OPEN EUROPEAN JOURNAL ON VARIABLE STARS

June 2008 http://var.astro.cz/oejv ISSN 1801–5964

THE 2008 FEBRUARY SUPEROUTBURST OF V452 CAS

Christopher Lloyd[1], Roger Pickard[2], Jeremy Shears[3], Ian Miller[4],

David Boyd[5] and Steve Brady[6]

1) Open University, Milton Keynes MK7 6AA, UK C.Lloyd@open.ac.uk

2) 3 The Birches, Shobdon, Leominster, Herefordshire, HR6 9NG, UK rdp@astronomy.freeserve.co.uk

3) Pemberton, School Lane, Bunbury, Tarporley, Cheshire, CW6 9NR, UK bunburyobservatory@hotmail.com

4) Furzehill House, Ilston, Swansea, SA2 7LE, UK furzehillobservatory@hotmail.com

5) 5 Silver Lane, West Challow, Wantage, Oxon, OX12 9TX, UK drsboyd@dsl.pipex.com

6) 5 Melba Drive, Hudson, NH 03051, USA sbrady10@verizon.net

Abstract: Observations of the 2008 February outburst of V452 Cas show that the profile, duration and magnitude at maximum were very similar to the previous superoutburst in 2007 September. Low-amplitude variations consistent with previously observed superhumps were also seen.

V452 Cas is a poorly observed UGSU class of dwarf nova with a range of $V \sim 15.3-18.5$ and was thought to have rare outbursts. Shears et al. (2008) have recently reported an observing campaign on this system and have revealed that it is much more active than previously thought, although the faintness of the outbursts means that they can be easily missed. V452 Cas was first identified as a dwarf nova by Richter (1969) and limited observations by Bruch et al. (1987) caught one outburst. Spectroscopic confirmation of the dwarf nova classification was provided by Liu and Hu (2000) when the star was in quiescence at $V = 18.6$. Systematic visual monitoring did not begin until 1993 but most of these early observations had a limiting magnitude brighter than 15.0 so were unlikely to detect an outburst. Nevertheless, the first visual discovery was made later that year.

Shears et al. have searched the data in the AAVSO International Database and identified eight probable outbursts between 1989 and 2005. Most of these are poorly observed, with sometimes just the discovery observation. However, in two outbursts times series observations revealed superhumps. These were first seen during the 1999 November outburst by Vanmunster and Fried (1999) who found the superhump period, $P_{sh} = 0.0891(4)$ d, and then during the 2000 September outburst by the Kyoto group (Kato 2000), although no period was reported. During the 2007 September superoutburst Shears et al. found a progression

Table 1: Equipment used

Observer	Telescope	CCD
Miller	0.35 m SCT	Starlight Xpress SXVF-H16
Pickard	0.30 m SCT	Starlight Xpress SXVF-H9
Shears	0.28 m SCT	Starlight Xpress SXV-M7

June 2008 http://var.astro.cz/oejv ISSN 1801–5964

from early superhumps with $P_{sh} = 0.08943(7)$ d to late superhumps with $P_{sh} = 0.08870(2)$ d, at about 3 or 4 days into the outburst.

During an intensive observing campaign between 2005 and 2008 Shears et al. discovered a further 23 outbursts. Most of these are short with durations of < 4 days and are never brighter than 16.0C while 7 have durations > 8 days and are also brighter than 16.0C. The shorter outbursts are identified as normal outbursts while the longer and brighter ones are superoutbursts. This division is consistent with what is known about the outbursts with superhumps. The 1999 September superoutburst lasted for 12 days and reached 14.7vis. Unfortunately there are insufficient observations of the 2000 September superoutburst to gauge its duration but it did reach 15.1vis. The 2007 September superoutburst was observed extensively by Shears et al. and lasted at least 11 days, but was possibly a little fainter than the others, reaching 15.3C at maximum.

From the timings of the superoutbursts Shears et al. were able to derive a superoutburst period and the ephemeris has been used to help predict when these might be seen. The initial ephemeris suggested that one would occur in the middle of 2008 January (Shears and Lloyd, 2007), but the two outbursts discovered around this time, on 2008 January 4 and February 1 (Miller, 2008), both turned out to be normal outbursts. The superoutburst was finally seen about a month later but was not well observed due to a combination of poor visibility since it was close to solar conjunction, and poor weather. The equipment used is given in Table 1 and the sequence was the same as that used by Shears et al., provided by the AAVSO (Henden and Sumner 2002) and given in Appendix 1. The unfiltered observations were reduced as V and all the data are given in Appendix 2.

Two unfiltered observations on the two nights before the outburst put the system fainter than 17.2C. On 2008 February 28 it was seen in outburst at 16.0C and four days later it was slightly brighter at 15.7C. The following night a single observations gave $V = 15.63$ and on the same night a long time series gave $V \sim 15.7$. The second, shorter time series five days later put the star in decline at $V \sim 16.2$. The profile of the outburst is shown in

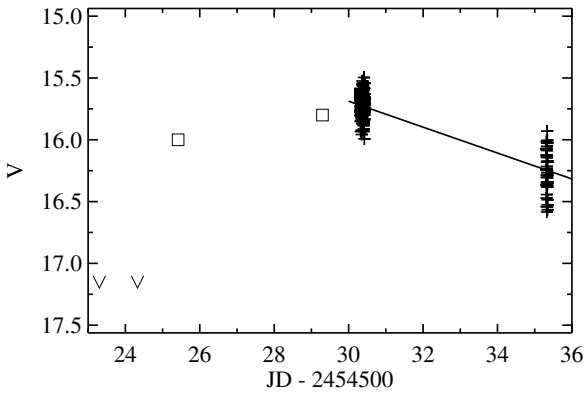

Figure 1: Light curve of the 2008 February superoutburst of V452 Cas showing the two upper limits prior to the outburst and the general profile of the outburst. Single unfiltered observations are shown as open squares and the time series V data as crosses. The other single V measurement is obscured by the first time series.

June 2008 http://var.astro.cz/oejv ISSN 1801–5964

Figure 1 and it closely mirrors the 2007 superoutburst described in detail by Shears et al. From the profile the diagnostic features of the superoutburst are the duration, in this case > 10 days and the magnitude at maximum, which is $V \sim 15.7$. The observations near the middle of the outburst probably correspond to those at the end of the plateau phase in the 2007 superoutburst and the second time series probably occurs two or three days prior to the final fade to quiescence. The decline rate of 0.10 mag/day over the second half of the outburst is very similar to the decline rate of the 2007 superoutburst over the same period. The best alignment of the two outbursts suggests that the 2007 superoutburst was discovered a day after it went into outburst. The onset of the 2008 superoutburst is well defined by the negative observations, but there is a few days uncertainty for the 2007 superoutburst so it is quite possible that it was discovered one day after the outburst began.

The long time series was taken under poor conditions and the errors are larger than expected, so to improve the visibility of any variation a 5-point median filter has been applied and the independent values are shown in Figure 2. There is a suggestion of a cyclical variation and that has been fitted by a second order Fourier series with the late-superhump period from Shears et al. It is clear that the first harmonic is very strong and gives the impression that the period is half the expected value. Shears et al. did not see any variation similar to this but day six of the 2007 superoutburst, probably corresponding to $JD = 2454349$ was not observed. The light curve from two days later does show a likely increase in the first harmonic but not to the extent seen here. The amplitude at this stage of the 2007 superoutburst was 0.2 magnitudes and that is similar to the range seen here.

The outburst characteristics of V452 Cas are now much better understood than previously but it is still an object worthy of continued attention. The normal outbursts are faint and short and can be easily missed but the superoutbursts are seen much more reliably. Shears et al. have identified all the superoutbursts since 2005 so it would be useful to extend this complete record to study their longer term behaviour. The next two superoutbursts are expected in 2008 June/July and November/December when the star is well placed for northern hemisphere observers.

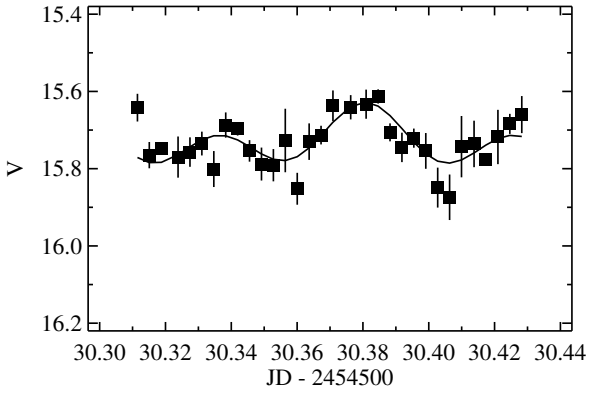

Figure 2: Light curve of the long run showing the independent 5-point median filtered data with the Fourier fit fixed at the late-superhump period, $P_{sh} = 0.08870$ d.

Acknowledgements

This research has made use of the VizieR catalogue access tool and the SIMBAD database, operated at CDS, Strasbourg, France, and NASA's Astrophysics Data System.

References

Bruch A., Fischer F.J., Wilmsen U., 1987, Astron. Astrophys. Suppl. Ser., **70**, 481-516 1987A&AS...70..481B

Henden A., Sumner B., 2002, AAVSO finding chart 020301 and sequence F or FR chart http://www.aavso.org/observing/charts/

Kato T., 2000, vsnet-campaign 510 [1] http://www.kusastro.kyoto-u.ac.jp/vsnet/Mail/vsnet-campaign/msg00510.html

Liu W., Hu J.Y., 2000, Astrophys. J. Suppl. Ser., **128**, 387-401 2000ApJS..128..387L

Miller I., 2008, baavss-alert 1509 and 1555 http://tech.groups.yahoo.com/group/baavss-alert/message/1509 http://tech.groups.yahoo.com/group/baavss-alert/message/1555

Richter G.A., 1969, Mitt. Veränderliche Sterne, **5**, 69-72 1969MitVS...5...69R http://www.stw.tu-ilmenau.de/observatory/observatory_3_1.html [2]

Shears J., Lloyd C., 2007, baavss-alert 1494 http://tech.groups.yahoo.com/group/baavss-alert/message/1494

Shears J., Lloyd C., Boyd D., Brady S., Miller I., Pickard R., 2008, J. Brit. Astron. Assoc., in press, http://adsabs.harvard.edu/abs/2008arXiv0805.1591S

Vanmunster T., Fried R., 1999, vsnet-alert 3707 (see Appendix 3)

[1] The link to vsnet-campaign frequently times out but is generally available, in contrast to vsnet-alert messages which are not available

[2] The link to MVS documents has changed recently from http://www.stw.tu-ilmenau.de/science/pub/MVS/texts/MVS... and the link to the on-line document from the ADS does not currently work