

COMMISSION 27 OF THE I. A. U.  
INFORMATION BULLETIN ON VARIABLE STARS  
Number 1805

Konkoly Observatory  
Budapest  
1980 June 16

UBV - OBSERVATIONS OF SOME CATAclySMIC VARIABLES

I. Observations

11 cataclysmic variables were observed in the four nights from July 15th to July 18th, 1979, with the 1 m-telescope of the Florence and George Wise Observatory of the University of Tel Aviv, Israel. Among them are seven old novae, two recurrent novae, one dwarf nova (WZ Sge, formerly considered a recurrent nova) and the novalike object Vulpecula 1979, which was near maximum during the time of observation. The telescope was equipped with a photoelectric two-channel-photometer. The measurements were made with UBV-filters. In order to determine the extinction and to tie the instrumental system to the international UBV-system some standard stars given by Landolt (1973) were observed several times each night.

As a rule the stars were observed during several nights for a few minutes at a time. Therefore statements about light and colour variations within one night are somewhat speculative. However, differences from night to night can be determined. Only HR Del (in four nights), V 841 Oph and V 603 Aql (each in one night) were observed for a longer time in order to obtain light curves. The B and V measurements were made with integration times of 5 seconds, the U measurements with those of 10 seconds.

The results of the observations are given in Table I. For each observing night the number of measurements for each star, the resulting V

TABLE I  
Observational data

Star	Type	Number of obs.	Date (UT) 1979 July	V	B-V	U-B	Phase	Reference
V 603 Aql	N	21	16.91	11.58 ± 0.02	-0.06 ± 0.01	-0.98 ± 0.01		
		21	17.82	11.80 ± 0.03	-0.07 ± 0.02	-0.94 ± 0.01		
		217	18.79 - 18.85	11.44 ± 0.10	-0.07 ± 0.02	-0.99 ± 0.02		
T CrB	RN	36	15.79	9.90 ± 0.01	1.37 ± 0.02	0.58 ± 0.07		
		21	17.78	9.88 ± 0.01	1.40 ± 0.02	0.59 ± 0.06		
		21	18.77	9.95 ± 0.01	1.42 ± 0.01	0.71 ± 0.04		
Q Cyg	N	21	16.89	14.94 ± 0.18	0.31 ± 0.19	-0.71 ± 0.07		
		21	17.93	15.13 ± 0.20	0.29 ± 0.21	-0.83 ± 0.11		
HR Del	N	416	15.93 - 16.06	11.89 ± 0.06	0.15 ± 0.04	-1.03 ± 0.03	0.24 - 0.98	Hutchings (1979)
		341	16.96 - 17.06	11.95 ± 0.08	0.13 ± 0.05	-1.02 ± 0.03	0.21 - 0.84	Hutchings (1979)
		199	17.98 - 18.04	11.87 ± 0.04	0.14 ± 0.03	-1.03 ± 0.04	0.19 - 0.55	Hutchings (1979)
		377	18.94 - 19.06	11.86 ± 0.06	0.18 ± 0.02	-1.00 ± 0.02	0.84 - 0.51	Hutchings (1979)
DQ Her	N	21	16.79	14.72 ± 0.12	0.04 ± 0.13	-0.78 ± 0.05	0.47 - 0.50	Schneider, Greenstein(1979)
		21	17.89	14.78 ± 0.15	0.03 ± 0.13	-0.69 ± 0.06	0.15 - 0.18	Schneider, Greenstein(1979)
DI Lac	N	21	18.90	14.43 ± 0.12	0.13 ± 0.11	-0.75 ± 0.04		
HR Lyr	N	15	15.85	15.82 ± 0.28	0.01 ± 0.25	-1.06 ± 0.11		
		21	17.81	15.00 ± 0.28	0.30 ± 0.27	-0.60 ± 0.14		
RS Oph	RN	15	15.92	11.52 ± 0.04	0.98 ± 0.02	-0.09 ± 0.02		
		26	16.90	11.47 ± 0.05	0.93 ± 0.02	-0.16 ± 0.02		
		21	17.79	11.26 ± 0.03	0.92 ± 0.02	-0.21 ± 0.02		
		21	18.79	11.50 ± 0.04	0.92 ± 0.02	-0.17 ± 0.02		
V 841 Oph	N	192	16.81 - 16.87	13.50 ± 0.08	0.33 ± 0.08	-0.55 ± 0.05		
		21	18.86	13.36 ± 0.06	0.40 ± 0.05	-0.59 ± 0.04		
WZ Sge	UG	12	15.88	14.49 ± 0.13	0.00 ± 0.11	-1.07 ± 0.03	0.55 - 0.60	Robinson et al. (1978)
		21	17.91	14.75 ± 0.15	0.17 ± 0.14	-0.91 ± 0.08	0.42 - 0.51	Robinson et al. (1978)
Nova Vul 1979	N ?	11	15.91	8.814 ± 0.003	0.431 ± 0.004	0.321 ± 0.003		
		11	16.92	8.850 ± 0.005	0.445 ± 0.006	0.341 ± 0.005		
		21	17.95	8.856 ± 0.009	0.445 ± 0.008	0.361 ± 0.008		
		16	18.87	8.849 ± 0.007	0.447 ± 0.008	0.331 ± 0.008		

magnitudes and the B-V, U-B colour indices are listed. The noted errors are standard deviations resulting from the differences between the single measurements and the mean. In case of intrinsic light variations of the star, these errors contain a systematic contribution and are thus larger than the statistical error. This applies particularly to the objects observed for long time intervals, where the variations were sometimes considerable.

For binaries with known ephemerides (obtained from the references quoted) the table contains the phase during which the observations were made. In the case of T CrB the errors in the ephemerides of Paczynski (1965) are so large that it is not meaningful to give the phases of the observations.

## II. Discussion

Almost all objects show significant light variations from night to night. Colour variations - though not in all cases significant - are also present. These results are in agreement with measurements of the same objects by other authors. For the fainter stars colour variations may be masked by the larger statistical errors. For objects with short duration of observing runs light variations on short time scales were not noticed. Only T CrB on July 17th and RS Oph on July 15th, 16th and 17th show intensity variations within a few minutes. The corresponding fragmentary U light curves are reproduced in Figure 1. The scale of the abscissa is 5 minutes.

It is known that such flickering is typical for cataclysmic variables and confirmed by the longer observing runs of HR Del, V 841 Oph and V 603 Aql. The light curves of these stars are shown in Figure 2a-c. The large scatter of the data points in some light curves does not

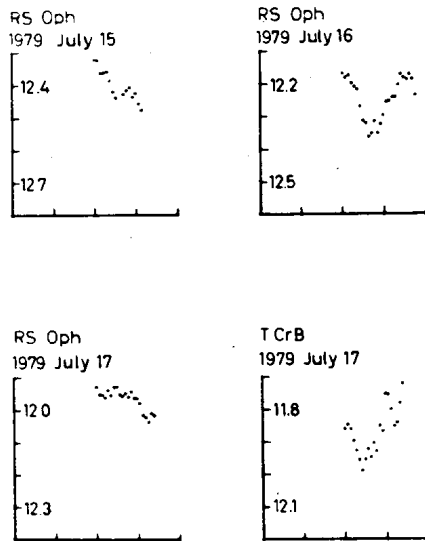


Fig. 1 Fragmentary U light curves of RS Oph and T CrB. The scale of the abscissa is 5 minutes.

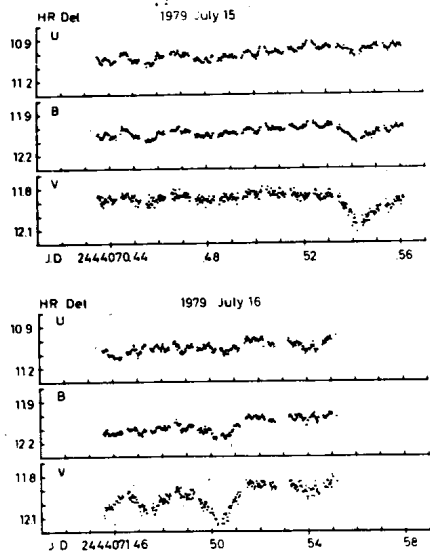


Fig 2a

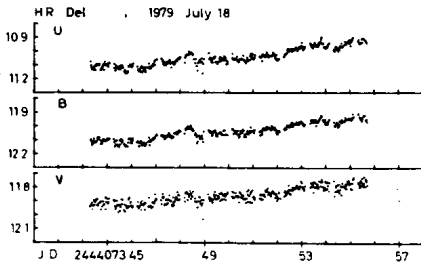
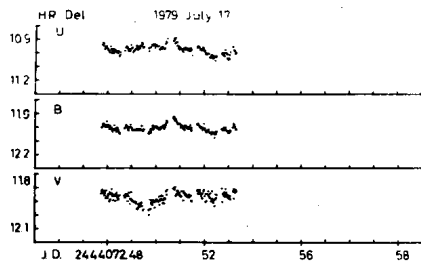


Fig. 2b

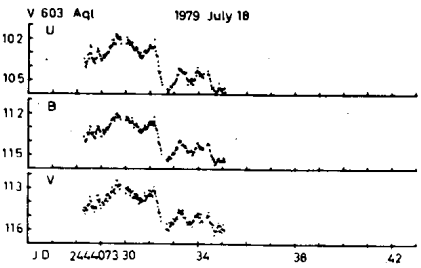
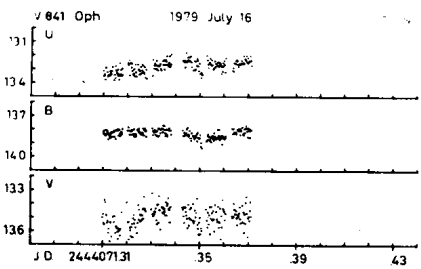


Fig. 2c

Fig. 2a-c UBV light curves of HR Del, V 841 Oph and V 603 Aql.

indicate intrinsic variability on a short time scale. There is a clear dependence of the amplitude of the scatter upon the mean counting rate of the photometer, proving that it arises from photon statistics. The light curves in different colours are quite similar for V 841 Oph and V 603 Aql, indicating that colour variations do not occur on time scales less than a few hours. For HR Del the short term low amplitude variations are also remarkably similar in all 3 colours. However, the "deep" minima show strong colour dependence and are increasingly stronger in the long wavelength bands.

None of the observed light curves exhibits strictly periodic phenomena, but the well defined minima in the light curves of HR Del may be related to each other. Since no period derived from these minima is in agreement with either Hutchings' (1979) or Tempesti's (1979) period, I refrain from giving still another value, especially since the geometry of the system as derived by Hutchings is unlikely to lead to eclipses. It is possible that HR Del shows transient quasi-periodic light minima, the cause of which is unknown.

The amplitudes of the light variations of HR Del are rather small compared to those of other cataclysmic variables as already noticed in (unpublished) observations of HR Del of September 1977, August 1978 and October 1978. The present variations of V 841 Oph are very small in contrast to observations made in August 1978, when in all colours amplitudes of up to  $0.3^m$  within a few minutes were normal. Of all observed stars V 603 Aql shows the largest light variations (apart from the night to night variations of HR Lyr). In this case no light curves from other epochs are available for comparison.

The author thanks the staff of the Wise Observatory of Tel Aviv University and the Smithsonian Research Foundation (Grant SFC-0-3005) for their hospitality and for the opportunity to use their facilities at Mitzpe Ramon, Israel. He is also grateful to the Deutsche Forschungsgemeinschaft for a travel grant.

ALBERT BRUCH\*

Astronomisches Institut der  
Westfälischen Wilhelms - Universität  
Münster

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\* Visiting Astronomer, The Florence  
and George Wise Observatory, Tel Aviv  
University, Israel