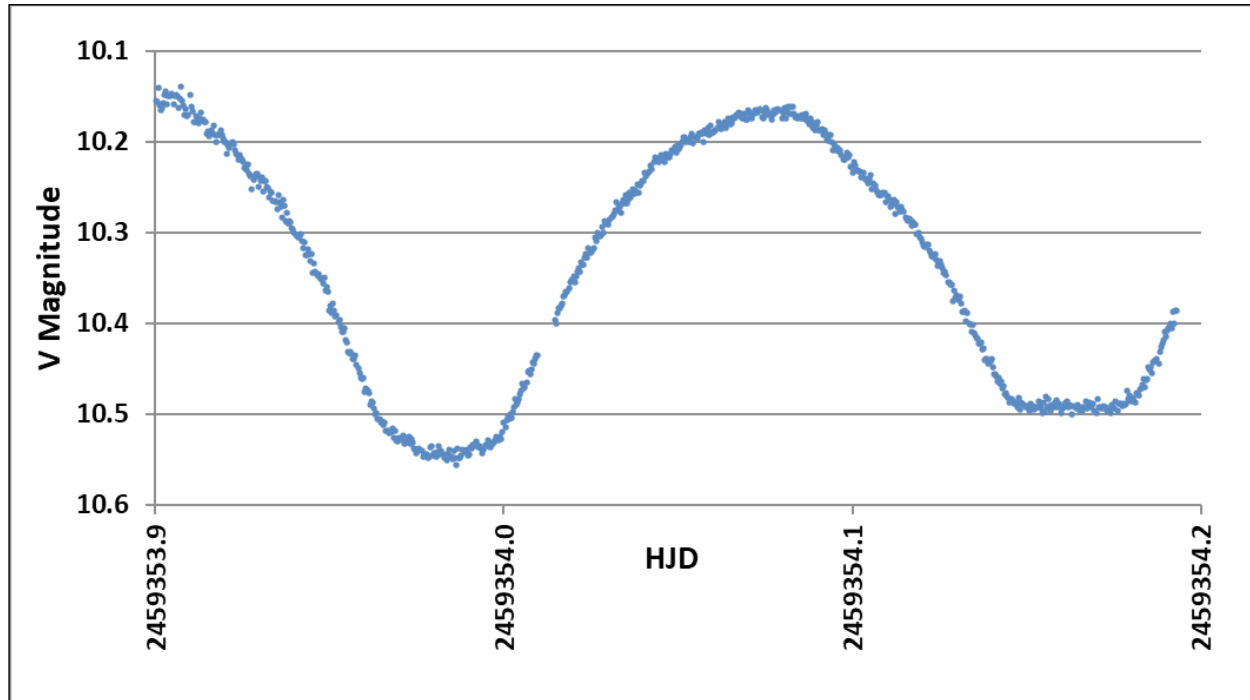




Mark Blackford and Roy Axelsen have been looking at period and light curve variations in OW Lupi, a *W Ursae Majoris*-type eclipsing binary. Mark's *V* band light curve recorded on the night of May 19, 2021 is shown above. The secondary eclipse is total and the magnitude difference between primary and secondary eclipses is about 50 mmag. See Mark's article on page 9 of this issue for further details.

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From the Director – *Mark Blackford*

Welcome to the final edition of the Newsletter for 2023. As mentioned in the previous newsletter, NACAA XXXI will be held over the Easter weekend in Parkes, NSW. The preliminary programme can be found at <https://nacaa.org.au/2024/programme>. On that page you will also see a link to Call for Presentations. On Good Friday Variable Stars South will hold a day-long symposium (VSSS7). Then on the Saturday we will host an hour-long Variable Stars Panel discussion as part of the NACAA programme.

Virtual attendance will be possible for both NACAA XXXI and VSSS7, although in-person participation is always a much-preferred option if you can get to Parkes. A farewell BBQ at the famous “Dish” radio observatory will be a highlight. I will put out a call for VSSS7 presentations shortly via the VSS Google Group.

In September AAVSO held a fascinating webinar by Dr Brad Schaefer outlining the history and imminent outburst of the 80-year recurrent nova T CrB. Prominent features in B and V light curves leading up to the 1946 eruption are again being observed, leading to a predicted outburst in 2024 ± 0.3 (or thereabouts). You can view the recording on AAVSO’s YouTube channel (<https://www.youtube.com/@AAVSOHQ>).

Previous outbursts of T CrB have reach magnitude 2 after a very rapid rise of only a few hours from about V mag 11. Whilst our northern colleagues are in the box seat to discover the outburst, there is a window of opportunity for southern observers to beat them to the punch. At the very least it would most probably be the brightest nova any of us are likely to see if your latitude allows.

Another video I’m sure many of you would be interested in is titled “Opening A New Eye to Ancient Light: The Optical Advances of the James Webb Space Telescope” presented by Dr. Marshall Perrin, Space Telescope Science Institute (STScI), Baltimore, Maryland, USA. It can be accessed via the following URL:

<https://www.sydney.edu.au/science/news-and-events/events/dr-peter-domachuk-memorial-lecture.html>

In the September 2023 RASNZ Southern Stars journal Stan Walker summarises our current limited understanding of Dual Maximum Mira stars. Stan then outlines a VSS project to gather precise V, B-V and spectroscopic data needed to interpret physical process involved in evolutionary changes in these stars. This will be a medium-term endeavour lasting several years and more observers are needed.

The new ASI2600mm-pro CMOS camera mentioned in this column in the previous newsletter is proving to be a very capable instrument for photometry. There were a couple of teething issues, though. Firstly, the file size is much larger than my other cameras so processing them with the current laptop is a slow process. Initial testing on standard star fields gave disappointing results, until I realised the B and V filters were misidentified in the filter wheel setup. This system is intended for bright star wide field photometry and the current 80mm f6 refractor is not ideal. With Christmas not too far away, I’ll be dropping hints to the good wife that another telescope would be a great present.

Late winter/early spring observing conditions have been quite good at Congarinni Observatory, although controlled burn-offs and the occasional bush fires have continued to affect some observing sessions. A little rain would be welcomed, my water tanks and local dams are getting quite low.

Wishing you all clear skies and good health,

Mark Blackford



AAVSO campaign to monitor bright supernova progenitors.

The following is from the AAVSO:

The AAVSO is partnering with the SuperNova Early Warning System (SNEWS) team to create a new campaign centered around supernova progenitors. The goal is to keep track of bright stars that have the potential to go supernova reasonably soon so that we have a record of the star leading up to such a monumental event. This project is open to all observing types and has a large target list so everyone should be able to find a way to contribute.

There are currently 192 targets, 90 of which are in the southern hemisphere and therefore should be of interest to VSS members. All show some degree of variability with maxima ranging from 0 magnitude down to about 10th magnitude.

Visual observations are encouraged for those targets with the largest amplitudes (>0.3 mag.). The recommended observing cadence is weekly/twice a week (not more frequently, please).

CCD/DSLR observations of stars with less than 0.1 mag. variation should be the priority for observers with electronic detectors. Observers are encouraged to use a V filter, but multicolor data are of course useful. Recommended observing cadence is one set of exposures (one per filter) weekly/twice a week.

Spectroscopic observations might be requested in the future for interesting targets.

More details can be found at the following webpages:

<https://www.aavso.org/aavso-alert-notice-836>

<https://www.aavso.org/snews-campaign>

Pro-Am Astronomy Research Collaboration (PARC)

I recently received the following email from Tim Spuck, Co-Chair of the IAU Pro-Am Working Group, which may be of interest to some of you.

Calling all Amateur Astronomers,

As you may recall, last year, you completed a survey expressing interest in collaborating with professional astronomers from the International Astronomical Union (IAU) on various research efforts. The newly launched IAU Pro-Am Research Collaboration (PARC) initiative promotes and facilitates research initiatives between amateur and professional astronomers. We invite amateur astronomers from around the world to visit the PARC web portal, explore the “Active Projects”, and sign up to participate in those that are of interest to you.

PARC Web Portal LINK - https://www.iau.org/science/scientific_bodies/working_groups/professional-amateur/

Please note that new projects will be added as they are proposed by professional astronomers and approved, so be sure to visit the PARC web portal regularly to explore new opportunities.

In addition to these research opportunities, the first PARC workshop will take place in person in Mumbai, India, December 1-3, 2023. This is a great opportunity for amateurs to learn about new projects, tools and techniques, and to meet other amateurs and professionals interested in research collaborations. Please visit the link below for more information and to register for the meeting.

PARC Meeting LINK: <https://khagolmandal.com/ProAm2023.html>

Thank you so very much for your time and consideration, and please share this invitation with others who may be interested. We are looking forward to your participation! If you have any questions, please direct them to Tim Spuck at tspuck@au.edu or Aniket Sule at aniket.sule@gmail.com.

Best wishes,

Tim Spuck, Pro-Am Working Group Co-Chair

Aniket Sule, Pro-Am Working Group Co-Chair

False variables in Union Obs. Circ. 48 – *Mati Morel*

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Abstract

A study of the list of 69 variables announced by Wood (1920) enables me to quantify his success rate in discovering true variables, amounting to about 3 in 4 of his objects, with the remainder being constant or dubious due to plate defects. I have been able to calibrate Wood's photo-blue scale of magnitudes with respect to modern B, though some of his estimates are badly off-scale.

Introduction

In the period 1890 to 1910 astronomers were grappling with a new discipline, the application of dry plates to sky photography. This process for mass market use was booming, but the use in astronomy created challenges. No single manufacturer of plates/films dominated the market, as would happen later in the 20th century. Rather, there were many potential outside suppliers to an observatory, with no widely agreed standards. Each supplier was free to write his own specifications. An observatory that hoped to produce reasonably uniform results over a long period of time would have to assess different brands, as characteristics did vary from one brand to another. Gill and Kapteyn (1895) noted this fact, while recording the names of some suppliers, with such names as

Paget Prize Plate Company

Derby Dry Plate Company (Abney plate)

London Drop shutter special plates (by Wratten)

Film defects were an issue. The occasional defect may have been tolerable in terrestrial images; they would not be acceptable in professional sky photographs, and was taken seriously.

UOC48: reported results

In UOC48, Wood (1920) reported the results of a proper motion survey, conducted by comparing pairs of Sydney Observatory plates, taken between 1894 and 1908, some being single-image exposures while others, the AC series, were triple-image. Exposure times varied from 30min to 60min. The greater part of Wood's work concerned proper motions, but he also detected 69 variable stars, a few of which were already known. It appears that few, if any, of his discoveries received further scrutiny, but all received regular VS names in the 1920s. In some cases assumed variability was based on a **single** positive observation, on one plate. What is the reliability of the methods employed? Wood used a blink-microscope to detect proper motions, and the occasional variable star. Photographic magnitudes were also assigned, but these were eyeball estimates off the plate, according to their own magnitude scale.

Wood's magnitude scale

As noted above, Wood assigned photo-magnitudes to his target stars, whether proper motion or variable. These are very rough, often only to a whole magnitude. I have compiled a list of 62 stars, with his

magnitudes in the range 11p to 14p. The faintest class (14p) is rare with only 3 stars. Having identified each star with its J2000 position I looked up its corresponding B mag in APASS.

For each magnitude class 11, 12, 13 and 14, I determined its mean value, and also an average for B. I constructed a regression curve, the datapoints corresponding to each magnitude class. Wood's mags are the X-ordinate, while B is the Y-ordinate. See **Figure 1**. The points have a linear slope. As a general rule, the plotted curve has a consistent offset from standard B. I have done rigorous calculations of standard deviations for each individual magnitude class. Standard deviation is a measure of how dispersed the data is in relation to the mean. **SD** is given for **B**, and the number of values.

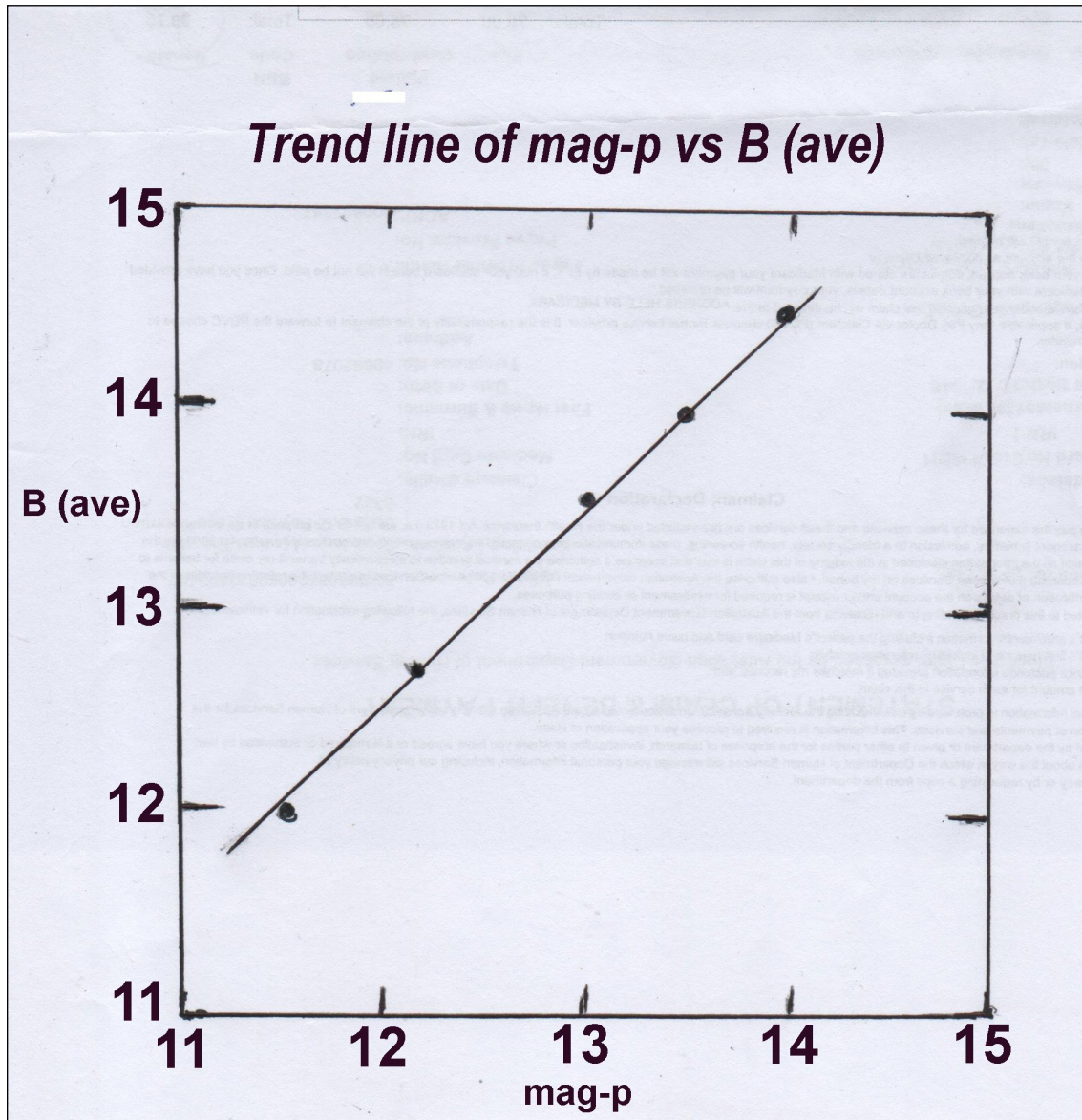


Figure 1. Trend line showing the general relationship between Wood's photo-magnitude in each magnitude class and modern B. Stars of 13.5p are plotted separately.

11^m.2(mean): 0.66(26); **12^m.25(mean):** 0.57(22); **13^m.0:** 0.67(6); **13^m5:** 0.75(5); **14^m.0:** 0.41(3)

All magnitude classes are fairly noisy, on the basis of **SD**, but the trend is clear, to the upper right of Figure 1. The relationship between Wood's photo-blue mags. and **B** is best expressed by

$$B = 1.05 \times Mp + 0.40 - (Mp \times 0.6) \div 14$$

It is most accurate within the magnitude range 12 to 14.5.

Overstated magnitudes by Wood

From the above, and to be true to his own scale, Wood could only have generally reported estimates down to 14.5 (=15.0B). However, in his list of new variables we find estimates of 15, 15½ and even 16p.

I find that in two cases his faint mags are overstated.

- In the field of AH Car Wood references three stars. 13, 13, and 15½. The fainter of the three is not 15½ but really 14.568B (APASS).
- AE Cen (EA) found by Wood, and reported at 15½ on 1895 May 22. VSX quotes its range as 12.25 to 14.15V. Its B mag at minimum is not known but even so is unlikely to have dipped below 15.0B, the nominal threshold.
- In 1981 I retrieved the original Sydney plates used by Wood for TY Velorum. A re-examination of these plates showed that two of Wood's estimates (9.55p and 9.6p) were badly in error, at least 2^{mag} too bright, for no obvious reason. See Morel (1981).

Wood's variables

Wood detected 69 variables on Sydney plates. Apart from one known defect (NSV 2734) all have been given VS names. A breakdown by constellation is given in Table 1. The identification and classes are secure for the majority. Seven objects are of unknown type, while another six are possibly or very certainly the result of plate defects. The latter group is discussed further below.

It is noteworthy that 17 stars, or 24.6% of the total are classed as **CST** - constant or probably constant. This proportion, 1 in 4, is rather high, and I suspect that it is due to the unsuitability of the plate material for making precise estimations of magnitude. This is attested to by the considerable scatter at the 11 - 12 magnitude level. Wood rated 26 of his **pm** stars at 11^m but their true B mags range from 11.12 to 13.64. Stars of 12^m show somewhat less scatter, and 13^m and 14^m even less. The AAVSO's VSX database provides current details on all variables, but I differ in a few cases.

Table 1. *Breakdown of Wood's Variables, by Constellation.*

Const	Names
Ara	Z, ST, SU, SV, SW, SX
Car	Y, SW, AF, AH*, AI*, AK, AL, AS, AT, AX*, BO
Cen	W, RV, UV, AB, AC*, AD, AE, AF, AG*, AH*, AI*, AK
Cru	SS
Gru	X
Hor	Y*, Z*, RR*
Ind	X, RT*
Lup	Y, RV*
Nor	T, RT, RV, RW, RX*, RY, RZ
Pav	RU, RV, RW, RX, RY
Phe	X, Y*, Z
Pic	Z, NSV 2734
Tel	RZ, SS, ST, SU
Vel	TW, TX, TY*, TZ, UU, UV, UW, UY*, VY*, CN

Notes

(1) Stars considered to be constant in VSX are marked with an asterisk.

(2) Stars of unknown class: SU Ara, AK Cen, RW Pav, X Phe, SU Tel. UV & UW Vel

(3) **SU Ara.** (2000) 17:02:37.58 -54:26:00.0 Unknown class. ID seems secure (ASASSN-V). From APASS, V=13.815, B=14.50. Wood's observations are quoted: "1894 Aug. 3, 12^m, good image. 1906 July 20, nil". The range suggested by him is inconsistent with recent observations.

(4) **AH Car.** This is undoubtedly real, but Wood's description is haphazard and unhelpful. It is one of three stars, two of 13^m and one faint star between them. To quote : "1897 Feb 24. 12.0. 1910, Jan. 17, 13.0 two images, the third 15½ (sic)". I identify these stars as those in the near vicinity of his approximate position. See **Figure 2..** Their coordinates and BV data are given, as follows.

Star 1: (J2000) 07 19 21.20 -56 10 39.0 13.64B, 13.51V, B-V 1.13 APASS(29)

Star 2: (") 07 19 28.36 -56 10 01.7 14.57B, 13.47V, B-V 1.10 APASS* [Previous DR]

Star 3 : (") 07 19 41.03 -56 09 33.6 13.96B, 13.26V, B-V 0.70 APASS(29)

The BV data for No. 2 is taken from a previous DR of APASS; the BV colours in the current DR are quite wrong, as confirmed by SkyMapper. Possibly No. 1, being brightest in B, is AH Car.

(5) **RW Pav.** (J2000) 18:55:09 -57:55 00 Wood states : "Fair image, =11^m on new plate [1908 July 4]: invisible on three other plates." No var. found here in later work. Probably a defect.

(6) **Y Phe.** (J2000) 23:39:37.59 -53:43:34.5 Id. secure. $m_p = 13.0$ (Wood), B=13.38, V=12.84. No class given in VSX, but the light curve in ASAS-3 indicates it is CST, V=12.84 (0.081).

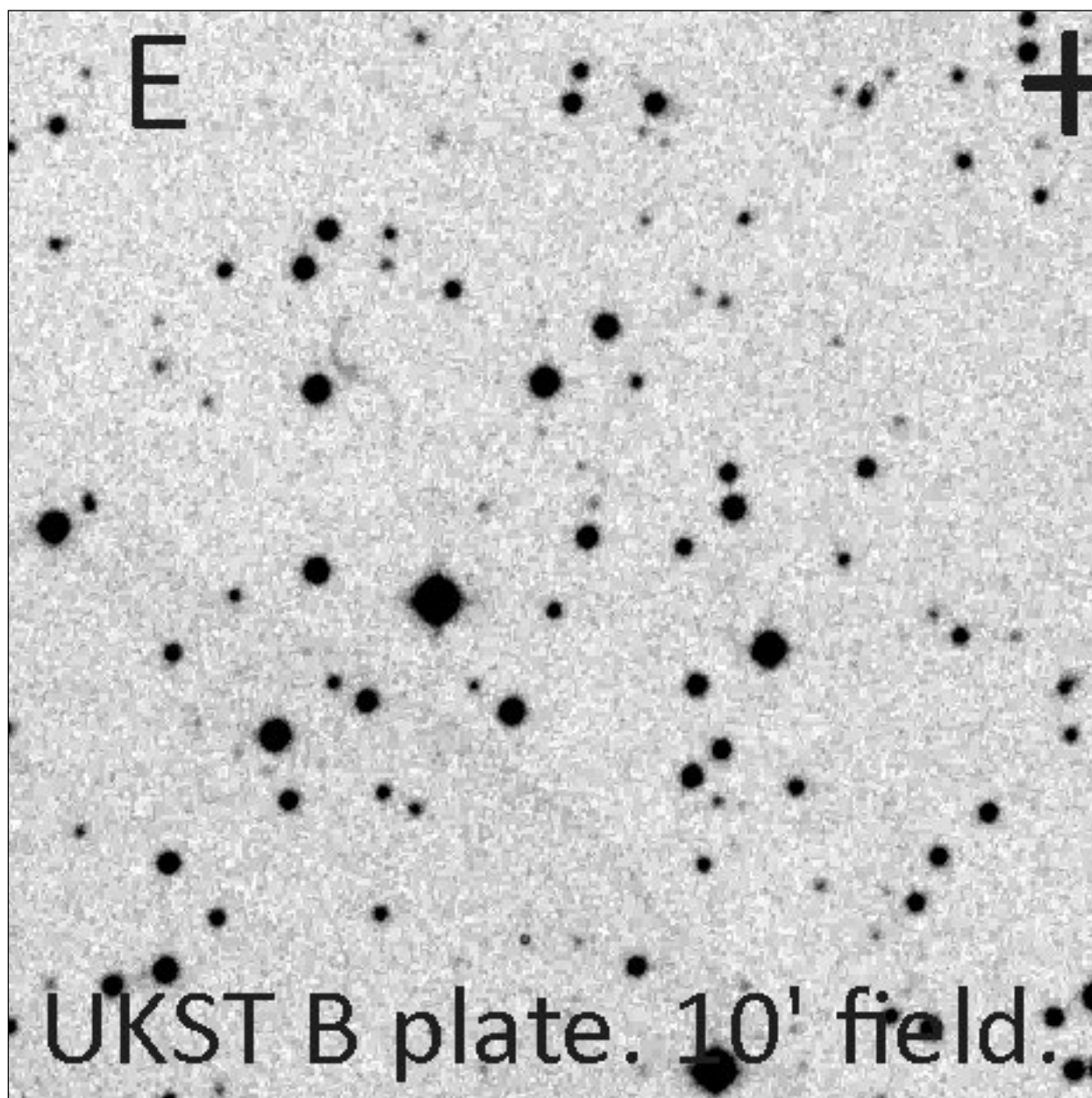


Figure 2. Identification chart for AH Car. Nearby stars 1, 2 and 3 are described in the text. The (very) approximate position of AH Car, given by Wood, is (1875.0) 07^h17^m.1 -55°56' and is shown with a cross. His variable is presumed to refer to one of the three nearby stars.

False detections due to plate defects

I have isolated 3 instances where the paucity of positive observations by Wood and lack of subsequent recovery leads me to suspect plate defects being involved. The likelihood of defects being the culprit is given as 95% or more in 3 instances. Another 3 instances are rated at 50/50, which means there is a possibility of a plate defect, but due to Wood's poor position he may have observed a nearby star, within $r = 1'$ or $1.5'$. These cases are discussed in detail. See **Table 2**.

Table 2. *Observations of Doubtful Stars, with Probability Ratings.*

Star VS Name	UOC48 Obs dates Bright	Faint	Possible Star ID	Probability of defect	Notes
NSV 2734	1906.01.23	1897.01.31	-----	100%	
*Z Hor_def	1894.11.01	1906.11.15 (inv.)	-----	100%	See Notes
UV Vel	908.04.02 (12p)	1897.03.08 (15p)	GSC 8606 1063	50%	See Notes
UW Vel	1897.03.30 (12.0)	1897.02.25 (inv <15)	GSC 8606 1505	50%	See Notes
AH Cen	1908.05.25 (12½)	1898.04.22 (15½/trace)		50%	See Notes
RV Lup	One image of triple film missing	GSC 8678 0342	GSC 8678 0342	95%	See Notes

Notes

***Z Hor_def** Extra image (14^m?) noted on 1894 plate, near the fixed star now named Z Hor (CST).

UV Vel. Lies 40" due N of GSC 8606 1063 $V=12.18$, $B=13.33$, $B-V=1.12$. This star is generally consistent with Wood's data, CST. VSX lists a faint star SE, but is too faint, $B=17.04$, $B-V=2.39$.

No other bright variables of large amplitude lie in this vicinity. More likely a field star.

UW Vel. Wood's position coincides almost exactly, by chance?, with a faint variable found by the ASASSN-V team at (J2000) 09 49 05.19 -56 24 47.0, very faint and red ($V=14.14$, $B-V=1.774$) and there is no evidence of it ever rising within reach of the Sydney plates, or Wood's estimates. Possibly Wood's position is in error, and he was looking at GSC 8606 1505 about 2.4' east, at (J2000) 09 49 23.03 -56 24 26.03, $V=11.823$ $B-V=1.24$ $B=13.063$ CST according to ASAS. Was there a defect involved in Wood's published position in error?

AH Cen. VSX classifies this star as CST, but id. uncertain.

RV Lup. Identified by Hoffmeister, but CST. Missing image (of triple) is likely a film defect.

Discussion

I identify 17 stars in Wood's list as certainly or probably **constant**. This amounts to 24.6% of the total. Add another 3 stars which have a high probability (95-100%) of being misreported due to plate defects and the rate of false variability rises to 29%. The 5% leeway allows for the possibility of a real event having been recorded.

Conclusion

This work attempts to "calibrate" Wood's photo-blue magnitude scale, to allow a comparison with the modern B scale. The result appears to be reasonably successful, but with caveats, given the rough nature of Wood's magnitude estimates. This work extends similar work done around W Dor (Morel 2023). The number of Wood stars now shown to be CST is a window into the work done at Union Observatory around 1920.

References

- Gill, D., Kapteyn, J.C. 1895-1900 Cape Photographic Durchmusterung, Ann. Cape Obs. 3. Part 1
Morel, M. 1981 Publ. Var. Star Section RASNZ No. 9 (C81) p38
Morel, M. 2023 VSS Newsletter 2023-3 (July 2023) p4
Wood, H. 1920 Union Obs. Circ. 48 pp41-52

Introduction

OW Lupi is a neglected W Ursae Majoris-type eclipsing binary which, according to the AAVSO Variable Star Index (VSX), varies between 10.03 - 10.39 V over a period of 0.360317 d (<https://www.aavso.org/vsx/>). The SIMBAD database (<http://simbad.cds.unistra.fr/simbad/>) list its spectral type as G5 V, similar to the sun (G2 V), and parallax as 5.688 ± 0.0172 mas which equates to a distance of 546.2 ± 1.6 ly.

There appear to be no published studies specifically on OW Lupi. This article presents an analysis of period variations of this system based on a small number of directly measured times of minimum and a few dozen epochs derived from several photometric surveys.

This study was, in part, motivated by an apparent anomaly noticed by Roy Axelsen in Brent Joyce's analysis of TESS observations. More on that later.

Initial Observed minus Calculated diagram

The earliest published epoch of primary minimum is HJD 2452840.696 (Otero and Clau, 2004) which was derived from ASAS-3 survey observations. This epoch, and the period they determined are listed in the VSX.

There are no directly measured times of minimum of individual eclipses in published papers, however, Roy Axelsen and the author recorded several light curves between May 2021 and August 2023 from which 1 primary and 5 secondary minima times were measured. Figure 1 shows the author's V band light curve recorded on the night of May 19, 2021. The secondary eclipse is total and the magnitude difference between primary and secondary eclipses is about 50 mmag. The measured range is somewhat larger than listed in the VSX.

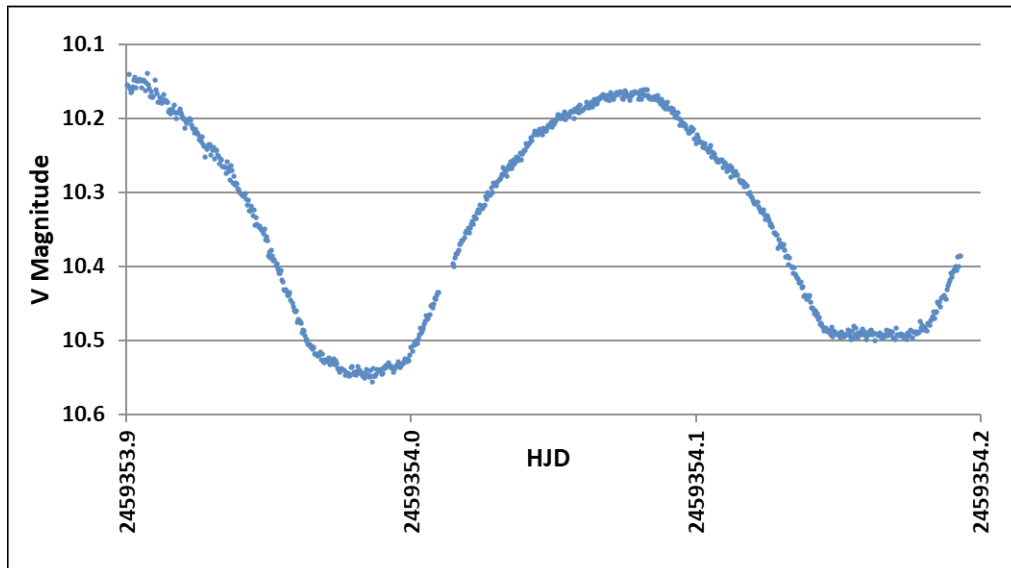


Figure 1. OW Lupi V band light curve recorded between 2459353.8884 HJD and 2459354.1932 HJD.

Observed minus Calculated (O-C) diagrams are used to study period changes in eclipsing binaries (as well as many other fields science). The difference between an observed eclipse time and the predicted time (calculated from the number of complete orbits, or cycles, since a reference epoch and an assumed period) are plotted against the cycle number.

The VSX epoch and period were used to construct the O-C diagram in Figure 2. More recent observations are not consistent with the VSX epoch and/or period. To resolve the issue a more complete O-C diagram was needed.

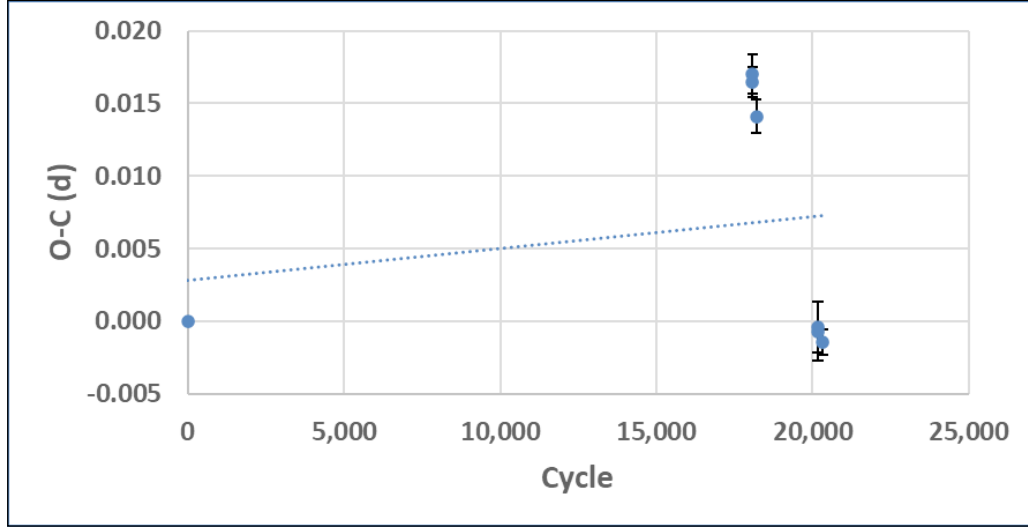


Figure 2. Initial O-C diagram using VSX epoch and period.

Table 1. Epochs of minimum from photometric surveys and measured by Axelsen and Blackford.

Epoch (HJD)	Error (d)	Source	Epoch (HJD)	Error (d)	Source
2452031.2378	0.0065	ASAS-3	2454614.5192	0.0024	SuperWASP
2452031.4231	0.0041	ASAS-3	2454945.8216	0.0056	ASAS-3
2452725.7546	0.0033	ASAS-3	2454946.0059	0.0049	ASAS-3
2452725.9348	0.0056	ASAS-3	2457062.4328	0.0043	ASAS-SN
2452840.6960		VSX/Otero	2457062.6184	0.0057	ASAS-SN
2453114.8973	0.0049	ASAS-3	2457851.6779	0.0063	ASAS-SN
2453115.0763	0.0057	ASAS-3	2457851.8604	0.0057	ASAS-SN
2453500.7914	0.0043	ASAS-3	2458602.0201	0.0001	TESS
2453500.9710	0.0057	ASAS-3	2458602.2003	0.0002	TESS
2453832.8204	0.0053	ASAS-3	2458607.9655	0.0002	TESS
2453862.5471	0.0011	SuperWASP	2458608.1453	0.0002	TESS
2453862.7288	0.0009	SuperWASP	2458622.0172	0.0002	TESS
2453928.3053	0.0020	SuperWASP	2458622.1966	0.0002	TESS
2453928.4851	0.0023	SuperWASP	2459335.0660	0.0003	TESS
2454180.7041	0.0018	SuperWASP	2459335.2474	0.0008	TESS
2454180.8839	0.0017	SuperWASP	2459345.6950	0.0005	TESS
2454256.7265	0.0040	ASAS-3	2459345.8766	0.0008	TESS
2454256.9104	0.0059	ASAS-3	2459353.9827	0.0010	MGB
2454300.3267	0.0016	SuperWASP	2459354.1634	0.0013	MGB
2454300.5066	0.0016	SuperWASP	2459359.0282	0.0004	TESS
2454553.8065	0.0020	SuperWASP	2459359.2064	0.0003	TESS
2454553.9872	0.0023	SuperWASP	2459399.9208	0.0012	MGB
2454597.7653	0.0045	ASAS-3	2460106.1273	0.0020	RAA
2454597.9446	0.0031	ASAS-3	2460109.0101	0.0018	RAA
2454614.3388	0.0026	SuperWASP	2460160.8948	0.0009	MGB

Sources of additional epochs

Several photometric survey archives containing OW Lupi observations were identified. The Photometric Data Retriever (PRD) program, reviewed in the 2022-2 edition of the VSS newsletter, was used to retrieve observations from the ASAS-3 and SuperWASP surveys. The ASAS-3 observations were made every few days between December 2000 and September 2009. SuperWASP imaged the target area every few nights between May 2006 and May 2008, recording several dozen observations on each of those nights.

ASAS-SN observations were accessed through the External Links section of AAVSO's Variable Star Index (VSX). Observations were recorded every few days between May 2014 and September 2018.

Finally, TESS data from 2019 (Sector 11) and 2021 (Sector 38) were downloaded from the MAST portal (<https://mast.stsci.edu/portal/Mashup/Clients/Mast/Portal.html>). TESS observation in Sector 11 were recorded at 30-minute cadence between March 24th and May 5th, 2019, and Sector 38 at 10-minute cadence between March 29th and May 26th, 2021. For this analysis the QLP PDCSAP version of the TESS data was used, see (Blackford, 2021) for a description.

No other accessible survey archives contained observations from which epochs could be determined.

The sparse photometry technique (Blackford, 2022) was used to determine several epochs of primary and secondary eclipses from each of the surveys. These are listed in Table 1, along with the VSX epoch and minima times by Axelsen and Blackford.

Revised O-C diagrams

Figure 3 shows the O-C diagram with all 50 epochs plotted using the VSX epoch and period to determine the cycle number and O-C value. Note the much larger range on the vertical axis compared with Figure 2.

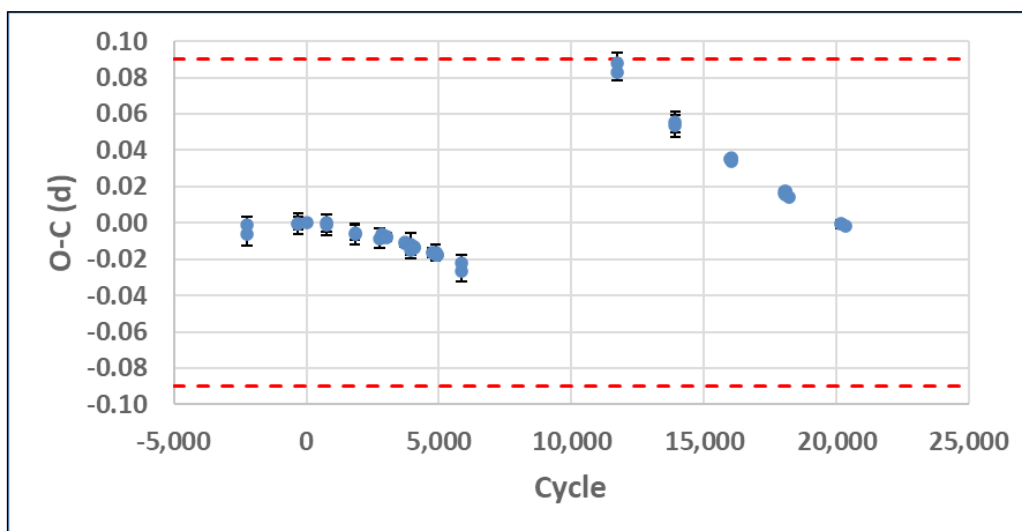


Figure 3. *O-C diagram using VSX epoch and period showing jump due to cycle count errors.*

The discontinuity at about cycle number 10,000 is a clear indication of a cycle count error. These occur when the O-C value exceeds plus or minus one quarter of the orbital period, 0.09 d in the case of OW Lupi. When this happens, the formula used to calculate cycle number returns a value half a cycle too low or too high, i.e., primary eclipses are misidentified as secondaries and vice versa. The red dashed lines in Figure 3 indicate where cycle count errors would occur.

Once recognised, cycle count errors can be manually corrected by adding or subtracting 0.5 from the calculated cycle number. Figure 4 shows the OW Lupi O-C diagram after making these corrections. Data points now form a smooth, roughly sinusoidal curve.

Figure 4 shows an overall downward trend indicating the assumed orbital period of 0.360317 d is frac-

tionally too long. Linear regression of the measured epochs and corrected cycle numbers yields a period of 0.3603073(2) d. Using this refined period and the VSX epoch produces the O-C diagram in Figure 5 which contains no jumps due to cycle count errors. The following formula should be for predicting future eclipses:

$$T(\text{HJD}) = 2452840.696 + 0.3603073 * C \quad (\text{Eq. 1})$$

Where C is the cycle number since $T_0 = 2452840.696$ (HJD).

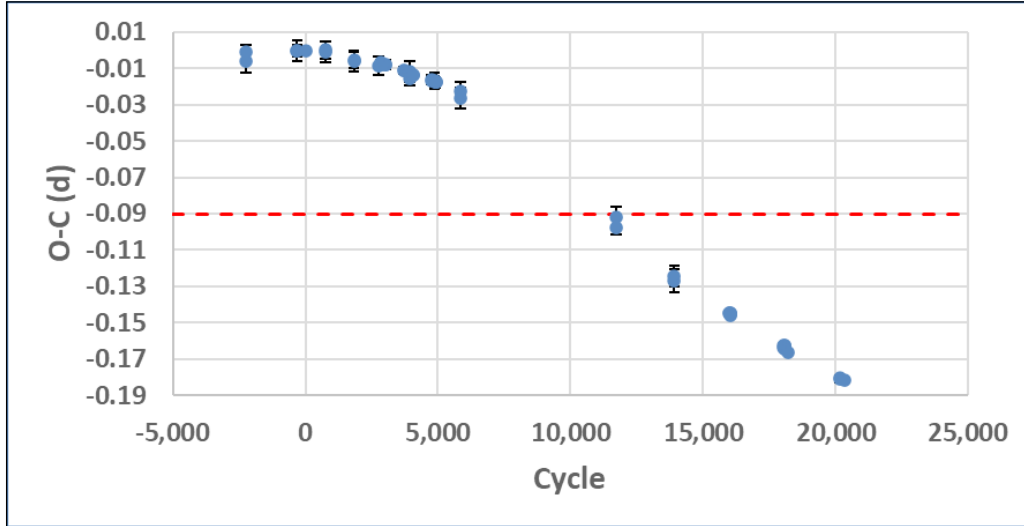


Figure 4. *O-C diagram using VSX epoch and period with cycle count errors corrected.*

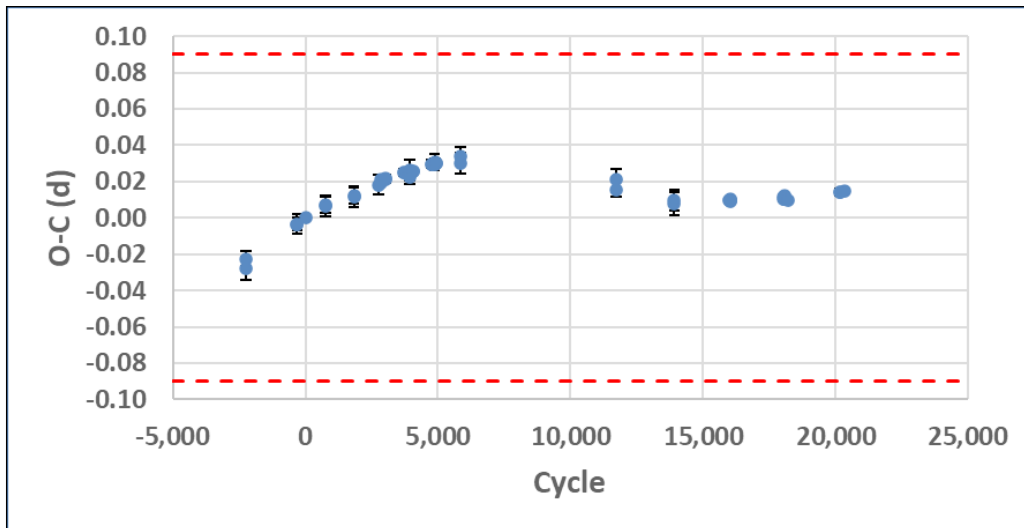


Figure 5. *O-C diagram using VSX epoch and refined period.*

TESS light curves

Coincidentally, TESS observed OW Lupi at the same time the light curve in Figure 1 was recorded, but at lower cadence, Figure 6. Vertical and horizontal scales are the same in both figures. TESS observes in the infra-red, approximately equivalent to the Cousins I band. The magnitude difference between primary and secondary eclipses in the TESS light curve is about 50 mmag, very similar to the V band light curve. However, some eclipses recorded by TESS showed significant changes in depth over time scale of a few days. This is readily seen in the phased light curve of Sector 38 observations.

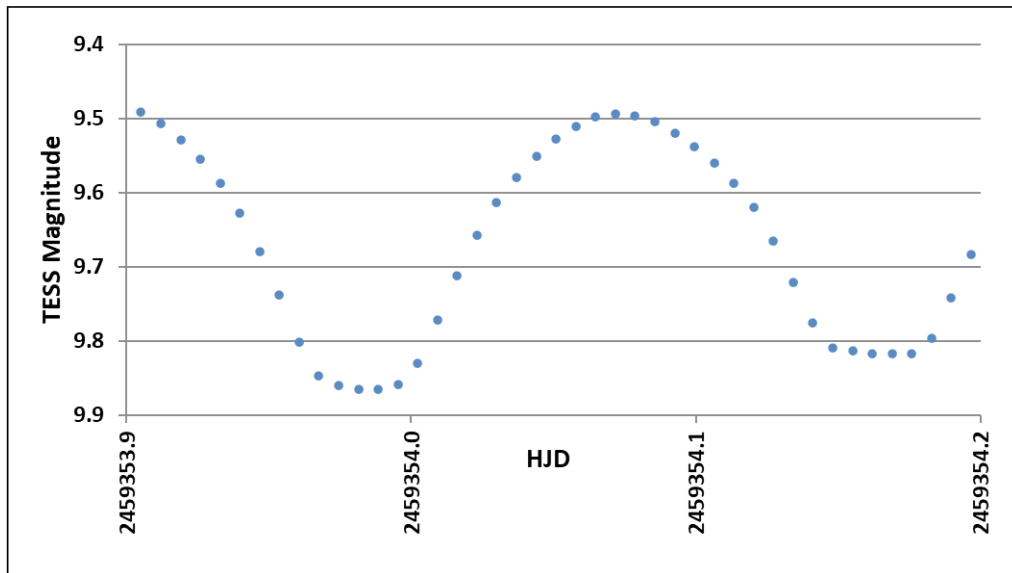


Figure 6. *TESS light curve recorded simultaneously with the light curve in Figure 1.*

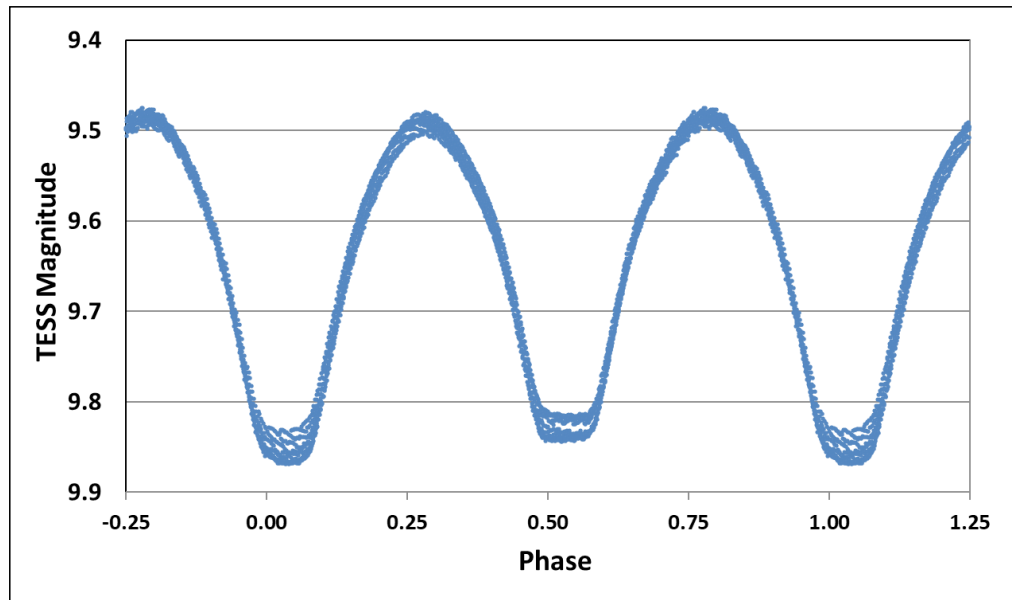


Figure 7. *TESS Sector 38 (2021) light curve phased using Equation 1.*

Discussion

Early data points in the O-C diagram of Figure 5 show a downward parabolic curve while later data points suggest an upward parabolic curve. Although it is far too early to be certain, the OW Lupi system could possibly contain a third body in a multi-decade eccentric orbit about the close eclipsing pair. More eclipse timings over coming years and decades are required to extend the O-C diagram.

Light curve modelling and spectroscopic analysis may help determine the presence of a third star, however, there do not appear to be any published results for OW Lupi.

Variations in eclipse depths shown in Figure 7 are similar to those observed in another W Ursae Majoris-type eclipsing binary, AE Phoenicis. These are known to be caused by rapid evolution of star spots on both components of the binary (Barnes, et al., 2004).

Conclusions

Minima timings of OW Lupi by Blackford and Axelsen, and epochs derived from photometric survey archives, were used to study eclipse timing variations by means of Observed minus Calculated diagrams. A revised period was determined that avoids discontinuities caused by cycle count errors. The shape of the final O-C plot may be caused by a third body orbiting the close binary, however further eclipse timings are needed to test this hypothesis.

Variations in depth of both primary and secondary eclipses seen in TESS light curves are likely due to star spot activity.

Photometrists are encouraged to observe OW Lupi to measure new times of minimum. Light curve modelling and spectroscopic analysis are also highly desirable.

Acknowledgements

I thank Roy Axelsen and Brent Joyce for pointing out eclipse depth variations in TESS light curves.

This research made use of the AAVSO VSX database and the SIMBAD and VIZIER databases, operated at CDS, Strasbourg, France and of NASA Astrophysics Data System Bibliographic Services. This paper includes data collected by the TESS mission, which are publicly available from the Mikulski Archive for Space Telescopes (MAST). This research made use of AAVSO's VStar software and Peranso (www.peranso.com), a light curve and period analysis software.

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Diffraction Limited's CCD control program MaximDL has been the dominant program for computer control of CCD cameras for over 25 years and I have used it for nearly 20 years. There wasn't much else around when I bought my first CCD camera – an SBIG ST200XE and I spent a lot of time learning how to use it with my 10" Meade SCT. After trying my hand at pretty pictures I quickly decided that I had no artistic talent and decided to switch to photometry.

The Meade mount was poor at tracking so I bought SBIG's AO-7. They called it Adaptive Optics, others, less charitably, said it was just active optics. Whatever it was called it worked brilliantly with the Meade with corrections being made at over 20Hz. MaximDL was the only program that could control the AO-7 and its successor the AO-8.

For many years I successfully used Maxim with an SBIG ST9XE/AO-8 camera and guider but in 2016 I made the move to El Sauce in Chile with a Planewave CDK14, an SBIG STT 1603 camera and an AO-8A. MaximDL was still the only game in town for the AO-8 even though there were now several new control programs available.

I stuck with MaximDL when I moved up to a CDK20 scope in 2021 as I was still using the SBIG camera and AO-8A, but by 2022 I wanted a better camera and, on the advice of the team at El Sauce, I opted for a Moravian C3 CMOS camera and a standard off-axis guider. Now I was freed from the tie-in to Maxim and could look at other control software. And I needed to.

Over the years the folks at Diffraction limited had tinkered so much with the AO-8 control that every new release brought new problems, culminating in v6.21 with the re-introduction of a major problem that they had fixed when moving from V4 to V5. By then I was ready to ditch the AO.

I was in Perth earlier this year so I took the opportunity to contact TG Tan and arrange a meeting. I had worked alongside TG on KELT and later, on TESS SG1, but had never met him in person. It turned out to be a fruitful meeting as he introduced me to a new telescope and camera control program called Voyager.

In Voyager you first set up a profile (Figure 1) in which you tell the program what equipment you are using. You can setup many different profiles and use any one you want.

Figure 1. The profile setup page of Voyager

Voyager is ASCOM compliant and will control an ASCOM camera and mount so there is no need to use

MaximDL or any other control program. It will use Maxim if you wish and there are circumstances where you could want this. Simply make a profile where your camera and/or mount are controlled by Maxim.

Once you have a profile setup then you can use its “On-the-fly” section. Here you can use Voyager in a semi-manual mode. Enter your target name and coords in the top line then jump to the “Sequence Configuration” section by clicking the gear icon in front of the word “Sequence” (Figure 2).

Sequence Configuration

Change Profile To This Sequence [X] [Icon] [X]

Target Name: Target RA: DEC: Copy Paste Rotation: 0.00

Target Type: ☒ Default ☐ Comet ☐ Asteroid Fast Find Find SESAME RoboClip Comets Asteroids

Target Key: Profile: C:\Users\Phil\Documents\Voyager\Profile\VC3 + MDL6.30.v2y

Slot	Type	Filter	Suffix	Exposure	Bin	Speed	Readout Mode	Gain	Offset	Repeat	Copy	Paste	X
1				0	1			0	0	1			
2				0	1			0	0	1			
3				0	1			0	0	1			
4				0	1			0	0	1			
5				0	1			0	0	1			

Sequence Constraints On Start Cooling Pointing Rotator Tracking Plate Solving Meridian Flip Guide/Dithering Shot Focus On Error On End

Sequence Mode: Cyclic Round Repeat: 1 [Times]

Sequence Directory: ☒ Auto ☐ Manual C:\Users\Phil\Documents\Voyager\Sequence\Target Select

Sequence Sub Foldering / File Naming

- ☐ Use FILE PATTERN
- ☐ Override FILE PATTERN
- ☒ Use Voyager STANDARD
 - ☐ Create Logical Data Subfolder Inside Sequence Directory (all between 00:00 to 08:00 AM are from yesterday)
 - ☐ Create Data SubFolder for Filter Name

Figure 2. The sequence configuration page - Sequence Tab.

From the Sequence tab in the middle of the page enter the filter, exposure, binning and number of repeats, plus any details that your camera requires. Further down you enter the destination folder for your data.

Sequence Configuration

Change Profile To This Sequence [X] [Icon] [X]

Target Name: Target RA: DEC: Copy Paste Rotation: 0.00

Target Type: ☒ Default ☐ Comet ☐ Asteroid Fast Find Find SESAME RoboClip Comets Asteroids

Target Key: Profile: C:\Users\Phil\Documents\Voyager\Profile\VC3 + MDL6.30.v2y

Slot	Type	Filter	Suffix	Exposure	Bin	Speed	Readout Mode	Gain	Offset	Repeat	Copy	Paste	X
1	Light	R		120	2			0	0	200			
2				0	1			0	0	1			
3				0	1			0	0	1			
4				0	1			0	0	1			
5				0	1			0	0	1			

Sequence Constraints On Start Cooling Pointing Rotator Tracking Plate Solving Meridian Flip Guide/Dithering Shot Focus On Error On End

Run this Program/Script BEFORE Time Wait [X]

Time Wait On Start ☒ Interval: 3 0 0 [hh:mm:ss] ☐ Absolute

Run this Program/Script AFTER Time Wait [X]

Point Target On Start ☒

Inject Focus On Start ☐

Open Flat Device Cover ☐ Device #1 ☒ On Start ☐ After Time Wait On Start

Calibrate DONUTS ☐ (Only for DONUTS external software) ☐ On ALT/AZ Coords ALT AZ [DD MM SS] or [DD MM SS.sss] ☒ On Place

Figure 3. Sequence configuration page - On Start tab.

There are 14 tabs to check and it would be a good idea to check each one. If you are just doing a quick photometry run and are already focused and have your guider working then look at the “On Start” tab (Figure 3). For semi-automation set what time you want the observations to begin and whether you need to move to the target at the start of the session. Finally look at the “On Error” and “On End” tabs. Set a ‘Good Night’ routine (I just Park the scope but leave the camera on and cold).

Once you have setup your sequence save it. To run it click the arrow to the right (Figure 4).

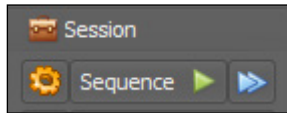


Figure 4. To run your sequence click the blue arrow

Voyager’s big advantage over a program like Maxim is its scripting language – Dragscript. As the name implies you simply drag from a predefined list of actions onto a form using a supplied editor

Voyager comes with several sample scripts that you can edit using the Dragscript editor. Scripts can be very short, just a few lines or very long, many pages. I have a very simple script (Figure 5) that uses a couple of pre-defined sequences: 1) to take dusk flats and 2) to take a sequence of frames using a set filter. If for some reason the dusk flat fails then it will attempt dawn flats. At the end it will park the scope and leave the camera on.

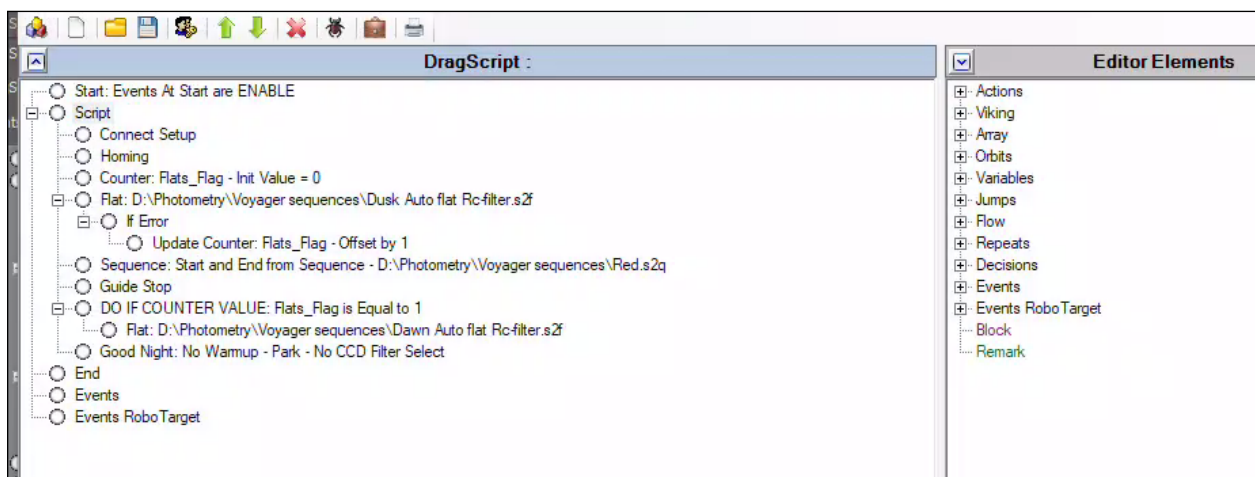


Figure 5. My basic script to take flats and run a sequence using a red filter

I am very much a beginner with Voyager so can only show you a brief outline of its capabilities but there are ample instructions for every aspect of the program on the web at the Voyager Wiki here: https://wiki.starkeeper.it/index.php/Main_Page. There is also Voyager Forum at <https://forum.starkeeper.it/> and a large selection of instructional videos available on YouTube.

With a 60 day free trial it’s worth giving it a try.

Publication watch

Stan Walker and **Ed Budding** published an article in the Journal of Astronomical History and Heritage:

Walker, W.S.G., Budding E., *Highlights From The Golden Age Of The Auckland Observatory's Stellar Photometry Programme*. JAHH 26(2), 303–324 (2023).

Abstract: Auckland Observatory has a proud history of variable star research that extends back more than half a century. In this paper we briefly outline events leading up to the founding of the Observatory and discuss its construction, before summarizing highlights from the Observatory's stellar photometry program with the Zeiss 50-cm Edith Winstone Blackwell Telescope.

Stan also had a review article on Dual Maxima Miras published in the September issue of Southern Stars.

Walker, Stan. *Dual Maxima Miras*. Southern Stars, Volume 62, number 3. September 2023. p27

Abstract. This review covers one of Variable Stars South's projects, the study of Mira variable stars showing two maxima in each cycle. Available information is provided for each of the five known stars of this type and steps to check other suspected DM Miras are discussed. Fully transformed measures in V and B-V during the maximum 25% or so of the light curve will provide temperature values as will simple spectroscopy. Compared with the classical search for period changes which has shown less than ten positive changes in well over a century's observing this is expected to be more rewarding. It provides amateurs with a better way to study evolutionary aspects of Mira stars on a much shorter time scale

Phil Evans has two ArXiv articles published on exoplanets:

Hord B. J. et al. *Identification of the Top TESS Objects of Interest for Atmospheric Characterization of Transiting Exoplanets with JWST*. arXiv:2308.09617

Abstract. JWST has ushered in an era of unprecedented ability to characterize exoplanetary atmospheres. While there are over 5,000 confirmed planets, more than 4,000 TESS planet candidates are still unconfirmed and many of the best planets for atmospheric characterization may remain to be identified. We present a sample of TESS planets and planet candidates that we identify as “best-in-class” for transmission and emission spectroscopy with JWST. These targets are sorted into bins across equilibrium temperature T_{eq} and planetary radius R_p and are ranked by transmission and emission spectroscopy metric (TSM and ESM, respectively) within each bin. In forming our target sample, we perform cuts for expected signal size and stellar brightness, to remove sub-optimal targets for JWST. Of the 194 targets in the resulting sample, 103 are unconfirmed TESS planet candidates, also known as TESS Objects of Interest (TOIs). We perform vetting and statistical validation analyses on these 103 targets to determine which are likely planets and which are likely false positives, incorporating ground-based follow-up from the TESS Follow-up Observation Program (TFOP) to aid the vetting and validation process. We statistically validate 23 TOIs, marginally validate 33 TOIs to varying levels of confidence, deem 29 TOIs likely false positives, and leave the dispositions for 4 TOIs as inconclusive. 14 of the 103 TOIs were confirmed independently over the course of our analysis. We provide our final best-in-class sample as a community resource for future JWST proposals and observations. We intend for this work to motivate formal confirmation and mass measurements of each validated planet and encourage more detailed analysis of individual targets by the community.

Hagelberg, J. et al. *TOI-858 B b: A hot Jupiter on a polar orbit in a loose binary*. arXiv:2309.11390

Abstract. We report the discovery of a hot Jupiter on a 3.28-day orbit around a 1.08 MSun G0 star that is the secondary component in a loose binary system. Based on follow-up radial velocity observations of TOI-858 B with CORALIE on the Swiss 1.2 m telescope and CHIRON on the 1.5 m telescope at the Cerro Tololo Inter-American Observatory (CTIO), we measured the planet mass to be $1.10 \pm 0.08 M_J$. Two transits were further observed with CORALIE to determine the alignment of TOI-858 B b with respect to its host star. Analysis of the Rossiter-McLaughlin signal from the planet shows that the sky-projected obliquity is $\lambda = 99.3 \pm 3.8$. Numerical simulations show that the neighbour star TOI-858 A is too distant to have trapped the planet in a Kozai-Lidov resonance, suggesting a different dynamical evolution or a primordial origin to explain this misalignment. The 1.15 Msun primary F9 star of the system (TYC 8501-01597-1, at $\rho \sim 11''$) was also observed with CORALIE in order to provide upper limits for the presence of a planetary companion orbiting that star.

About

Variable Stars South is an international association of astronomers, mainly amateur, interested in re-searching the rich and under-explored myriad of southern variable stars.

Renamed from the Variable Star Section of the Royal Astronomical Society of New Zealand, it was founded in 1927 by the late Dr Frank Bateson, OBE, and became the recognised centre for Southern Hemisphere variable star research.

VSS covers many areas and techniques of variable star research, organised into projects such as Beginners' Visual Observations and Dual-Maxima Miras. The goal of each project is to obtain scientifically useful data and results. These may be published in recognised journals, or supplied to international specialist data collection organisations.

VSS is entirely an internet based organisation, working through our website <http://www.VariableStars-South.org> and its e-group <http://groups.google.com/group/vss-members>. It also encourages members to work in with major international organisations such as the British Astronomical Association, the Center for Backyard Astrophysics and the American Association for Variable Star Observers.

To find out more, please visit our website, where, incidentally, you will find PDF copies of all our newsletters. Our website has a great deal of information for VSS members, and for anyone interested in southern hemisphere variable star research. All VSS project information and data is kept here too.

Who's who

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Visit our website to see a list of our area advisers, and to find out about our projects and how to contact their leaders

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After you've joined and received your membership certificate, you will be signed up to the VSS-members egroup (see above), and you will also receive a password to access the members' areas of our website.

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These are welcomed and should be sent to the Editor (phil@astrofizz.com). I'd prefer Microsoft Word (or compatible) files with graphics sent separately. Don't use elaborate formatting or fancy fonts and please do not send your contribution as a fully formatted PDF file.

Publication dates are January, April, July and October, nominally on the twentieth day of these months and the copy deadline is the thirteenth of the month though earlier would always be appreciated.

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