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SIMULTANEOUS MULTIWAVELENGTH OBSERVATIONS OF DWARF NOVAE SYSTEMS AT QUIESCENCE AND IN OUTBURST

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The results of photometric and spectroscopic observations of dwarf novae are presented. The data were obtained during an international program of multiwavelength observations, held in 1986 February at several observatories, of dwarf novae during the first and subsequent days of outburst. During the campaign numerous dwarf novae were monitored in order to catch them in outburst. Preliminary results and analysis of some objects are reported elsewhere. A total of 30 dwarf novae were observed in the northern and southern hemispheres. Among them 37% were caught in outburst, including 10% on the rise to outburst and 17% in decline. Photometric observations were carried out in the *UBVRI* system and colour indexes were calculated. Colour-colour diagrams and light curves of the particular stars were constructed. $U - B$, $B - V$ and $V - R$, $B - V$ diagrams are presented in Figs. 1 and 2 respectively. The data shown in Figs. 1 and 2 confirm many results obtained previously, and shows clustering of the objects, depending on their orbital periods, above the main sequence at minimum (Echevarria 1984; Echevarria, Costero & Michel 1993). This region is a very large one, reflecting differences in types of dwarf novae. SU UMa type stars and other short period systems are considerably bluer in both $U - B$ and $B - V$ colours. During an outburst cycle, the systems trace a loop on the colour-colour diagram, with the general pattern shown in the $U - B$, $B - V$ diagram. However the colour changes are very individual and rather characteristic for each star. The large part of the loop covers the rise to outburst. The systems at maximum occupy a very distinct region, slightly above main sequence B9-A0 stars. However several systems

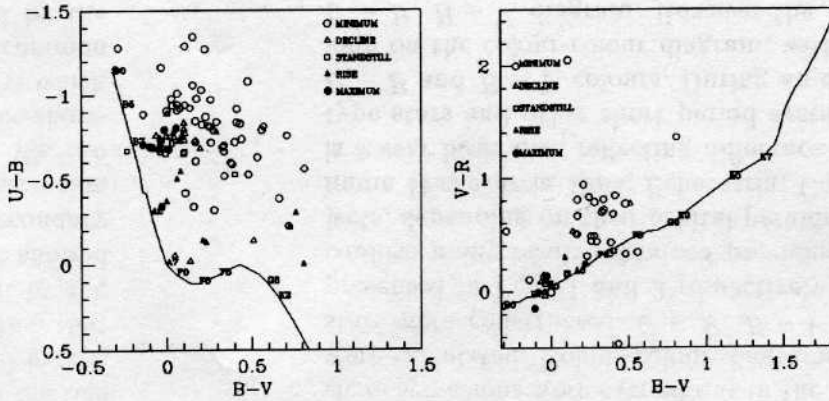


Figure 1. Left: Colour-colour diagram of dwarf novae at several stages of outburst and quiescence. The solid line corresponds to the main sequence. Right: $B - V$ versus $V - R$ diagram for the same objects shown in the left plot. Note the clustering of points at outburst maximum near the main sequence.

displayed peculiarities, which are also presented. A clear delay of UV flux was observed in the case of SS Aur in outburst, as opposed to MU Cen, which displays increasing U flux during the slow rise to outburst. DO Dra is also peculiar for its extremely red colours in the near-IR, and it exhibits a huge contribution from the secondary despite its relatively short orbital period.

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LONG-TERM BRIGHTNESS CHANGES OF TWO CVS

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Abstract. The long-term light curves of the AM Her type binary BY Cam and the nova-like variable PG 2133+115 are presented. The *BVR* observations were carried out at a 0.5 m telescope equipped with a high sensitive TV tube superisocon (Abramenko et al. 1978), the *UBV* photoelectric data were obtained at 0.6 and 1.25 m telescopes and the photographic estimates were made from the negatives obtained at the 0.4 m astrograph in Crimea.

Both stars show high and low brightness states. They show similar behaviour in some respects: the amplitude between high and low states was about two magnitudes in *B*, but the duration of a low state was approximately two months for BY Cam and 1...2 years for PG 2133+115.

1. PG 2133+115

Green, Ferguson & Liebert (1982) noted that this star has a UV excess and so is possibly a CV. We obtained *UBV* (1984–95) and photographic (1960–95) observations of this CV. On average, magnitudes and colours were as follows: $V = 14.7$ mag, $B - V = 0.0$ mag, $U - B = -0.9$ mag. Misselt & Shafter (1995) and the current authors did not detect the period of 2.9 h, found earlier from radial velocity variations. According to the photographic observations in 1969–70 the object was 2 mag fainter than the mean level and 1 mag light variations with a time-scale of 10...20 days were observed (see Fig. 1).

We suggest that PG 2133+115 is a CV which is principally in the 'on' brightness state and is observed at a comparatively small inclination angle.

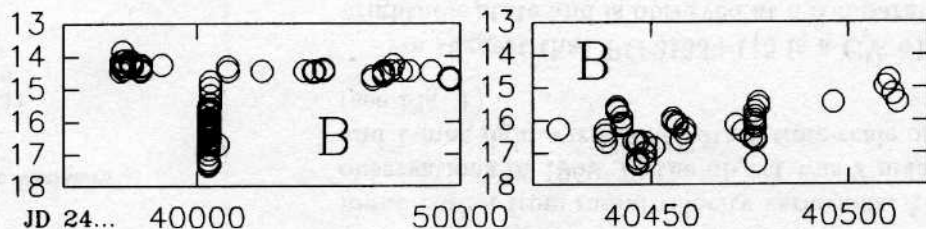


Figure 1. Left: PG 2133+115 in 1960-94. Right: The low state in 1969.

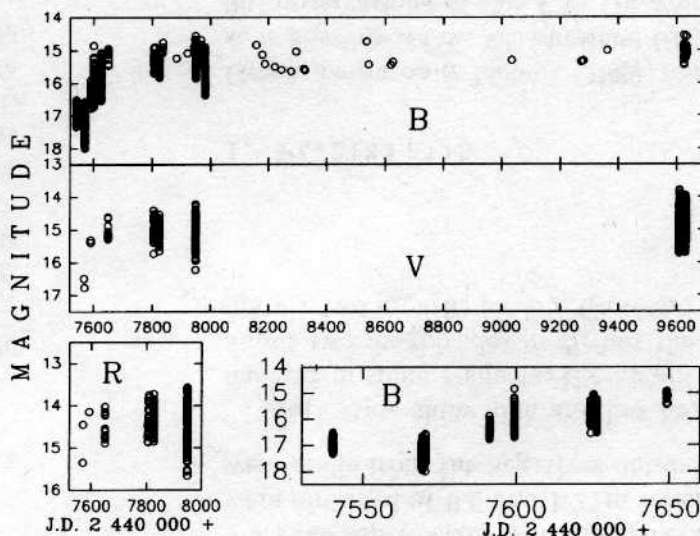


Figure 2. Left: BY Cam in 1989-94. Right: Low and intermediate states of BY Cam.

2. BY Cam

TV observations of BY Cam were obtained in 1989-90 and in 1994, photoelectric in 1994, and photographic estimates in 1953-93. The *BVR* light curve is shown in Fig. 2 (left), which demonstrates the low and high brightness states. In more detail the low and intermediate states are shown in Fig. 2 (right). The low state duration was a brief episode lasting two months only, returning to the high brightness level during three months. The maximal amplitude of the long-term variations was detected in *B* (2 mag).

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