COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4955

Konkoly Observatory
Budapest
13 September 2000

HU ISSN 0374 – 0676

1432–0033: A NEW ECLIPSING SU UMa-TYPE DWARF NOVA

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The object LBQS 1432–0033 was detected as a cataclysmic variable (CV) of unknown type by C. Berg during the course of his QSO (Quasi Stellar Objects) spectroscopic survey (Berg et al. 1992). He reported 1432–0033 at a quiescent magnitude of $B = 18^{\rm m}_{.}5$, and showing typical emission lines. He also was the first to point out the resemblance to the dwarf novae HT Cas and U Gem. The J2000.0 coordinates for 1432–0033 are $\alpha = 14^{\rm h}35^{\rm m}00^{\rm s}_{.}14$, $\delta = -00^\circ 46' 07''_{.}0$ (Downes et al. 1997), while astrometry by Henden (2000) yields a position of $\alpha = 14^{\rm h}35^{\rm m}00^{\rm s}_{.}24$, $\delta = -00^\circ 46' 05''_{.}8$ (J2000.0).

Here we report differential time-series photometry of 1432–0033 during the June 2000 outburst, by two observatories from the Center for Backyard Astrophysics. We detected superhumps with a period of $0^{\rm d}_{.}078 \pm 0^{\rm d}_{.}002$ and also found eclipses in 1432–0033, yielding an orbital period of $0^{\rm d}_{.}07273 \pm 0^{\rm d}_{.}00001$. Our observations firmly establish 1432–0033 as a genuine eclipsing SU UMa-type dwarf nova.

The first detected outburst of 1432-033 was observed visually by Stubbings (1999a) on 1999, May 10.446 UT with a reported magnitude of $m_v = 15.0$. The outburst, presumably a superoutburst, lasted at least 10 days (Stubbings 1999b). A next outburst was reported by Schmeer (2000), who found the object around $14^{\rm m}_{.}5$ on unfiltered CCD images taken with the Iowa Robotic Observatory (IRO 2000) telescope on 2000, April 06.378 UT. While 1432–0033 was still faint on an image taken on April 04.378 UT, it was clearly rising on April 05.376 UT. This outburst was probably a normal, faint outburst, as indicated by visual observations (Pearce 2000). 1432–0033 was again reported in outburst at a visual magnitude of $m_v = 14.9$, on 2000, June 24.419 UT (Stubbings 2000). For the first time, this outburst was monitored intensively by CCD photometry, the results of which are discussed below.

The shortest likely interval between outbursts of 1432–0033 is about 79 days. The maximum superoutburst cycle, derived from the above observations, is about 411 days, although there is a high likelihood that the true supercycle value will be smaller. More intensive monitoring of 1432–0033 will be required to further refine this value. The outburst amplitude is about 4 magnitudes.

Upon notification of the outburst of 1432–0033, a small observing campaign was launched by the Center for Backyard Astrophysics (CBA). The CBA is a multi-longitude network of professional and amateur astronomers (Patterson 1998), who study periodic

Table 1: Log of photometry

UT Date	JD Start[1]	Length (hr)	Telescope[2]	Points
26 June 2000	1722.4075	2.33	1	74
28 June 2000	1724.4007	2.09	1	47
29 June 2000	1724.9994	0.95	2	111
30 June 2000	1725.7665	5.89	2	612

[1] 2,450,000 +
[2] (1) = CBA Belgium, 0.35-m; (2) = CBA Pakuranga, 0.25-m

phenomena in cataclysmic variables. Target campaigns and results of the CBA are regularly reviewed on the CBA Web site (http://www.astro.bio2.edu/cba). The CBA campaign on 1432–0033 accumulated 11.3 hours of coverage over 4 nights and 844 datapoints. Details are listed in Table 1.

Time-resolved and differential (variable − comparison) CCD photometry of 1432–0033 was started at CBA Belgium on June 26, 2000, using a 0.35-m $f/6.3$ Schmidt–Cassegrain telescope, mounted on an AstroTechniek FM-98 German equatorial mount, and equipped with an SBIG ST-7 CCD camera (Kodak KAF-0400 CCD for imaging and Texas Instruments TC211 CCD for guiding). For a complete description of the CBA Belgium Observatory equipment and software, see Vanmunster et al. (2000). We used GSC 4984 691 ($12^{\mathrm{m}}_{.}7$) as the comparison star, whose constancy was confirmed by other check stars. Camera control, telescope guiding and photometric imaging were all done using *MaxIm DL/CCD* (Cyanogen Productions Inc.). Images were stored as FITS files and were corrected for standard debiasing and flat fielding. Data reduction was completed using the profile fitting algorithm (PSF) of *MIPS* (Buil et al. 1993), immediately following image acquisition, allowing incoming observations of 1432–0033 to be monitored in a quasi-real-time mode. This approach revealed the real-time development of superhumps in the system and allowed the immediate classification of the object as a new SU UMa-type cataclysmic variable (Vanmunster 2000).

Further observations at CBA Belgium and CBA Pakuranga were obtained over the next nights (Table 1), allowing a more detailed analysis of the superhump period. After removing linear trends in the light curve, we performed a period analysis using the Phase Dispersion Minimization PDM method (Stellingwerf 1978). The resulting theta diagram is shown in Figure 1. The best superhump period is $0^{\mathrm{d}}_{.}078 \pm 0^{\mathrm{d}}_{.}002$. Given the rather limited amount of observations and the baseline of 5 nights only, we could not derive a more accurate superhump period value. The superhump full amplitude was about $0^{\mathrm{m}}_{.}2$.

Next to the detection of superhumps, we also found eclipses in 1432–0033, as shown in Figure 2, that depicts CBA Pakuranga observations between JD 2451725.77 and JD 2451726.01. Observations at this observatory were made with a 0.25-m $f/10$ Schmidt–Cassegrain telescope and SBIG ST-6 CCD camera. There are only a very limited number of SU UMa-type cataclysmic variables exhibiting eclipses. Yet, they provide the unique opportunity to reconstruct the brightness distribution of the accretion disk from the observed light curve, and to study the evolution of the accretion disk structure over time. Eclipses in 1432–0033 had a more or less symmetric profile and an average duration of 23 minutes. The eclipses showed an average depth of 0.6–0.7 magnitudes.

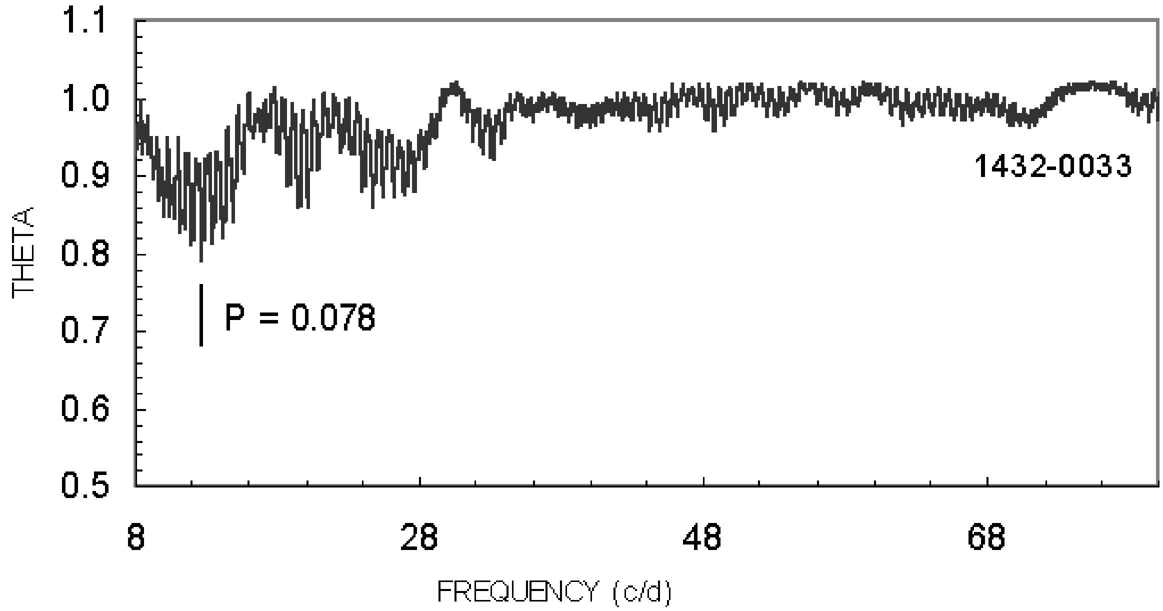

Figure 1. Period analysis of 1432–0033.

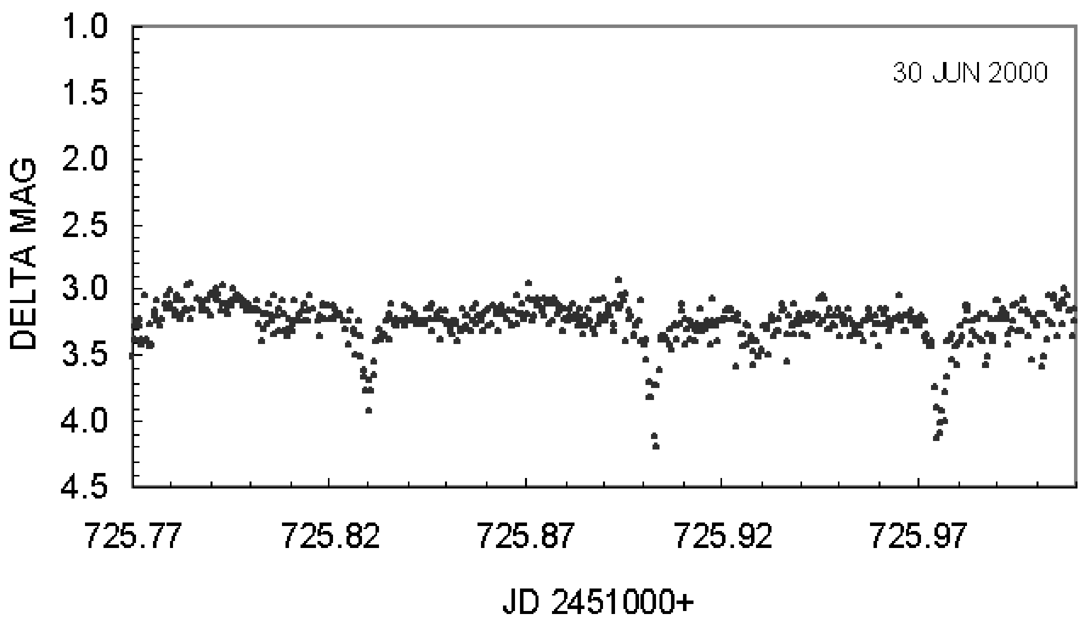

Figure 2. Eclipses in the light curve of 1432–0033.

Over the course of the outburst, we were able to make 6 useful mid-eclipse timings of 1432–0033. From these, we derived an orbital period of $0\overset{\mathrm{d}}{.}07273 \pm 0\overset{\mathrm{d}}{.}00001$. We also derived a heliocentric mid-eclipse ephemeris :

$$\begin{aligned} T = \mathrm{JD}\ 2451725.03349 &+ 0\overset{\mathrm{d}}{.}072727 \times E \\ \pm 0.00053 &\pm 0.000013 \end{aligned}$$

where E is the cycle number.

The superhump excess value $\varepsilon = (P_{\mathrm{sh}} - P_{\mathrm{orb}})/P_{\mathrm{orb}}$, where P_{sh} and P_{orb} denote the superhump and orbital period, respectively, is 7.8 percent. Knowing that typical ε values are around 2 to 3 percent, the high ε value for 1432–0033 is likely to be explained by the uncertainty of the P_{sh} value.

A next superoutburst of 1432–0033, hopefully during a better visibility season, will probably allow a more accurate determination of the superhump period (and hence the ε), and in addition, provides a great opportunity to study the eclipses and accretion disk structure in full detail.

Acknowledgements. We are grateful to the Center for Backyard Astrophysics for their continuous support in our stellar CCD photometry research work.

References:

Berg, C., et al., 1992, *Astrophys. J. Sup.*, **78**, 409
Buil, C., Klotz, A. et al., 1993, *Manual for the Microcomputer Image Processing System*, V2.0
Downes, R., Webbink, R., Shara, M., 1997, *PASP*, **109**, 345
IRO, 2000, `http://denali.physics.uiowa.edu/IRO/index.shtml`
Henden, A., 2000, *vsnet-alert*, No. 5030
Patterson, J., 1998, *Sky and Telescope*, October 1998, 77
Pearce, A., 2000, *vsnet-alert*, No. 5034
Schmeer, P., 2000, *vsnet-alert*, No. 4571
Stellingwerf R.F. 1978, *ApJ*, **224**, 953
Stubbings, R., 1999a, *vsnet-alert*, No. 2965
Stubbings, R., 1999b, *vsnet-obs*, No. 20713
Stubbings, R., 2000, *vsnet-alert*, No. 5030
Vanmunster, T., 2000, *vsnet-alert*, No. 5037
Vanmunster, T., Skillman, D.R., Fried, R.E., Kemp, J. Novak, R., 2000, *IBVS*, No. 4940