The Changing Nature of the Dwarf Nova BV Centauri

Alan Plummer
Linden Observatory, 105 Glossop Rd., Linden, NSW, 2778, Australia

Peter Horn
29 Eunoe St., Katoomba, NSW, 2780, Australia

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Abstract A 54-year light curve of the dwarf nova BV Cen is presented. Interpretation of the curve raises possibilities including a slow decrease in mass transfer with a larger recent drop, evidence for a magnetic cycle, and a strengthened case for an unobserved nova eruption some time in the past.

1. Introduction

BV Centauri is a well observed dwarf nova listed in the *General Catalogue of Variable Stars* (GCVS; Kukarkin *et al.* 1971) as UGSS type, with a quiescent visual range of 12.8–13.3 mag, and an outburst period of 149.4 days (Kukarkin *et al.* 1971). Warner (1995) lists the orbital period as 0.61day and a secondary spectrum of G5-8V. Frank Bateson of the Variable Star Section of the Royal Astronomical Society of New Zealand (VSS RASNZ) put the object on their observing program in 1954, instigating decades of observation. Later, other observations went to the AAVSO. The recent merging of the two databases has made this information very easily accessible. For this work, the *All Sky Automatic Survey* (ASAS; Pojmański 2002) observations of BV Cen have also been added. In total, there is almost perfect coverage from 1954 until recent years, when an annual break occurs. One of us (AP) has observed the object for several years, including the last two outbursts.

2. Observations

The complete observations have been plotted using PERANSO software (Vanmunster 2005), and the resulting light curve is presented in Figure 1. No distinction is necessary between the AAVSO, RASNZ, and ASAS data sets because the visual and electronic observation sets both have excellent coverage, and no magnitude correction is required. Next, the number of days between outburst peaks was measured and plotted in Figure 2. The triangles are the maxima of the major outbursts, and the squares represent peaks that only went to 12.0 magnitude. The determination of the 12th magnitude peaks is rather subjective, as there is no clear distinction between the quiescent noise and (real) flickering, and the smaller maxima. However, note that many of these minor peaks are as clearly defined in the data as the full outbursts.

3. Discussion

Although a real statistical analysis is outside the present scope, there is much to be gleaned from these two figures. Figure 1 shows clearly that the outburst behavior of the object has changed in recent years. Obviously, the GCVS 149.4-day average is no longer safe to apply. In fact, Figure 2 shows that the average time between outbursts has been increasing gradually over time, possibly from the beginning of the data.

Concerning the minor peaks (Figure 2, squares), while there do appear to be some interesting features worthy of attention (e.g., possible clustering and an apparent cessation since December 2001), no further analysis is done here. Only the full outbursts are discussed below.

The major peaks (triangles) in Figure 2 imply much. The increasing period between outbursts is possibly indicative of decreasing mass transfer from the secondary star, resulting in slower build up in the disc before outburst (Warner 2008). Menzies *et al.* (1986) put forward the idea that BV Cen had an unobserved classical nova eruption a century or more ago, and this current behavior is to be expected if that is indeed the case. It is not impossible such an outburst was missed. While there were fine observers in the south during the 19th century, not the least being John Tebbutt (1834–1916) in Australia, the fact remains there were fewer observers than in the northern hemisphere.

Concerning the dramatic recent increase in period between outburst peaks, Warner (2008) suggests that some critical point has been passed in the reduction of mass transfer, or that some as yet unknown characteristic has changed in the disc. Coincident with this major change in behavior, the quiescent magnitude dropped by 0.5 magnitude or so, and has been slowly rising since. In passing we note that the visual comparison sequence has remained unchanged through almost the entire 54-year period, only being revised in 2007–2008 (Morel 2008).

The shape of the outbursts are worthy of note. As noted by Menzies *et al.* (1986), BV Cen has a slow rise to a peak and a slow fall similar to the old classical nova and now dwarf nova GK Per ($p \approx 1000$ days). A more typical dwarf nova eruption has a faster rise, a plateau of some sort, and a faster decline. Compare the light curves of BV Cen and GK Per with the dwarf nova prototypes U Gem and SS Cyg in Figure 3. Although the outburst shape of BV Cen does show variations (Bateson 1974), and sometimes even a brief standstill (as can GK Per), no outburst of BV Cen examined in these data shows a plateau. With the increase in period found here combined with shape of the outbursts, BV Cen now resembles GK Per significantly more than the U Gem or SS Cyg prototypes.

A possible solar-like magnetic cycle might be discernable in Figure 2. The ~8 year oscillations of increasing amplitude visible in the later two thirds of the figure may be interpreted as a magnetic cycle in the G5-8V secondary star.

Such a process, located at the base of the convective layer, could cyclically increase the radius of the secondary, thus similarly increasing the mass transfer through the L1 point (Warner 1995, 2008).

4. Conclusion

The changing nature of the light curve of BV Cen warrants further study, whatever the cause. What is the meaning of the smaller outbursts and their apparent cessation? What is their relationship to the full outbursts? Are the above interpretations of Figure 2 correct? Has there indeed been some critical point reached in the reduction of mass transfer, and why?

The most recent outburst, that of September 2008, was observed by only two people (known so far at least; one of us (AP) and Rod Stubbings of Australia, both visual observers) plus the ASAS. Three observers is an absolute minimum to be sure of catching an outburst. It is hoped that more observers will participate in the long term study of BV Cen.

5. Acknowledgements

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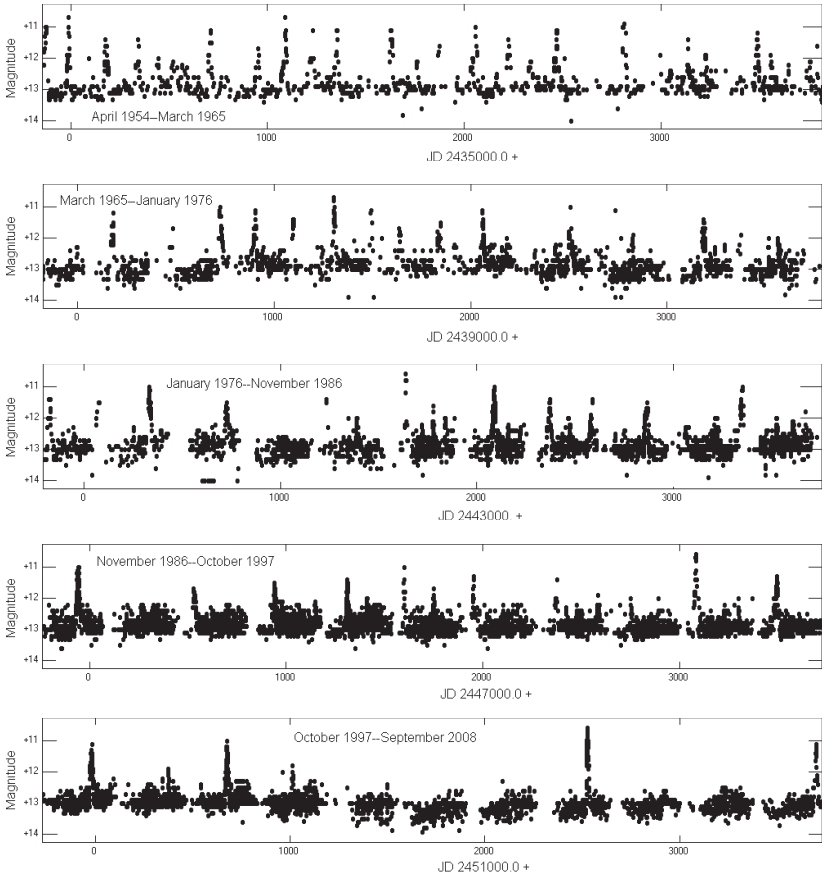

Figure 1. The Light curve of BV Cen using the observations of the RASNZ, AAVSO, and ASAS. No distinction is made between visual and *V* data.

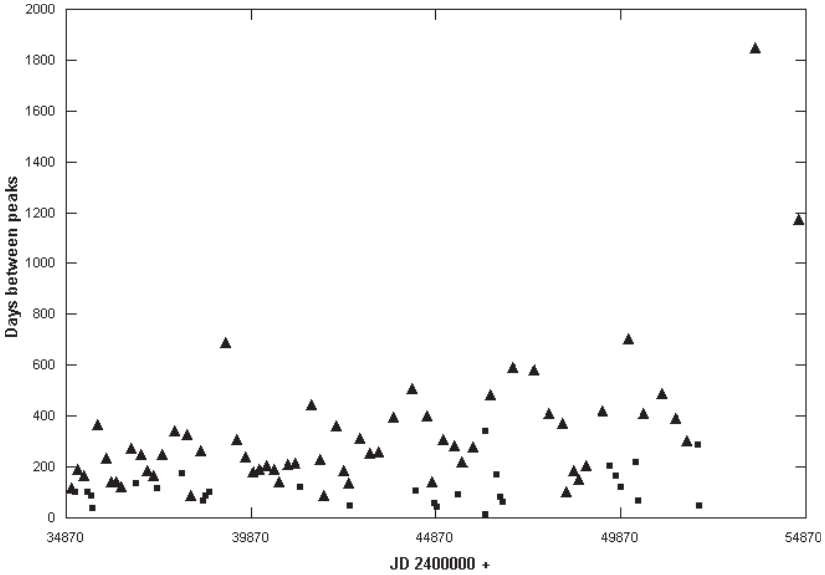

Figure 2. The number of days between outburst peaks of BV Cen. Triangles are normal outbursts; squares are outbursts that go only to 12.0 magnitude.

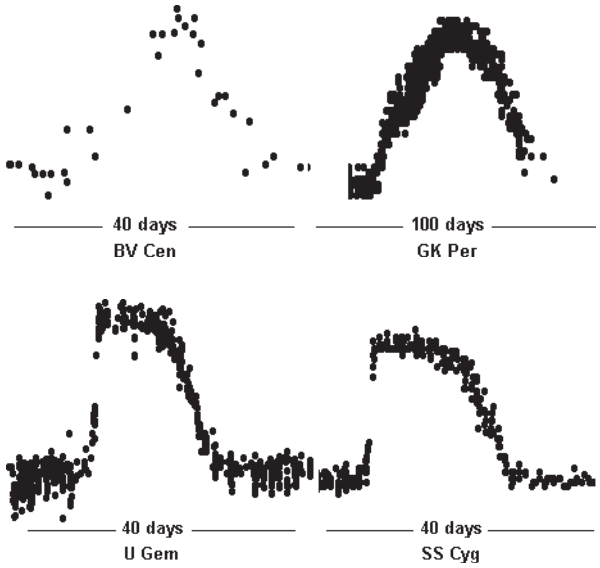

Figure 3. Examples of outbursts from the light curves of BV Cen, GK Per, U Gem, and SS Cyg. The BV Cen excerpt is the last outburst shown in Figure 1, and the GK Per, U Gem, and SS Cyg data are extracted from the AAVSO International Database.