HS2325+8205 – a frequently outbursting dwarf nova

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We monitored the recently discovered dwarf nova HS2325+8205 intensively for two years from mid-2007 and detected 44 outbursts. The outbursts were of two types: 33 were short outbursts lasting less than 7 days and no brighter than magnitude 14.0, and 11 were long outbursts lasting more than 9 days, reaching magnitude 13.9 or brighter. The outburst recurrence period is 8 to 14 days. The star appears to spend very little time at quiescence and we found no evidence of Z Cam-like standstills in the light curve.

Introduction

HS2325+8205 was discovered in a search for cataclysmic variable stars in the Hamburg Quasar Survey.[1,2,3] Its properties were determined by Pyrzas *et al.*[4] who found that it is an eclipsing dwarf nova with P_{orb} = 4.66h, placing it above the period gap in the orbital period distribution of dwarf novae. They observed four outbursts in a 50-day interval and inferred an outburst period of ~12 to 14 days. Out of eclipse, the brightness varies between magnitude ~17.3 and ~13.7 (unfiltered CCD). Eclipses are about 0.8 magnitudes deep.

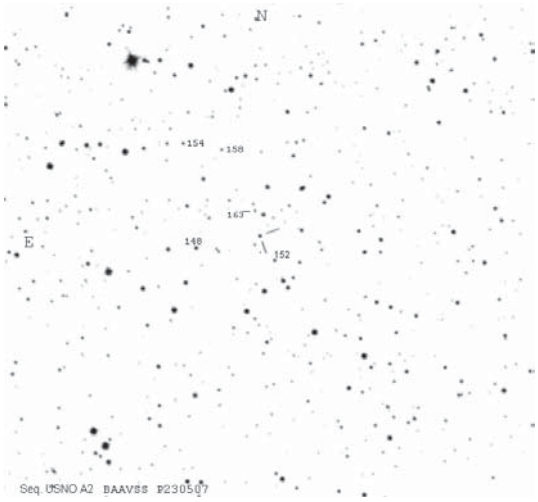

Figure 1. Chart for HS2325+8205 *(BAAVSS P230506)*.

In this paper we report further observations of HS2325+8205 obtained during a 2-year campaign to investigate the duration and frequency of the outbursts. The dwarf nova is located in Cepheus at RA 23h 26m 50.4s, Dec. +82° 22' 12" (J2000).[4]

Observations of HS2325+8205

The authors conducted an observing campaign on HS2325+8205 between 2007

June 2 and 2009 June 4. Gary Poyner observed visually, whilst the other observers used unfiltered CCDs. All observers used the BAA chart and sequence, P230506, based on USNO A2.0 photometry (Figure 1). Since the aim was to identify outbursts rather than obtain precise photometry, we combined all data into a single dataset for analysis. The average spacing of the data in each season was 2.6 days. The lightcurve in Figure 2 shows that the star varied between magnitude 17.3 and 13.6. Note that the lines joining the data points in Figure 2 are purely to guide the eye, rather than to indicate a continuity of observational coverage between each point.

Analysis of outburst duration and frequency

The brightness of many dwarf novae varies at minimum. Thus we assumed that any observation where HS2325+8205 was equal to or brighter than magnitude 15.8, about 1.5 magnitudes above typical quiescence, meant that the star was in outburst. We observed 44 separate outbursts during the observing campaign and the details of these are given in Table 1. We have given a range for each outburst duration: the smaller number is the interval between the first positive outburst observation and the last (*i.e.* the minimum duration), whereas the larger number is the time between the observation immediately preceding the detection of the outburst and the observation immediately after the outburst (*i.e.* the maximum duration).

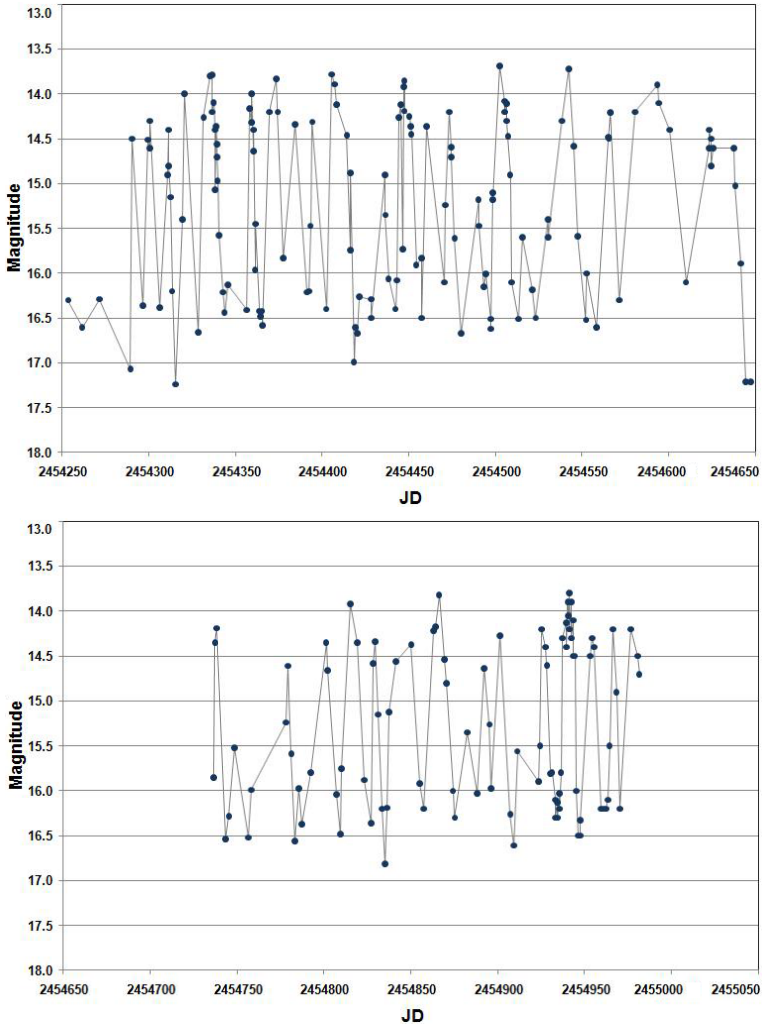

Figure 2. Lightcurve of HS2325+8205. *Top:* Data from 2007 June to 2008 June. *Bottom:* Data from 2008 June to 2009 June. Note: lines joining data points are merely to guide the eye.

It is evident from the outburst durations and brightnesses listed that there are two categories of outburst exhibited by HS2325+8205. 33 of the outbursts appeared to be short, typically lasting less than 7 days and no brighter than magnitude 14.0. By contrast, 11 of the outbursts were longer, lasting more than 9 days, and brighter, reaching magnitude 13.9 or brighter. The ratio of short outbursts to long outbursts is 3, but we note that long outbursts did not occur every third outburst. Instead there are 1 to 5 short outbursts between long outbursts.

The intervals, ΔT, between consecutive outbursts are given in Table 1 and the distribution is plotted as a histogram in Figure 3. Gaps in the data will inevitably mean that some outbursts will have been missed (we certainly missed one or more outbursts between 2008 Jul 03 and Sep 26, so no value of ΔT is given for this interval). Nevertheless, the generally good observational coverage should give a reasonable indication of the likely outburst timescale. The median interval between outbursts is 12.6 days and the mean is 14.3 days (standard deviation= 6.2 days). The histogram shows that the shortest interval between outbursts is 8 days with the mode at 9 days. There are also concentrations at 12, 15 and 18 days. The longer periods probably represent combinations of multiple outburst cycles.

Discussion

Our observations confirm those of Pyrzas *et al.*[4] that HS2325+8205 undergoes two types of outburst: 'long' and 'short'. Such behaviour has been noted in many dwarf novae.[5] Moreover we observed that the long outbursts were generally brighter, which is also apparent in the data presented by Pyrzas *et al.*[4]

Our observations of HS2325+8205 also show that it is a particularly active dwarf nova given its frequent outbursts and short recurrence period of 8 to 14 days. Moreover it appears to spend very little time at quiescence (Figure 2). The outburst period is consistent with the majority of dwarf novae having P_{orb} between 4h and 5h, where the outburst period is 7 to 32 days.[4] Nevertheless HS2325+8205 is at the lower end of the range. In terms of its outburst behaviour we note some similarities with the dwarf nova CG Dra which also spends little time at quiescence and outbursts every ~11 days.[6] We further note the similar orbital periods of CG Dra (4.52h)[7] and HS2325+8205 (4.66h).[4] The physical properties of CG Dra's component binary stars, such as the mass of the primary and secondary, have yet to be determined, but when they are it will be interesting to see how similar they are to those of HS2325+8205.

Pyrzas *et al.*[4] speculated that HS2325+8205 may be a member of the Z Cam family of dwarf novae, based on its short outburst period. One of the characteristics of the Z Cam family is that they exhibit 'standstills' in the lightcurve during which the star remains at a brightness intermediate between outburst and quiescence for long periods. To test their Z Cam hypothesis, they encouraged observers to monitor the star frequently. Given the two years of observations we accumulated, we therefore examined our data (Figure 2) for such standstills, but could find no evidence for any. Whilst this does not rule out a Z Cam classification (two years is probably insufficient coverage), we consider it unlikely and suggest that the system is probably a member of the SS Cyg family. We certainly encourage further monitoring of this fascinating star.

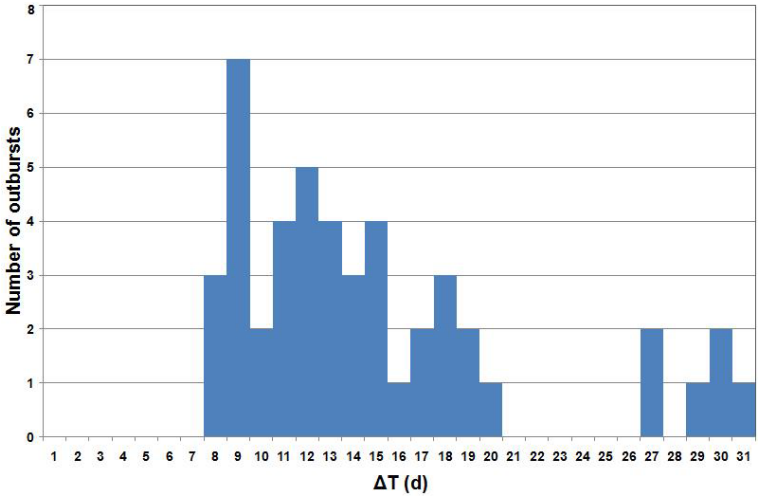

Figure 3. Histogram of the outburst intervals in one-day bins

Table 1. Outbursts of HS2325+8205 between 2007 June and 2009 June

Detection date	*JD*	*ΔT (d)*	*Max. mag*	*Outburst length (d)*	*Outburst type*
2007 Jul 09	2454290.5		14.5	1 to 6	s
2007 Jul 17	2454299.5	9.0	14.3	1 to 6	s
2007 Jul 29	2454310.7	11.2	14.4	1 to 6	s
2007 Aug 06	2454319.5	8.8	14.0	2 to 9	s
2007 Aug 19	2454331.7	12.2	13.8	9 to 14	l
2007 Sep 14	2454358.4	26.7	14.2	3 to 6	s
2007 Sep 25	2454369.4	11.1	13.8	8 to 12	l
2007 Oct 10	2454384.3	14.9	14.3	1 to 6	s
2007 Oct 19	2454393.3	9.0	14.3	2 to 10	s
2007 Oct 31	2454405.4	12.1	13.8	11 to 15	l
2007 Dec 01	2454436.5	31.0	14.9	1 to 8	s
2007 Dec 09	2454444.4	8.0	13.9	9 to 11	l
2007 Dec 25	2454460.5	16.0	14.4	1 to 10	s
2008 Jan 05	2454471.3	10.8	14.2	5 to 6	s
2008 Jan 24	2454490.3	19.0	15.2	1 to 6	s
2008 Feb 01	2454498.4	8.1	13.7	10 to 12	l
2008 Feb 18	2454515.4	17.0	15.6	1 to 8	s
2008 Mar 04	2454530.5	15.0	15.4	1 to 8	s
2008 Mar 12	2454538.5	8.0	13.7	9 to 15	l
2008 Apr 08	2454565.3	26.9	14.2	2 to 6	s
2008 Apr 23	2454580.5	15.1	14.2	1 to 12	s
2008 May 06	2454593.5	13.0	13.9	9 to 16	l
2008 Jun 05	2454623.5	30.0	14.4	2 to 15	s
2008 Jun 19	2454637.5	14.0	14.6	5 to 19	s
2008 Jul 03	2454651.5	14.0	13.6	10 to 30	l
2008 Sep 26	2454736.3	ND	14.2	2 to 7	s
2008 Oct 08	2454748.3	12.0	15.5	1 to 9	s
2008 Nov 07	2454778.3	30.0	14.6	3 to 6	s
2008 Nov 21	2454792.4	14.1	15.8	1 to 8	s
2008 Nov 30	2454801.3	9.0	14.4	2 to 5	s
2008 Dec 09	2454810.3	9.0	13.9	13 to 17	l
2008 Dec 27	2454828.4	18.2	14.3	3 to 5	s
2009 Jan 05	2454837.3	8.9	14.6	4 to 8	s
2009 Jan 18	2454850.3	13.0	14.4	5 to 7	s
2009 Jan 31	2454863.3	13.0	13.8	11 to 14	l
2009 Feb 19	2454882.4	19.0	15.4	1 to 12	s
2009 Mar 01	2454892.3	9.9	14.6	4 to 12	s
2009 Mar 10	2454901.3	9.0	14.3	1 to 10	s
2009 Mar 20	2454911.3	10.0	15.6	1 to 6	s
2009 Apr 01	2454923.4	12.1	14.2	7 to 8	s
2009 Apr 14	2454936.4	13.0	13.8	11 to 13	l
2009 May 01	2454953.4	17.0	14.3	2 to 6	s
2009 May 12	2454964.4	11.0	14.2	4 to 17	s
2009 May 24	2454976.5	12.1	14.2	5 to 6	s

ND: not determined, due to the low frequency of observations during the period 2008 Jul to Sep as described in the text. l = 'long' outburst, s = 'short' outburst

Acknowledgments

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