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

Number 5526

Konkoly Observatory
Budapest
10 May 2004

HU ISSN 0374 – 0676

FLICKERING AND PERIODIC ACTIVITY IN THE 2004 OUTBURST OF BZ UMa

PRICE, A.[1]; VANMUNSTER, T.[2]; STARKEY, D. [1]; BOYD, D.[3]; ZISSELL, R.[4]; GARY, B.[5]; GRAHAM, K.[6]; MACDONALD II, W. [1]; AQUINO, B. [1];WEST, D. [7]; BLACKWELL, J. [1]; WALKER, G. [1]; SIMONSEN, M. [8]; HENDEN, A.[9]; TEMPLETON, M. R.[1]; MATTEI, J.A.[1];

[1] American Association of Variable Star Observers (AAVSO),
Clinton B. Ford Astronomical Data & Research Center
25 Birch St., Cambridge, MA 02138, USA; email: aavso@aavso.org

[2] Center for Backyard Astrophysics - Belgium
Walhostraat 1A, B-3401 Landen, Belgium
e-mail : Tonny.Vanmunster@cbabelgium.com

[3] 5 Silver Lane, West Challow Oxon OX12 9TX UK
Email: drsboyd@compuserve.com

[4] Williston Observatory, Mount Holyoke College, South Hadley, MA 0175, USA;
e-mail: rzissell@mhc.mtholyoke.edu

[5] 5320 E. Calle Manzana, Hereford, AZ 85615

[6] 23746 Schoolhouse Road
Manhattan, IL 60442

[7] West Skies Observatory
P.O. Box 517, Derby, KS 67037, USA
e-mail: dwest61506@aol.com

[8] C. E. Scovil Observatory, 2615 S.
Summers Rd., Imlay City, MI, USA

[9] Universities Space Research Association/U. S. Naval Observatory, Flagstaff, AZ 86001 USA;
email: aah@nofs.navy.mil

BZ UMa, α=$08^{\rm h}53^{\rm m}44\overset{\rm s}{.}14$ δ=$+57^\circ48'41\overset{''}{.}1$ (J2000) (Downes et al., 2001), is a UG system (Kholopov et al., 1985) that has defied subclassification. Its orbital period, 0.0679 days, (Ringwald et al., 1994) and mass ratio, 0.20, (Jurcevic et al., 1994) suggests subclassification as a UGSU. Detection of superhumps in an outburst would be expected as well, but to date they have not been seen. It has also been suggested in literature that BZ UMa is a TOAD (Howell et al., 1995) and/or an intermediate polar (Kato, 1999).

BZ UMa was detected in outburst visually by Mike Simonsen on Feb 25.3, 2004. The AAVSO immediately began an intensive CCD campaign to observe BZ UMa (Price et al., 2004). Eleven AAVSO observers made 4,270 CCD observations over the course of four nights. Reduced data were reported to 0.01 magnitudes. The observations were combined into four datasets representing each night of observations and analyzed separately. A 2nd order polynomial fit was applied independently to the first, second and fourth night of observations before their data were combined in order to remove the long term fading trend and to remove zero-point differences from filtered and unfiltered observations.

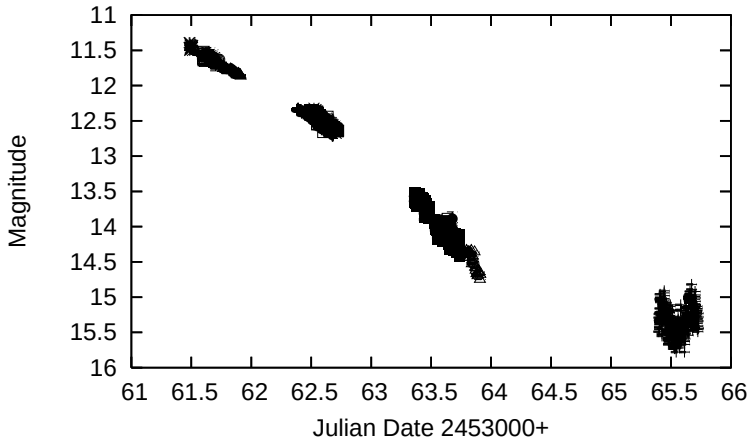

Figure 1. AAVSO BZ UMa 2004 Outburst CCD Light Curve

On the third night a 3rd degree fit was needed due to the rapid decline of BZ UMa at the time. All calibrated photometry was done by the individual observer and includes flat and dark frame application. Uncertainty was reported for each observation and is available with the entire data set upon request made to the AAVSO (`aavso@aavso.org`).

Johnson B and V field calibration was performed on multiple nights using the USNO-FS 1.0m telescope along with a large set of Landolt standards of wide color and airmass. A complete table of field stars, including complete BV data, is given in `5526-t1.txt`. The comparison chart used by the observers is given in Figure 1.

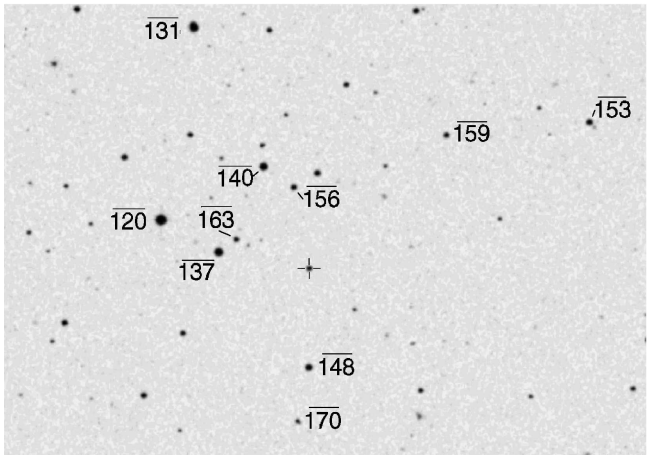

Figure 2. Comparison star chart ($8' \times 6'$, N is down, E is right) - BV data and errors are given in `5526-t1.txt`

Fourier and wavelet analysis (Foster, 1996) do not reveal the detection of superhumps or any coherent periodic activity until the fourth night when the orbital period appears. Fourier analysis with the CLEAN algorithm (Foster, 1995) results in a period of 0.068 $\pm$ 0.002 days in that fourth night of data. The power spectrum of the Fourier analysis reveals red noise (Fig. 3) which is associated with rapid flickering (Hellier, 2001) which is also seen in the light curve (Fig. 4). However, a hint of periodic activity is detected

in the power spectrum for the third night (Fig. 5). A period of 0.030 ± 0.0004 days was determined during this episode which is similar to that reported in the 1999 outburst (Kato, 1999).

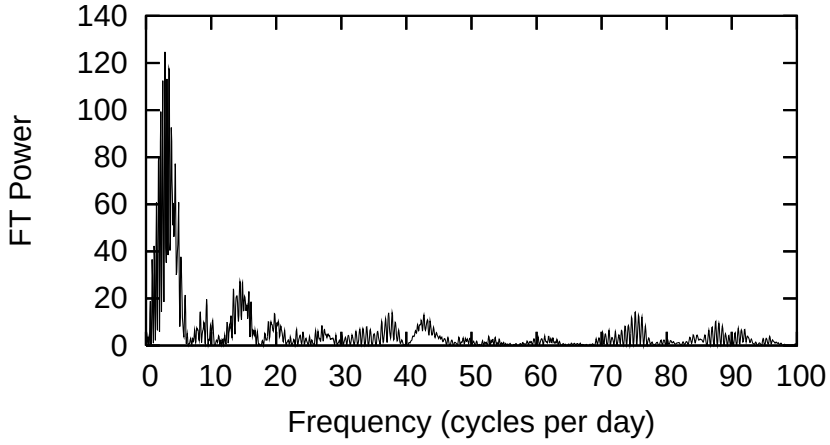

Figure 3. Evidence of low frequency flickering in power spectrum red noise from the first night (Feb. 25 - Feb. 26).

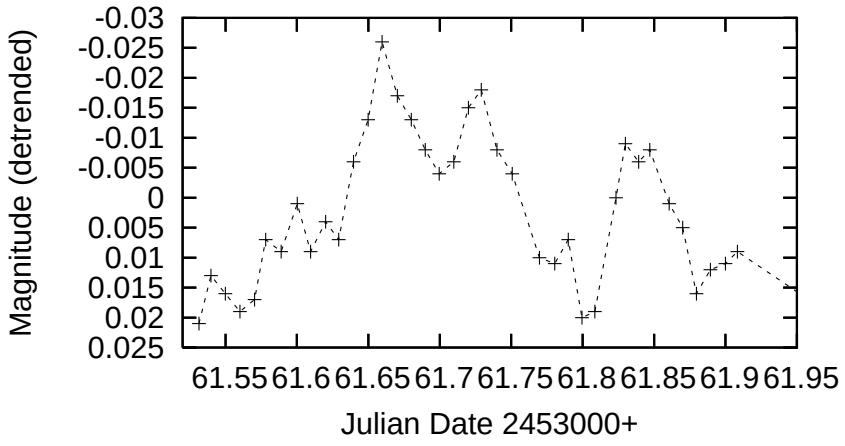

Figure 4. Evidence of flickering in light curve from the first night (Feb. 25 - Feb. 26). Data has been averaged into 0.01 day bins.

The AAVSO International Database has 10,820 observations of BZ UMa by 159 observers dating back to November 21, 1968. Analysis reveals 20 outbursts where BZ UMa was brighter than 14.5 visual magnitude and observed by more than one observer. A long period of inactivity occurred between 1976 and 1992 where only 1 outburst was detected and confirmed despite consistent monitoring. An average cycle of 312.6 days between outbursts was computed while omitting that gap. That would predict the next future outburst around January 3, 2005 ± 108.3 days using the standard deviation as error. High precision observations with good temporal resolution could help detect further periodicities and determine the nature of this enigmatic system.

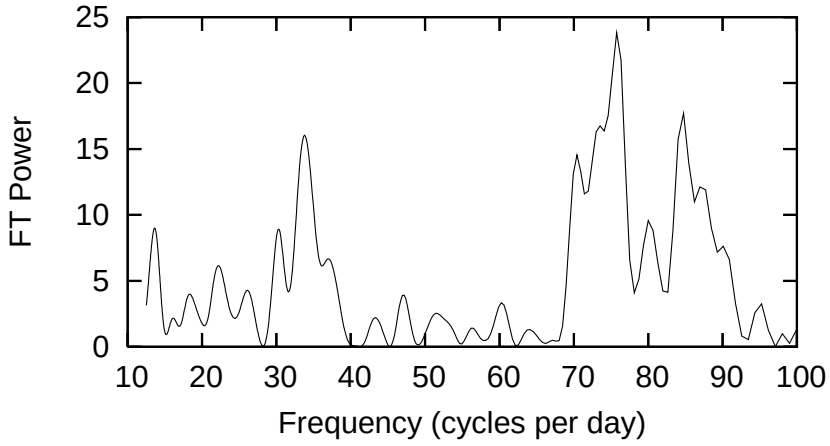

Figure 5. Periodicity around 33 cycles per day in power spectrum for the third night (Feb. 28 - Feb. 29).

Acknowledgements: We acknowledge the use of SIMBAD operated through the *Centre de Données Astronomiques* (Strasbourg). We also thank Grant Foster for statistical advice.

References:

Downes, R. et al., 2001, Publ. Astron. Soc. Pac., **113**, 764. *A Catalog and Atlas of Cataclysmic Variables: The Living Editions*

Foster, G., 1995, *Astron. J.*, **109**, 1889.

Foster, G., 1996, *Astron. J.*, **112**, 1709.

Hellier, C., 2001, *Cataclysmic Variable Stars - How and Why They Vary.* (New York: Springer). p.151.

Howell, S. et al., 1995, *ApJ.*, **439**, 337.

Jurcevic, J. S., Honeycutt, R. K., Schlegel, E. M., Webbink, R. F., 1994, *PASP*, **106**, 481

Kato, T., 1999, *IBVS*, No. 4768.

Kholopov, P. N., et al., 1985, General Catalog of Variable Stars, 4th edition, Moscow

Price, A., and Waagen E., and Mattei, J., 2004, *AAVSO News Flash Special Notice No. 15*, `http://www.aavso.org/publications/newsflash/sp15.shtml`

Ringwald, F. A., Thorstensen, J. R., Hamway, R. M., 1994, *MNRAS*, **271**, 323