

Two cataclysmic variables similar to WZ Sagittae

Jeremy Bailey *Hatfield Polytechnic Observatory, Bayfordbury House,
Hertford SG13 8LD*

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Summary. The cataclysmic variables UZ Boo and WX Cet both resemble WZ Sge in showing large outburst amplitudes (~ 8 mag), slow declines from outbursts, and long intervals between outbursts. It is proposed that these three stars form a distinct sub-group of the dwarf novae and that they may all have similar binary structure.

Introduction

WZ Sagittae is a cataclysmic variable which had outbursts in 1913, 1946 and 1978. It is an eclipsing binary with a period of 82 min (Krzeminski & Kraft 1964). The star is catalogued as a recurrent nova (Kukarkin *et al.* 1969) but its apparently low luminosity has led to the suggestion (Warner 1976) that it is more closely related to the dwarf novae than to the other recurrent novae. The recurrent novae are generally of higher luminosity being binary systems containing giant secondaries (Bailey 1975a; Warner 1976), for example, T CrB with a binary period of 228 days. Observations of the recent outburst of WZ Sge have confirmed its similarity to the dwarf novae. The outburst spectrum (Nather & Stover 1978) shows broad absorption and doubled emission lines typical of a dwarf nova at outburst, and thought to arise in a bright accretion disk. The observation of a photometric period 1 per cent longer than the orbital period (Targon 1979; Bohusz & Udalski 1979) is also strikingly similar to the superhump phenomenon observed during supermaxima of VW Hyi and several similar dwarf novae.

The outburst light curve of WZ Sge is however, different from those normally observed in dwarf novae. The light curve observed for the most recent outburst is given in Fig. 1. It shows a steady decline with an initial rate of about 0.1 mag/day. There appear to be more rapid variations superimposed on this, in particular a deep minimum on about January 2.

Most dwarf novae show outburst light curves which can be divided into two types. The short outbursts show an immediate rapid decline after reaching maximum, whereas during long outbursts the star remains at maximum for ~ 10 days before declining rapidly. The rate of decline is found to correlate with the orbital period of the binary systems (Bailey 1975b, 1978), the only exception to this being the supermaxima of some SU UMa type stars which show a slower decline than would be expected.

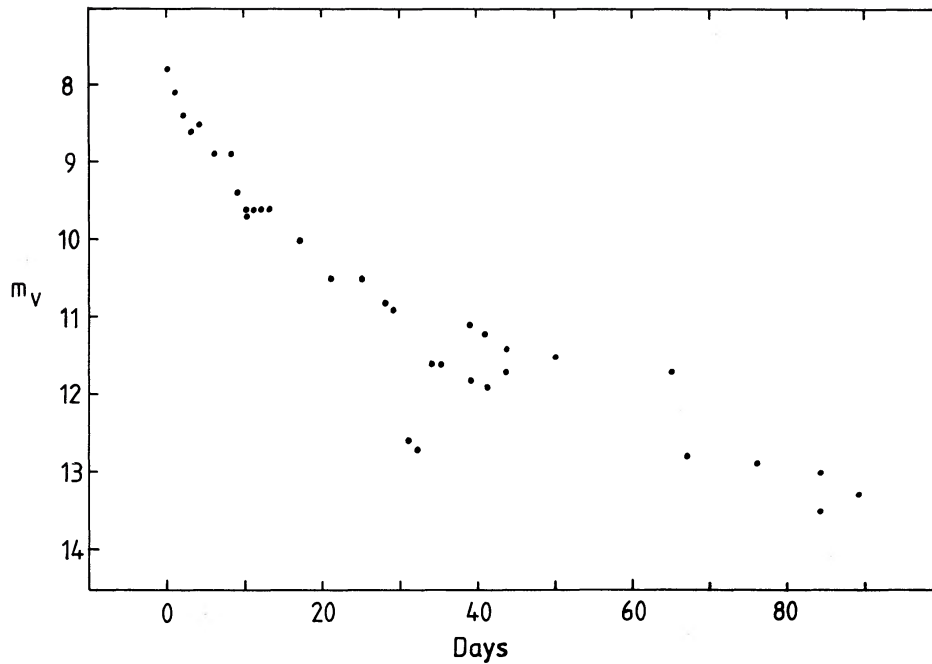


Figure 1. Light curve of the 1978 outburst of WZ Sagittae from visual observations published in *IAU Circulars* and *The Astronomer*. Day 0 = 1978 December 1.

We shall assume the accretion model for dwarf nova outbursts in which they are caused by a sudden increase in the mass transfer rate from the secondary (Bath 1973, 1976; Bath *et al.* 1974). The decline rate is then normally determined by the evolution time-scale of the disk under the action of viscosity (Lynden Bell & Pringle 1974), and we assume that it is this which is related to the binary period in the way observed. However, it is possible that in some cases, particularly in short period binaries such as the SU UMa stars, the mass transfer rate could vary more slowly than the disk's viscous evolution timescale. The decline in WZ Sge is slower than that in any other dwarf nova, and very much slower than the orbital period—decline rate relation would predict. If the same outburst model is applicable to WZ Sge then the slow decline must indicate a slow decrease in the mass transfer rate from its maximum value. The deep minimum observed around January 2 indicates that the disk can vary much more rapidly, and provides further evidence that the overall decline is much slower than would be determined by disk viscosity.

The light curve of WZ Sge also differs from those of dwarf novae in two other respects. The outburst amplitude of around 8 mag is larger than normal for dwarf novae most of which lie in the range 1–5 mag. The interval between outbursts of 33 yr for WZ Sge is longer than that for most dwarf novae. The longest reliably established mean cycle length in a dwarf nova is 320 days in the case of UV Per (Howarth 1978). However it is probable that longer mean cycle lengths do occur but are difficult to establish reliably, and it is possible that some outbursts of WZ Sge have been missed.

If we are correct in interpreting the outburst as due to instability in the secondary, then the unusual light curve of WZ Sge must be caused by unusual properties of the secondary in this system. Investigations of the binary structure of WZ Sge have suggested that the secondary may be of very low mass, though there has been some controversy over the details of the binary model (Robinson, Nather & Patterson 1978; Ritter 1978; Fabian *et al.* 1978; Smak 1979).

We here draw attention to two variables whose light curves closely resemble that of WZ Sge. They show large amplitude outbursts (~ 8 mag), slowly declining outbursts (~ 0.1 mag/day) and long intervals between outbursts.

UZ Bootis

UZ Boo (= HV 10426) was discovered by Hanley & Shapley (1940) who observed four outbursts on Harvard plates. They classified it as a U Gem star with range 13.2 to fainter than 16.1. A further outburst was discovered in September 1978 by members of the AAVSO (Bortle 1978) and independently by amateur astronomers in Finland (Kellomaki 1979). The star reached a maximum of 11.5 and declined slowly to around 13.8 over 30 days. A reliable finding chart for UZ Boo was published by Walker & Olmstead (1958). The chart published by Brun & Petit (1957) gives an incorrect position for the object. The position of UZ Boo was measured from a photograph taken during the 1978 outburst (Hurst 1978) to be RA $14^{\text{h}} 41^{\text{m}} 45.28^{\text{s}}$, Dec $+22^{\circ} 13' 35.7''$ (1950). At this position on the Palomar Sky Survey prints there is a blue star of about 19 mag, barely visible on the Palomar red print. The shortest observed interval between outbursts is one of 360 days.

WX Ceti

WX Cet (= BV 416) was discovered by Strohmeier (1964a) who observed an outburst of 10.5 mag in 1963 September. The star was originally considered to be a nova. A study of Harvard patrol plates by Gaposchkin (1976) revealed three further outbursts one of them reaching 9.5 mag. The outburst observed by Strohmeier showed a decline of 3 mag over 20 days. On the Palomar Sky Survey the star is blue and of about 18 mag. The shortest observed interval between outbursts is one of 450 days. Finding charts for WX Cet have been published by Strohmeier (1964b) and Wyckoff & Wehinger (1978). The latter gives the position as RA $01^{\text{h}} 14^{\text{m}} 37.6^{\text{s}}$, Dec $-18^{\circ} 12' 10.7''$ (1950).

Discussion

Both objects closely resemble WZ Sge in showing an outburst amplitude of ~ 8 mag and a decline rate from maximum of ~ 0.1 mag/day. The intervals between outbursts are shorter than those observed in WZ Sge but still longer than normal for dwarf novae. The blue colour at quiescence and the high galactic latitudes ($+64$ for UZ Boo, -79 for WX Cet) would seem to rule out the possibility of the objects being recurrent novae similar to T CrB. We therefore propose that UZ Boo, WX Cet and WZ Sge form a distinct subgroup of the dwarf novae, and suggest that they might all show similar binary structure, i.e. that they are short period binaries with low mass secondaries.

Observations of these stars at quiescence would be difficult owing to their faintness. During outbursts, however it should be possible to observe the superhump phenomenon which seems to occur in the long outbursts of all short period dwarf novae, including WZ Sge.

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