`

ISSN 2631-4843

The British Astronomical Association

Variable Star Section Circular

No. 198 December 2023

Guy Hurst receives the British Empire Medal

BAA Office: PO Box 702, Tonbridge TN9 9TX

Contents

Cover Picture

Guy Hurst receives the British Empire Medal

Photo Allan Lorrain

See page 4 for details.

Back to contents

From the Director — *Jeremy Shears*

Variable Star Section Meeting

Variable star enthusiasts gathered in a gloriously warm and sunny Northampton on Saturday September 2. In spite of rail strikes, attendance was very high, with some people having braved tortuous journeys of up to 10 hours just to be there. It was wonderful to see old and new faces again. It was also great to be back at the Northamptonshire Natural History Society (NNHS) Humfrey Rooms, through the good offices of Nick Hewitt. He and his NNHS team made us feel very welcome. The agenda featured a superb line up of speakers and I would like to thank them all for their highly informative presentations.

VSS meeting speakers and organisers ***(image by James Dawson)*** *Left to right front row – Ian Sharp, David Conner, Phil Masding, Robin Leadbeater, Andy Wilson, David Boyd, Shaun Albrighton & John Toone. Back row – Gary Poyner, Jeremy Shears & Christopher Lloyd.*

A report by Ray Pearce appears later in this Circular and recordings of the talks can be viewed via the BAA website (https://britastro.org/event/variable-star-section-meeting-2) thanks to Andy Wilson.

Many thanks to Gary Poyner for organising the programme, Nick Hewitt and colleagues at NNHS for being such hospitable hosts and caterers, Andy Wilson for IT support, each of the speakers and, of course, the audience for attending.

Back to contents

We hope to hold the next VSS meeting during 2025, resuming our biennial schedule which was disrupted by the pandemic.

New visual observing milestone for Gary Poyner

Hearty congratulations to Gary for logging his 350,000th visual variable star observation on November 15.006. It was an observation of FO Per fading from outburst at 14.0.

Well done Gary for this remarkable achievement!

Guy Hurst, BEM

Guy Hurst was awarded the BEM in the King's Birthday honours in June in recognition of his contribution to astronomy over the years and in particular in his role as editor of The Astronomer (TA) magazine, since 1975.

Guy is, of course, also co-ordinator of the UK Nova/Supernova patrol, a joint effort of the VSS and TA, and a long-standing VS observer.

Regrettably Guy was not well enough to attend the official presentation and so arrangements were made for the Lord Lieutenant of Hampshire, HM The King's personal representative in the County, to present the medal to him at his home in Basingstoke.

Many congratulations to Guy, on behalf of the VSS, for this well-deserved award!

Guy Hurst, BEM and the Lord Lieutenant of Hampshire, Nigel Atkinson *(image by Alan Lorrain)*

Nova Vul 2021 (V606 Vul)

Many observers followed the eruption of V606 Vul which was discovered by Itagaki on 2021 July 16 and promptly confirmed as a classical nova by Robin Leadbeater who obtained a spectrum within a

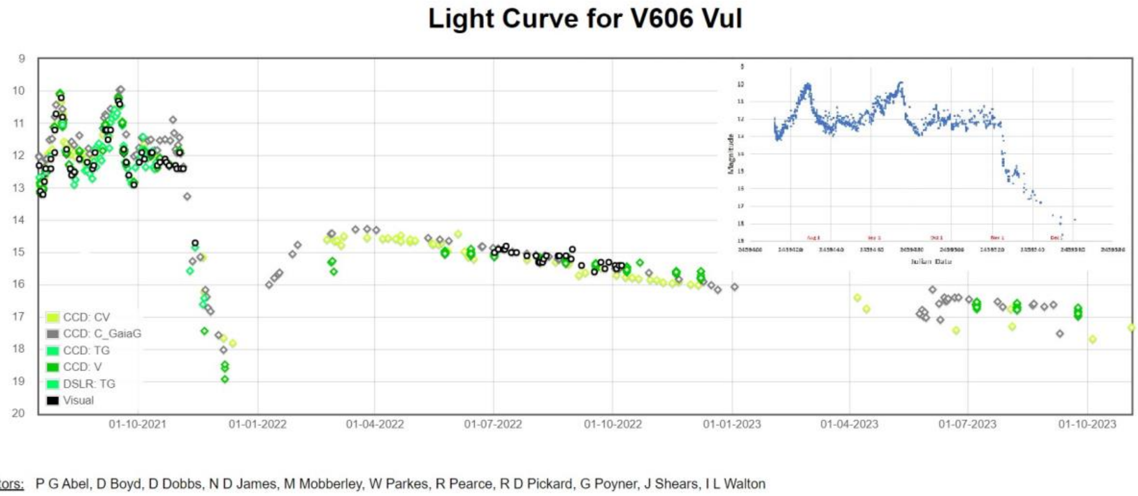
Back to contents

few hours of discovery. A paper recently submitted to the *Astrophysical Journal* (https://arxiv.org/abs/2311.04903) by Kirill Sokolovsky (Department of Astronomy, University of Illinois at Urbana-Champaign, USA) uses high precision photometry from *TESS* to study the nova at very high time resolution between days 9 and 36 of the eruption, supported by observations from amateur astronomers, including members of the Variable Star Section and the AAVSO.

V606 Vul was a slow, dusty nova and the paper presents evidence of an asymmetric photosphere during the plateau phase of the eruption and multiple mass ejections.

This is the first time that a nova eruption has been studied with such high precision over such a long period of time, showing what a powerful tool *TESS* is. However, the *TESS* observation window represents only a small part of the nova eruption which is why the authors relied on the global light curve generated by other ground-based observers. In fact, Sokolovsky's paper relies heavily on photometry and spectroscopy by amateurs, some of whom are listed as authors.

At the time of writing, the nova is just below magnitude 17, which is still several magnitudes brighter than before the eruption (g = 21). Further observations are encouraged.



Light curve of V606 Vul. The main plot shows data from the BAA VSS database. The inset shows an expanded view of the first part of the eruption from the 2022 August BAA *Journal*.

T CrB

Don't forget to keep monitoring the recurrent nova in the run up to its next eruption. Observers have been observing it in the evening and morning sky during November, but it will soon become a morning object.

Observing UGER systems

Don't forget the campaign, coordinated by Stewart Bean, to detect outbursts of UGER-type dwarf novae. These are frequently outbursting systems and the aim is to study variation of their supercycle lengths – the time between successive superoutbursts. Targets include **ER UMa** itself, **IX Dra**, **RZ LMi**, **V1159 Ori**, **YZ Cnc** and **DI UMa**.

Christmas and New Year wishes

With Christmas fast approaching, I would like to wish all readers a very merry Christmas and many clear skies to enjoy the variables during 2024 (surely it must be better than I've experienced in the second half of 2023!).

Variable Star Section Meeting
Northampton Natural History Society
September 2nd, 2023

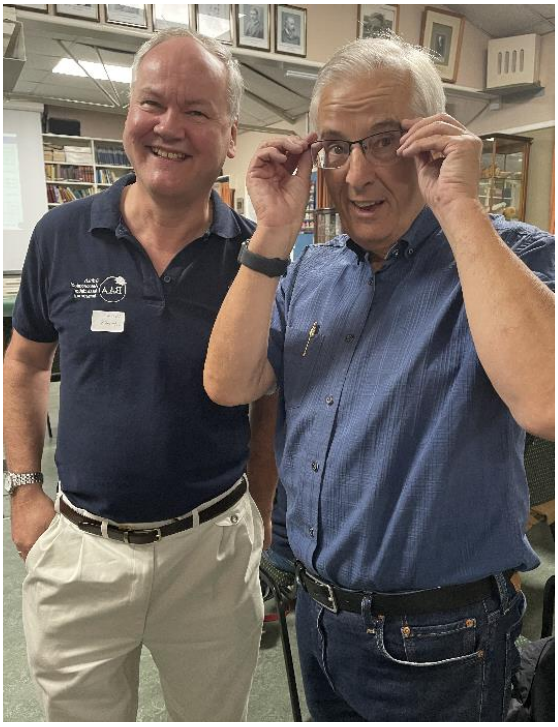
Ray Pearce

starman.rp@gmail.com

The first Variable Star section meeting since 2018 was held in Northampton, England on September 2nd 2023. Despite a train strike, 45 people attended and with nine varied topics, the day was a resounding success.

The BAAVSS were formally welcomed by Dr. Nick Hewitt of the Northampton Natural History Society, who said that he was happy to see the VSS back at Northampton, where they have had so many successful meetings in the past. The Director, Prof. Jeremy Shears, then welcomed the members to our first meeting since 2018. In his review of the intervening period, he reported that the section had sadly lost Ian Miller and Janet Simpson, but on a brighter note he offered congratulations to Roger Pickard who was awarded the Merlin Medal and Gary Poyner who received the Walter Goodacre Medal and to top off the list Guy Hurst, who was unable to attend, had been awarded the British Empire Medal in the Kings Birthday Honours list. Other achievements included John Toone reaching 200,000 observations in the database and Shaun Albrighton reaching 100,000.

Highlights in the observing field included the dimming of Betelgeuse, RW Cep rising to a new high, S CrB experienced its largest recorded amplitude, Nova Cas 2020, and RS Oph first outburst for 16 years. What next? T CrB is predicted to increase early to mid-2024 - watch this space.



Jeremy Shears & Nick Hewitt

Jeremy ended by thanking his fellow officers for their support and introduced the first speaker - David Conner

Observing Eclipsing Binaries With Online Telescopes - David Conner

David began by briefly outlining his methods of establishing accurate timing of maximum eclipse, he then described his use of a remote telescope, the Bradford Telescope later renamed COAST, which is a 17” Dall Kirkham, its advantages being better skies, less light pollution, but it also has a weakness in that observations are logged but will be executed at a time to suit the optimum observing sequence for the telescope. This can be overcome with time by scheduling the same stars frequently and then folding the light curve at the known period, known as a phase diagram, which will produce a measurable light curve from the scattered observations. David then showed a number of light curves produced by this method and explained the circumstances causing the variation in shapes of the different curves.

David Conner

What Can Eclipse Timings Tell Us - Dr Christopher Lloyd

Chris began by explaining that light curves of eclipses which can provide physical data about the stars involved which is not possible for single stars, and that eclipse timings can also provide data on period changes in the interaction. He then described the changes in sun-like stars as they approach the end of the main phase of their life including shell burning and helium flashes and showed how the curves varied depending on the masses involved. The rate of mass transfer reduces as they approach equality and at this point it starts to increase again. Period changes can be caused by stellar evolution, light travel time, eccentricity in the orbits causing precession, magnetic effects causing loss of angular momentum and even the possibility of a third body in the system.

Chris Lloyd

Mira Variable - A Short Overview - Shaun Albrighton

Shaun described his work on pulsating stars, mostly with binoculars and primarily Mira type stars. Why observe Mira stars? They are easy to observe and have large amplitudes, up to ten magnitudes in range.

Miras are highly evolved stars in their shell burning phase and are pulsating with self-sustaining periods. We were then shown light curves of various Mira stars and how the shape of the curve can be interpreted. Miras are under-observed to some extent and would benefit from more coverage as some have shown substantial period changes.

Shaun Albrighton

Modelling Pulsating Stars - Phil Masding & Robin Leadbeater

This double act was led off by Phil Masding who is a keen imager and has a background in mathematical modelling, consequently becoming interested in modelling of the behaviour of short period pulsating stars. Sir Arthur Eddington suggested that a shell in the star's envelope is not fully supported and falls inward compressing and heating the inner material which then heats the shell and pushes it out again. Modelling can divide the star into many layers and computers can then calculate the changes for each layer.

Phil Masding & Robin Leadbeater

Robin Leadbetter then described his part in the process which was to measure the radial velocities involved using spectra that he obtained which needed to be done to an accuracy of 2km/sec, which is the equivalent of one fifth of a pixel. The velocity is measured by a process called cross correlation. He then showed a number of curves produced by this method.

Phil then explained how he used the radial velocity data produced by Robin in the mathematical model he had constructed to produce pulsation curves. Modelling can then explain the shape and structure of light curves and radial velocities.

After an excellent light lunch generously supplied by our hosts the afternoon session commenced with Gary Poyner taking the afternoon session and introducing Rob Januszewski and a mystery object.

Ian Miller's PEP - Rob Januszewski

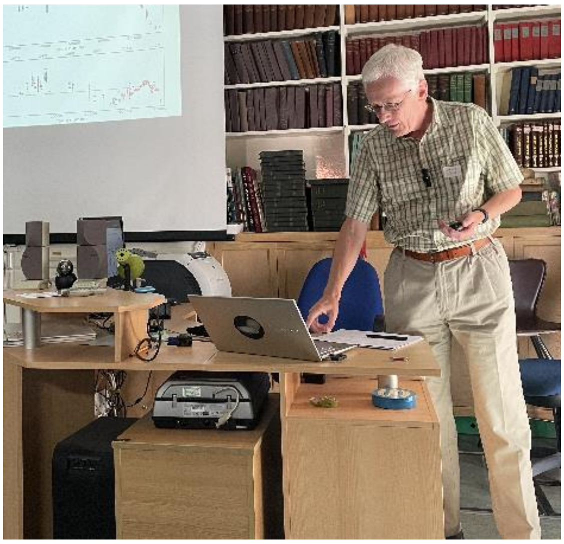
Rob showed us an instrument from the late Ian Miller's collection which was unidentified at first sight, however subsequent investigation showed it to be a home built photo-electric photometer.

In 1912 Paul Guthnick first showed that photo-multiplication could produce a visual image. A photomultiplier works to increase the strength of a signal and this revolutionised photometry but the process of obtaining the data was complex. A short discussion followed on whether it would be possible to get the instrument working again but because of the very high voltages involved it was deemed too dangerous to try, but the instrument will be retained as part of the section's history.

Rob Januszewski with Ian Millers PEP

<u>The Standard CV Evolution Model May Not Be The Whole Story - Dr. David Boyd</u>

David began by outlining the process which has been characterised as the standard model i.e., in a binary system mass from the secondary body transfers to the primary but the conservation of angular momentum means the transfer is not directly to the primary but via an accretion disc. This process continues until the reducing orbital period reaches the period gap.



David Boyd

A sample of twenty stars have been carefully monitored and it was found that less than half of the sample followed the reducing orbital period path, with some even showing increasing orbital periods, two stars showed bizarre erratic drops and two others showed abrupt changes in previously stable orbits. David is currently in communication with Professor Brad Schaefer regarding this work.

OJ287 - Dr Mark Kidger

Gary then welcomed Dr. Mark Kidger who recently retired from his post at ESA. Unfortunately, he could not be with us in person but with the help of Andy Wilson he was able to join us via the internet and Zoom.

Mark told us he has been observing OJ287 for about 40 years and it is a fascinating object which can vary as you watch.

Aimo Sillanpaa, an astronomer at Turku University in Finland built a light curve from a plate collection which seemed to him to show eclipses. However, Prof. Mauri Valtonen could not see an eclipse and instead advanced the idea of a small black hole in a precessing orbit around a much larger black hole with a period of 11.87 years. His latest model describes a primary black hole of 18 billion solar masses and a secondary black hole of 100 million solar masses. The secondary passes through the primary's accretion disc twice on each orbit which produces an increase in brightness. Unfortunately, the outburst forecast for 2019 was during solar conjunction and was not visible from Earth. However, the Spitzer telescope was able to see it and measured the outburst to be within two and a half hours of the prediction.

During winter 2022/2023 there was a change of character, a series of outbursts were noted at intervals of about seven days and it seems the accretion disc's surplus material is ejected into a relativistic jet travelling at 20-30% of light speed and the outbursts may have been shocks.

Sequence Files - John Toone

The BAA VSS is the only organisation to process and align long term visual photometry. Since 2022 charts and sequences have been updated and now use V band photometry for comparisons. John gave us a brief history of the sequence files starting originally with using ASV and Harvard scales but there were some large disparities, and from 1907 the Harvard scales were used with Hagen as a reserve. We are now able to recalculate results where original estimates were used. For the future all comparison stars are going to be updated hopefully eliminating errors, and data will be recalculated and aligned with modern V band photometry.

John Toone

It is recommended that observers should use BAA VSS charts wherever possible otherwise use AAVSO charts without magnitudes and use the BAA VSS sequences.

Back to contents

PCEB variables and a medley of software tools - Ian Sharp

Ian Sharp

Ian Sharp is a member of the Altair Group which was formed in 2010 and which he joined in 2019, their aim being to monitor a set programme of variable stars frequently to try and detect exoplanets by eclipse timing. So far none have yet been detected but the results have shown serious issues with several predicted models. He then outlined several software programs developed and used for their specific needs e.g., entering observations, scheduling observing sessions and photometry. We were then shown examples of light curves produced by the software and derived from their observations and the methods they used for determining the parameters of the curves such as points of ingress and egress from eclipse as well as the time of mid eclipse.

This concluded the afternoon session and at this point the Director thanked all of the speakers for their contributions to what had been a most interesting and wide ranging meeting that demonstrated the scope of the interests and expertise our section contained. He then thanked Andy Wilson for keeping the technical side running smoothly and, of course, the members for attending. Finally, he thanked the Northamptonshire Natural History Society for their hospitality and the efforts put in by their members in providing refreshments throughout the day.

Photo's James Dawson & Gary Poyner

CV & E News

Gary Poyner

garypoyner@gmail.com

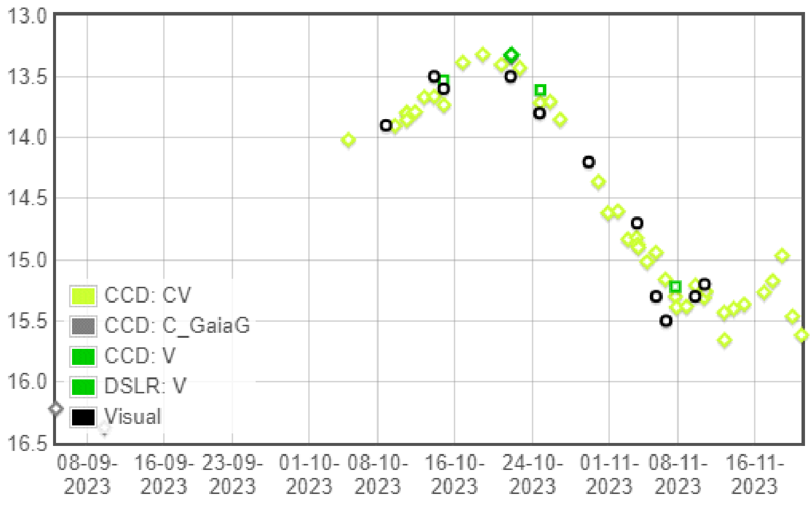
News of current activity in CV and eruptive stars on the BAAVSS programme, include the post nova CV V1363 Cyg and the RCB stars V742 Lyr and R CrB.

V1363 Cyg

This post nova CV was detected in a bright outburst on Oct 5.036UT at magnitude 14.02C, with the Open University PIRATE telescope. The outburst peaked at magnitude 13.2 visual on October 20, making this the brightest outburst yet seen in this system. The previous brightest outburst occurred in 2011 and was in comparison around 0.5 magnitudes fainter than in October 2023.

The profiles of the current and 2011 outbursts are showing a close similarity – a slow decline by 2 magnitudes taking on average 20d, before a pause followed by several small amplitude rebrightenings. Quiescent levels are variable in brightness throughout the history of the light curve (by around 1.5 magnitudes) for V1363 Cyg, but if a value of 16.5 is taken as a 'mean' quiescent level, then the 2011 outburst lasted ~150d. At the time of writing (November 2023), the current outburst has lasted 50d, and remains active around 15.0-15.5 magnitude with two short rebrightenings occurring during November. Observers are asked to continue to monitor for as long as possible. BAAVSS data goes back to 1990, with few positive observations for the 1990-2000 period (mainly visual), after which CCD interest in this interesting system seems to have taken off (Figures 1 and 2).

V1363 Cyg is classified as type N+UG in the AAVSO VSX, with a magnitude range of 13.1-18.0V [1]. Originally classified as type UGZ, the light curve displays no evidence for the characteristic 'standstill' evident in this subgroup and has correctly been reclassified as N+UG in VSX.



It's 'Post Nova' description comes from the IPHAS survey [2] searching for nova shells around CV's, which states that there appears to be tentative evidence for a "faint egg shaped shell of emission ~2 arcmin diameter, centred on the CV" [3]. Interestingly, the first two CVs to have nova shells confirmed were Z Cam and AT Cnc – both UGZ stars.

Figure 1: The current outburst, October 5 - November 22, 2023 Observers: G Fleming, ND James, D Mathews, G Poyner, GJ Privett, IL Walton. BAAVSS database.

Back to contents

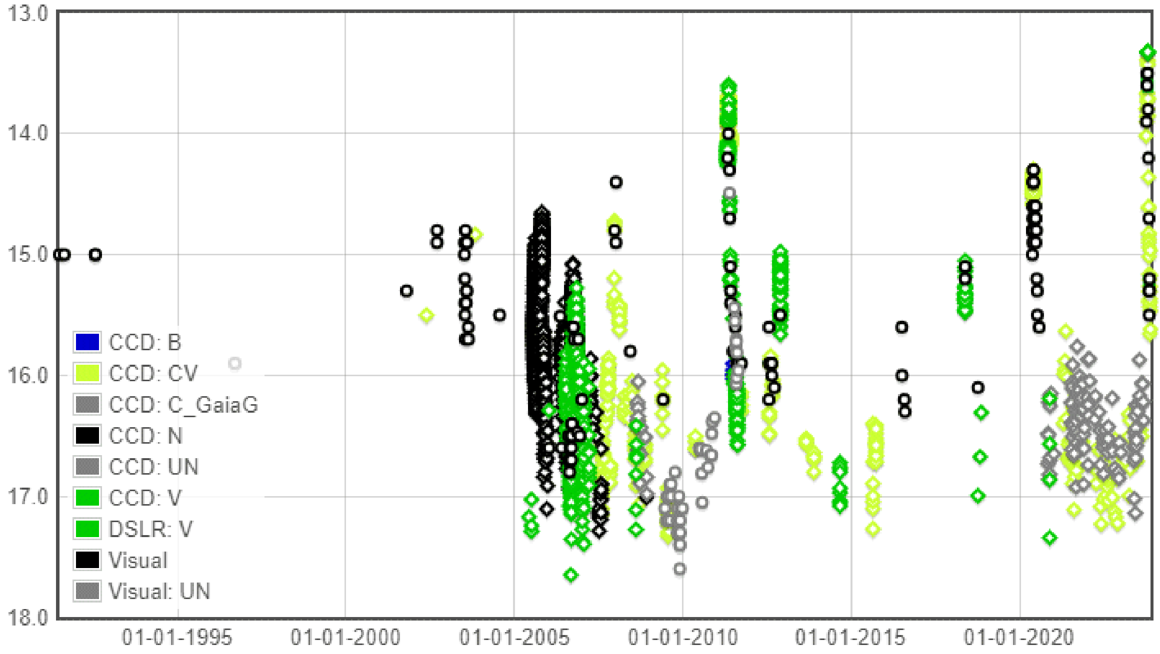


Figure 2: V1363 Cyg 1990-2023. Observers: D Boyd, G Fleming, ND James, S Johnston, CP Jones, JH Mallet, D Mathews, I Miller, M Mobberley, RD Pickard, G Poyner, GJ Privett, GW Salmon, J Shears, RH Tremblay, IL Walton, PB Withers. BAAVSS database.

V742 Lyr and R CrB

The RCB star V742 Lyr is currently undergoing its first fade since the long, historically deep fade of 2020-2021, which lasted 16 months and reached magnitude 19.4C at minimum [4]. The fade was detected during early November, and at the time of writing, had slowly faded to 14.7C by November 20. (Figure 3). Observers are asked to monitor this generally under-observed star for as long as possible in the evening sky, and to attempt early 2024 observations in the morning sky if possible.

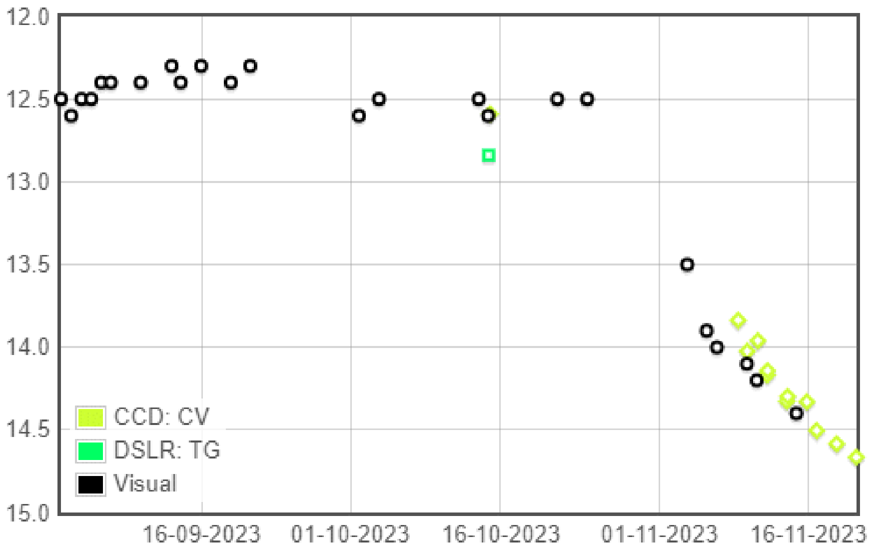


Figure 3. Early stages of the 2023 fade of V742 Lyr. Observers: W Parkes, G Poyner, PB Withers. BAAVSS database.

First mentioned in the last VSS circular (VSSC 197, September 2023), R CrB began a fade in May 2023, which resulted in a minimum of magnitude 10 being reached. The recovery stalled in August for about a month before a slow recovery resumed, and now in the third week in November, R CrB is just below magnitude 6.0 (Figure 4). The number of observations being reported at this time have naturally reduced as the field for R CrB becomes more difficult to observe in the evening sky, but R CrB is now also visible in the early morning sky before sunrise, so please continue to monitor over the coming months if possible.

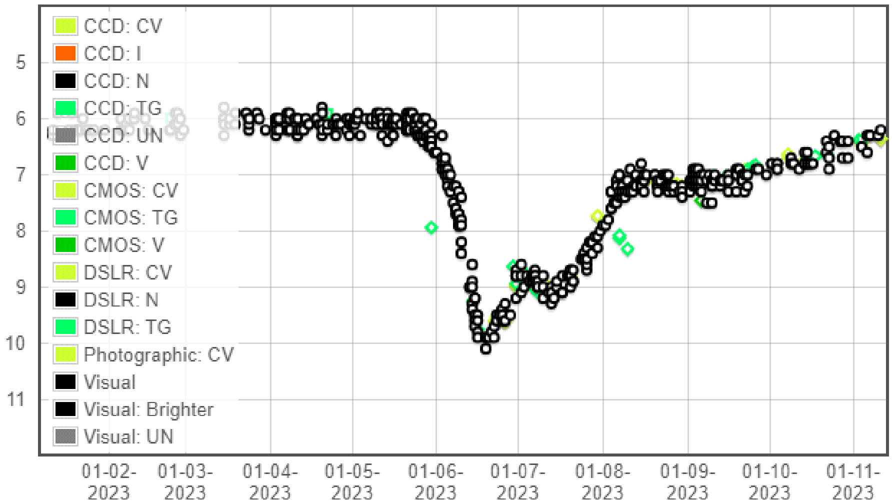


Figure 4. The Summer 2023 fade of R CrB and it's recovery. Observers: SW Albrighton, LK Brundle, TL Heywood, J Hilder, PC Leyland, H Meyerdierks, W Parkes, R Pearce, G Poyner, AR Pratt, JD Shanklin, J Shears, D Shepherd, J Toone, T Vale, PB Withers, WJ Worraker. BAAVSS database.

References

1. AAVSO VSX

2. IPHAS survey (iphas.org)

3. Searching for nova shells around cataclysmic variables. D.I Sahman et el, MNRAS 451, 2863-2876 (2015)

4. BAAVSS Circular 188, June 2021

Nova T CrB – 1866 and 1946

Tracie Louise Heywood

tracieheywood832@gmail.com

Many people will be watching out for the next outburst of the recurrent nova T Coronae Borealis, which is expected to occur before the end of 2024. In contrast, few were monitoring it at the time of its first recurrence in 1946. Hidden away in the 1946 April BAA Journal is this article by BAA member N F H Knight, one of the first observers to spot T Coronae Borealis in outburst on the morning of 1946 February 9th.

Nova (T) Corona; Borealis 1866 and 1946

By N. F.H. Knight

PREVIOUS HISTORY

The earliest record which can definitely be established of the remarkable nova-like object, Nova (T) Corona; Borealis 1866, was made in 1855 by Schonfeld at Bonn while assisting in the work of compiling that great star atlas, the Bonner Durchmusterung (1). The star is catalogued as BD+26o2765, of magnitude 9.5, which is only slightly brighter than the mean minimum value which has since been found for it. At that time, however, there was- no reason for supposing that the star was a variable at all; such a recognition of it came only as a result of its sudden and unexpected outburst in 1866, when for a few nights it appeared as a brilliant naked-eye object, which earned it the name of the "Blaze Star". It was first discovered on 1866 May 12, at about midnight, by Birmingham at 4m.0, in Ireland, and had then already reached the 2nd magnitude. Its rise must have been extremely rapid, for Schmidt, the Director of the Athens Observatory at that time, stated that he had been observing in the region of the star on the very evening of its appearance as a conspicuous object, and he felt convinced that it could not have been as bright as 4m.0 even two hours before Birmingham discovered it. But its temporary brilliance was of very short duration, and its subsequent decline unusually swift for a nova; for a week later it had fallen to the 6th magnitude and continued to become fainter until reaching its original 9m.5 only a month after the outburst. This was soon followed by a slight revival in mid-September of the same year, when the star increased fairly quickly to the 7th magnitude, remained brighter than the 8th magnitude for over a month, and then fell back slowly to about 9m-5 again by the early part of 1867. Thereafter the decline continued very slowly and with slight irregularities, until by 1871 the star had reached 10m.0, in the neighbourhood of which its light has probably remained almost stationary up to the time of the recent recurrence of activity. During this long interval of minimum small fluctuations in brightness were at one time detected photographically at Harvard (2); while Dr. Steavenson, observing the star visually for some years, also recorded very small changes between 9m.9 and 10m.2 (3), though he found that for the most part "the object appears to be sensibly constant in brightness " (4). The history of the star's spectrum is an interesting one. At the 1866 maximum, bright lines, chiefly of hydrogen, were seen by several observers, among whom Dr. Huggins remarked in addition that certain similarities with the spectrum of Betelgeuse appeared to be indicated. This accords with later observations of the post-maximum spectrum, made early in the present century, which clearly showed that by then the star's spectrum had settled down to one of type M; this was also the classification found for it as recently as 1932 (5). There is no doubt that T CrB, at minimum at least, is a red star; and since this is unusual for an ex-nova, it has been suggested that the star may be a double object, the brighter component being a red giant giving the M-type spectrum, and the fainter component a blue star which is actually the one responsible for the nova outburst. This would imply that the amplitude of the light change is really greater than it appears and would make it agree more closely with the average observed amplitudes of rapidly brightening novae, in which category T CrB certainly gives evidence of belonging. Moreover, Payne-Gaposchkin and Gaposchkin (6) have found that the star's mean light-curve for 1866, when corrected for the presence of a 10th-magnitude companion, bears a strong resemblance to those of Nova Auriga; 1892 and Nova Herculis 1934. It is thus clear that the concept of duplicity is capable of explaining many of the anomalous features found in the behavior of T CrB. But the theory has no bearing upon two other important peculiarities about the star: (a) its high galactic latitude of about +46d, which is considerably greater than the average value for novae occurring in the stellar system; and (b) the fact that, unlike the majority of ex-novae, it has not been observed in association with nebulosity of any kind, although Harvard photographs did once disclose the presence of a faint irregular nebula at about 5' from the Nova (7). Could this possibly be the matter ejected at a former outburst, and the star has since left it behind in space?

RECENT RECURRENCE

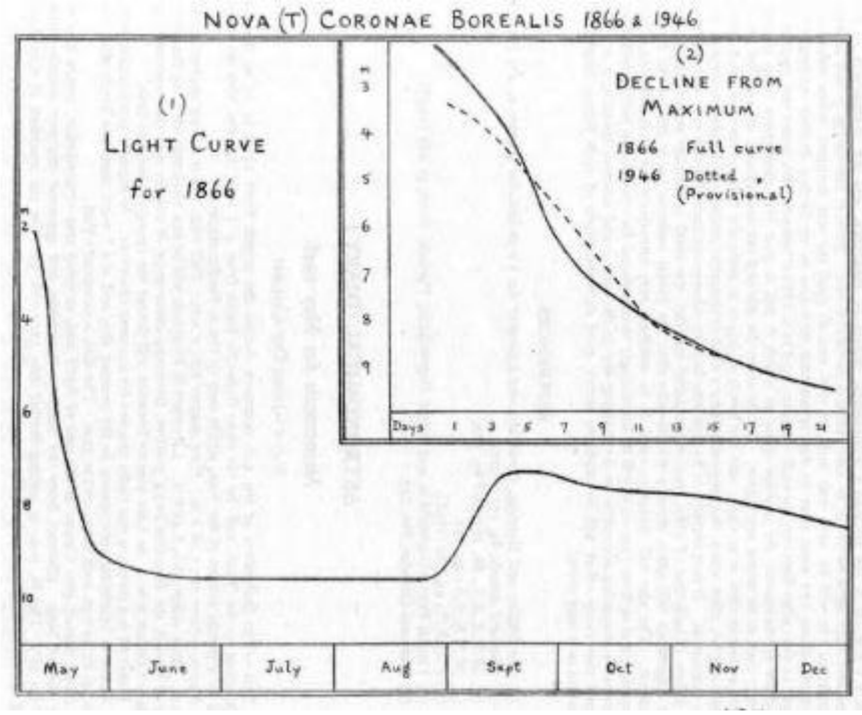
The exact time at which the star again rose to naked-eye visibility after an interval of nearly eighty years, and the maximum magnitude which it attained on this occasion, are not known for certain. It was first seen as of the 3rd magnitude, and naked-eye discovery thereof was made by the writer on 1946 February 8d 17h 40™ G.M.A.T (= 1946 February 9" 5h 40m U.T.) while in the act of pointing a small hand telescope of if inches aperture towards the constellation Corona Borealis for the purpose of making an observation of the well-known variable star, R CrB. A little later the following observation of the Nova was recorded:

Date and Time (G.M.A.T.)	Julian Date	Sky	Instrument	Class	Comparisons	Magnitude
1946 Feb. 8^d 18^h 15^m	2431860·736	1	Naked eye	1	ζ Her − 4 δ Her (1) v (1) η Her	3·40

Remarks.—Early dawn, but sky very clear and conditions excellent for naked-eye observation; colour of Nova appeared orangish.

Identity with the 1866 object was at once suspected on account of the apparent similarity of positions; and at the earliest possible opportunity the Royal Observatory, Greenwich, was fully informed of all the details relating to the discovery of the Nova, including its supposed identity, which was afterwards confirmed in writing by the Astronomer Royal. The following night the star was again seen at the 3rd magnitude by the Yerkes Observatory, U.S.A., who reported that a spectrogram which they obtained indicated a velocity of expansion of 4000 kilometres per second. The subsequent decline in brightness has been only slightly less rapid than in 1866. Two nights after discovery the magnitude had fallen to about 3.8, and on the third night to about 4.2. The star became invisible to the naked eye about one week after its first appearance, and probably reached 7m.0 on February 17 and 8m.0 on February 19 or 20. Now, at the end of February, the magnitude has fallen to about 9m.0, and the speed of its further decline is becoming more gradual as approach is made to normal minimum brightness again.

The accompanying diagram shows (1) the full light-curve for 1866, including the small revival of brightness in the autumn of that year, to which reference has already been made; and (2) a comparison of the declines from maximum in 1866 and 1946 respectively: the horizontal scale is here increased five times compared with that of the full 1866 curve, the vertical scales being the same in each case.



The 1946 curve, shown as a dotted line, is at the moment necessarily of a provisional kind; but as it is drawn from recent observations made by members of the B.A.A.V.S.S., it is not without a considerable degree of reliability, and the comparison of the 1866 and 1946 light-curves is to that extent a justifiable one. Several interesting points emerge therefrom. It will be seen that both in 1866 and in 1946 the star dropped below naked-eye visibility about one week after its first appearance, and also in its further decline reached 8m.0 about 11 days after discovery on each occasion; and as in 1866 it was probably about one magnitude brighter at maximum, the average speed at which it fell in that year must have been slightly greater than at its recent apparition. But between the 4th and 6th magnitudes the star fell about twice as fast in 1866 as in 1946; and the result of this is to make the two curves cross each other at about 5m.0, after which they appear to take a slightly different course and finally coalesce at the 8th magnitude. It now remains to be seen whether the subsequent curve for this year will continue to follow closely that of 1866, and in particular whether the small temporary restoration to the 7th magnitude will again occur a few months after the initial outburst, as it did on the former occasion. The star will therefore need to be watched very attentively for a considerable time to come; and as from now on it will be increasingly better placed for observation before midnight, afterwards becoming accessible in the evening sky in the spring and summer months, it is to be hoped that every effort will be made to secure good determinations of such future magnitude changes as it may reveal.

REFERENCES

(1) See Miiller and Hartwig, Geschichte und Literatur der Veranderlichen Sterne, 2, 435 (1920)·
(2) Harvard Annah, 84, 151 (1920).
(3) M.N.R.A.S., 86, 366, and 87, 570.
(4) M.N.R.A.S., 92, 720.
(5) P.A.S.P., 44, 318 (1932)-
(6) Cecilia Payne-Gaposchkin and Sergei Gaposchkin, Variable Stars, p. 263 (1938).
(7) Harvard Circular, No. 247.

Recent observations of Mira variables on the BAAVSS programme. 1

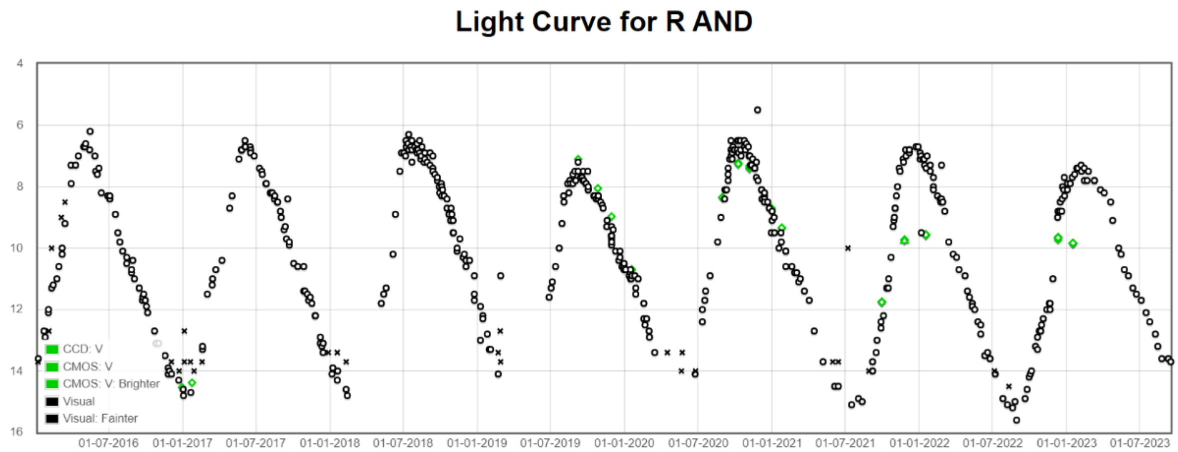
Shaun Albrighton

shaunalbrighton93@gmail.com

In this first part of a series of articles, we look at the activity of 11 Mira variables since 2016. Observations during this period show interesting behaviour, including an instance of a record maxima, in the case of W And.

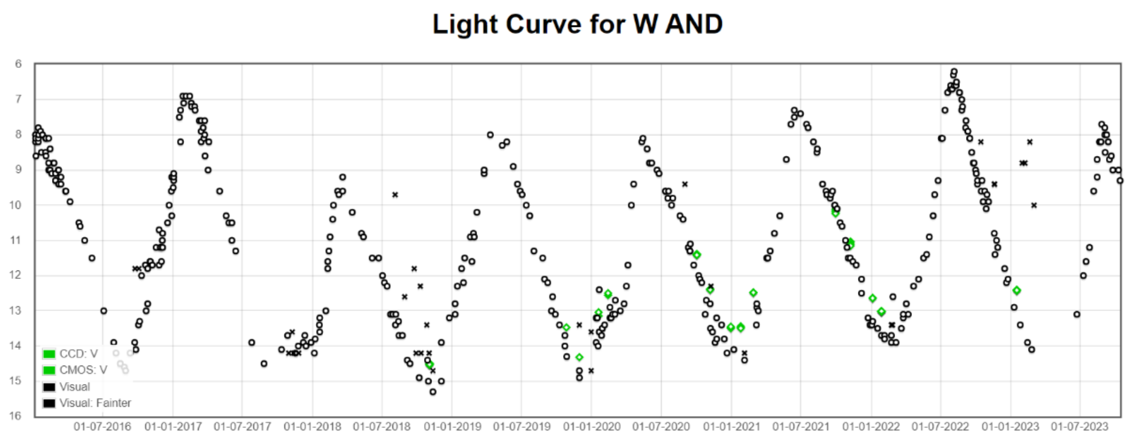
R And

VSX [1] lists the extreme range as 5.8-15.2V, P=409.2d, Sp S3,5e,8e (M7e), Rise 38% (155d). Observations since 2016, confirm the extreme range of over 9 magnitudes. Due to lying near to the ecliptic, R And can be difficult to observe, particularly when minimum occurs in Apr/May.



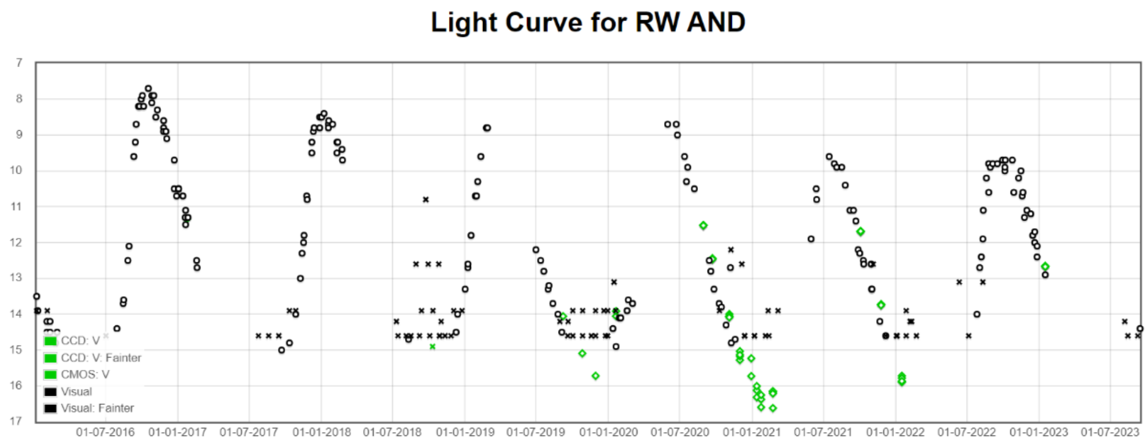
W And

VSX Range, 6.7 - 14.6, Period 397.3d, Sp S6,1e - S9,2e. Rise 42% (162d). It will be noted from the plot below, that there is clear variation in both maximum and minimum. Of note are the faint maximum in 2018, where W And did not reach 9th mag, which compares to the very bright max of approx. 6.5 in 2022. Interestingly the star experienced a faint minimum of approx. 15th mag, in 2018, following the faint max, compared to 14th in 2022, prior to the very bright max.



RW And

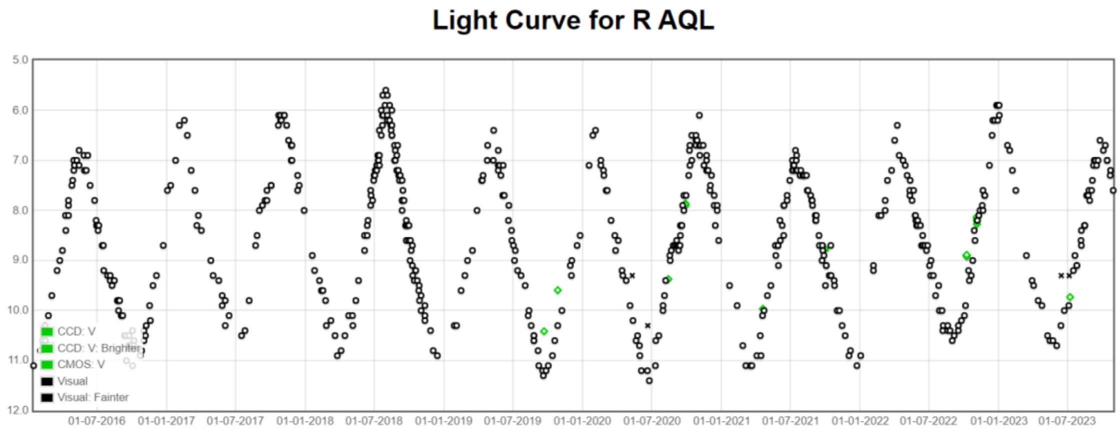
VSX Range 7.9 - 15.7V; Period 430d, Sp M5e - M10e(S6;2e). Rise takes only 36% (114d). This rapid rise is clearly seen on the plot below. Observers are encouraged where possible, to follow RW And during minima, which has not been observed visually. Please note the V Band observations in 2021 recording minimum at 16.8.

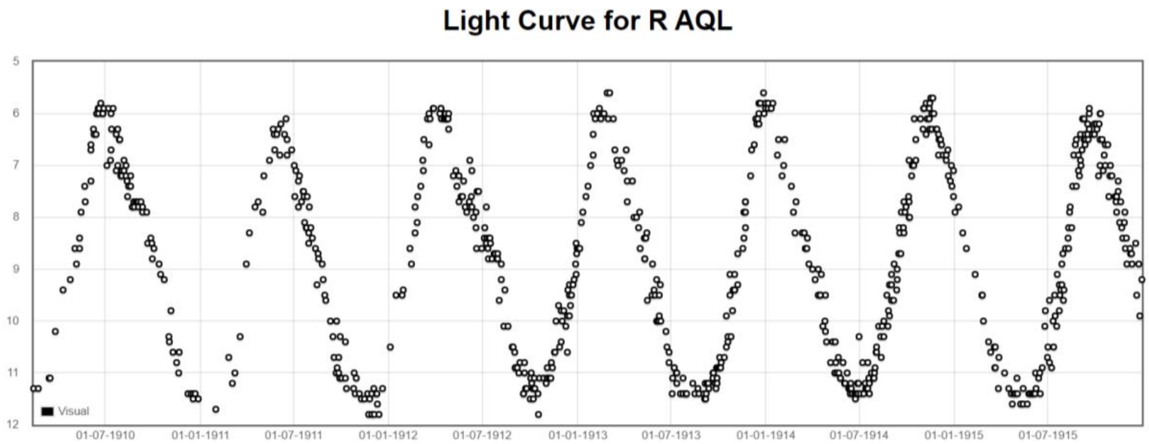


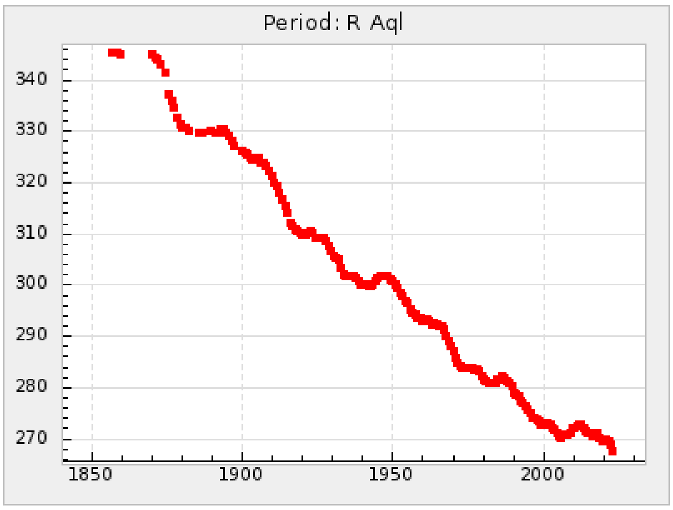
R Aql

VSX Range 5.5 - 12V, Period 270.5d, Sp M5e - M9e, Rise 42% (114d). Below are two plots for R Aql, one recent and the other covering a period in the 1920s. What becomes obvious is that the period has dramatically reduced over this period of time. Also plotted are plots of Period v Time [2], for a selection of three Mira variables in Aquilae. Whilst all Mira's show some variation in period, this is normally either random in nature, or cyclical. In the case of R Aql, it is clearly seen that the period has consistently reduced from about 346d in 1870 to a current value of below 270d.

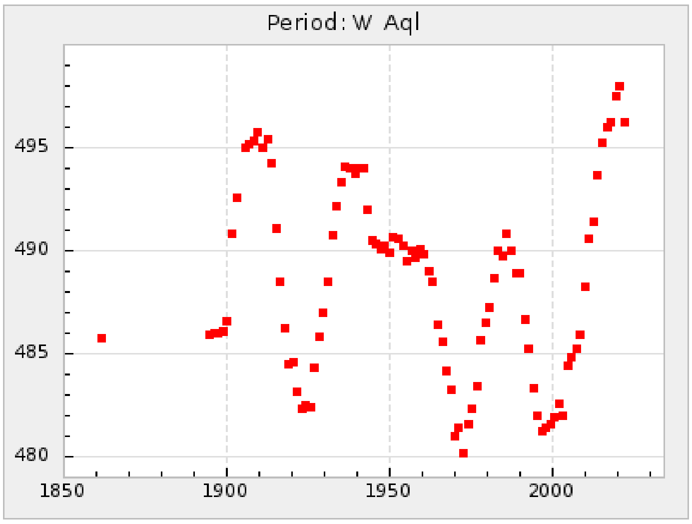
Observers are encouraged to observe R Aql, to monitor future behaviour and evolution of this star.



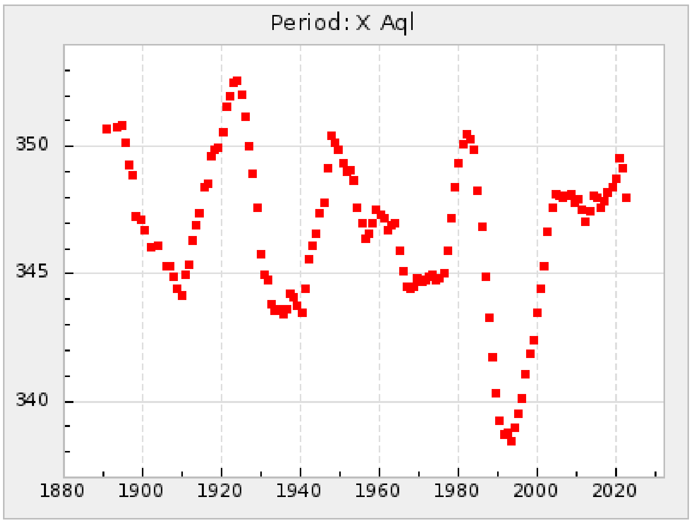




Mean period: 298.83, Mean epoch: 2443129.6
GCVS period: 284.2, GCVS epoch: 2443458
GCVS spectral type: M5e-M9IIIe



Mean period: 487.95, Mean epoch: 2439043.1
GCVS period: 490.43, GCVS epoch: 2439116
GCVS spectral type: S3,9e-S6,9e

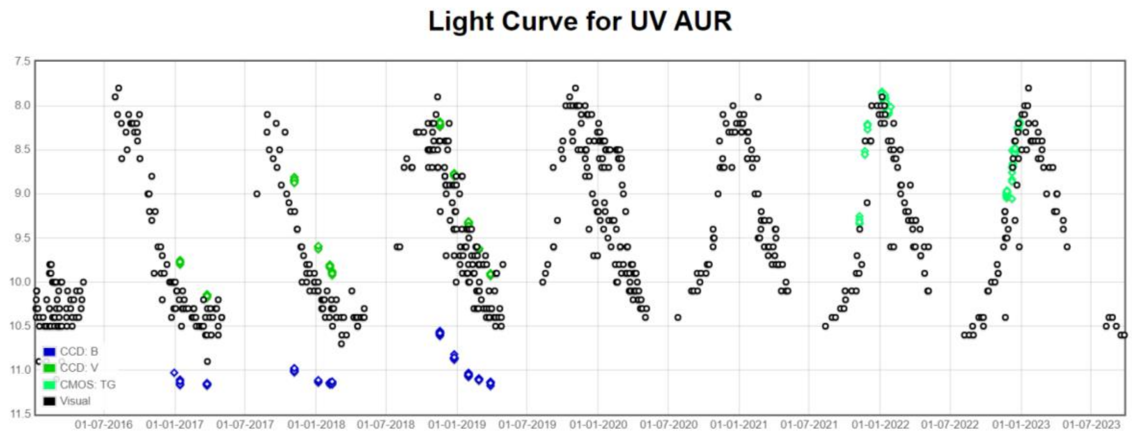


Mean period: 346.32, Mean epoch: 2441467.8
GCVS period: 347.04, GCVS epoch: 2441487
GCVS spectral type: M6e

Back to contents

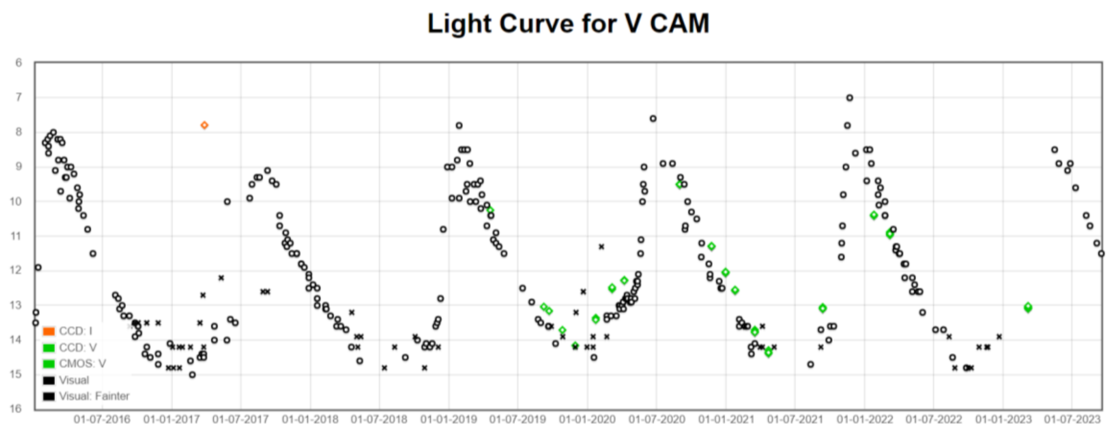
UV Aur

VSX Range 7.3 - 11.1V, Period 393.7d, Sp C6, 2 - C8, 2 Jep (Ne) + B9V. UV Aur has a mag 11 comp at 3.4”, so this is taken into account when the VSX lists the minimum magnitude for the star. Being a carbon star, means that it appears very red, as such there is a larger scatter than normal, depending on the observer’s sensitivity to red light. During the period, UV Aur appears to have varied visually in the range 8.0 - 10.5.



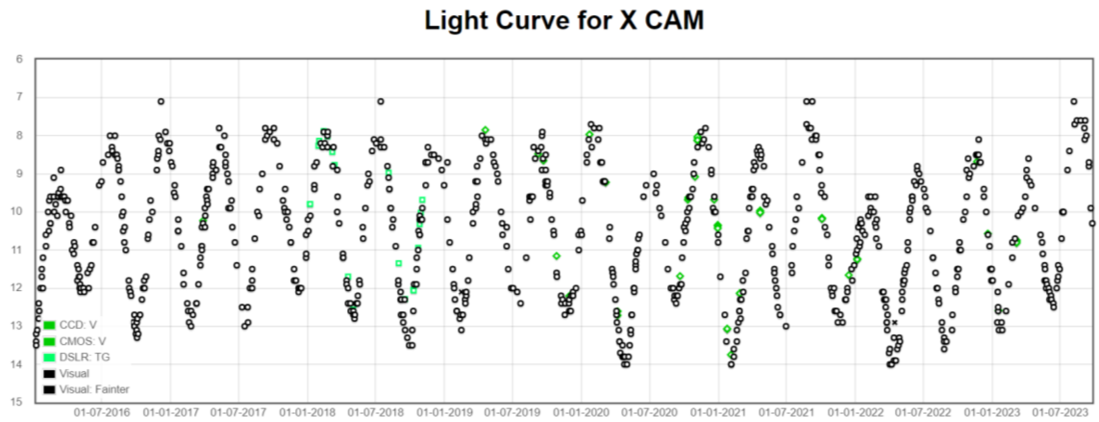
V Cam

VSX Range 7.3 – 16V, Period 516.3d, Sp M7e. Rise 32% (165d). The plot below clearly shows the fast rise to maximum, occupying less than a third of the period. Also note that whilst maxima seem to be in the VSX range, minima have appeared brighter in visual at around 15th magnitude.



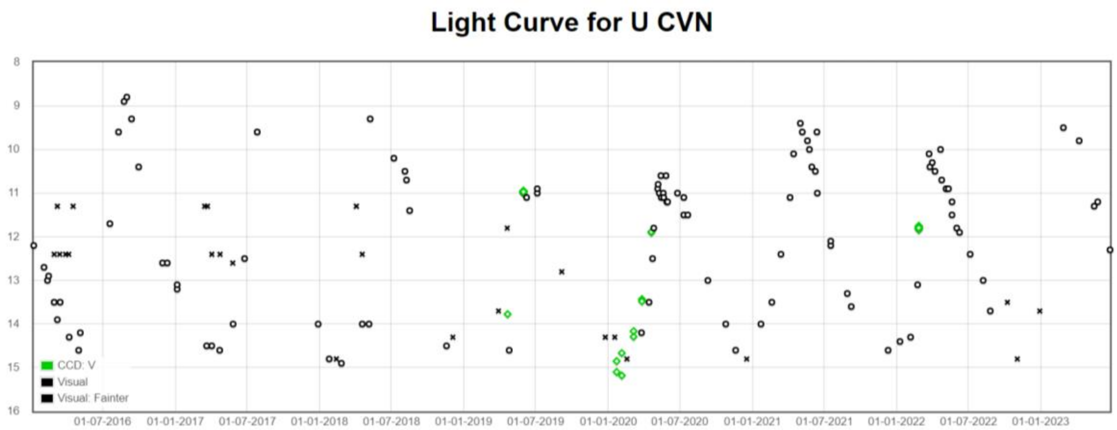
X Cam

VSX Range 7.1 – 14.3V, Period 143.56d, Sp K8, M8e. Rise 48% (70d). X Cam is a short period Mira and true to form has a more symmetrical light curve. It is the brightest K type Mira known. Note the range in both maxima and minima, in particular the faint max, 9.6 in 2022 which was preceded by a bright max at approx. 7.1.



U CVn

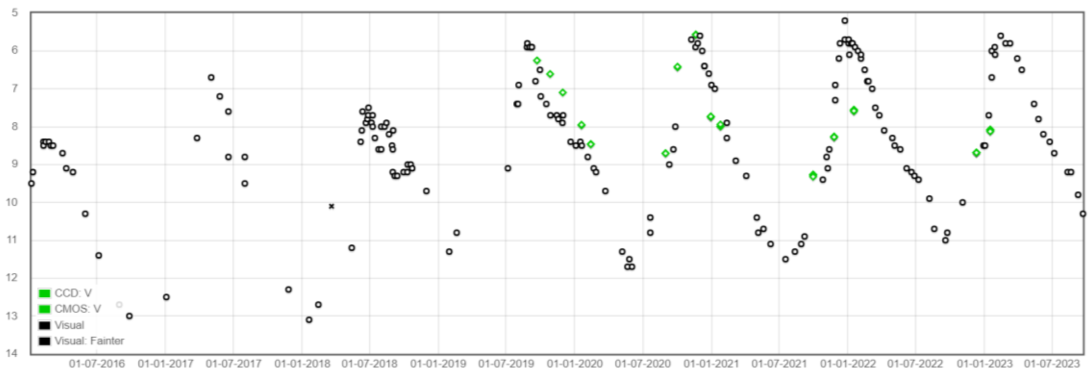
VSX Range 9.0 – 16.1V, Period 345.65d, Sp M7e. This fainter under observed Mira, deserves more attention. Maxima seem to vary between approx. mag 9.0 and 10.9. Minima, whilst sometimes missed, appear to be around 15th magnitude.



R Cas

VSX Range 4.7 – 13.5V, Period 430.46d, Sp M6e – M10e. Rise 40% (172.18d). R Cas is a bright Mira variable, which can reach naked eye visibility. It was dropped from the BAAVSS programme, along with others in the 1970s, but was re added as it became apparent that the star was still popular with some observers and that long term monitoring of Mira stars was essential to understanding their evolution. Of note is the faint maximum in 2016 and the wide range in both max and min.

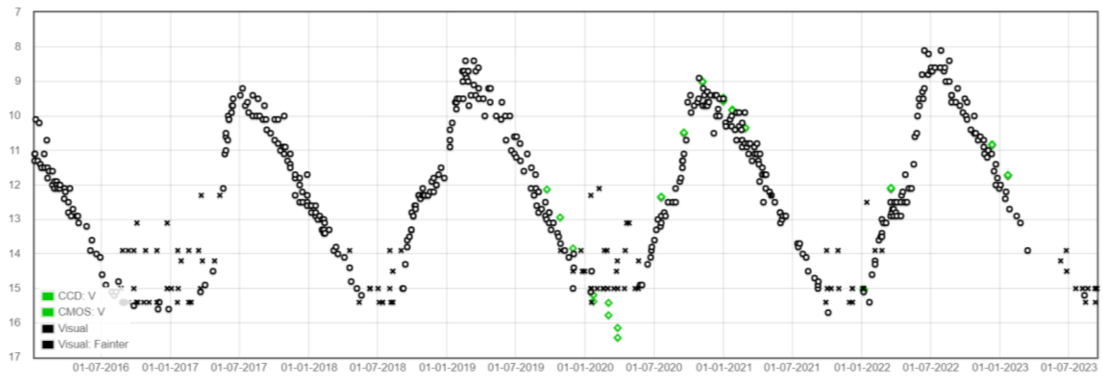
Light Curve for R CAS



S Cas

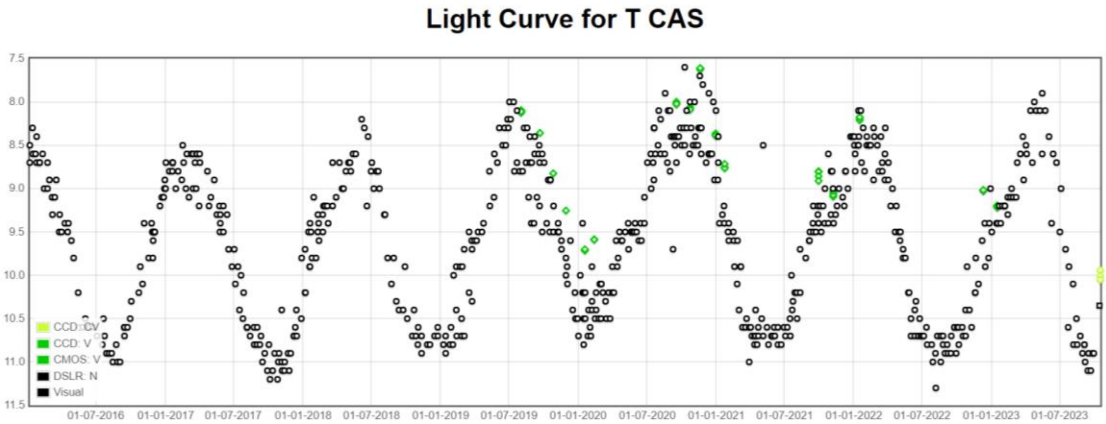
VSX Range 7.9 -17.3, Period 608.2d, Sp S3,4e – S5, 8e. Rise 43% (262d). This long period Mira is difficult to follow visually at/near minimum due to its faintness. This would be a worthwhile addition for observers using CCD V.

Light Curve for S CAS



T Cas

VSX Range 6.9 - 13V, Period 440d, Sp M6e - M9.0e. Rise 55% (242d). T Cas is unusual in that the star takes longer to rise to max, than it takes to fade to min. This is due to the star exhibiting pronounced humps on the rising branch or double maxima. This is another star that would benefit from having more observers, consistently conducting observations.



References

1. All data from [VSX]

2. Plots by Tomas Karlsson (SAAF). [Period length over time for Mira stars]

KU Ursae Majoris: Unfortunately, not variable after all

Christopher Lloyd

cl57@ymail.com

Examination of TESS and other survey photometry of the supposed SR variable KU UMa shows no variation at the mmag level, and other data point to the star being a K4.5–K5-type main-sequence star. The nearby suspect NSV 5088 is also found to be constant to the same level.

The variable star KU Ursae Majoris is listed in Simbad as an LPV Candidate and in the VSX as a possible SR variable. The star was first identified as variable by Takamizawa (Kato, 2000) as TmzV746, and then in the 76th Name-List (Kazarovets et al., 2001). Takamizawa's photographic observations were taken over five years from 1995 and show a range of m_{pg} =14.0–14.8, with no discernible pattern (see Figure 1). The data have a mean m_{pg} = 14.37 ± 0.24 (sd). The star then appears to have been ignored but in the previous *Circular* (Mathews, 2023) published a run of *V* -band photometry from 2018–2020 that showed all but one of the observations lying in the narrow range *V* = 14.35–14.50, and are consistent with the APASS magnitude of *V* = 14.386 ± 0.032.

The star has been observed by the All-Sky Automated Survey for Supernovae (ASAS-SN) (Shappee et al., 2014; Kochanek et al., 2017) in the *V* - and Sloan *g*-bands, where it is listed as a nonperiodic, possible rotational variable J110537.10+582008.1. Data are also available from the Zwicky Transient Facility (ZTF) (Masci et al., 2019) in the *zg*, *zr* and *zi* bands, and from the Asteroid Terrestrial-Impact Last Alert System (ATLAS) project (Tonry et al., 2018; Smith et al., 2020) in their Orange (o) and Cyan (c) bands. The ASAS-SN data are shown in Figure 2 and cover the period 2012–2018 in *V* and 2018–2023 in *g*. There is no indication of any variation, although the scatter, particularly in *g* is relatively large, and the mean magnitudes are *V* = 14.36 ± 0.05 (sd) and *g* = 14.96 ± 0.09 (sd). A search for any periodicity using a Discrete Fourier Transform (DFT) limited the amplitude to $0^{m}.015$. A similar picture emerges from the ZTF data which are shown in Figure 3, where the mean magnitudes are 14.864 ± 0.022, 13.8011 ± 0.022 and 13.429 ± 0.018 in *zg*, *zr* and *zi* respectively, and the limit on

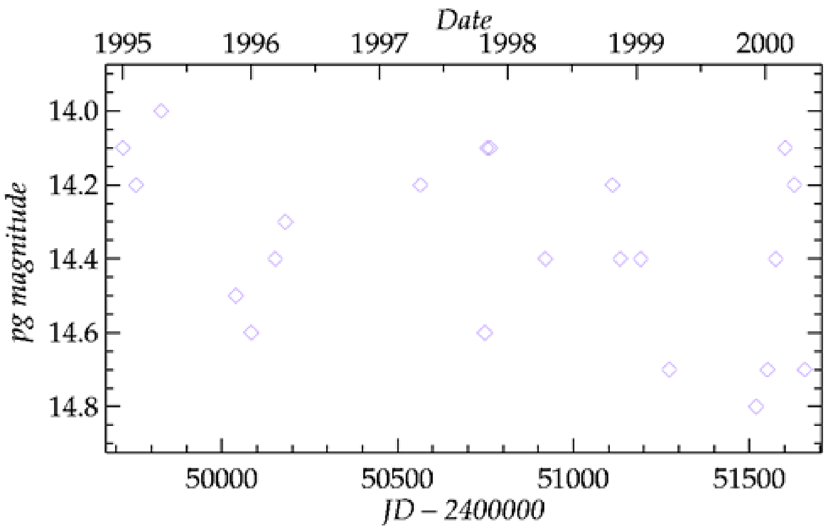


Figure 1: Takamizawa's photographic light-curve of TU UMa = TmzV746 showing a range of 14.0–14.8.

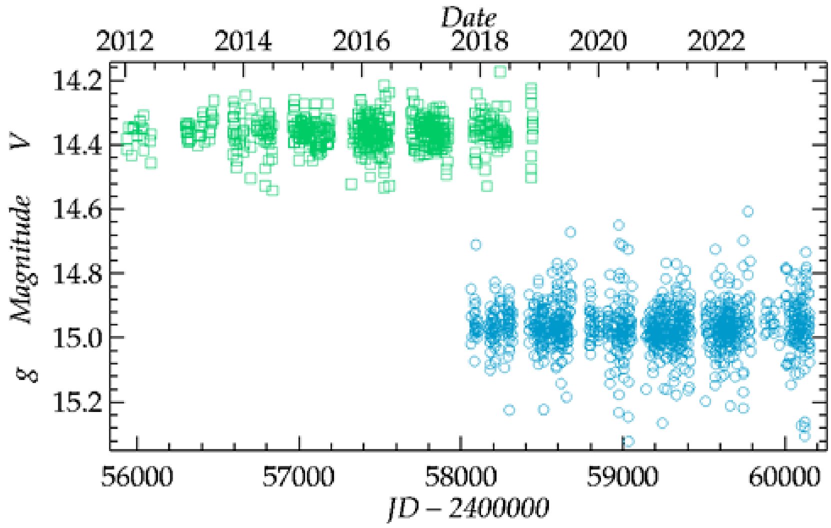


Figure 2: The ASAS-SN *V* - and *g*-band light-curves of TU UMa.

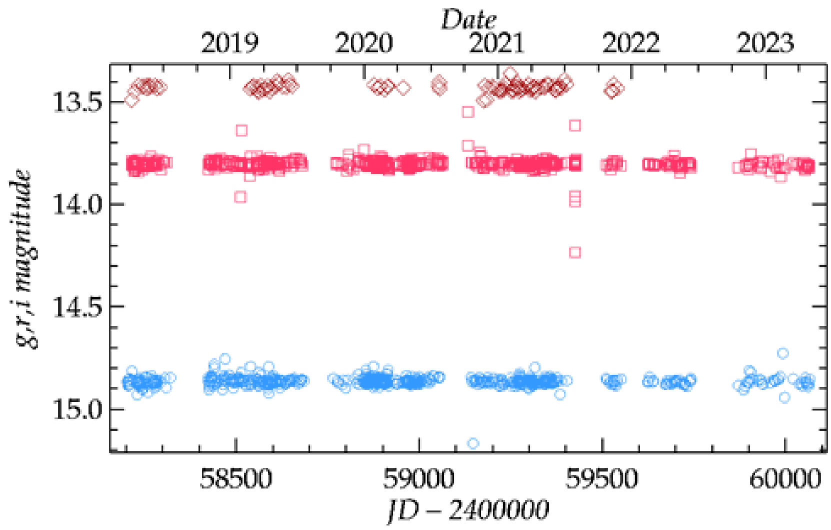


Figure 3: The ZTF *zg*-, *zr*- and *zi*-band light-curves of TU UMa.

any periodic signal from the DFT is $0^{m}.004$. Less extensive photometry is also available from *Gaia* DR3 where the mean $G = 13.897 \pm 0.003$ and PanSTARRS where the mean $g = 14.799 \pm 0.002$ indicating no significant variability. For completeness, and illustration, the ATLAS data are shown in Figure 4. The saturation limit of the ATLAS data lies at $V \sim 14$ and the bulk of the observations clearly show increased scatter and unnatural systematics, although the earliest points are more consistent.

KU UMa has been observed by the Transiting Exoplanet Survey Satellite (TESS) (Ricker et al., 2015) during August 2019 in Sectors 14 and 15 at the standard 30-minute cadence, during February 2020 in Sector 21, August 2021 in Sector 41 and February 2022 in Sector 48 at the 10-minute cadence. The TESS time-series photometry was downloaded from MAST archive at the STSci and the PDCSAP fluxes were used. The TESS sectors naturally divide into two parts due to the 1–2 day break for the data downlink so the light-curve comprises ten sections of $\sim$11 days of mostly continuous data. The normalized fluxes converted to relative magnitudes are shown for Sectors 14, 21, 41 and 48 in

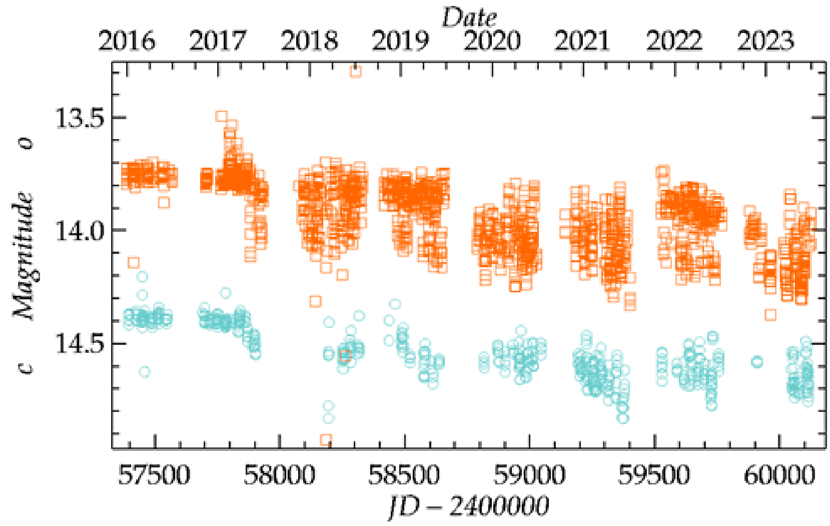


Figure 4: The ATLAS *c*- and *o*-band light-curves of TU UMa. The saturation limit of the ATLAS lies at $V \sim 14$ and the bulk of the data clearly show discordant values and systematics, although the earliest observations are more consistent.

Figure 5. Visual inspection of the light-curve shows no obvious variability and the standard deviations of the five sectors are 2, 6, 2, 4 and 3 mmag respectively, while the corresponding DFT limits on any periodic signal to 50 cd^{-1} are 0.5, 2.3, 0.3, 0.5 and 0.4 mmag.

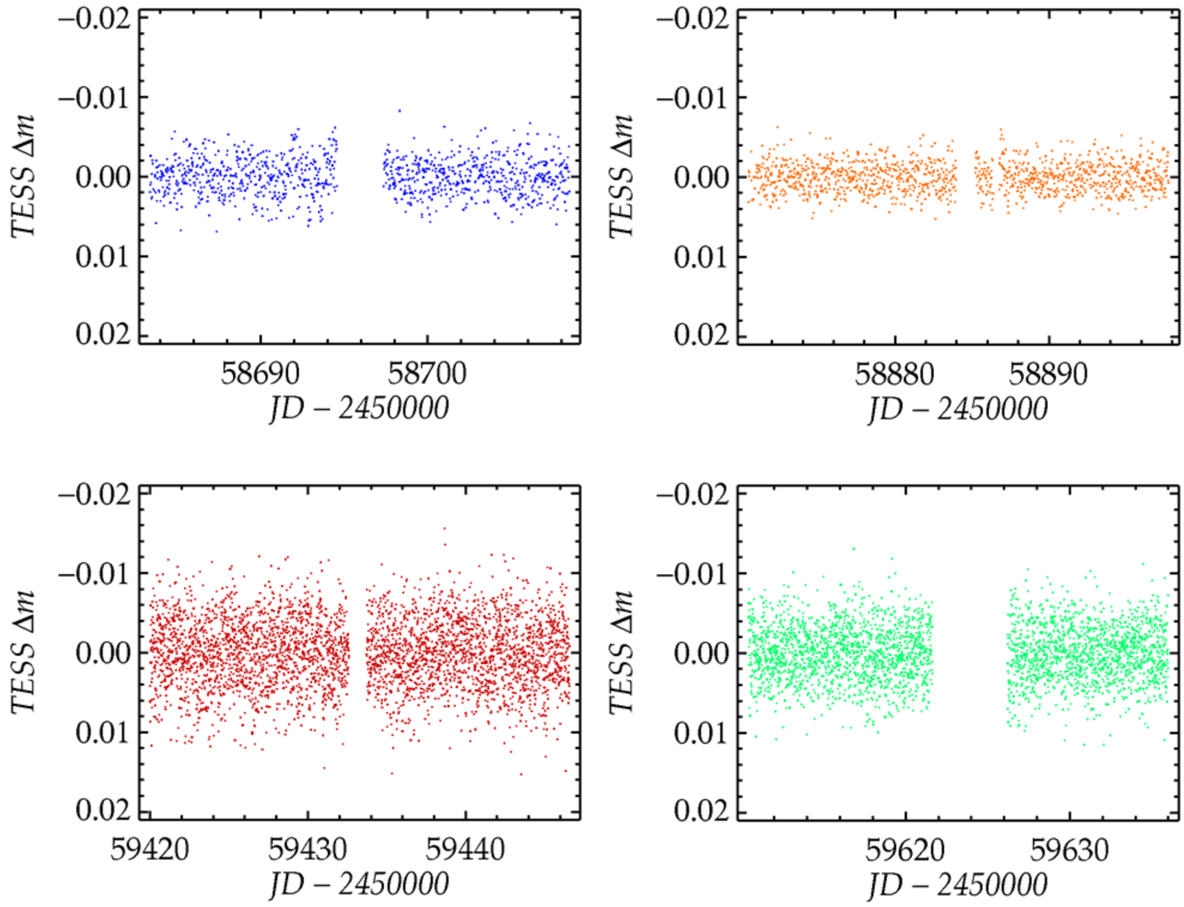


Figure 5: Epoch plot of the TESS data from Sectors 14, 21, 41 and 48. The data from Sector 15 are the least consistent and are not shown.

The distance to KU UMa is a rather precise 263 ± 1 pc (Bailer-Jones et al., 2021) and adopting $0^{m}.06$ reddening from *Gaia*, the observed $V = 14.39$ leads to an absolute magnitude of $M_V = 7.1$, so it is clearly not a giant. From the *Gaia* DR3 Apsis processing $T_{eff} = 4485$ K (Gaia Collaboration, 2022) and similar values are derived from LAMOST DR5 (e.g., Luo et al., 2019). Both M_V and T_{eff} are consistent with a K4.5–K5-type dwarf according to the Rochester calibration (see Pecaut & Mamajek, 2013)), so KU UMa is apparently a constant, single main-sequence star.

The only remaining question is why did Takamizawa conclude that this star was variable? The observations were made using twin 10-cm F4 patrol cameras and T-Max400 120 photographic film, and had a limiting magnitude of $m_{pg} \sim 15.0$. The uncertainties are not reliably known but are likely to be no smaller than $0^{m}.1$–$0^{m}.2$, although possibly less than the observed scatter of $0^{m}.24$. The maximum brightness of KU UMa is fainter than the vast majority of Takamizawa's discoveries so this, and the associated errors, may have been a contributory factor. Another factor may have been a variable comparison star, and although these are not published, one of the nearby stars of comparable brightness is now known to be variable. LINEAR 24128889 = ASASSN-V J110902.73+585605.7 is a W UMa star at $V \sim 14.5$ with an amplitude of $0^{m}.5$, lying 45 arcmin from KU UMa.

The suspect variable NSV 5088, lies 59 arcmin from KU UMa, and is already listed as non-variable by VSX, but not identified as 'constant'. The ASAS-SN data show no obvious trends and no periodic signal above $0^{m}.01$. The TESS data from the same sectors as discussed above show an almost identical level of inactivity, so it may be considered as constant to < 1 mmag. There are no ZTF data.

Acknowledgements

The author is pleased to acknowledge the use of the NASA/ADS, the SIMBAD database and the VizieR catalogue access tool. The author gratefully acknowledges use of the AAVSO Variable Star Index (VSX). This paper includes data collected by the TESS mission, which are publicly available from the Mikulski Archive for Space Telescopes (MAST). Funding for the TESS mission is provided by NASA's Science Mission directorate.

References

Bailer-Jones, C. A. L., Rybizki, J., Fouesneau, M., et al., 2021, *AJ*, **161**, 147

Gaia Collaboration, 2022, *VizieR Online Data Catalog*, I/355

Kato, T., 2000, *VSNET-newvar No*, **385**

Kazarovets, E. V., Samus, N. N., & Durlevich, O. V., 2001, *Information Bulletin on Variable Stars*, **5135**, 1

Kochanek, C. S., Shappee, B. J., Stanek, K. Z., et al., 2017, *PASP*, **129**, 104502

Luo, A. L., Zhao, Y. H., Zhao, G., et al., 2019, *VizieR Online Data Catalog*, V/164

Masci, F. J., Laher, R. R., Rusholme, B., et al., 2019, *PASP*, **131**, 018003

Mathews, D., 2023, *British Astronomical Association Variable Star Section Circular*, **197**, 9

Pecaut, M. J. & Mamajek, E. E., 2013, *ApJ Suppl*, **208**, 9

Ricker, G. R., Winn, J. N., Vanderspek, R., et al., 2015, *Journal of Astronomical Telescopes, Instruments, and Systems*, **1**, 014003

Shappee, B. J., Prieto, J. L., Grupe, D., et al., 2014, *ApJ*, **788**, 48

Smith, K. W., Smartt, S. J., Young, D. R., et al., 2020, *PASP*, **132**, 085002

Tonry, J. L., Denneau, L., Heinze, A. N., et al., 2018, *PASP*, **130**, 064505

Gibraltar, 125 years after Colonel Markwick

John Toone

enootnhoj@btinternet.com

An account of observing variable stars from Gibraltar in 2023 which is the same location where Colonel Markwick had discovered T Cen and RY Sgr in the 1890's.

Prior to being appointed as the second VSS Director in 1899 Colonel E E Markwick had undertaken a military posting to Gibraltar during 1893-1898 from where he had discovered two of the southern hemisphere's most important variable stars T Cen and RY Sgr. Those discoveries were the result of a survey of the southern sky in search of new variable stars which Markwick described as follows [1]:

On arriving at Gibraltar in May 1893, and knowing I should probably be stationed there some years, I determined to attack the zone 27.5^0 to 45^0 S. Dec., using a binocular, and comparing the sky with the Uranometria Argentina. About one or two evenings per month were devoted to this. It was a somewhat rapid survey, which consisted in identifying the configuration of the stars as given in the maps, and in noting whether their relative apparent magnitudes agreed (or otherwise) with the maps.

Any stars not in the map which were considered fairly brighter than 7m. (the limit of the U.A.) were noted for special subsequent observation, and any stars whose brightness was markedly discordant with that in the map or catalogue of the U.A. were similarly noted.

This search has resulted in the discovery of 2 new variables, viz., T Centauri and A.G.C. 26,384. Both of these stars were independently discovered by Mrs. Fleming from the peculiarity of their photographic spectra. I also observed independently the star S Sculptoris, before I saw its announcement as a variable (see A.N., No. 3342, p. 93) and the star RR Sagittari (see E.M. for 1895, November 15, letter 38,210).

Upon completion of his survey Markwick published a list of 72 suspected stars [2], and when I recently examined the list, I found that the locations of four suspect stars were coincident with the subsequently named variables Z Scl, V349 Pup, PX Pup & BK Gru.

In 2023 I undertook a holiday on Gibraltar (often called the Rock) and planned to take advantage of the more southerly latitude for observing variable stars just as Markwick had done 130 years earlier. I was in Gibraltar from the 26th July to the 8th August and I took with me a C8 telescope and 12x50 binoculars. My primary targets were to be RY Sgr and T Cen in order to get a feel for those stars from the same locality that they were discovered. Both stars are at declination 33^0 S and are only fleetingly visible above the horizon from my home base in Shrewsbury. Prior to travelling I had no information of where on Gibraltar that Markwick undertook his astronomy from, so that would also be subject to investigation whilst I was there.

Gibraltar is a British Overseas Territory forming an extension from Spain in a north/south direction with the Rock steeply rising over 400m. My first impression of the Territory was its compact nature with the Rock totally dominating the skyline. This meant that a fair portion of the night sky would be obscured by the Rock from all points on the Territory except from the top of the Rock itself.

I figured that Markwick could only have "attacked zone 27.5^0 to 45^0 S" from either the top of the Rock or the southernmost tip of the Territory. The summit of the Rock is an arduous trek (note the 19th

century track winding up the side of the rock visible in figure 5) so I concluded that Markwick most likely observed from a position south of the Rock. The land does extend some distance to the south of the Rock and is less populated so it is the most logical position to attempt astronomy at sea level.

In 2023 from my hotel (aptly named the Rock Hotel) balcony I could only see slightly east of overhead and the western half of the sky towards the Bay of Gibraltar, although the position did afford some impressive sunsets over the Spanish mainland. I headed to Europa Point (at latitude 36^0 N, one of the most southern parts of the European mainland) that I felt would give me the best view of the night sky including the southern elements not visible from the UK.

Europa Point turned out to be location of Harding's Fort and Artillery Battery that was operational during Markwick's tour of duty on Gibraltar. The fact that there had been an active military installation at a favourable position for "attacking zone 27.5^0 to 45^0 S" indicated to me that Harding's Battery at Europa Point is the most likely location that Markwick undertook at least some of his astronomical work.

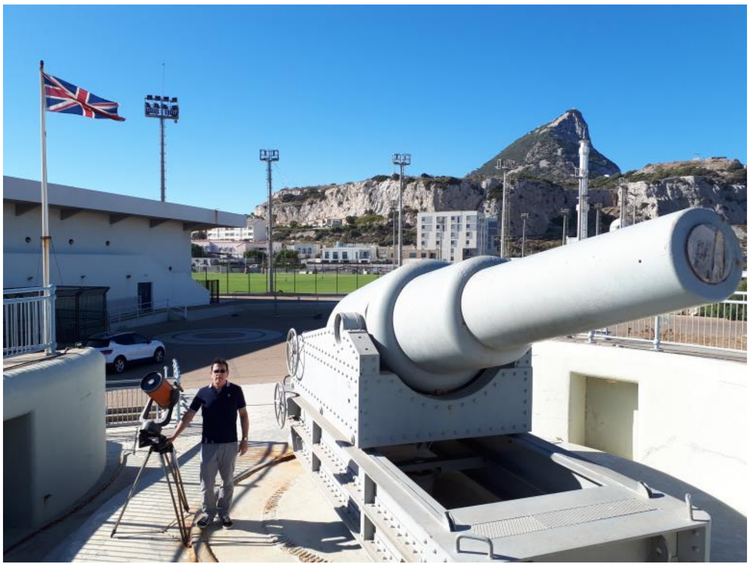
Between 1878 and 1904 the primary armament at Harding's Battery was a 12.5inch rifle muzzle loading gun which was restored to its original condition in 2013. It was interesting to compare the original installation cost of £2981 with the restoration cost of £60,000. I appreciated from a visit to Jersey in 2021 [3] that military gun emplacements make good locations for astronomical work on account of their sweeping panoramic views.

From Harding's Battery the Rock appeared to only obscure 30% of the sky below Polaris which equated to a loss of about 12^0 in altitude/declination towards the north. Southwards I only lost a degree or so to the mountains of Morocco across the Strait of Gibraltar. Stars such as alpha & theta Ara at declination 50^0 S could be seen in binoculars.

I observed from Harding's Battery Observation Post (Figure 1) except for when the wind became intolerable and then I moved within the gun emplacement (Figure 2) which provided ample shelter. All of the nights from Europa Point were clear or partly clear but that was not the case elsewhere on the Territory due to the influence of the Rock. Light pollution presented the main challenge at Europa Point including the local light house & sports ground floodlights augmented by the distant lights in Spain & Morocco.

Figure 1: Harding's Battery Observation Post which was my primary location for observing on Gibraltar. This is the sea level position where the sky is least obscured by the Rock and allows a clear view of the southern sky. The coastline of Spain is on the right and the mountain Jebel Musa in Morocco is on the left. The photo captures nine cargo ships and one ferry navigating the Strait of Gibraltar. Photo by Alexander Toone.

Figure 2: Harding's Battery is where I observed when wind proved too disruptive at the observation post. The 38-ton gun appeared much the same as when Markwick was in Gibraltar. The southern edge of the Rock is in the background and the sports ground floodlights were not in use after 11pm. My hire car used for transporting the C8 telescope is also in the background. Photo by Alexander Toone.



In terms of astronomical work, I was able to follow RY Sgr on twelve nights rising from magnitude 11.0 to 10.4 as it recovered from a deep fade. There was only one night (30th July) when RY Sgr could not be seen due to the close proximity (8^0 distant) of the gibbous moon.

T Cen was also seen on two nights at magnitudes 6.9 & 6.7 but with difficulty due to its low altitude in the direction of the Strait of Gibraltar.

My stay in Gibraltar happened to coincide with a primary minimum of AC Her which enabled me to record the nightly change in magnitude at this key stage of the light curve. The rise in brightness peaked at a rate of 0.3 magnitude/night (Figure 3).

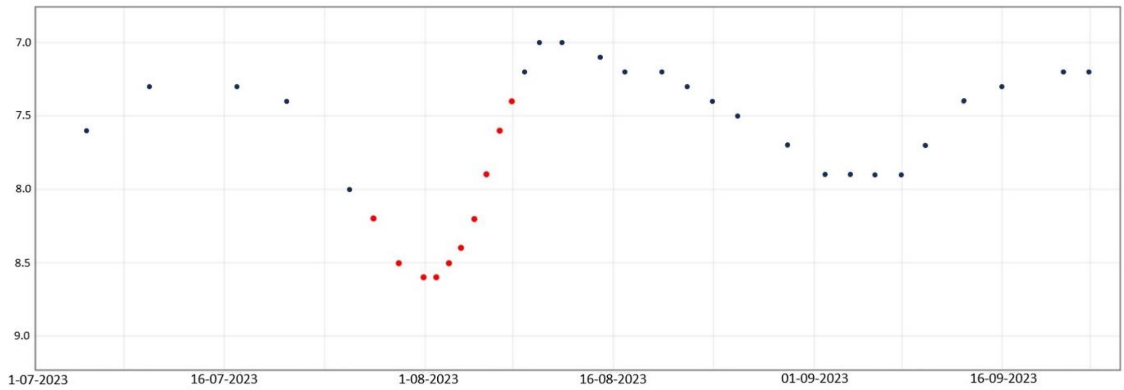


Figure 3: The light curve of AC Her covering one full period of 75 days in July – September 2023. Observations made from Gibraltar coincident with the primary minimum are coloured red. At times, particularly around primary minimum, AC Her warrants observing on a nightly basis.

I secured observations of SS Cyg on all nights and this included the commencement of a long outburst on the 31st July (Figure 4). I was able to record a small dip in brightness in the early stage of the maximum plateau phase which is similar to what I have seen previously in long outbursts of U Gem [4].

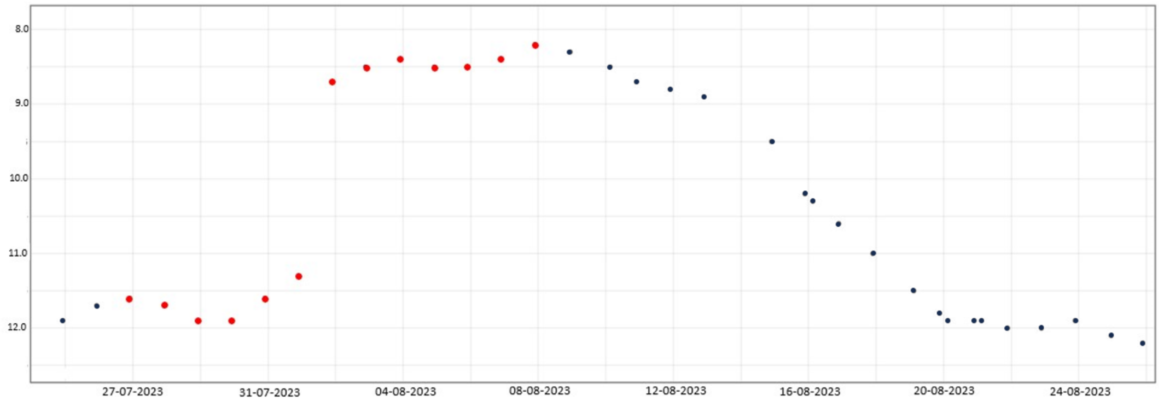


Figure 4: The light curve of SS Cyg covering the period 24th July to 25th August 2023 illustrating a "Gibraltar" type long outburst. Observations were secured on all nights apart from the 13th August which represents an exceptional run of nightly data over a monthly period. Observations made from Gibraltar are coloured red.

In 1909 Markwick made the following comment on the long outbursts of SS Cyg [5]:

I call the "Gibraltar" type, because the light-curve, on the adopted scale, somewhat resembles the contour of that rocky fortress seen from the west.

I consider myself very fortunate to have experienced a "Gibraltar" type outburst of SS Cyg from Gibraltar itself. This outburst can be compared with the contour of the Rock from the NW direction in Figure 5.

Figure 5: The Rock of Gibraltar photographed from a north-west direction in the latter part of the 19th Century. Note the primary mode of transport in those days was still by sailing ship. This is the closest photo I can find from around Markwick's time that correlates to his impression of the long outbursts of SS Cyg. The photo was originally published in 'Sights and Scenes of the World – A Photographic Portfolio' by Edward L. Raymond in 1894; reproduced with permission from bridgemanimages.com.

As I prepared to depart from Gibraltar, I noted the appearance of the Rock from the airport (Figure 6). To me from a northern direction, the Rock contour more resembled a light curve of a Type II-P supernova which includes a plateau phase during the decline.

Figure 6: The Rock of Gibraltar photographed from a northerly direction on the 8th August 2023 as I prepared to depart from the Territory. The contour of the Rock from this direction reminded me of a light curve of a Type II-P supernova. The aircraft in the foreground flew me back to the UK which was thankfully a more-speedy mode of transport than a sailing ship.

Due to the local light pollution the Milky Way was never prominent and despite the ample number of clear nights I did not class Gibraltar at sea level as particularly favourable for astronomy. However, during my stay there I was able to achieve my primary objective of observing RY Sgr & T Cen plus I had the added bonus of witnessing a "Gibraltar" type outburst of SS Cyg. I am not sure how often this has been accomplished from Gibraltar since the departure of Colonel Markwick 125 years beforehand.

References:

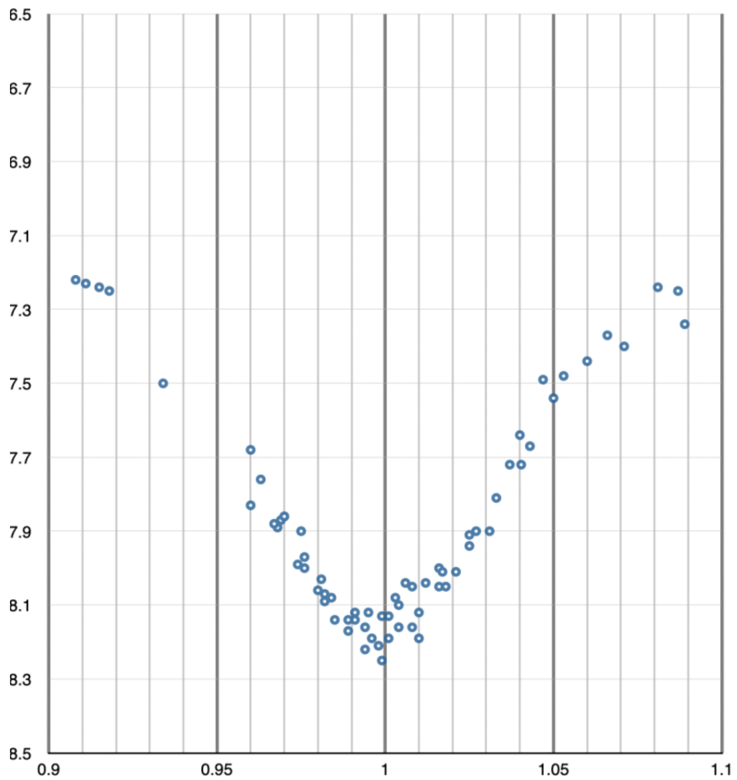
1. 1896 Mem BAA Vol V. Part II, Page 40
2. 1896 Mem BAA Vol V. Part II, Page 42-47
3. 2021 VSS Circular 190, Page 20-22
4. 2015 VSS Circular 164, Page 12
5. 1909 JBAA Vol XIX, Page 204

Eclipsing Binary News

Des Loughney
desloughney@blueyonder.co.uk

TV Cassiopeiae

This Algol type system is on our observing list and there have been many reports of observations in previous editions of this Circular. I have been studying the system for some years. The phase diagram below illustrates 127 DSLR measurements around primary minimum between September 2020 and October 2023. The vertical axis is V magnitude and the horizontal axis a phase diagram where 1 represents the predicted time of the primary minimum. The phase diagram is based on the current Krakow period of 1.8125927 days. The GCVS database states a period of 1.8125913 days and the AAVSO database a period of 1.8125956 days. The period used by Cummings (1) was 1.8126 days in 1917.



The shape of the light curve, as found by Cummings (1), figure 2 below, is similar and suggests a partial eclipse. Since Cummings wrote her thesis it has been found that variations in the period of TV Cas are due to mass transfers between the primary and the secondary (2). Below I reproduce a figure from the paper (2) which illustrates the variation in period, over time, of TV Cassiopeiae, due to mass transfer. It shows the value of keeping track of the period of variables such as TV Cassiopeiae.

Cummings was not aware of mass transfer and eclipsing binaries and therefore had some problems in interpreting her measurements. Nevertheless, her measurements, using an outdated methodology of interpreting photographic plates, was very valuable as it gave a snapshot of the light curve of TV Cas at that time, in the period 1914-15.

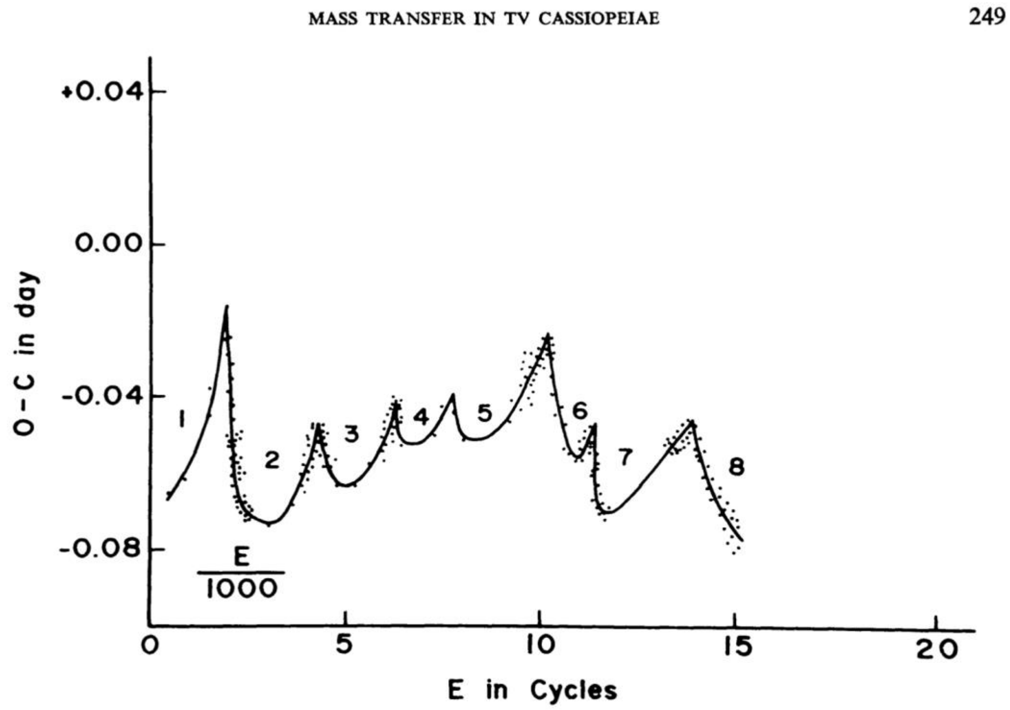
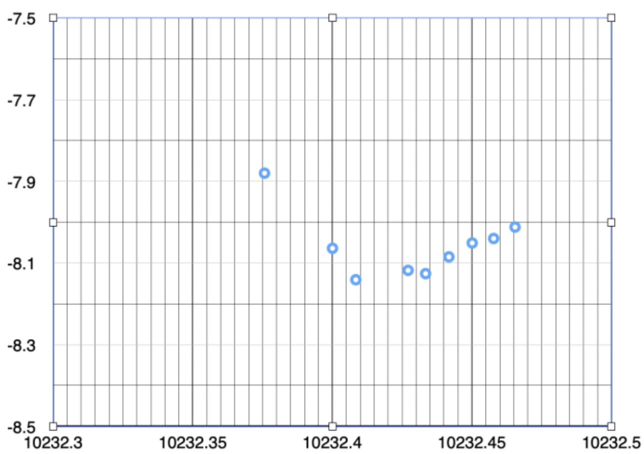


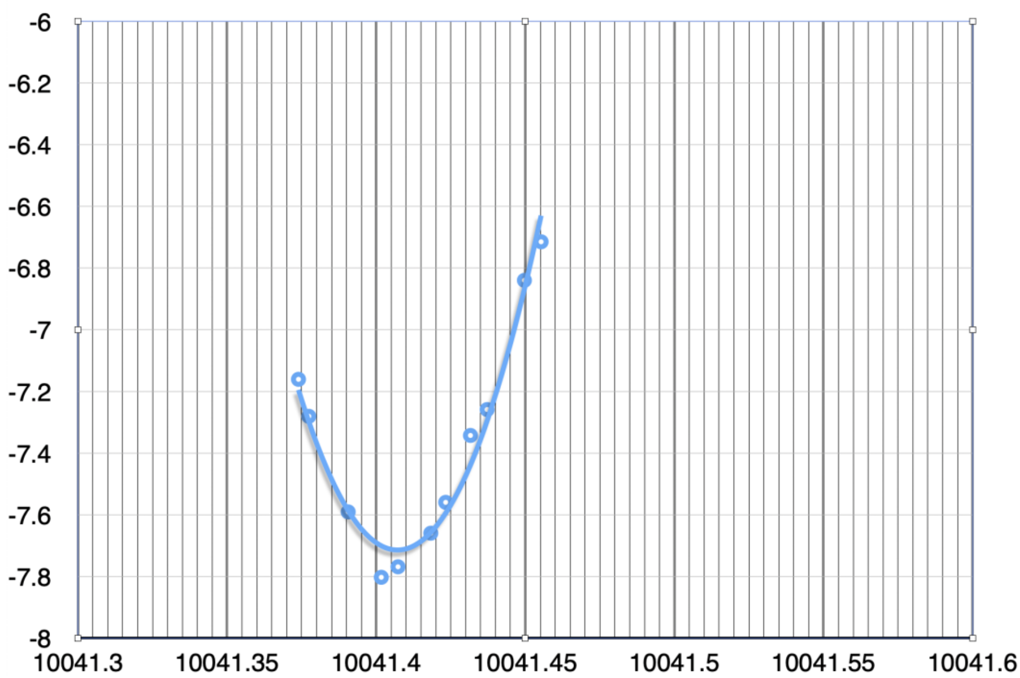
Fig. 1. The O–C curve of TV Cas between 1901 to 1977. The number identifying each parabolic segment corresponds to *n* in Table II.

I was able to observe a primary eclipse of TV Cassiopeiae on 14/10/23. My measurements are reproduced below. The vertical axis is V magnitude, and the horizontal axis is HJD. The descent to primary minimum seems to fit in with the normal light curve of TV Cas but the recovery after what would notionally be the time of primary minimum seems to be unusual. Primary minimum typically reaches a depth of 8.3 magnitude but this did not happen on the night of the 14/10/23. The recovery from primary minimum was delayed. The usual explanation for this effect is an unusual thickness/opaqueness of an accretion disk. It would have been beneficial to have continued the measurements, but cloud intervened. I am looking forward to the opportunity of observing another primary minimum to discover if the effect will be repeated.



RZ Cassiopeiae

On 6/4/23 an opportunity arose to measure an eclipse of RZ Cas. The measurements were made using DSLR methodology which are illustrated in the figure below. The vertical axis is V magnitude, and the horizontal axis is HJD where 10041.3 represents 2460041.3 HJD. The light curve is drawn using a spreadsheet programme. The time of primary mid-eclipse is determined using the bisected chord method. Mid eclipse was determined to be 2460041.4226 HJD. The predicted time of mid-eclipse was 2460041.4075. The time of the eclipse was 21.7 minutes later than predicted. The elements used by Krakow in making the prediction date from JD 2452500 which is 7541 days before the observed eclipse or over 20 years ago. This is evidence that the period is slightly longer than twenty years ago. For more information see (3). Another paper (4) suggests that the shape of the light curve at primary minimum (and therefore the estimation of the time of primary minimum) can be modified by short term variations which maybe a delta Scuti type oscillation.



References

1. “The Eclipsing Binary TV Cassiopeiae” 1917, MA Thesis by Edith Eleanor Cummings, University of Missouri: <https://mospace.umsystem.edu/xmlui/handle/10355/56390>

2. Mass Transfer in TV Cassiopeiae: U.S Chaubey: Astrophysics and Space Science, Volume 63, Issue 1, pp.247-252. < https://link.springer.com/article/10.1007/BF00647761>

3. “RZ Cassiopeiae: An Interacting Algol-type Binary Star with a Pulsating Primary and Transient Accretion Activity” Philip Reed January 2023. American Astronomical Society Meeting #241, id. 302.23. Bulletin of the American Astronomical Society, Vol. 55, No. 2 e-id 2023n2i302p23

4. “Short-period light variation of an eclipsing binary system: RZ Cassiopeiae” The Astronomical Journal, 122:418-424, 2001 July.

Period behaviour of the long-period Algol system AM Aur

Christopher Lloyd

cl57@ymail.com

Examination of TESS, other survey photometry and photographic data of the Algol-type system AM Aur suggests that the period alternates between two approximately constant values with ΔP = ±0.00143 d, on a time scale of at least a century.

AM Aurigae (HD 282585, GSC 02391-00611) is a little-studied tenth-magnitude eclipsing binary with P = 13.618 d and a primary minimum $1^{m}.1$ deep in V , and a weak secondary eclipse. As the system is relatively bright it has been recognised as an eclipsing binary for many years. The variability was discovered nearly a century ago by Guthnick (1929), and subsequent work on the photographic light-curve described by Kurochkin (1951) and Shugarov (1974) indicate a major shortening of the period at JD ~ 2425000 (1920). Photographic and sporadic visual observation continued up to JD ~ 2424600 (1985) and modern data are available from the turn of the current century. The widely reported spectral type of F0 given by Simbad appears to originate with the Henry Draper Catalogue but types of A5 and A8 are also given. There is wide range of reported temperatures from T_{eff} ~ 6700 to 4400 K, with *Gaia* DR3 providing the highest values.

The only photometric solution appears to be based on the photographic light-curve by Svechnikov & Kuznetsova (2004), who suggest that the components are A8+[G6IV], with the secondary component (close to or) filling its Roche lobe, in the standard Algol-type EA/DS configuration. The spectral type of the secondary is based on photometric considerations. They find the inclination i = $81^{\circ}.5$, the mass ratio q = 0.210, the relative radii are r_1 = 0.077 and r_2 = 0.184, with the surface brightness ratio J_1/J_2 = 7.60 in the blue. The eclipses are partial, which may suggest why the system has been neglected.

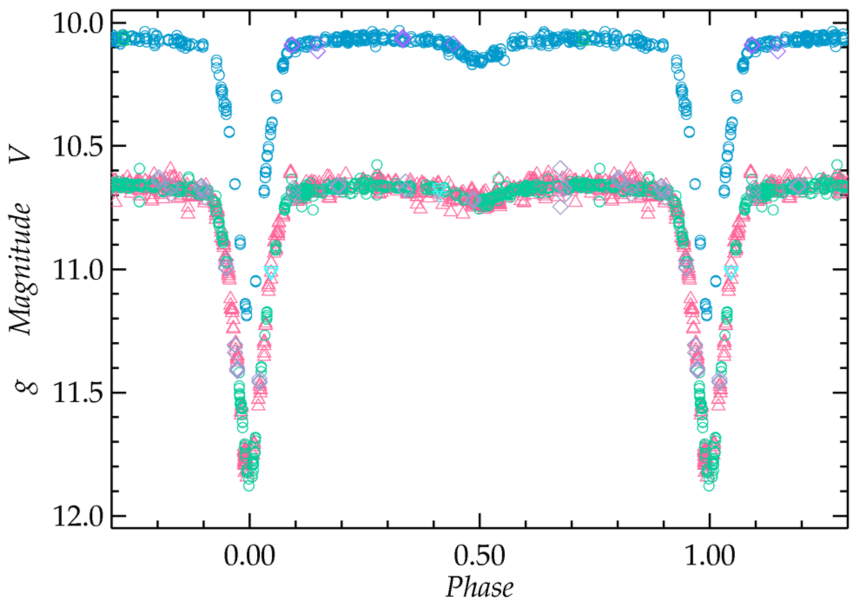


Figure 1: The ASAS-SN V and g-band data folded on their optimal period. An additional $0^{m}.2$ has been added to the g data to aid visibility. The depth of the secondary eclipse is significantly different between the two bands with $0^{m}.09$ in V and ~ $0^{m}.05$ in g due to large temperature difference between the components.

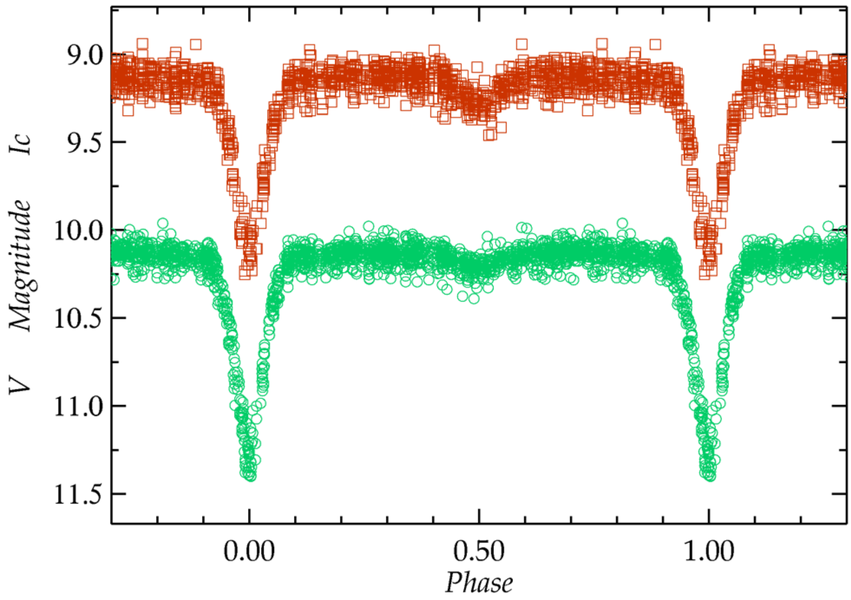


Figure 2: The KWS *V* and *Ic*-band data folded on their optimal period. As with the ASAS-SN *V* and *g*, data the depth of the secondary eclipse is significantly different between the *V* and *Ic* bands due to large temperature difference between the components.

Times of minima have been collected by the O–C Gateway and the BAV Lichtenknecker-Database, and these are dominated by photographic timings, which are probably based on faint observations rather than any measured minima. There are a smaller number of visual timings and generally these are more self-consistent than the photographic data. There are only three modern timings reported. The earliest of these come from the Northern Variability Sky Survey (NSVS) Woźniak et al. (2004) but have been divided in two and recalculated to provide composite timings using a high-harmonic Fourier fit.

The star has been observed by the All-Sky Automated Survey for Supernovae (ASAS-SN) (Shappee et al., 2014, Kochanek et al., 2017) in the *V* - and Sloan *g*-bands, The ASAS-SN data cover the period 2012–2018 in *V* and 2018–2023 in *g* and are shown in Figure 1 folded on the optimum period. There is a clear difference in the depth of the secondary eclipse between the two bands with depths of $0^m.09$ in *V* and $\sim 0^m.05$ in *g*, and this reflects the large temperature difference between the components. The rms errors to the fits are $0^m.012$ in *V* and $0^m.022$ in *g*. Timings have been calculated for subsets of the data using a high-harmonic Fourier fit, but in order to sufficiently populate the primary eclipse these have had to cover up to four years in some cases. Data have also been taken from the Kamogata/Kiso/Kyoto Wide-field Survey (Maehara, 2014), which provides *V* data from 2011 and *Ic* data 2013 to the present. The data show larger residuals than the ASAS-SN data with a rms of $0^m.053$ and $0^m.063$ in *V* and *Ic* respectively. Composite times of minima have been measured from five subsets of the *V* data and three of the *Ic* data, again to ensure good coverage of the minima. The other set of data used was described in the previous *Circular* by Conner (2023) and provides one composite minimum based on *V* -band data taken over the past two years.

AM Aur has been observed by the Transiting Exoplanet Survey Satellite (TESS) (Ricker et al., 2015) during December 2019 in Sectors 19, at the original 30-minute cadence, during September and October 2020 in Sectors 43 and 44 at the 10-minute cadence, and December 2022 in Sector 49 at the 200-second cadence. The TESS time-series photometry was downloaded from MAST archive at the STScI, and the ’native’ SAP_FLUX fluxes were used from the Quick Look Pipeline (QLP) processing,

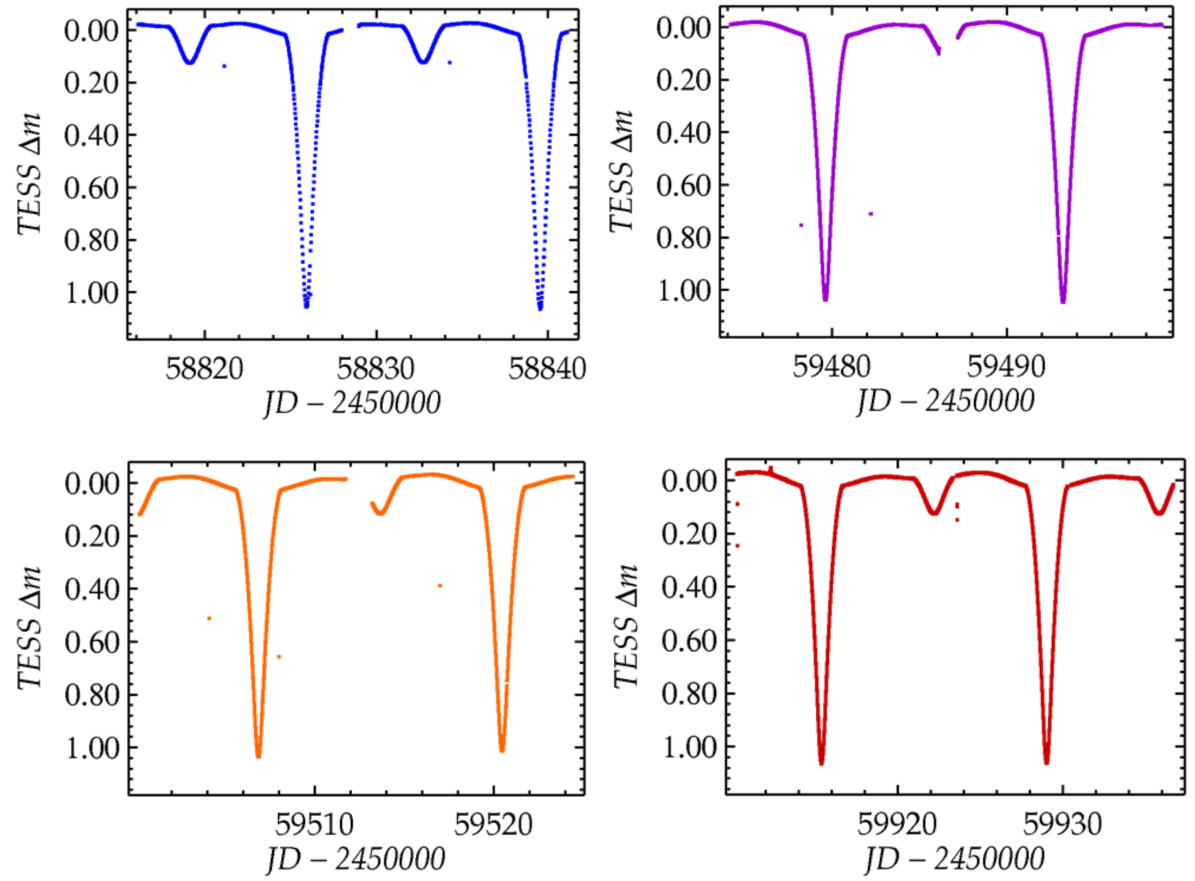


Figure 3: Epoch plot of the TESS data from Sectors 19, 43, 44 and 59. Times of minima were measured for eight primary and four secondary minima using the Kwee–van Woerden method.

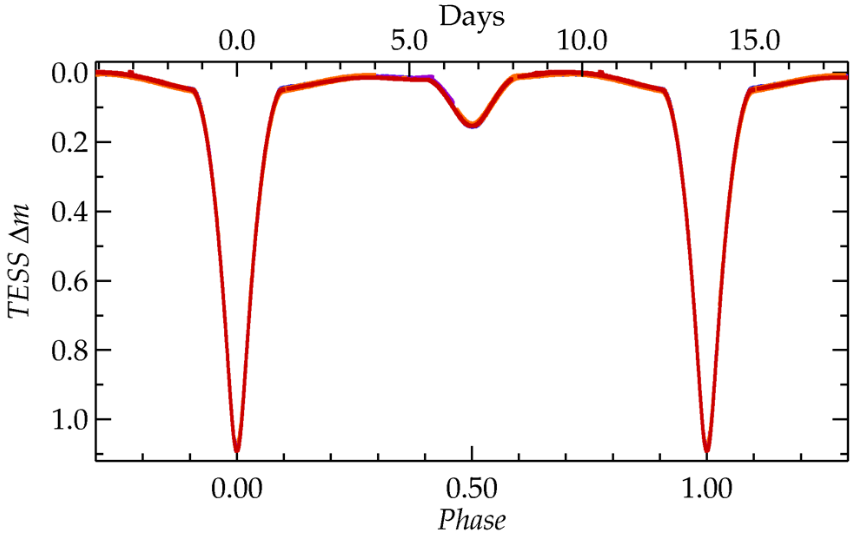


Figure 4: The TESS data of AM Aur folded on the optimum period. The higher-cadence data obscure the earlier data. The depth of the secondary eclipse in the broad red TESS band is $0^{m}.15$, and clearly deeper than in the other light-curves.

Back to contents

Table 1. Times of minimum of the modern data

HJD	error	Min	Cycle	O-C	Band	Data set
2451499.0659	0.0111	1	0	−0.0248	R	NSVS (This paper)
2451580.7738	0.0116	1	6	−0.0287	R	NSVS (This paper)
2452683.9245	0.0003	1	87	0.0121	R	Kotkova & Wolf (2006)
2452983.5290	0.0002	1	109	0.0065	R	Kotkova & Wolf (2006)
2456551.6194	0.0159	1	371	0.0129	V	KWS (This paper)
2457082.7495	0.0100	1	410	0.0159	Ic	KWS (This paper)
2457327.8700	0.0091	1	428	0.0009	V	KWS (This paper)
2457341.5238	0.0031	1	429	0.0361	V	ASAS-SN (This paper)
2457804.5183	0.0050	1	463	−0.0033	V	ASAS-SN (This paper)
2458145.0455	0.0096	1	488	0.0579	V	KWS (This paper)
2458744.2149	0.0032	1	532	0.0071	g	ASAS-SN (This paper)
2458819.11470	0.00037	2	537.5	0.0044	C	TESS (This paper)
2458825.93017	0.00192	1	538	0.0105	C	TESS (This paper)
2458832.72965	0.00040	2	538.5	0.0007	C	TESS (This paper)
2458839.54584	0.00011	1	539	0.0076	C	TESS (This paper)
2458853.1496	0.0140	1	540	−0.0074	Ic	KWS (This paper)
2459139.1587	0.0093	1	561	0.0103	V	KWS (This paper)
2459193.6402	0.0037	1	565	0.0172	g	ASAS-SN (This paper)
2459479.61191	0.00008	1	586	−0.0025	C	TESS (This paper)
2459493.23019	0.00013	1	587	−0.0029	C	TESS (This paper)
2459506.84855	0.00008	1	588	−0.0031	C	TESS (This paper)
2459520.46523	0.00008	1	589	−0.0051	C	TESS (This paper)
2459588.5391	0.0152	1	594	−0.0244	Ic	KWS (This paper)
2459588.5651	0.0122	1	594	0.0015	V	KWS (This paper)
2459588.5653	0.0040	1	594	0.0017	g	ASAS-SN (This paper)
2459683.8973	0.0121	1	601	0.0033	V	D.Conner (This paper)
2459915.39449	0.00006	1	618	−0.0164	C	TESS (This paper)
2459922.19375	0.00056	2	618.5	−0.0265	C	TESS (This paper)
2459929.01256	0.00005	1	619	−0.0170	C	TESS (This paper)
2459929.0145	0.0051	1	619	−0.0150	g	ASAS-SN (This paper)
2459935.80945	0.00032	2	619.5	−0.0294	C	TESS (This paper)

as opposed to the QLP KSPSAP_FLUX. The TESS sectors naturally divide into two due to the 1–2-day break for the data downlink so the light-curve comprises eight sections of ~11 days of mostly continuous data. The normalized fluxes converted to relative magnitudes are shown in Figure 3 and the phase diagram folded on the optimum period in Figure 4. Times of minima were measured from the individual eclipses using the Kwee & van Woerden (1956) method to provide eight primary and four secondary minima.

The O–C diagram of all the data is shown in Figure 5 and this is dominated by the large scatter of photographic timings. The ephemerides over the intervals given by Kurochkin (1951) and Shugarov (1974) are show by lines, and used more data than are shown here. The plot is constructed using the

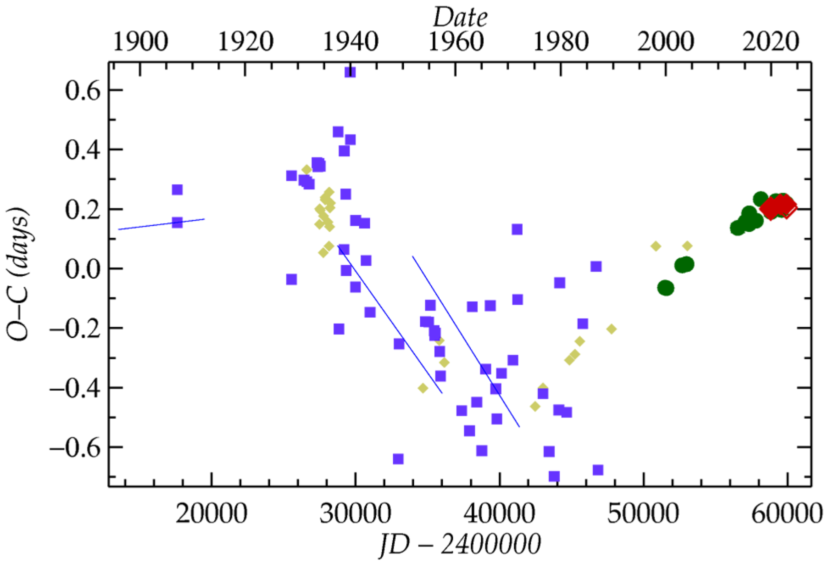


Figure 5: The O–C diagram of all the AM Aur timing data constructed using Equation 1 showing the photographic data (squares), visual data (small diamonds), modern CCD data (circles) and the TESS data (larger diamonds). The lines show the ephemerides of the different intervals of photographic data given by Kurochkin (1951) and Shugarov (1974). The earliest ephemeris includes data not shown on the plot. The modern data clearly have a longer period than the bulk, and probably all, of the photographic data.

mean ephemeris for all the data given by

$$HJD_{MinI} = 2451499.130(37) + 13.618201(30) \times E \qquad (1)$$

and this period is close to the one measured for the early photographic data, $P = 13^{d}.61828$, and indicated by the early ephemeris line. It is clear that despite the large scatter, the bulk of the photographic timings have a significantly shorter period than the one used to generate the plot. The

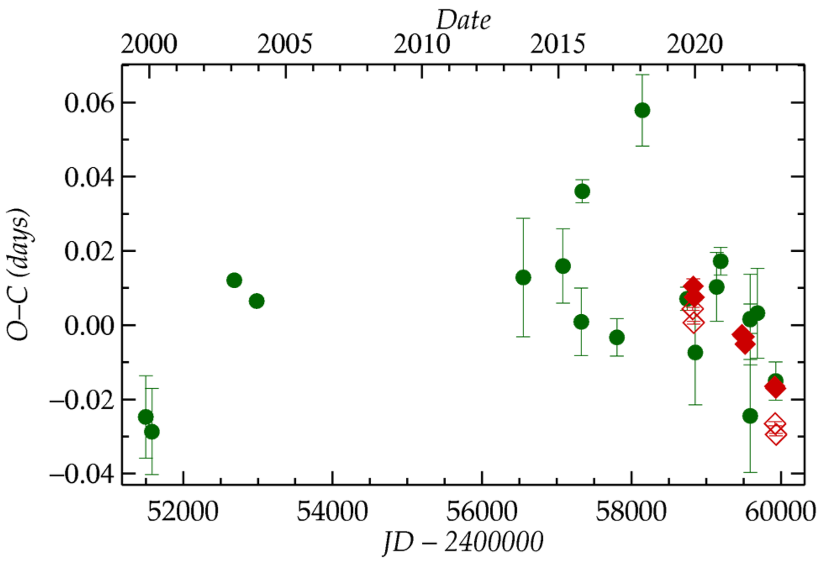


Figure 6: The O–C diagram of the modern timing data constructed using Equation 2. The symbols are as before but the TESS secondary minima are shown by open symbols and appear to be slightly offset relative to the primary eclipses. The TESS primary minima are much higher precision than the other data and are not consistent with the mean ephemeris of the modern data suggesting that the period has changed during this interval.

two measured values are very similar at $P = 13^d.61727$ and $13^d.61715$, as clearly indicated on the plot. The modern data have a much longer period given by

$$\mathrm{HJD_{MinI}} = 2451499.091(10) + 13.618641(19) \times E \qquad (2)$$

and the O–C diagram of this subset is shown in detail in Figure 6, constructed using this ephemeris. The timings are listed in Table 1. The dispersion is such that it is difficult be confident of any change in the period, except that the TESS data are clearly aligned on a different trajectory, given by

$$\mathrm{HJD_{MinI}} = 2458825.9301(14) + 13.618328(26) \times E \qquad (3)$$

and are in fact close to the ephemeris of all the data given by Equation 1, and the earliest photographic data. The change in behaviour over the past 20 years indicates that the period of the system is migrating from the long period seen recently, probably towards the short period seen in the bulk of the photographic data between JD ~2425000−2445000 (1930–1970). Assuming largely constant period sections then the fractional period change $\Delta P/P = +0.000105$ between the bulk of the photographic data, and the modern data, and a similar negative period change after the early photographic data. The other interesting fact to emerge from Figure 6 is that the TESS secondary eclipses appear to be systematically early, which suggest an asymmetric distribution of light around the system, probably due to spots.

In summary, AM Aur is more active than previously thought, but given that this is an Algol system that should not be a surprise. A period change had been suspected previously but the more accurate modern data have put that into context and a pattern has begun to emerge. It seems most likely that the period moves between two broadly constant period sections with alternate period changes of $\sim\pm0^d.00143$ on a time scale of at least a century. The behaviour over the past 20 years suggests that another change is under way.

Acknowledgements

The author would like to thank Klaus Bernhard for helpful input. The author is pleased to acknowledge the use of the NASA/ADS, the SIMBAD database and the VizieR catalogue access tool. The author gratefully acknowledges use of the AAVSO Variable Star Index (VSX). The author also gratefully acknowledges the Czech Astronomical Society for supporting the O–C Gateway and to the BAV for supporting the Lichtenknecker Database. This paper includes data collected by the TESS mission, which are publicly available from the Mikulski Archive for Space Telescopes (MAST). Funding for the TESS mission is provided by NASA's Science Mission directorate.

References

Conner, D., 2023, *British Astronomical Association Variable Star Section Circular*, **197**, 30
Guthnick, P., 1929, *Astronomische Nachrichten*, **235**, 83
Kochanek, C. S., Shappee, B. J., Stanek, K. Z., et al., 2017, *PASP*, **129**, 104502
Kotkova, L. & Wolf, M., 2006, *Information Bulletin on Variable Stars*, **5676**, 1
Kurochkin, N. E., 1951, *Peremennye Zvezdy*, **8**, 351
Kwee, K. K. & van Woerden, H., 1956, *Bulletin of the Astronomical Institutes of the Netherlands*, **12**, 327
Maehara, H., 2014, *Journal of Space Science Informatics Japan*, **3**, 119
Ricker, G. R., Winn, J. N., Vanderspek, R., et al., 2015, *Journal of Astronomical Telescopes, Instruments, and Systems*, **1**, 014003
Shappee, B. J., Prieto, J. L., Grupe, D., et al., 2014, *ApJ*, **788**, 48
Shugarov, S. Y., 1974, *Peremennye Zvezdy Prilozhenie*, **2**, 83
Svechnikov, M. A. & Kuznetsova, E. F., 2004, *VizieR Online Data Catalog*, V/124
Woźniak, P. R., Vestrand, W. T., Akerlof, C. W., et al., 2004, *AJ*, **127**, 2436

Back to contents

Observations of two Eclipsing Binaries; showing long term variations in CQ Aurigae and the timing of a secondary minimum of BX Andromedae

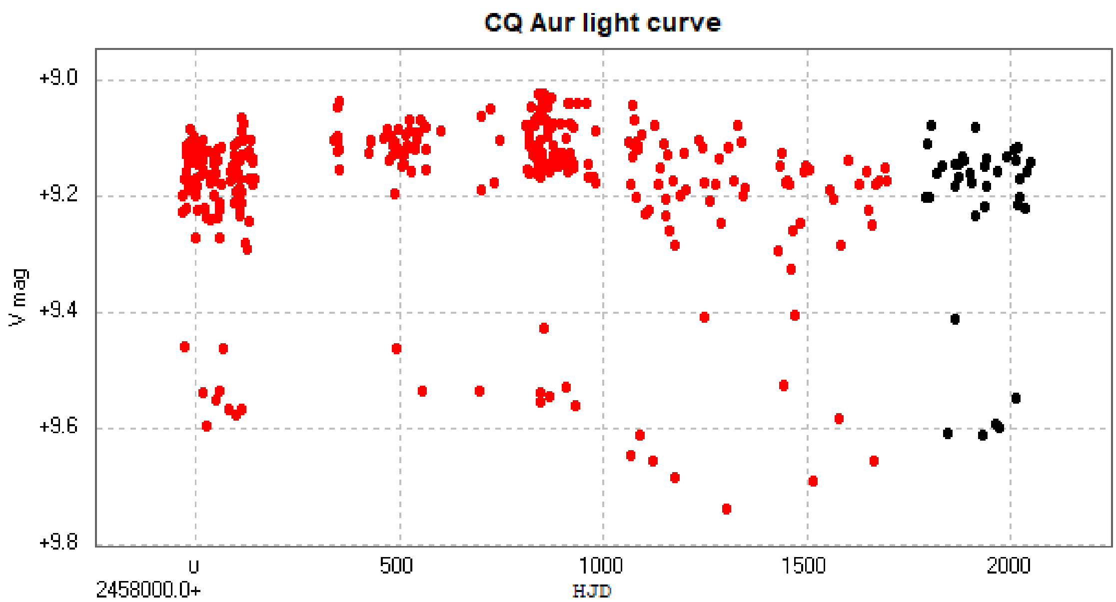
David Conner

david@somerbyconners.plus.com

Observations of two eclipsing binaries; showing long term variations in CQ Aurigae and the timing of a secondary minimum of BX Andromedae.

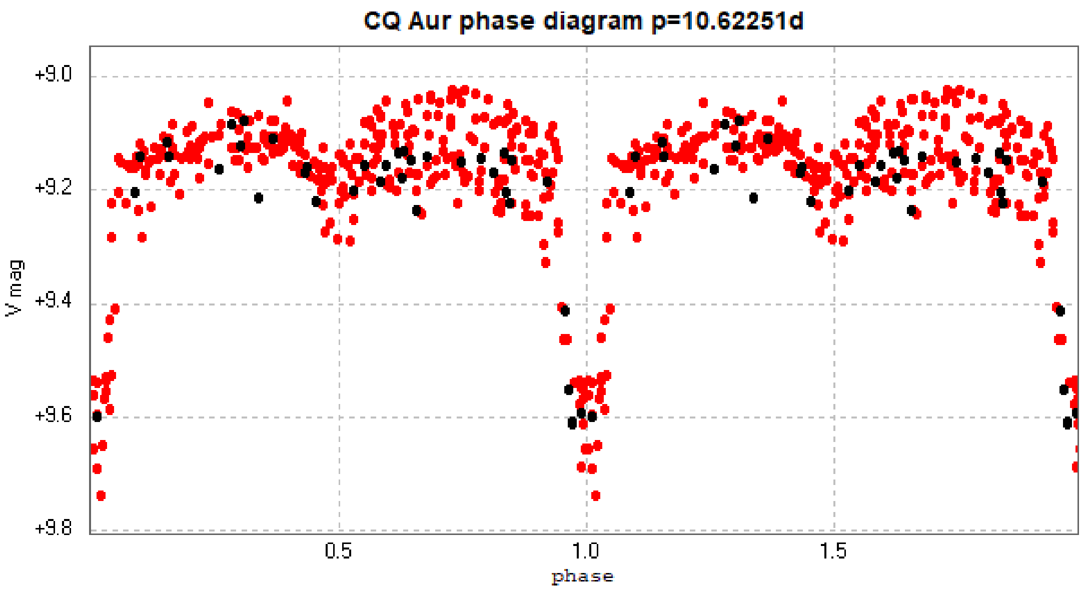
CQ Aurigae

This eclipsing binary system was previously discussed in VSSC 187 (2021 March). The following light curve and phase diagram were constructed from images taken with the Open University COAST telescope using a V filter. The 314 red data points are observations made between 2017 August 8 and 2022 April 26, while the latest 37 observations are in black and were made between 2022 July 31 and 2023 April 12.

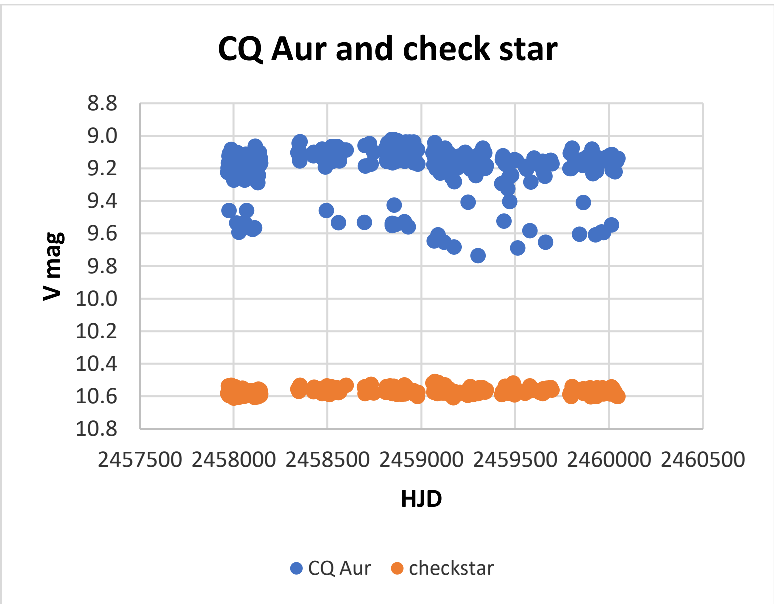


From the available data points, it can be seen that the overall brightness is generally increasing again after the recent decrease. The system is catalogued as an EA/RS type, which have a light curve which can have unequal maxima and can also change over many cycles (the O'Connell effect, possibly due to 'starspots' on the RS CVn component, see Kang 1993.).

The corresponding phase diagram (below) suggests that the maximum between the secondary and the primary minima is still fainter than the 'average' for this section of the phase diagram, but that the primary minimum is possibly brighter than previously.



Just to check that this effect was not due to a systematic error, the following light curves show CQ Aur as varying while the check star is not.



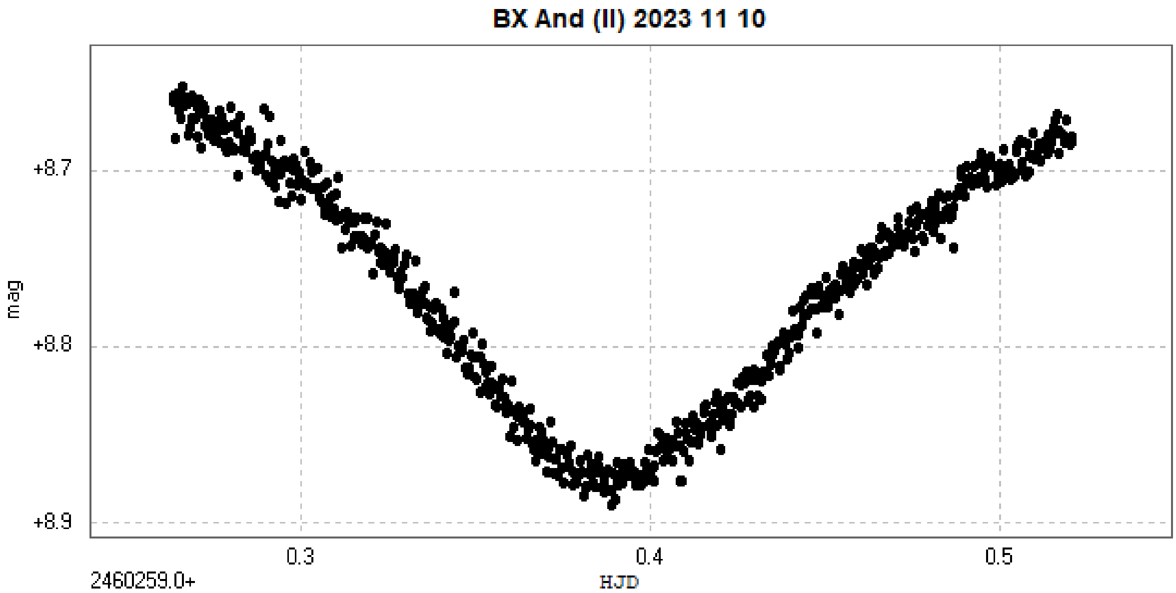
BX Andromedae

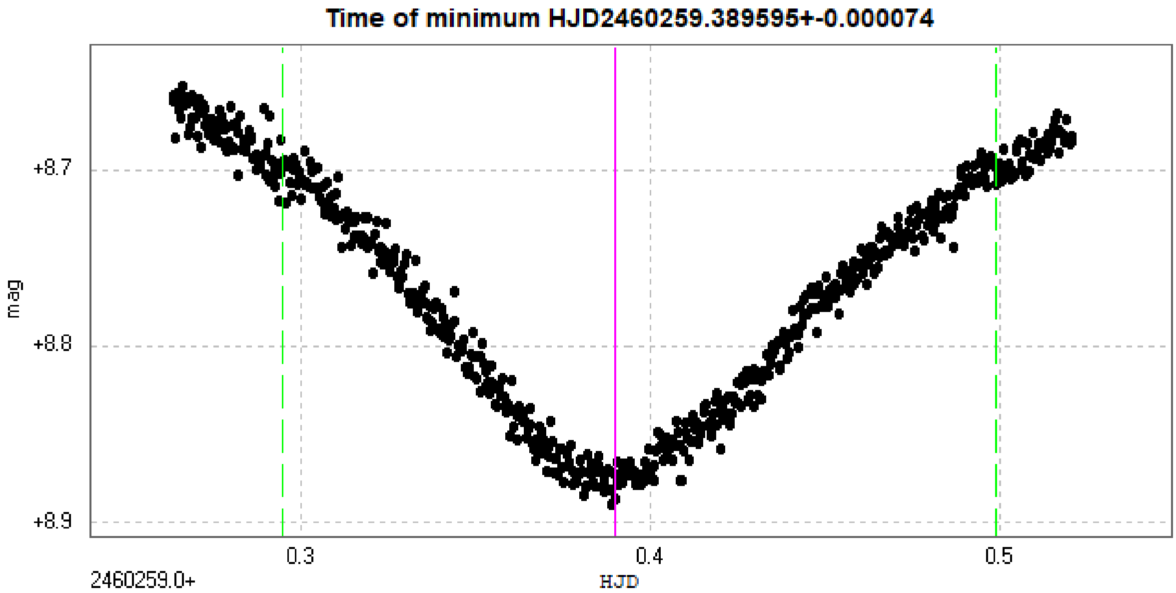
A secondary minimum of the eclipsing binary BX And (period = 0.61 days) was observed from Somerby Observatory with the 2 inch Titan on 10th November 2023.

This enabled the time of the secondary minimum to be determined as follows.

Star	HJD of min	Filter	Error	Type of minimum
BX And	2460259.389595	CV	0.000074	secondary

Back to contents





More information can be found on my website.

Back to contents

Recent *minima* of various Eclipsing Binary stars. 7

Tony Vale

tony.vale@hotmail.co.uk

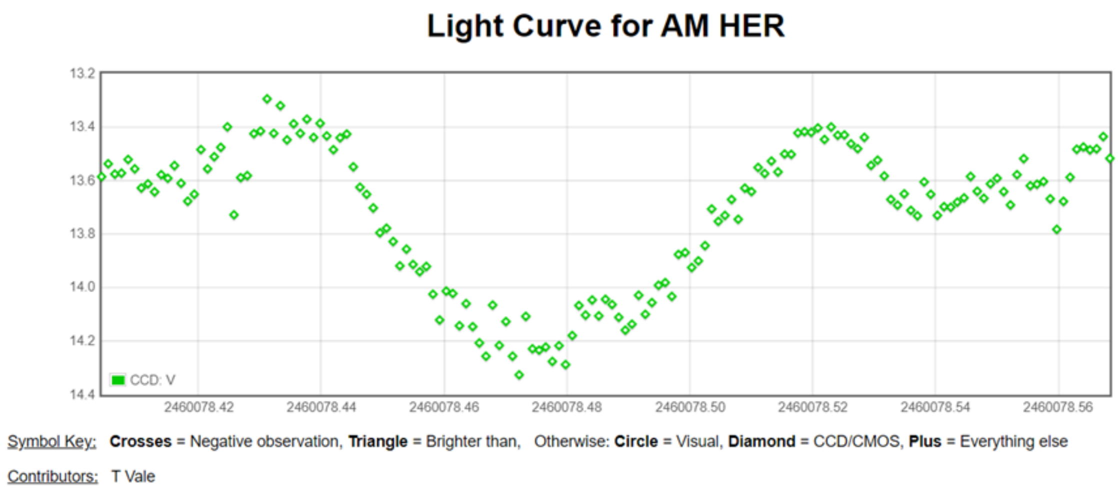
This report lists recent timings of minima of various eclipsing binaries. The observations from which the timings were obtained have all been posted to the BAAVSS photometric database.

Times of minima of some Eclipsing Binaries

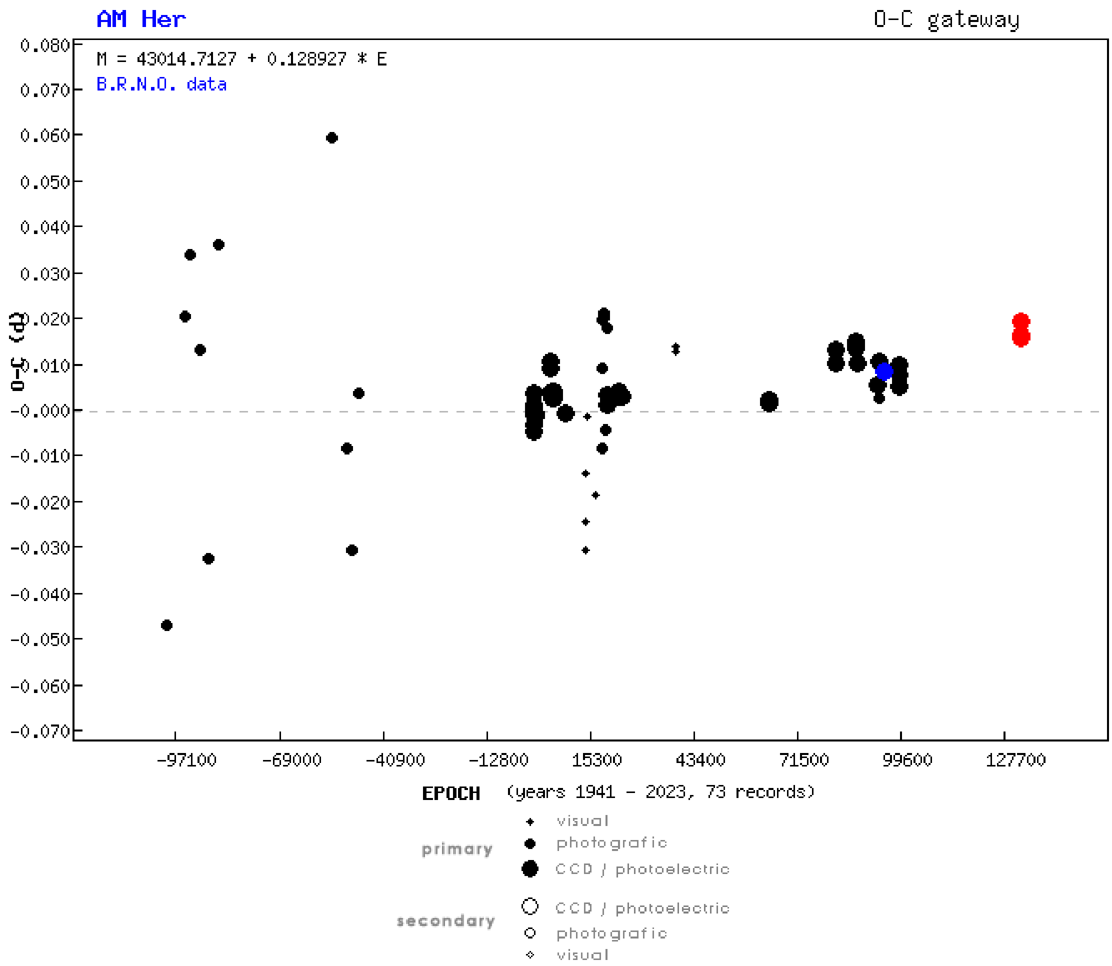
Star	HJD of Min	Filter	Error	Type of Minimum
AM Her	2460078.47846	V	0.00316	Primary
UX UMa	2460080.49978	V	0.00020	Primary
UX UMa	2460085.41705	V	0.00100	Primary
UX UMa	2460085.61323	V	0.00060	Primary
EX Dra	2460087.55549	V	0.00050	Primary
EX Dra	2460089.44536	CV	0.00030	Primary
AM Her	2460091.49735	CV	0.00100	Primary
AM Her	2460094.46205	CV	0.00200	Primary
AD And	2460168.60543	V	0.00050	Primary
CW Cas	2460166.48142	V	0.00040	Secondary
V608 Cas	2460171.48327	V	0.00050	Primary
Z Dra	2460172.45406	V	0.00250	Secondary
SW Lac	2460192.62124	V	0.00046	Primary
CW Cep	2460230.46420	V	0.00203	Primary
V388 Cyg	2460224.47314	V	0.00039	Secondary

The observations from which these timings were obtained were made from May 2023 to October 2023 using a 102mm refractor and an ASI 183MM-Pro cooled mono CMOS camera. The timings were extracted using Bob Nelson's Minima software.

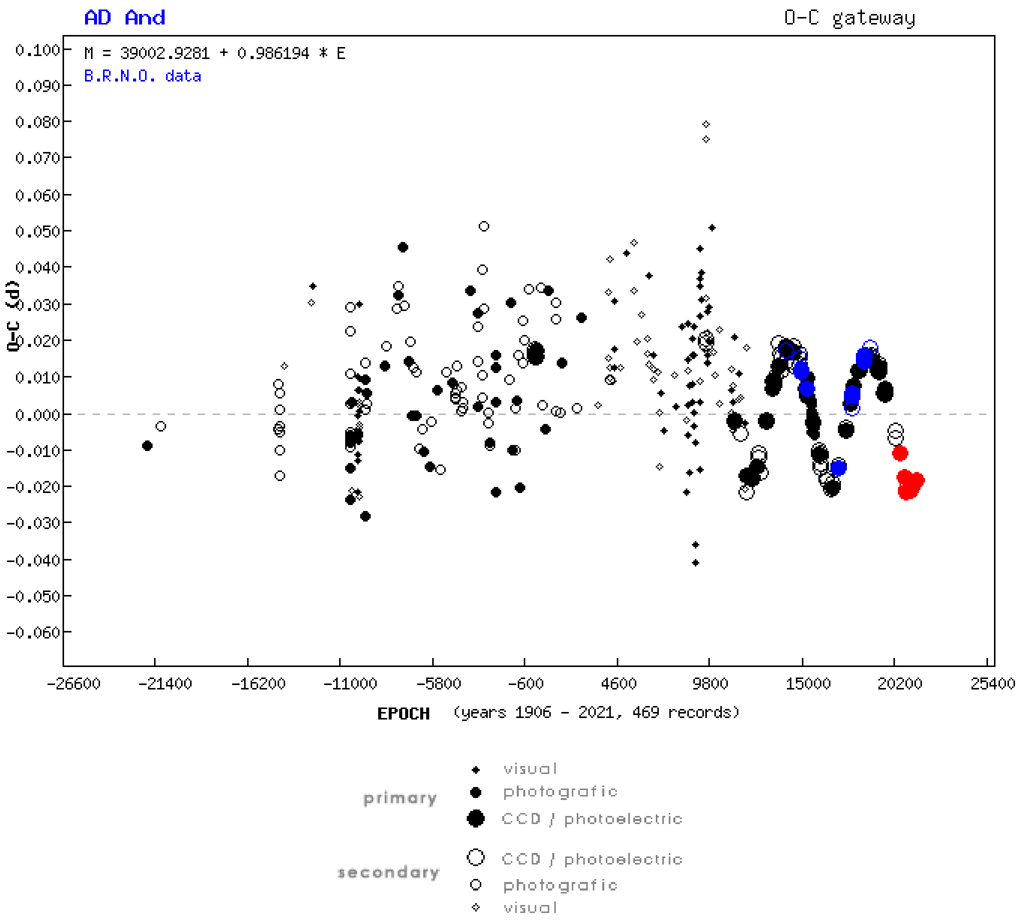
These observations include some dwarf novae which show eclipses: AM Her, UX UMa and EX Dra. The light curves of these objects over a cycle are quite interesting, this example shows the primary minimum for the first of the three minima of AM Her included above :



The secondary minimum is also visible. AM Her is a polar so there is no accretion disc and therefore no hot spot where the stream of material from the secondary would join the disc as in most other types of dwarf novae. Instead, the very strong magnetic field of the white dwarf draws material directly from the secondary onto its surface along magnetic field lines. The O-C diagram for AM Her is shown below. (As in all the O-C diagrams in this article, my timings are shown in red) :

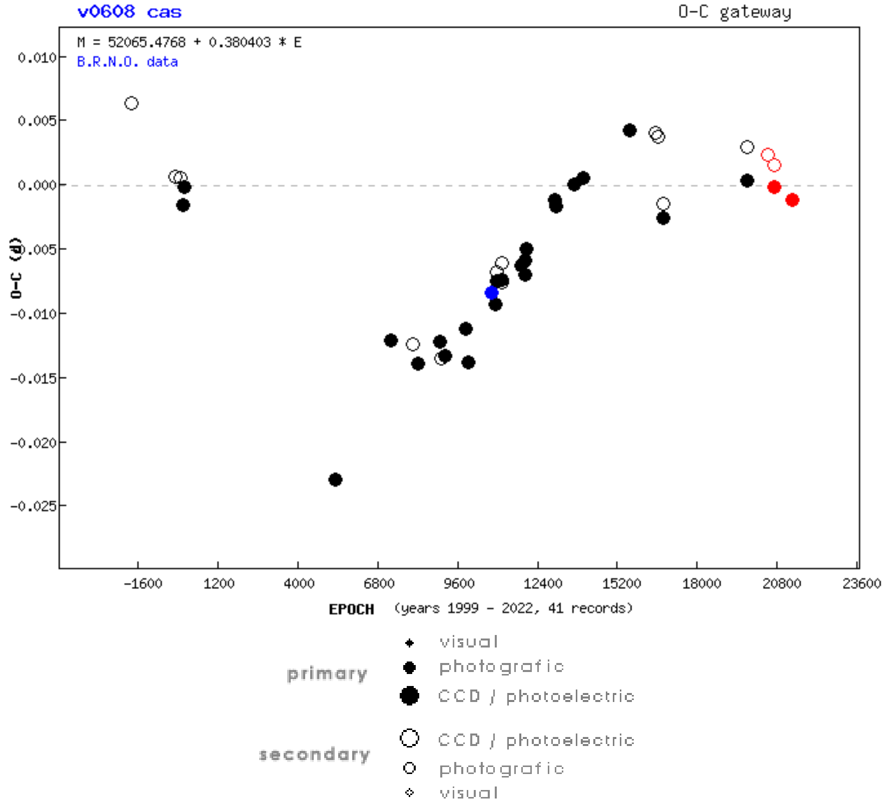


Back to contents

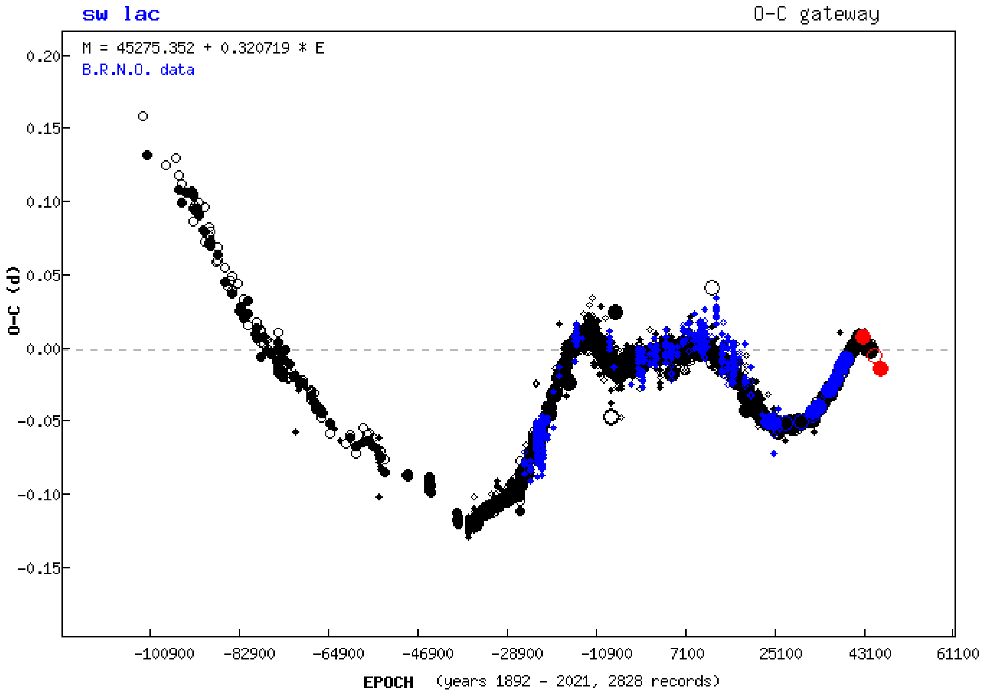


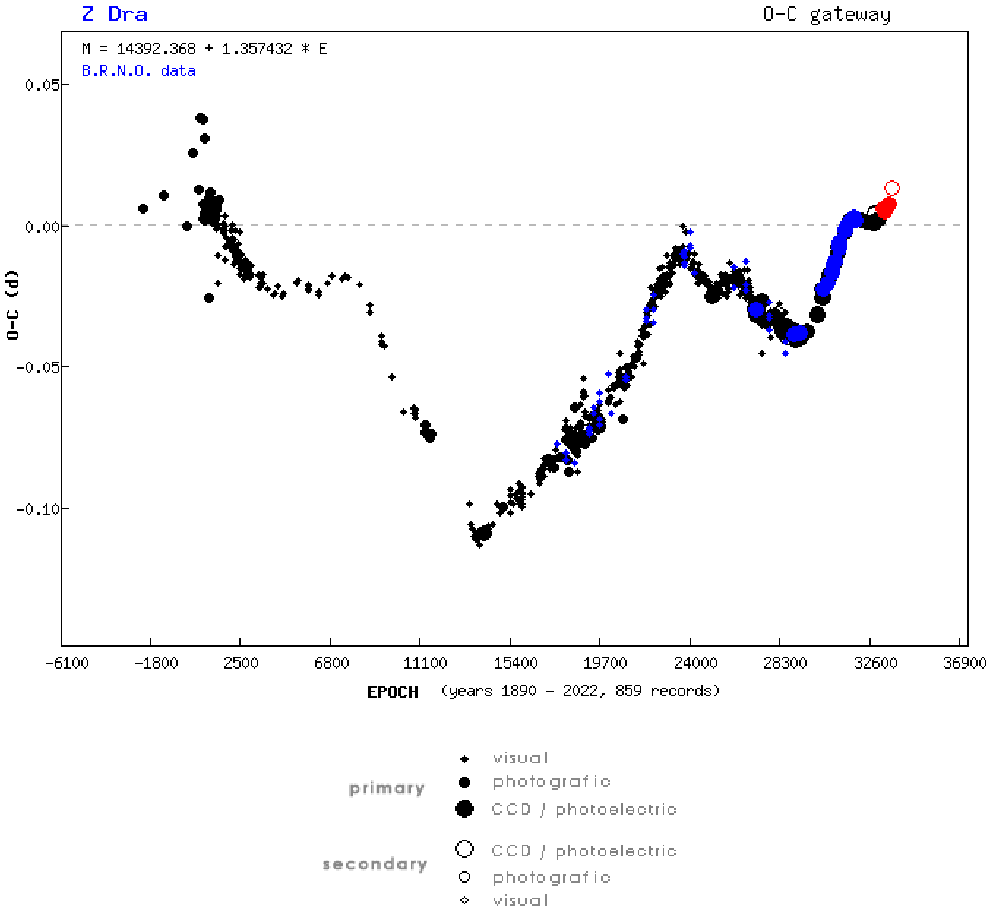
The timing of AD And shown above, together with observations already published in earlier Circulars are shown in red in the diagram below and suggest that the system has passed its closest approach and is now receding from us again.

V608 Cyg continues to show a sinusoidal O-C as Chris Lloyd suggested it would ([Circular 193, p30](#)):

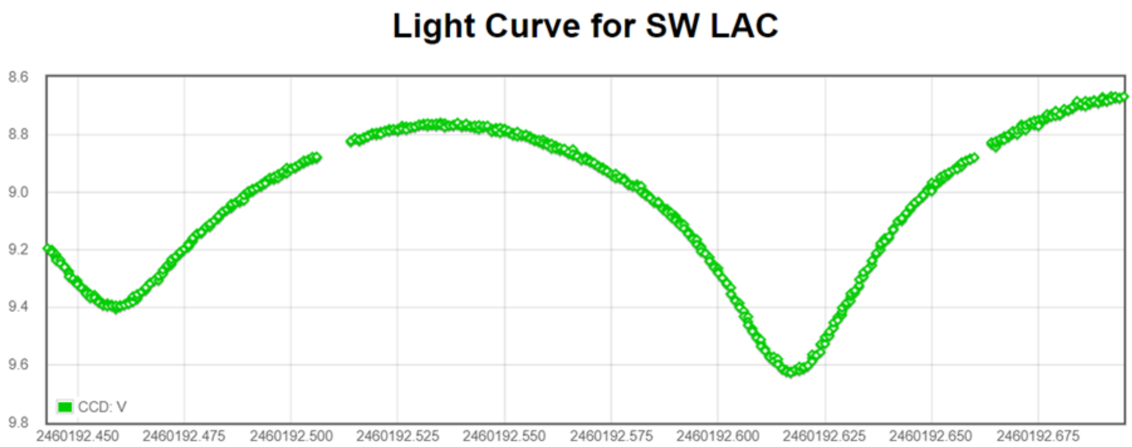


The O-C diagrams of both SW Lac and Z Dra are rather complex showing abrupt changes from increasing to decreasing period and vice versa :





The light curve from which the above timing of the primary minimum of SW Lac was determined is shown below. SW Lac is an eclipsing binary of the W Uma type with elliptical components almost in contact and a common envelope.



Symbol Key: **Crosses** = Negative observation, **Triangle** = Brighter than, Otherwise: **Circle** = Visual, **Diamond** = CCD/CMOS, **Plus** = Everything else

Contributors: T Vale

Back to contents

Section Publications

Hard Copy Charts	**Order From**	**Charge**
Telescopic	Chart Secretary	Free
Binocular	Chart Secretary	Free
Eclipsing Binary	Chart Secretary	Free
Observation Report Forms	Director/Red Star Co-ordinator	Free
Chart Catalogue	Director	Free
Binocular VS charts Vol 2	Director or BAA Office	Free

Charts for all stars on the BAAVSS observing programmes are freely available to download from the VSS Website www.britastro.org/vss

Contributing to the VSSC

Written articles on any aspect of variable star research or observing are welcomed for publication in these circulars. The article must be your own work and should not have appeared in any other publication. Acknowledgement for light curves, images and extracts of text must be included in your submission if they are not your own work! References should be applied where necessary. Authors are asked to include a short abstract of their work when submitting to these circulars.

Please make sure of your spelling before submitting to the editor. English (not US English) is used throughout this publication.

Articles can be submitted to the editor as text, RTF or MS Word formats. Light curves, images etc. may be submitted in any of the popular formats. Please make the font size for X & Y axes on light curves large enough to be easily read.

Email addresses will be included in each article unless the author specifically requests otherwise.

Deadlines for contributions are the 15th of the month preceding the month of publication. Contributions received after this date may be held over for future circulars. Circulars will be available for download from the BAA and BAAVSS web pages on the 1st day of March, June, September and December.

Deadline for the next VSSC is February 15th 2024.

BAA www.britastro.org
BAAVSS www.britastro.org/vss
BAAVSS Database https://www.britastro.org/photdb/
BAA Spectroscopic Database https://britastro.org/specdb/
BAAVSS Circular Archive http://www.britastro.org/vss/VSSC_archive.htm

Section Officers

Director
Prof. Jeremy Shears
Pemberton, School Lane, Tarporley, Cheshire CW6 9NR
Tel: 07795 223869 E-mail bunburyobservatory@hotmail.com

Secretary
Bob C. Dryden
21 Cross Road, Cholsey, Oxon OX10 9PE
Tel: 01491 201620 E-mail visual.variables@britastro.org

Chart Secretary
John Toone
Hillside View, 17 Ashdale Road, Cressage, Shrewsbury SY5 6DT
Tel: 01952 510794 E-mail enootnhoj@btinternet.com

Pulsating Stars Co-ordinator
Shaun Albrighton
4 Walnut Close, Hartshill, Nuneaton, Warwickshire CV10 0XH
Tel: 02476 397183 E-mail shaunalbrighton93@gmail.com

CV's & Eruptive Stars Co-ordinator, Circulars Editor & Webmaster
Gary Poyner
67 Ellerton Road, Kingstanding, Birmingham B44 0QE
Tel: 07876 077855 E-mail garypoyner@gmail.com

Nova/Supernova Secretary
Guy Hurst
16 Westminster Close, Basingstoke, Hants RG22 4PP
Tel: 01256 471074 E-mail guy@tahq.org.uk

Eclipsing Binary Secretary
Des Loughney
113 Kingsknowe Road North, Edinburgh EH14 2DQ
Tel: 0131 477 0817 E-mail desloughney@blueyonder.co.uk

Database Secretary
Andy Wilson

Tel: 01934 830683 E-mail andyjwilson_uk@hotmail.com

Telephone Alert Numbers for Nova and Supernova discoveries telephone Guy Hurst. If answering machine leave a message and then try Denis Buczynski 01862 871187. Variable Star alerts call Gary Poyner or post to BAAVSS-Alert – **but please make sure that the alert hasn't already been reported**.