UBV OBSERVATIONS OF R CrB-TYPE VARIABLES AND RELATED OBJECTS

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Abstract. *UBV* observations obtained during the period 1972–73 are presented for the following five R CrB Stars: GU Sgr, SU Tau, XX Cam, DZ And, V973 Oph, and the hydrogen-poor, carbon-rich stars BD + 10°2179 and HD 137613. Observations of SU Tau were obtained when it was coming out of the 1972 light minimum.

Apart from undergoing sudden drops in light of four to five magnitudes, some R CrB stars seem to show small amplitude ($\geqslant 0.1$ mag. in V) light variations in a period of a few tens of days even at maximum light (Fernie *et al.*, 1972; Sherwood, 1975). RY Sgr is known to exhibit a Cepheid-type light variation of 38.6-day period (Alexander *et al.*, 1972; Pugach, 1977) and R CrB is suspected to show a 44-day periodicity in the small amplitude light variations (Fernie *et al.*, 1972). To establish periodicity in these small amplitude light variations at maximum light, and to study the relationship with the R CrB phenomenon of sudden diminution in light, long-term photometric monitoring of these stars is desirable. It is also of interest to see whether these small amplitude light variations could be seen in other hydrogen-poor carbon stars which do not show R CrB-type variations. To this end, the *UBV* observations were obtained with the 24-in photometric reflector of Lick Observatory using a refrigerated 1P21 photomultiplier and the standard *UBV* filters during the 1972–73 period. The observations are given in Table I. The typical photometric errors are ± 0.025 in V, ± 0.020 in $B - V$ and ± 0.025 in $(U - B)$.

BD + 10°2179 and HD 137613 are two hydrogen-poor, carbon-rich stars which do not show the R CrB-type of variability (Warner, 1967). In the period of 85 days covered by these observations, HD 137613 showed no periodic variations greater than 0.1 mag. in V. The mean V mag. and colours agree with that given by Mendoza and Johnson (1965). For BD +10°2179, the observations given here cover a period of 100 days and overlap in time with the observations reported by Landolt (1973). There does not seem to be any periodic variations in light greater than 0.1 mag. in V, although Landolt (1973) remarks that the total range in V mag. (0.09) and larger-than-expected r.m.s. errors might indicate variability.

GU Sgr is a known R CrB-star (Hoffleit, 1959, 1976). In the period of 43 days covered by these observations, the star showed variations of 0.3 mag. in V, 0.1 mag. in $B - V$, and 0.2 mag. in $U - B$. The star was at maximum light during this period

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TABLE I

Star	JD	V	$B-V$	$U-B$
BD + 10°2179	2441 364.8611	9.98	−0.20	−0.85
	364.9514	9.98	−0.20	−0.85
	400.8090	9.97	−0.19	−0.87
	404.8118	9.95	−0.19	−0.87
	405.8174	9.99	−0.19	−0.89
	435.7611	9.98	−0.19	−0.86
	442.7979	9.95	−0.20	−0.88
	448.7563	9.96	−0.19	−0.91
	450.7389	9.94	−0.20	−0.89
	453.7410	9.99	−0.20	−0.87
	462.7031	9.97	−0.19	−0.86
	463.7138	9.95	−0.20	−0.89
	464.7206	9.92	−0.20	−0.90
HD 137613	2441 401.0153	7.50	1.20	0.85
	435.9444	7.51	1.19	0.87
	442.8792	7.49	1.17	0.85
	448.8799	7.52	1.20	0.82
	450.9049	7.46	1.20	0.80
	453.8319	7.54	1.22	0.86
	462.8035	7.51	1.20	0.84
	479.7993	7.50	1.17	0.79
	480.7778	7.48	1.18	0.85
	484.7465	7.44	1.19	0.81
	485.7340	7.50	1.16	0.86
GU Sgr	2441 442.9586	10.38	1.18	0.76
	448.9813	10.51	1.25	0.78
	450.9663	10.35	1.22	0.71
	453.9437	10.26	1.17	0.68
	462.9069	10.28	1.17	0.89
	464.9264	10.40	1.26	0.81
	479.9000	10.19	1.15	0.68
	480.9049	10.37	1.17	0.78
	484.9118	10.19	1.14	0.73
	485.8764	10.26	1.15	0.74
SU Tau	2441 341.6818	11.50	1.48	1.00
	364.7632	11.20	1.42	1.02
	364.7799	11.19	1.40	0.91
	400.7028	10.92	1.34	0.82
	405.6660	10.66	1.34	0.94
	405.6729	10.65	1.31	1.17
	435.6715	10.39	1.22	0.64
	435.6813	10.41	1.27	0.44
	442.6715	10.12	0.99	0.62
	653.8333	10.16	1.17	0.63
XX Cam	2441 364.6875	7.31	0.82	0.35
DZ And	2441 364.6722	10.22	1.23	1.29
V973 Oph	2441 484.8978	10.66	2.18	2.28

of observation (Hoffleit, 1976). Bateson and Jones (1973) observed a semi-regular variation in light with a 38-day period. There seems to be an indication of periodicity of ~ 30 days in the observations reported here.

SU Tau was observed when it was in the recovery phase from the deep minimum of 1972. From the magnitude and colours given by Fernie *et al.* (1972) for light maximum – i.e., $V = 9.77$, $B - V = 1.08$ and $U - B = 0.43$ – the average circumstellar reddening relations for this recovery phase seem to be given by $\Delta V/\Delta(B - V) = 4.3$ and $\Delta(U - B)/\Delta(B - V) = 1.47$ for the ratio of total to selective absorption and for the colour–colour relation, respectively. This is similar to relations observed by Alexander *et al.* (1972) for the recovery phase of RY Sgr $\Delta V/\Delta(B - V) = 4.3$, $\Delta(U - B)/\Delta(B - V) = 1.3$. The other two stars DZ And and V973 Oph are now believed to be non-members of R CrB class. Orlov and Rodriguez (1975) have shown that DZ And is not an R CrB star because of the presence of hydrogen lines in the spectrum. Spectrograms obtained in October 1978 with the 40-in. telescope at Kavalur at a dispersion of 125 Å mm^{-1} also show strong Hα in absorption. On the basis of the spectrum, Feast (1975) reports that V973 Oph is also not a member of the R CrB class.

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