280           506         .4046         .665         .5280           506         .4046         .665         .5890           506         .406         .667         .3890           506         .4381         .573         .3100           606         .2877         .573         .3100           607         .2878         .560         .3466           608         .2878         .560         .3466           608         .2878         .573         .3466           609         .2878         .578         .3466           609         .2878         .3466	.2858	.627 .639	.2900 .2917	.503 503	.4427	.556	.2849 2849	523
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38.18         41.7         24.04         6.25         369.3878         553         412.869           4.70         4.70         22.24         657         3054         558         4172.869           4.70         4.70         22.22         657         3054         558         4172.869           4.70         4.70         22.22         657         3054         558         4279           4.70         4.70         22.22         557         3180         4288         2279           286         4.70         378         578         378         278         278           286         4.70         378         578         378         389         389           286         4.70         378         578         378         389         379           387         4.70         378         578         370         378         378           4.70         378         4.70         378         578         379         378           384         4.77         4.70         378         4.72         378         378           287         4.70         378         4.72         4.74         378         378	1,473   1,474   1,625   369 2878   1,426   1,625   369 2878   1,424   1,625   369 2878   1,424   1,625   369 2878   1,424   1,625   369 2878   1,424   1,625   369 2878   369	3403	264.	2338	, 69.	0116.	3/4	7.303	
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28.65         .531         .2872         .534         .534,8           28.65         .531         .2872         .536         .534,8         .534,8         .534,8         .534,8         .534,8         .534,8         .534,8         .534,8         .534,8         .534,8         .534,8         .534,8         .534,8         .534,8         .534,8         .534,8         .346,9         .234,8         .534,8         .346,9         .346,5         .544,8         .346,9         .346,5         .346,5         .346,5         .346,5         .346,5         .346,5         .346,5         .346,5         .346,5         .346,5         .346,5         .346,7	26.55         27.25 <th< td=""><td>) •</td><td></td><td>.2657</td><td>.590</td><td>.3180</td><td>887.</td><td>2895</td><td>.656</td></th<>	) •		.2657	.590	.3180	887.	2895	.656
1,000	3028, 452, 3831, 576, 577, 577, 578, 578, 578, 578, 578, 578	028,2635	53.	.2725	.592	.3262	725.	8762. 9000	480
1,271, 1,775, 1,725, 1,227, 1,	3846	9782.	458	/ K & & & & & & & & & & & & & & & & & &	5,56	3403	, <b>,</b> ,	.3059	, 98,
354.2         557         3026         576         3553         3574         3744           3816         443         3772         456         612         337           4031         456         3772         456         387         387           4427         446         3772         456         387         387           4427         446         3772         456         387         340           4427         446         377         466         377         347           4227         446         377         466         377         347           2351         448         377         466         376         347           2351         448         377         466         376         467         347           237         448         467         467         467         357         344           237         448         378         467         467         357         344           237         448         378         467         478         364         364           237         447         378         467         478         364         364	35,42	3274	924.	2958	.530	3465	.542	.3103	\$69.
1,278	1,000	.3542	.557	3026	.516 316	3533	.556	31/46	\$ \$ 4
1,273	1,278	3816	613	.3187	24.18	3667	, 26, 613	3237	652
2.14.7         .77.6         .37.85         .663         .3355         .440         .3854         .663         .3355         .440         .3854         .663         .3355         .440         .3854         .663         .3355         .340         .3854         .340         .340         .340         .345         .340         .345         .340         .345         .340         .345         .340         .345         .340         .345         .340         .345         .340         .345         .346         .345         .346         .345         .346         .345         .345         .345         .345         .346 <td>1427 177 177 177 177 177 177 177 177 177 1</td> <td>1504°</td> <td>287</td> <td>31.72</td> <td>627</td> <td>3724</td> <td>.634</td> <td>.3282</td> <td>.637</td>	1427 177 177 177 177 177 177 177 177 177 1	1504°	287	31.72	627	3724	.634	.3282	.637
2351 4.26 3.774 4.76 3.914 6.68 3.401 2.351 4.26 3.910 6.91 3.401 2.351 4.26 3.910 6.91 3.401 2.351 4.26 3.910 6.91 3.401 2.351 4.26 3.910 6.91 3.401 2.351 4.26 3.901 6.901 3.401 2.351 4.26 3.901 6.901 3.401 2.351 4.201 2.351 2.351 4.201 2.351 2.351 4.201 2.351 2.351 4.201 2.351 2.	2351428355544035142351438351843835184383518438351843835184384383518438	7777	627	.3547	02.7	.3785	699	.3355	9.
2351         448         3537         448         3949         379         3445           2351         448         3791         445         3969         3557         3445           2351         423         426         4036         669         3557         3557           2370         4271         536         4170         669         3557         3567           2387         466         556         4170         669         3557         3567           2390         526         4274         566         4273         677         4367           2396         526         4379         566         4379         367         4367           4300         526         4379         566         4379         567         4379           4400         526         4476         576         4367         4367         4367           4400         457         4579         4579         547         4367         4378           4400         457         4579         4579         547         547         547           4400         4570         4570         4746         552         527         527	2351 4.48 3.957 4.4% 3.959 1.00 2.251 4.48 3.959 1.00 2.251 4.48 3.959 1.00 2.251 4.48 3.959 1.00 2.251 4.48 3.959 1.00 2.251 4.470 2.250 2.251 4.470 2.250 2.251 4.251 2.251			.3555	077.	.3854	889	.3401	584
2531 1428 3771 1532 4036 1693 2557 2564 2558 2564 2568 2564 2568 2564 2568 2564 2568 2564 2568 2564 2568 2564 2564 2568 2564 2564 2568 2564 2568 2564 2568 2564 2568 2564 2568 2564 2568 2564 2564 2564 2564 2564 2564 2564 2564	2531 .428 .3718 .425 .3969 .2521 .428 .3718 .425 .3969 .2521 .428 .3718 .425 .4368 .425 .4368 .2531 .426 .425 .4368 .2531 .426 .425 .426 .425 .426 .426 .256 .426 .426 .256 .426 .426 .256 .426 .426 .256 .426 .426 .256 .426 .426 .256 .426 .256 .426 .256 .426 .256 .426 .256 .426 .256 .256 .256 .256 .256 .256 .256 .2		504	.3637	967.	.3910 2000	7694	3776	, 55. 7.5.
2877         .1.71         .3885         .536         .4108         .682         .3604           2887         .1.51         .1064         .637         .4170         .686         .3604           2887         .4064         .637         .4170         .668         .4283         .641         .264           3302         .586         .4319         .566         .4298         .641         .364           3302         .687         .4249         .649         .649         .641         .364           3302         .687         .4284         .649         .4239         .540         .364           3302         .687         .4284         .649         .4284         .541         .364           4004         .451         .506         .4467         .558         .426         .436         .436           4004         .451         .461         .467         .452         .236         .236           4004         .451         .469         .454         .522         .2302           4450         .454         .454         .454         .2433         .2433           .454         .454         .454         .454         .2433	2837	.2351	84.5	3775.	5. C. E. E.	4036	§	.3557	5.5
2837         4,65         4,064         6,53         4,170         664         232.2         4,170         664         4,283         264         4,283         264         4,283         264         364	2837	26.36	7.	3885	.536	9017	.682	3604	.53
2890 520 4,254 578 4,243 657 429,3227 73,3227 73,3227 73,3227 73,3227 74,33227 74,33227 74,33227 74,33227 74,3322 54,3227 74,3227 54,3	2390	2837	597	7907	.635	.4170	999.		į
374.6         .596         .4319         .586         .4319         .586         .4319         .586         .4419         .586         .4419         .596         .4419         .4539         .541         .541389 <td>3.302</td> <td>2990</td> <td>.520</td> <td>.4254</td> <td>578</td> <td>•4243</td> <td>.637</td> <td>1226.624</td> <td>125.</td>	3.302	2990	.520	.4254	578	•4243	.637	1226.624	125.
3.790         .786         0.41.2011         .598         .4467         .556         436.1929           3.778         .489         .2014         .4619         .4539         .540         .1995           4.718         .459         .3101         .461         .4539         .522         .2055           4.188         .459         .3101         .461         .4571         .522         .2245           4.189         .459         .3105         .469         .4746         .522         .2245           4.400         .579         .3283         .503         .4844         .522         .2346           .461         .597         .3390         .542         .4989         .542         .2345           .2240         .577         .4989         .548         .254         .254           .2240         .578         .471         .2281         .667         .2869           .2400         .548         .578         .247         .276         .2760           .2400         .441         .2281         .667         .2760         .2760           .2400         .448         .528         .595         .2869         .2869         .2869 <t< td=""><td>3.790         .586         0.41,2011         .598         .4467           3.778         .489         .2194         .619         .4539           4.004         .451         .2194         .4601         .4579           4.188         .459         .3101         .461         .4671           4.188         .459         .3101         .461         .4671           4.189         .510         .469         .474         .4924           4.291         .597         .398         .577         .4924           4.292         .508         .577         .4924         .4924           4.293         .508         .577         .4924         .4924           2.240         .566         .4213         .447         .2221           2.260         .566         .4213         .447         .2221           2.240         .566         .532         .2474           2.248         .546         .536         .2474           2.248         .546         .536         .2474           2.248         .546         .536         .2474           2.248         .546         .536         .2474           2.258</td><td>33146</td><td>85. 82.</td><td>.4319</td><td>2000</td><td>006<b>7.</b></td><td></td><td>•</td><td>2</td></t<>	3.790         .586         0.41,2011         .598         .4467           3.778         .489         .2194         .619         .4539           4.004         .451         .2194         .4601         .4579           4.188         .459         .3101         .461         .4671           4.188         .459         .3101         .461         .4671           4.189         .510         .469         .474         .4924           4.291         .597         .398         .577         .4924           4.292         .508         .577         .4924         .4924           4.293         .508         .577         .4924         .4924           2.240         .566         .4213         .447         .2221           2.260         .566         .4213         .447         .2221           2.240         .566         .532         .2474           2.248         .546         .536         .2474           2.248         .546         .536         .2474           2.248         .546         .536         .2474           2.248         .546         .536         .2474           2.258	33146	85. 82.	.4319	2000	006 <b>7.</b>		•	2
3778         489         2194         619         4539         540         1995           4004         451         3000         446         4661         559         2057           4188         459         3101         461         4661         552         2245           448         459         3101         461         4661         552         2245           4400         519         464         562         2302         2245           450         519         464         562         2302         2245           450         573         3390         572         4989         548         2493           220         576         479         479         546         2493         2554           220         576         577         4989         548         2493         2554           220         586         477         479         576         2693         2693           220         477         474         522         5693         2693         2693           220         479         578         527         578         2893         2998         2998           243	.3778	3000	586		\$65.	14467	.556	436.1929	.659
4,004         4,51         3,000         4,44         4,601         5,52         3,502         4,604         4,704         5,52         3,502         4,603         4,704         5,52         3,502         4,603         4,704         5,52         3,502         4,603         4,704         5,52         3,502         4,502         3,502         4,502         3,502         3,502         4,603         4,704         5,52         3,502         3,502         4,603         4,603         5,52         3,502         3,502         3,502         3,502         3,502         3,502         3,503         3,503         3,503         3,503         3,603         3,603         3,603         3,603         3,603         3,603         3,603         3,603         3,603         3,603         3,603         3,603         3,603         3,603         3,603         3,603         3,603         3,603         4,603         3,603         3,603         4,603         3,603         4,603         3,603         4,603         3,603         4,603         3,603         4,603         3,603         4,603         3,603         4,603         3,603         4,603         3,603         4,603         3,603         4,603         3,603         4,603         3,603 <td></td> <td>.3778</td> <td>687</td> <td></td> <td>619</td> <td>.4539</td> <td>5,50</td> <td>.1995</td> <td>5.5</td>		.3778	687		619	.4539	5,50	.1995	5.5
1,188	1,188	7007	.451	3000	977		3	766	6,6
1,570	1,570	.4188	459	3016	[4,7	7707	526	2302	.667
1,597         3,399         54,2         4,924         5,52         24,32           2,208         577         4,989         5,48         24,32           2,24,2         374,3         576         4,11,2166         6,66         2854           2,64,0         586         4,213         447         22,23         667         276           2,000         4,11         0,423         5,66         2,283         607         2,760           2,000         4,11         0,423         5,78         2,283         607         2,760           2,000         4,11         0,423         5,28         2,248         607         2,760           2,000         4,0,439         1,252         40,539         3,048         40	7,671	7.570	238	.3283	503	7787	.528	.2365	•672
2420 .502 .3498 .577 .4989 .544 .2454 .2545 .2443 .2546 .660 .2624 .2554 .2546 .660 .2624 .2554 .2546 .660 .2624 .2554 .2660 .2624 .2660 .2660 .2624 .2660 .	2420 .502 .3458 .577 .4989 .2221 .2242 .2442 .22	1697	.597	.3390	275	7267	5775	.2432	679
2420	25420 .5422 .3974.3 .570 4.11.2166 .2544 .343 .3959 .510 4.11.2166 .2541 .2221 .2221 .2221 .2221 .2221 .2221 .2221 .2221 .2222 .2236		1	3498	.577	6867*	.548	2493	6.0
2546 - 34, -379, -371, -411, -411, -522, -563, -569, -569, -564, -586, -586, -586, -586, -544, -544, -544, -548, -558, -568, -568, -568, -568, -546, -544, -549, -558, -568, -	.2546	030.2420	202	.3743	576	-	9	2624	565
2000 .491 042,3312 .568 .358 .595 .2008 .2186 .544 .3486 .552 .2474 .549 .2988 .2438 +0,618 .3590 +0,489 .2525 +0,539 .3048 +0	2000 4.91 042,3312 .568 .2368 .2368 .2368 .2368 .2368 .2474 .3486 .532 .2474 .2438 +0.618 .3550 +0.489 .2525	3640	.586 .586	.4213	7447	-	.652	.2693	.562
2000			•		,	2283	607	00/22	26.5
0+ 0.618 .3590 +0.489 .2525 +0.539 .3048 +0	+0.618 .3590 +0.489 .2525	037,2000	67.	3486	.532	27.77	549	2988	57.5
		.2438	40.618	.3590	687.0+	.2525	+0.539	30/8	40.566

ν <sub>Δ</sub>		282 289 267 289 267 267	824. 84. 84.	563.	707	**************************************	337	, <u>2</u>	284	.277	.337	3775	.416	127	677:	64.	4	£07	383	345	327	88.	.30¢	277	8	027.	44.	•435	•439	393	.352	.337	317	326	+0.334
нел. Ј. D.	5441000+	411.36.29 .275. .275.	.3443 .3491	.3637 7637	3774	3862	3972	0807	1227	.4319	412,2699	2787	2862	29.05 29.50	3005	.3069 .3114	3158	326	3890	34.09 94.09	3455	.3566	.3614	429.3217									2768		
Δ Δ		25.1 25.1 25.1 340	28.	4.85 5.85 5.85 5.85	386	331	25.		239	.325	500	062. 72.	278	276	<b>8</b>	30°	312	355. 8363.	386	0.410 7.33	435	£ 7	87	ž.	.332	.374	2 % 4 %	833	272	86.	.324	•435	.384 .384	382	962.04
Hel.J.B.	2441000+	042.3820 .4243 .4243	044.1654	1986	.2219 3279	2427	2632	898	3108	369.2871	.2963	90°.	.3115	3200	.3351	3413	3536	3618	3735	3860	3917	2707	4112	.4778	4167.	7775	.4545	6897	477	.4932	.5038	411,2159	.2270	2336	2534
۸۷		0.359 363 312 380	3.55.55 5.55.55 5.55.55 5.55 5.55 5.55	922.	25.	£ 5. %	£ 68.	(73.	386.	% %	607	424	36.	380	36.	333	8	265	217	226	.249	316	.324	.347	.366	.386	986. 88.	38	.257	286.	.361	38	.228	.327	.503 -0.247
Hel.J.D.	2441000+	037.2469 2646 2688 2883 2893	.3200 .3200	3214	3447	3752	4075	3164.	2270	.2333	7572	2517	5492	.2661	2812	2873	3014	.3180	3465	3541	3621	3777	3874	.4248 .4248	.4312	041.2002	2186	3097	.3189	.3378	.3491	3676.	.4207	042.3305	3583
<b>∧</b> ∇		٥ ٤ ٤ ٤ ٤ ٤ ٤ ٤ 8	404. 714. 78.	ئۆرىن 4 7 %	÷ \$6.8	253	352	, <del>%</del> ;	, 8,45	191	\$26	355	E.E.	285	.23	.211	325.	& & &	388	.240	.268	250	.211	3,24	.343 380	343	.250	226	7/2	37.	370	311	.355	.256	.295 +0.357
Hel.J.D.	2441000+	014-2504 -2539 -2664 -2719	.3886 3070 2005	2886. 4886.	3376	014, 24,0	7582	304	33%	3791	.4053	.4310	6887	96.96	2840	.3017	.3531	.3799	.4271	.4417	029,2167	2541	99%	2827	3139	.3483	.3764	4170	***************************************	1897:		2539	5829	037.1996	.2181 .2431

Table 2c U Observations of BD-18° 3437

Hel.J.D.	Δ Մ	Hel.J.D.	Δ Ծ	Hel.J.D.	Δ Մ
2441000+		2441000+		2441000+	
014.2519 2586	+0 <b>.47</b> 4 •494	029.2358 .2535	+0.425 •383	037.4392	+0.535
.2688	.571	.2684	.383	041.2029	.604
<b>.</b> 2695	.568	.2844	•418	.2213	.622
<b>.28</b> 65	<b>.</b> 603	.3000	<b>.</b> 483	.3012	.407
.2872	•599	•3153	•550	.3105	<b>.3</b> 96
.3087	•555	•3309	•585	.3202	-411
•3094	.555	•3497	.533	•3290	<b>.</b> 475
.3237	.500	•3795	•455	.3400	•531
.3242	•500	.4014	.406	.3504	•557
•3390	.472	<b>.</b> 4198	•426	<b>.</b> 3750	<b>.</b> 538
•3398	•479	•4414	.500	<b>.</b> 3964	.472
		<b>.</b> 4580	<b>.</b> 548	.4218	<b>.</b> 453
017.2657	•439	.4702	•585		
.2875	.542			042.3326	.556
.2882	.545	030.2435	.464	•3493	-507
.3060	•550	.2556	.529	•3597	.454
.3227	.498	.2650	•544	.3840	.357
.3412	•433	• • • • • • • • • • • • • • • • • • • •	1/2	.4100	-479
.3817	.378	037.2007	.462	<b>.</b> 4260	.464
.3824	.369	.2192	<b>.</b> 453	<b>-4437</b>	.521
.4067	.468	.2443	•597	044.1668	.505
.4338 .4755	•567 •599	.2450 .2662	.628 .570	.1693	.504
.4907	•599 •490	.2669	•583	.1942	.556
•4907	•490	•2905	.467	•1970	•594
028.2642	.502	•2911	.484	.2181	•595
.2882	.418	.2968	.414	.2203	.608
.3038	.406	•3183	•411	.2392	.540
.3281	.416	.3186	.416	.2413	-531
.3549	.516	.3228	.421	2597	.452
.3823	.568	.3428	.466	.2621	.443
.4042	.534	•3433	-481	.2833	.411
.4288	.459	.3725	.530	.2856	.420
.4441	.418	.3732	.512	.3073	418
******		.4048	.609	3094	+0.419
029.2188	+0.477	.4055	+0.602	•,,-,-	/

Table 3 Times of Minima of BD-18° 3437

Hel.J.D. 2440000+	Eclipse	(o - c)	Weight
		d	
1014.288	р	- o⁴∞1	2.0
1017.297	8	- 0.000	2.0
1017.458	p	• 0.002	2.0
1028.378	8	- 0.002	2.0
1029.330	8	+ 0.000	2.0
1034.398	8	+ 0.002	0.3
1037.252	8	+ 0.006	1.5
1037,399	p	- 0.005	1.0
1040.251	p	- 0.003	1.5
1040,409	8	- 0.003	0.2
1041,361	8	- 0.001	1.0
1044.213	8	+ 0.001	1.2
1369.398	8	- 0.002	2.0
1412.305	p	- 0.001	2.0
1436.212	8	+ 0.002	0.5

Table 4 Fourier Coefficients of light variation outside the eclipses

Year	Filter	<sup>A</sup> o	<sup>A</sup> 1	A <sub>2</sub>	B <sub>1</sub>	В2	
1971	v	+ 0.9415 32	- 0.0237 30	- 0.0611 45	- ó.0007 14	- 0.0039 17	
	В	+ 0.9337 38	- 0.0261 37	- 0.0614 55	- 0.0022 18	- 0.0072 21	
	Ū	+ 0.9131 56	- 0.0268 56	- 0.0889 82	+ 0.0061 29	- 0.0043 33	
1972	٧	+ 0.9314 41	- 0.0104 35	- 0.0667 53	+ 0.0075 15	+ 0.0019 22	
	В	+ 0.9393 62	- 0.0016 50	- 0.0699 77	+ 0.0115 21	+ 0.0047 33	

Table 5a Observed depths of the minima

]	Primary			Secondary		
ν	В	υ	V	В	σ	
0.19	0.20	0.22	0.16	0.19	0.19	
0.18	0.20	-	0.17	0.20		
	V 0.19	0.19 0.20	V B U 0.19 0.20 0.22	V B U V 0.19 0.20 0.22 0.16	V B U V B  0.19 0.20 0.22 0.16 0.19	V         B         U         V         B         U           0.19         0.20         0.22         0.16         0.19         0.19

Table 5b Rectified depths of the minima

	]	Primary		\$	Secondary	
 Year	ν	В	υ	Ψ	В	υ
1971	0.015	0.015	0.00	0.040	0.060	0.01
1972	0.005	0.020	_	0.020	0.025	_

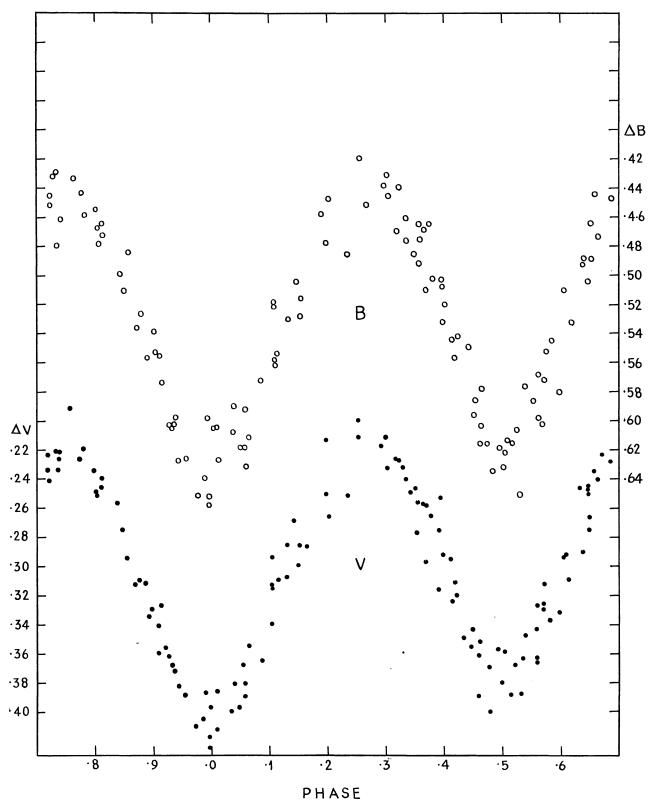


Figure 1 B and V light curves of BD-18 $^{\circ}$  3437 for 1971.

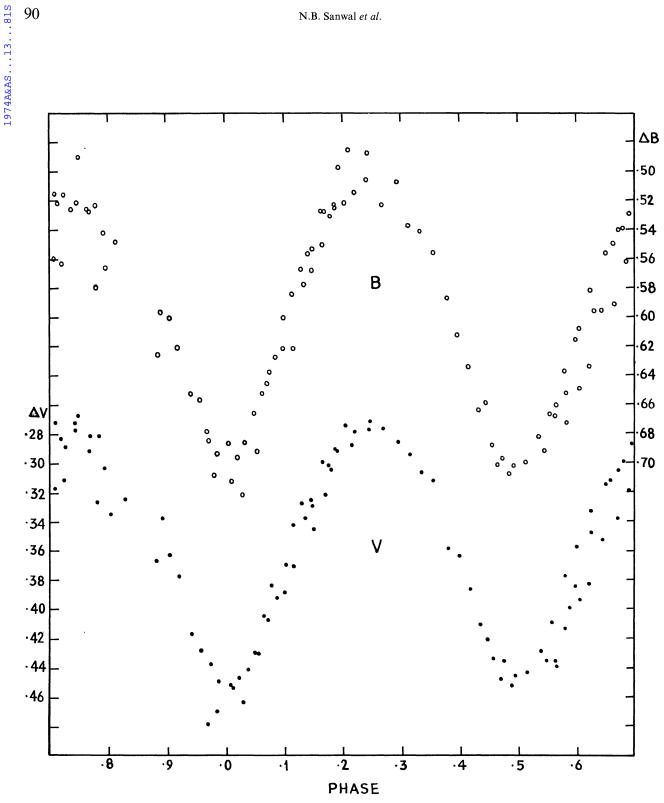


Figure 2 B and V light curves of BD-18° 3437 for 1972.