

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

Number 5319

Konkoly Observatory  
Budapest

4 October 2002

HU ISSN 0374 – 0676

**V432 Aur: A NEW ECLIPSING SYSTEM**

DALLAPORTA, SERGIO<sup>1</sup>; TOMOV, TOMA<sup>2,3</sup>; ZWITTER, TOMAŽ<sup>4</sup>; MUNARI, ULISSE<sup>3,5</sup>

<sup>1</sup> Via Filzi 9, I-38034 Cembra (TN), Italy

<sup>2</sup> Centre for Astronomy, N.Copernicus University, ul. Gagarina 11, 87100 Torun, Poland

<sup>3</sup> CISAS - Center of Space Studies and Activities “G. Colombo”, Univ. of Padova, Italy

<sup>4</sup> University of Ljubljana, Department of Physics, Jadranska 19, 1000 Ljubljana, Slovenia

<sup>5</sup> Osservatorio Astronomico di Padova - INAF, Sede di Asiago, I-36032 Asiago (VI), Italy

V432 Aur (= HD 37071 = BD +36°1204, spectral type G0) has been discovered as a variable star by the Hipparcos satellite (HIC 26434,  $V_T=8^m07$ ,  $B_T=8^m58$ ,  $H_P=8^m14$ ) which did not however recognized its type of variability. V432 Aur was therefore logged as an “unsolved” variable in the *Hipparcos Catalogue* (ESA 1997), with an amplitude of  $H_P=0.47$  mag. V432 Aur is located (J2000.0) at  $\alpha=05^h37^m32^s44$  and  $\delta=+37^\circ05'12''.4$ , corresponding to galactic coordinates  $l=172^\circ18$  and  $b=+02^\circ87$ . The parallax measured by Hipparcos is  $\pi = 8.43 \pm 1.58$  mas, corresponding to a distance of 118 pc.

The inability of Hipparcos to recognize the type of variability for V432 Aur probably derives from the low number of observations it was able to secured: 53 in the  $H_P$  band and 62 in both  $V_T$  and  $B_T$  bands. An amplitude of  $\sim 0.4/0.5$  mag and a spectral type G0 suggested us that V432 Aur could be an eclipsing system, and we therefore decided to place it on the Asiago eclipsing binary program (e.g. Dallaporta et al. 2000, 2002, Munari et al. 2001). At the time of writing, acquisition of radial velocities with the Asiago Echelle+CCD spectrograph is progressing, while  $B, V$  photometry is completed. We present here only the basic photometric results, a full orbital solution including radial velocity data being postponed to the conclusion of the spectroscopic campaign.

We observed in  $B$  and  $V$  (standard Johnson filters) from a private observatory near Cembra (Trento), Italy. The instrument was a 28 cm Schmidt-Cassegrain telescope equipped with an Optec SSP5 photometer. The diaphragm had a size of 77 arcsec, and the exposure time was usually 10 seconds. HD 36974 (HIP 26385,  $V_T=8^m249\pm0.016$ ,  $B_T=9.052\pm0.021$ , spectrum G5) was chosen as comparison star and HD 36930 (TYC 2416 970 1,  $V_T=8^m352\pm0.015$ ,  $B_T=8^m835\pm0.020$ , spectrum F8) as a check star. The comparison has been measured against the check star at least once every observing run. In all, 202 measures of the magnitude difference comparison-check have been collected, providing a constant magnitude difference with a standard deviation of 0.006 mag. Our results therefore confirm and improve Hipparcos/Tycho findings that both the comparison and the check stars are not variable, and therefore well suitable to serve in the photometry of V432 Aur.

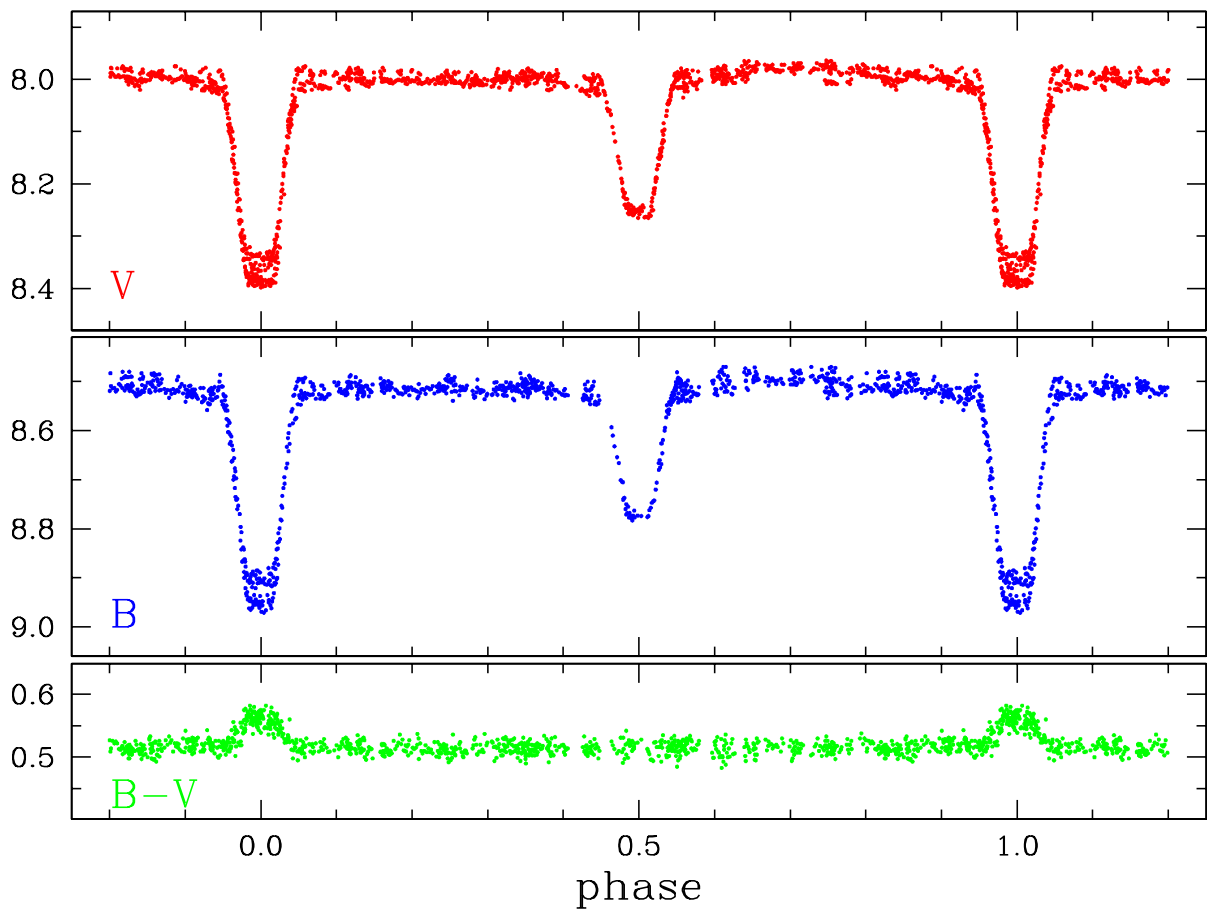
In all, 1407 measurements in  $V$ , and 1006 in  $B$  have been collected of V432 Aur between Dec. 1998 and Feb. 2002. All the observations were corrected for atmospheric extinction

and color corrections (via calibration on Landolt’s equatorial fields), and the instrumental differential magnitudes were transformed into the standard Johnson UBV system. The variable, comparison and check stars are very close on the sky so the atmospheric corrections were rather small (6 arcmin for HD 36974 and 10 arcmin for HD 36930). The close similarity of the color between the variable, comparison and check stars and the fact that all observations have been obtained for zenith distances  $60^\circ$  argue for a high internal consistency of our photometry of V432 Aur.

As expected, V432 Aur has turned out to be an eclipsing binary system. Spectroscopy reveals it to be a nice SB2 system. The primary eclipse follows the ephemeris:

$$\text{Min. I} = \text{HJD } 2451571.4123(\pm 0.0003) + 3^{\text{d}}08175(\pm 0.00001) \times E.$$

The  $B$  and  $V$  photometric data folded to this ephemeris are presented in Figure 1.

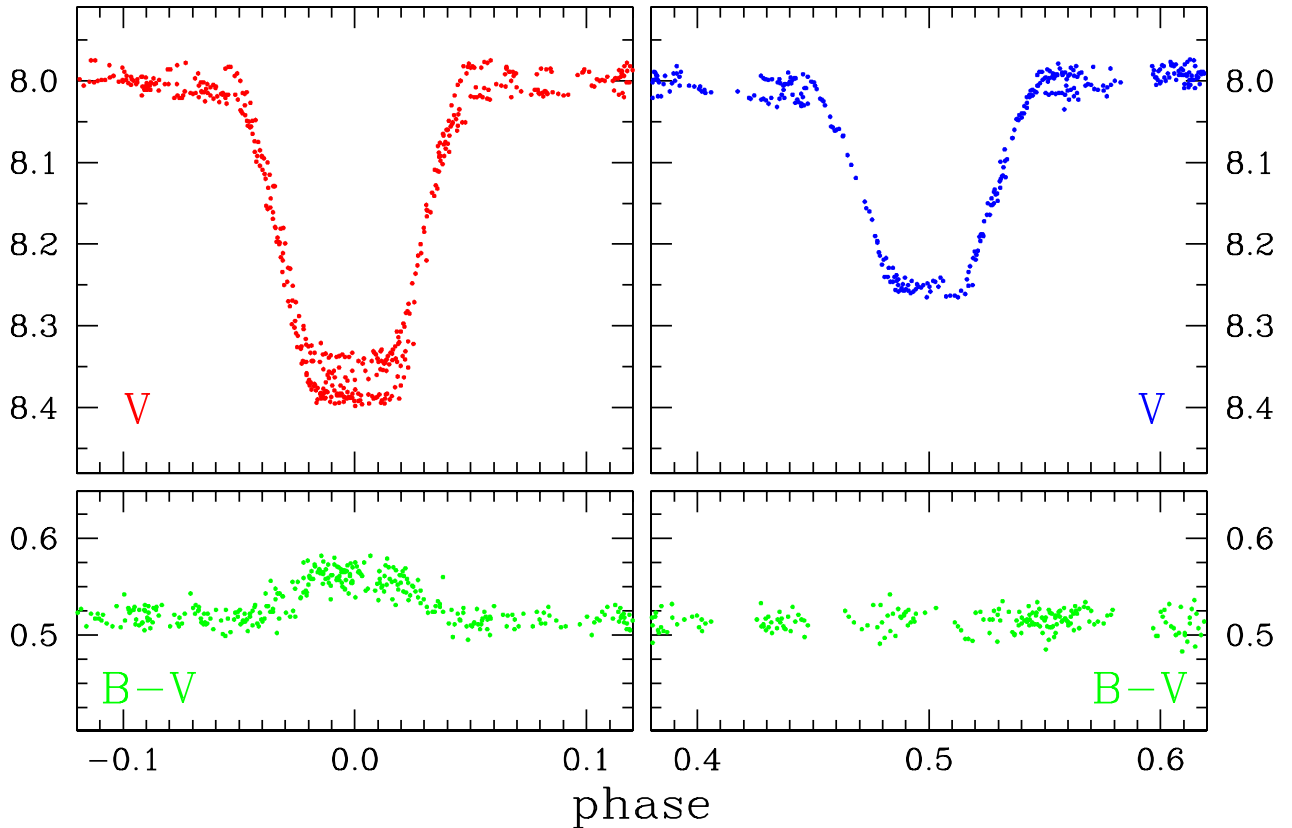


**Figure 1.**  $B$ ,  $V$  and color curves of V432 Aur folded to the 3.08175 day orbital period.

Both primary and secondary eclipses are flat bottomed with totality lasting about 0.035 of the orbital period ( $\sim 2.6$  hours). The primary star (that behind at primary eclipses) appears bluer by  $\Delta(B - V) \sim 0.05$  corresponding to  $\Delta T_{eff} \sim 210$  K. The primary eclipse is  $\sim 0.37$  mag deep. The secondary is well centered at phase 0.5 (thus no indication of an eccentric orbit) and is  $\sim 0.26$  mag deep.

The secondary star is intrinsically variable. As Figure 1 clearly shows, there is a large data *scatter* during the primary eclipse ( $\Delta V \sim 0.05$  mag), that reduces outside eclipses

(to  $\Delta V \sim 0.02$  mag). The scatter disappears during secondary eclipse (or at least it goes below the  $\Delta V \leq 0.01$  mag). Figure 2 offers an expanded view of the lightcurve around the primary and the secondary eclipses. It is impossible to mark with different symbols data belonging to individual observing runs, because the V432 Aur data come from 126 different observing nights.

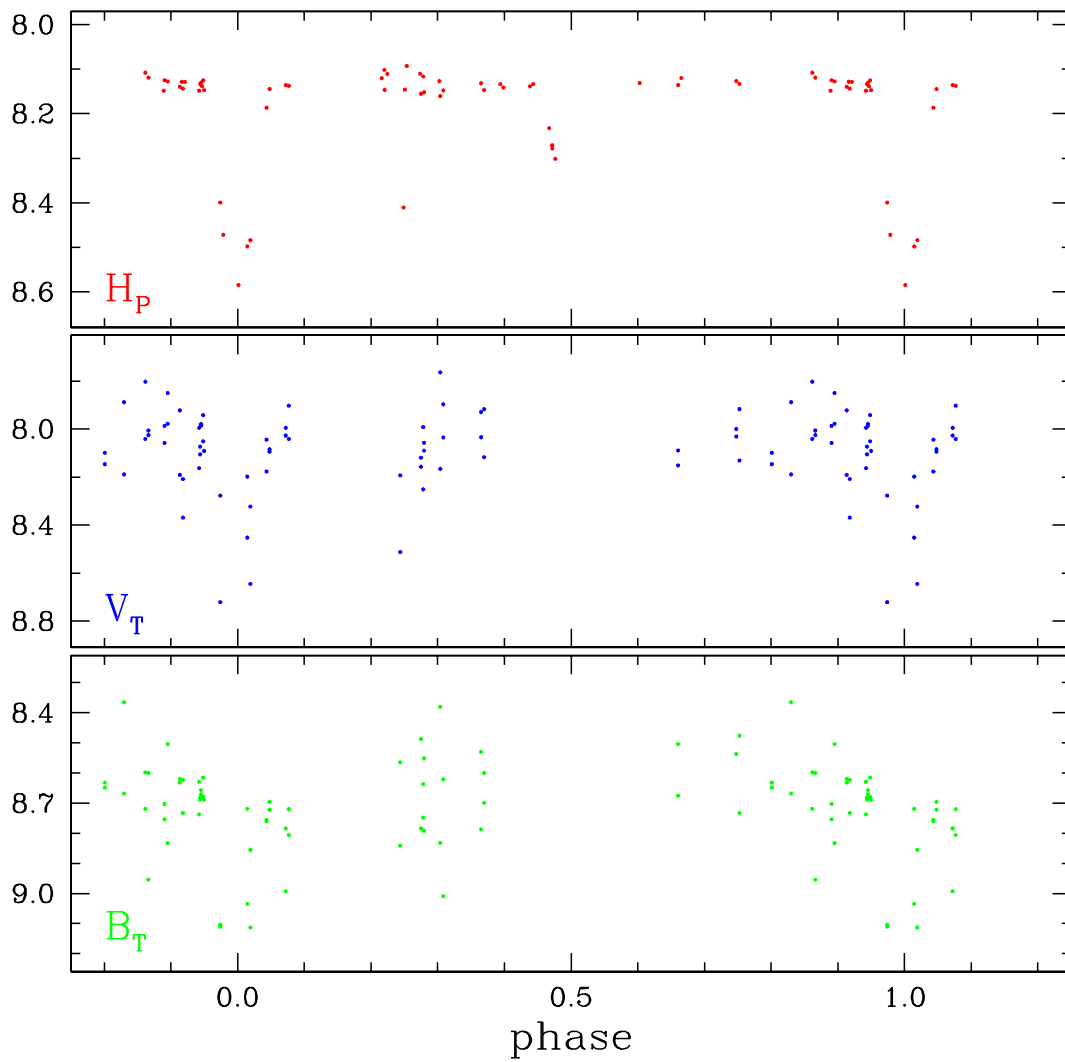


**Figure 2.** Expanded view around the primary and secondary eclipses of V432 Aur.

This scatter pattern is not connected to instrumental effects (observations from many different nights contributes to the light curve around both the primary and secondary eclipses), nor to variability of the comparison and/or check stars, that have been proven to be photometrically highly stable. The picture is consistent with the secondary star in V432 Aur being itself variable.

Which type of variable the secondary star might be is too uncertain at the moment. The time-scale of variability seems longer than a few hours. We have investigated the data outside eclipses searching for some indication of periodicity but without success. Given the minimal difference in  $B - V$ , the secondary star seems a couple of sub-types cooler than the primary, or a G2 star. More sophisticated investigations are required to determine which type of variable star is the secondary star in V432 Aur, and they will be attempted when the spectroscopic campaign will be concluded and the full orbital solution achieved.

Finally, Figure 3 graphs for comparison the Hipparcos and Tycho data folded to the orbital ephemeris above derived for V432 Aur. The paucity of  $H_P$  data in the eclipses and the large noise of the  $V_T$  and  $B_T$  data account for the *unsolved variable* status of V432 Aur in the Hipparcos catalogue.



**Figure 3.** Hipparcos  $H_P$  and Tycho  $B_T$  and  $V_T$  data for V432 Aur folded to the 3.08175 day orbital period.

*Acknowledgements.* This study was partly sponsored by Polish KBN Grant 5 P03D 00320

References:

- Dallaporta, S., Tomov, T., Zwitter, T., Munari, U., 2000, *IBVS*, 4990  
 Dallaporta, S., Tomov, T., Zwitter, T., Munari, U., 2002, *IBVS*, 5312  
 ESA, 1997, *The Hipparcos and Tycho Catalogues*, ESA SP-1200  
 Munari, U., Tomov, T., Zwitter, T., Milone, E. F., Kallrath, J. et al., 2001, *A&A*, **378**, 477