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The British Astronomical Association

Variable Star Section Circular

No. 182 December 2019

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Cover Picture

AB Aur and its associated reflection nebula

Digitised Sky Survey

From the Director — *Jeremy Shears*

Would you like to speak at the VSS meeting on 2020 May 9?

I hope that the next VSS meeting is firmly in your diary. It will take place on Saturday 9 May 2020 at the Humfrey Rooms in Northampton, courtesy of the Northamptonshire Natural History Society. Gary Poyner and I are putting the speaker programme together. We'd like to have a range of talks from members, so if you'd like to give a talk please can you contact Gary and me by the 31 January 2020.

WINTER MIRAS

M = Max, *m* = min.

W And	*m*=Nov/Dec
RW And	*m*=Dec
R Aqr	*m*=Jan/Feb
R Aql	*M*=Feb
V Cam	*m*=Jan
X Cam	*M*=Jan/Feb
SU Cnc	*m*=Dec
	M=Feb/Mar
U CVn	*m*=Jan/Feb
S Cas	*m*=Jan/Feb
W CrB	*m*=Feb/Mar
chi Cyg	*M*=Jan
S Cyg	*m*=Dec
V Cyg	*m*=Feb
SS Her	*m*=Jan
	M=Feb/Mar
SU Lac	*m*=Feb/Mar
RS Leo	*m*=Jan
W Lyn	*M*=Nov/Dec
X Oph	M=Dec/Jan '20
U Ori	*m*=Dec
R Ser	*m*=Dec/Jan '20
T UMa	*m*=Dec

Source BAA Handbook

Spectroscopy Software Training Workshop videos

The workshop held at the end of August was very well received. Videos of David Boyd's session on ISIS and John Paraskeva's sessions on BASS can be viewed from the BAA website:

https://britastro.org/video/17273/19252

Please note you need to be a BAA member and logged into your website account to be able to watch more than the first 2 minutes (if you are not already a BAA member, why not join? Digital membership costs a mere £30.50!). Many thanks to all those involved and to Andy Wilson and Dominic Ford for making the videos available.

LISA spectrograph available

BAA member Andrew Smith, one of our more advanced spectroscopists, very kindly donated a LISA spectrograph to the BAA to use in support of our initiative aimed at encouraging members to take up spectroscopy. We aim to lend the spectrograph to people who have suitable projects in mind. The instrument is now available for loan. This is a sophisticated instrument capable of a wide range of variable star projects. It would, for example, make a nice step up for those already using an Alpy or Star Analyser; or offer an opportunity for an experienced photometrist to become involved in spectroscopy. The LISA comes complete with a guide camera, but no imaging camera. It is a reasonably heavy spectrograph, especially when combined with both imaging and guide cameras, requiring a solid telescope mounting and robust focuser. So, any applications should demonstrate that your existing equipment is capable of handling the weight, and you should already have an appropriate imaging camera, typically a monochromatic CCD.

Those with a track record in spectroscopy and who have been submitting to the BAA Spectroscopy Database will be considered favourably, as well as experienced photometrists who submit their observations to the BAA VSS Database. All spectra taken with the LISA will need to be fully

processed and submitted to the BAA Spectroscopy database. The results should also be written up and submitted to either the VSSC or the BAA Journal.

Any application for the LISA needs to be based around a good variable star project that would suit the LISA and the duration of the project should also be specified. This should include time to get familiar with the LISA, and spectroscopy processing software, for anyone who is new to the subject. The following projects are intended as suggestions which could be used as the basis for the application, while all good project ideas will be considered.

• Spectroscopic monitoring of Mira stars over a pulsation cycle.

• Intensive observations of bright novae to monitor their changing spectra over the duration of an outburst.

• Monitoring Young Stellar Objects such as T Tauri and Herbig Ae stars to see if changes in their spectra are detectable over various time periods.

• Searching for Be stars.

If you are interested in borrowing the LISA spectrograph, you are invited to submit your proposal to the Director by 31 January 2020. David Boyd, who already owns a LISA, will be happy to advise on suitability of equipment and to offer support to whoever uses it, as will Andy Wilson. David, Andy and I will review applications from potential borrowers.

Please note that the applicant must be a member of the BAA and the VSS.

Variable Star of the Year 2020 - SV Sge

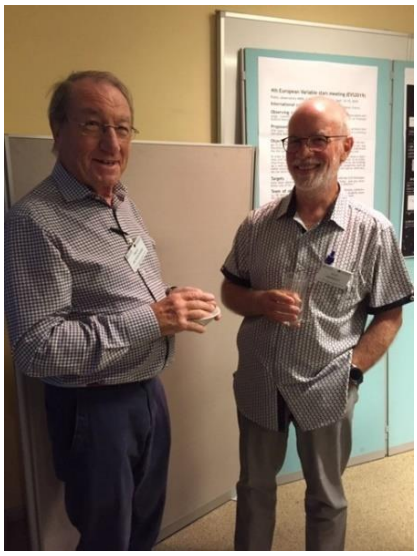
The 2020 BAA Handbook features the R CrB star SV Sge as its variable of the year. BAA members can read the article in the Handbook which was released in October; it is also available on the VSS website (http://www.britastro.org/vss/VSOTY.htm) along with previous VSOTY articles. Thanks to Gary Poyner for raising the profile of this fascinating star.

European Variable Star 2019 meeting

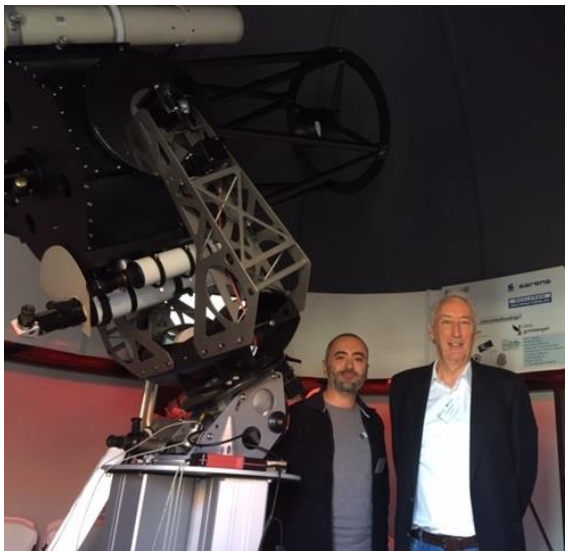
Along with nearly 60 other variable star enthusiasts, I participated in the EVS 2019 meeting held at the MIRA public observatory in Grimbergen, just north of Brussels, on Sep 13-15. Speakers, both professional and amateur, from all over Europe and the US gave presentations on a wide range of VS topics. I spoke about northerly cataclysmic variables from the Hamburg Quasar Survey. It was wonderful to meet old friends and make new ones – as well as meet people with whom I have only had the pleasure of email correspondence. Many thanks to

L-R: Boris Gänsicke (U. of Warwick), Robin Mentel (U. of Leiden), Christian Knigge (Southampton U.) & Arto Oksanen(Finland)

Josch Hambsch of the VVS, the Flemish astronomical society, and his colleagues at MIRA for organising it. The EVS is held every 3 years and the next one in 2022 is likely to be held in Spain, probably in the Barcelona area - details will be announced nearer the time.



Pierre de Ponthière (L) and Josch Hambsch (R)



Yenal Ogmen (Cyprus) and Chris Lloyd (U. of Sussex)

Visit to AAVSO HQ

A business trip to Cambridge, Massachusetts, in September provided an opportunity to visit HQ and meet AAVSO Director Stella Kafka and her team. This was actually my third visit to HQ. We talked about the latest developments in both the BAA VSS and the AAVSO, as well as in variable star astronomy, including how the latest sky professional surveys are providing more targets for amateurs to pursue. As you may know, every three months the VSS shares its observational data with the AAVSO – many thanks to Andy Wilson for managing our database and ensuring the updates are sent flawlessly.

End of year wishes

As this is the final Circular of 2019, I would like to wish you all a very Merry Christmas and Clear Skies for 2020!

Jeremy Shears

At AAVSO HQ. L to R: Elizabeth Waagen, Bert Pablo, the Director & Stella Kafka

VSS Campaign to observe U Leo

Jeremy Shears

Although U Leo has been linked to a possible nova in 1855, this is by no means certain and its identity remains something of a mystery. The VSS is launching a CCD photometry campaign on U Leo during the 2019/20 observing season with the aim of shedding light on this enigmatic star.

On 1876 February 20, C.H.F. Peters discovered the main belt asteroid 160 Una from Hamilton College's observatory at Clinton, New York [1]. He continued to follow it for the next few days as it tracked through Leo, comparing its brightness and position with field stars catalogued in the *Bonner Durchmusterung* (BD). In doing so, he noted that one of those field stars, DM +14°2239, which was listed as magnitude 9.5, was missing. On February 24, 160 Una was in the same telescopic field as DM +14°2239, but there was no sign of the latter. On other nights he reported the star as invisible or occasionally at the limit of visibility, leading him to conclude that DM +14°2239 "must evidently be ranked among the variables". It soon received the official moniker, U Leo, and Peters was credited with its discovery.

Fast forward to 1881, when Heinrich Kreutz of the Bonn Observatory checked the original observations of DM +14°2239 which were made in the mid-1850s [2]. The first, made on 1854 Jan 22 was doubtful (actually listed as mag "9.1?") and the second, 1855 Jan 18 was a definite observation at mag 9.1. Photography by Max Wolf at Heidelberg in 1891 to 1893 also failed to reveal anything brighter than 11th magnitude [3]. Duerbeck [4] also noted that the Markree catalogue, which contains observations of the region made between 1855 Mar 15 and 1856 Mar 13, does not list the star.

These observations led to speculation that the 1855 Jan 18 observation might have been a nova, N Leo 1855, which subsequently faded.

Downes and Szkody [5] investigated the field of N Leo in 1988 and failed to find a compelling candidate for an old nova. The closest star to the BD position showed an intriguing sinusoidal variation of 0.11 mag with a period of either 3.21 or 6.42 h and this 17.3 magnitude star has assumed the identity of U Leo ever since. Spectroscopy by Shara *et al*. [6] didn't reveal any emission lines (implying no accretion). Spectroscopy by Ringwald et al. [7] also failed to reveal any evidence that this star was an old nova.

Putting this all together naturally raises the question of whether there ever was a nova in Leo in 1855!

But the story doesn't end there. Boris Gänsicke recently interrogated CRTS data on U Leo and found a very clean and strong signal at ~3.204 h (see phase diagram of photometry folded on this period in Figure 1), consistent with Downes and Szkody's. Furthermore, its SDSS spectrum is suggestive of an F-type star, though it seems to have two emission lines near ~9500Å and a large IR excess (although there is a possibility this is background contamination). Again, this doesn't look like an old nova, but what is it? And is the object now identified as U Leo, the same as the one observed in 1855? But if, just if, the original DB observation of a mag 9.1 object was correct, what happened in 1855 to cause it to become so bright and disappear so quickly?

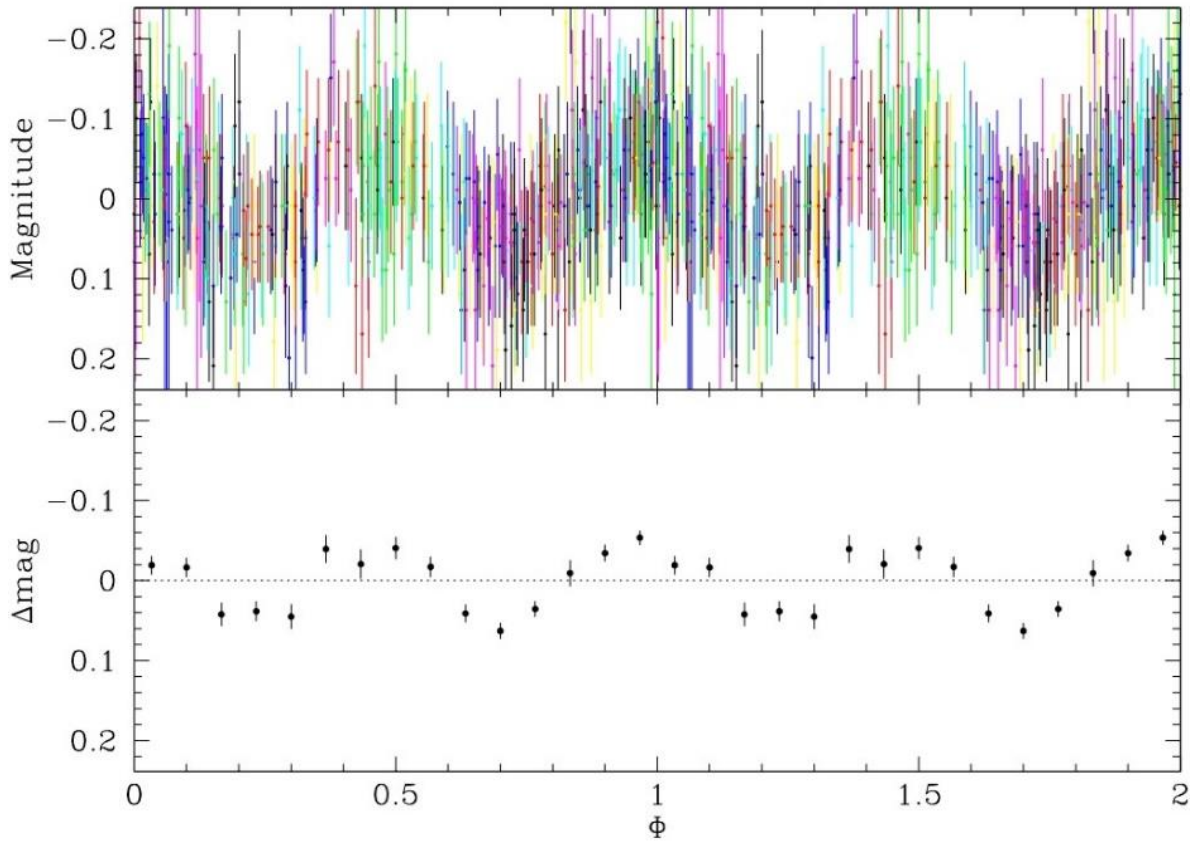


Figure 1: Phase diagram of CRTS photometry of U Leo folded on a period of 3.204 h

Boris hopes to get some photometry and perhaps spectroscopy on U Leo during the early part of 2020. So, I thought members of the VSS might like to carry out some long time series of the star to see if we can spot any variations. Might we pick up the sinusoidal variations, or perhaps something else? Ken Menzies and Roger Pickard performed some runs in 2019 March, but they were inconclusive. Given this star is rather faint, at mag 17.3, it will need long unfiltered exposures to get a reasonable signal-to-noise ratio. Exposures of a few minutes are also reasonable given the 3.2 h photometric period. I have been following U Leo using the SRO-50 telescope which is part of the AAVSOnet remote telescope facility (Figure 2).

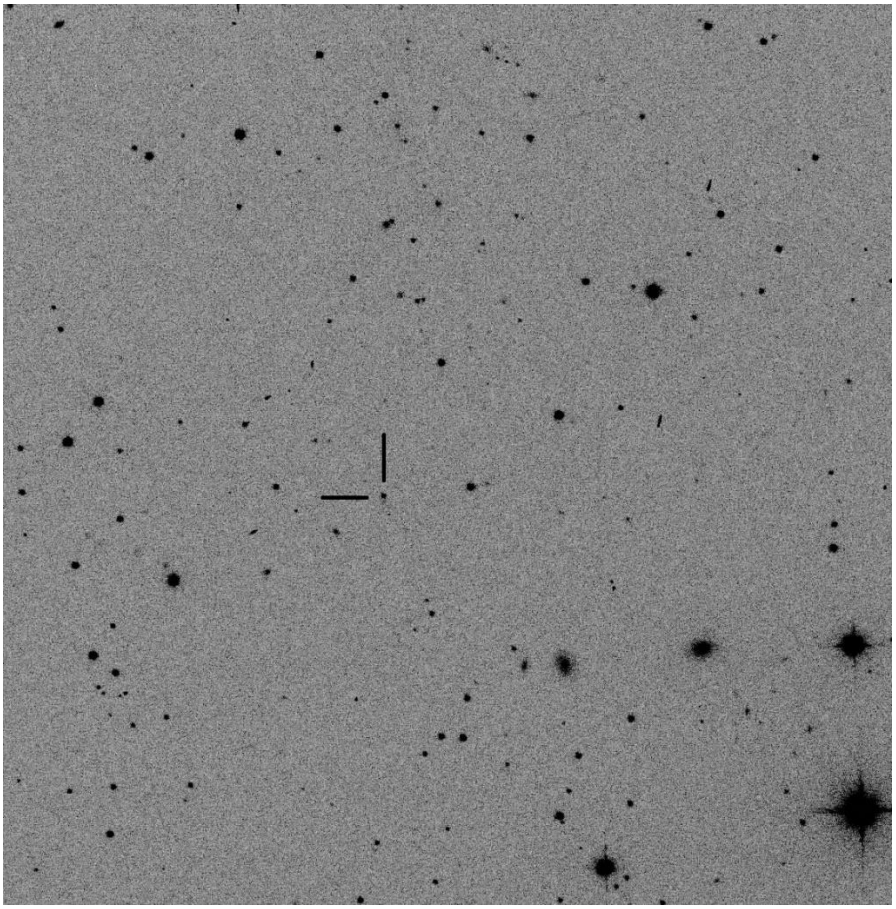


Figure 2: Field of U Leo. N top, E left, 18 arcmin. (SRO-50 telescope at Sonoita Research Observatory)

A chart and sequence for U Leo is available from the AAVSO website. Please submit your observations to the BAA VSS or the AAVSO database.

U Leo is located at RA 10 24 03.81 Dec +14 00 25.9 (J2000.0)

The campaign starts now and will continue until the end of the 2020 observing season.
If you have any questions, please contact me at bunburyobservatory@hotmail.com

[1] Peters C.H.F., AN, 87, 271 (1876)
[2] Kreutz H., AN, 100, 317 (1881)
[3] Wolf M., AN, 132, 287 (1893)
[4] Duerbeck H.W., *A Reference Catalogue and Atlas of Galactic Novae* (1987)
[5] Downes R.A. and Szkody P., AJ, 97, 1729 (1989)
[6] Shara M.M., Moffat A.F.J. & Potter M., AJ, 100, 540 (1990)
[7] Ringwald F.A., Naylor T. & Mukai K., MNRAS, 281, 192 (1996)

AB Aurigae – The September 2019 Fade

John Toone

AB Aur underwent a rare fading event in mid-September 2019. Details of the fade and possible links to previous fades seen in 1975 & 1997 are described.

AB Aur is the Northern hemisphere's brightest Herbig Ae pre-main sequence star, normally steady at magnitude 7 but with occasional dust obscuration events causing fades to magnitude 8.

In BAA VSS Circular 95, page 13 (March 1998) I provided details of fade events detected visually by BAA VSS observers in 1975 and 1997. Both fades were remarkably similar being 1.2 magnitude deep and lasting just 70 hours.

In BAA VSS Circular 180, page 10 (June 2019) I gave an overview of the photometric variations of AB Aur and requested enhanced monitoring to look out for potential fades during the 2019/2020 apparition centered on December 2019.

The 2019/2020 apparition began on 23 July 2019 and I observed AB Aur on 26 nights up to 14 September 2019. During this time AB Aur showed minimal variation between 7.0 and 7.2 with a mean magnitude of 7.15.

Then on the morning of 18 September 2019 AB Aur was seen at magnitude 7.6, equal to comparison star E. This was the faintest I had seen AB Aur outside of the 1997 fade since commencing visual monitoring on 7 October 1978 (observations secured on 2063 nights). I put out an alert message at 05:57GMT on 18 September 2019 and observations undertaken on the next two nights recorded a rise back to magnitude 7.2.

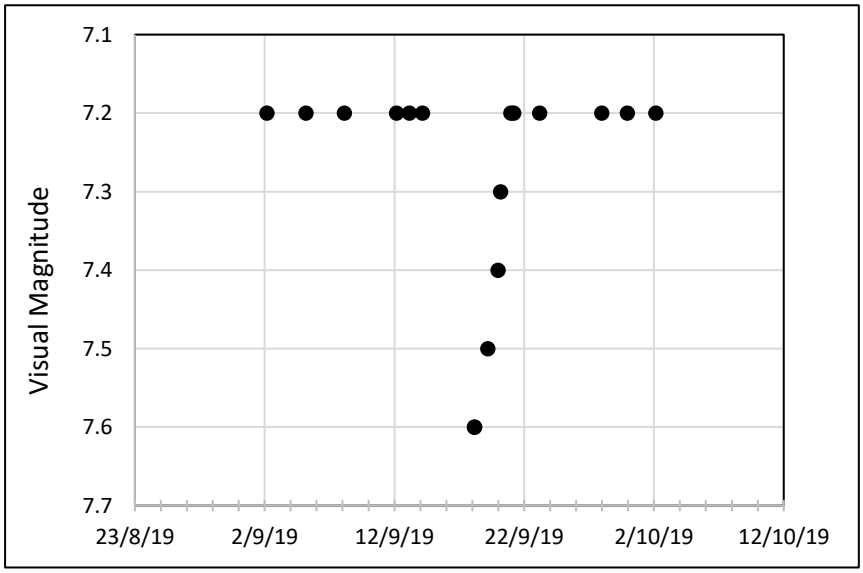


Figure 1: Visual observations John Toone

The September 2019 fade was only 0.4 magnitude deep compared with the 1.2 magnitude fades seen in 1975 and 1997. Since I missed the start of the fade it may have been deeper than magnitude 7.6 but probably not by much because the star appeared steady at the time of the detection of the fade.

The time intervals between the 1975, 1997 & 2019 fades are as follows:

8037 days: 1975/11/30 to 1997/12/01
7962 days: 1997/12/01 to 2019/09/18

Since the September 2019 fade was 75 days earlier than anticipated (on the assumption the same dust stream with a stable trajectory was responsible) and also shallower, it is worth observers maintaining enhanced monitoring throughout the second half of the 2019/2020 apparition in case the September 2019 fade is merely a precursor to an event more akin to that seen in 1975 and 1997. Alternatively, it could well be that the September 2019 fade is directly related to the 1975 & 1997 fades but the dust stream responsible has changed (possibly shifted position and become less dense). Future photometric and spectroscopic monitoring will hopefully clarify the situation.

BAAVSS Pulsating Star Programme

Shaun Albrighton

This short report shows light curves for seven semi regular/irregular stars on the Pulsating Programme of the VSS, from the period 01/01/2015 – 31/10/2019, and details of the 2019 maximum of omicron Cet.

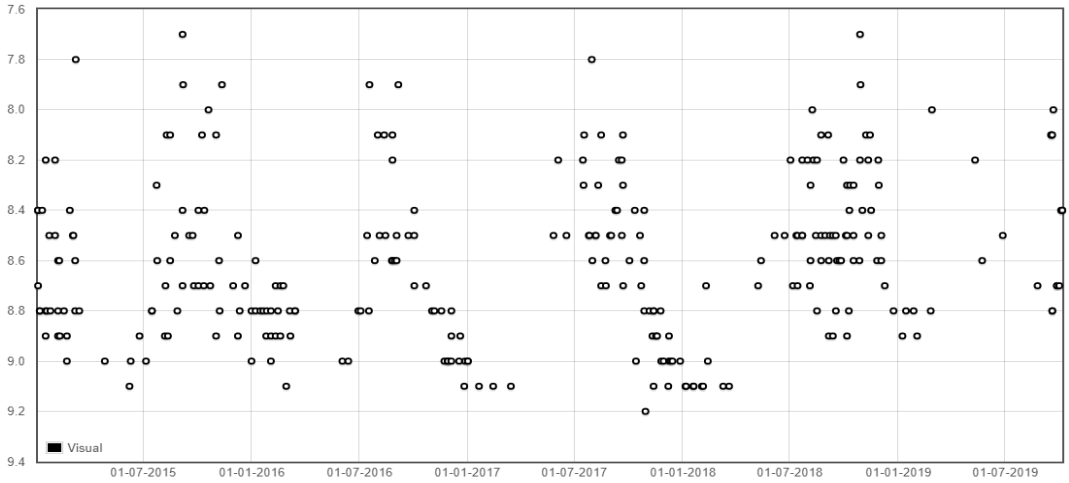
Basic details for the seven stars are listed in the table below. All plots are taken from the BAAVSS database.

Star	Type	Mag Range	Period (Days)
AQ And	SRb	7.70 – 9.50	169
W Cep	SRc	7.02 – 8.50	350
RU Cyg	SRa	8.00 – 9.40	233.43
BC Cyg	SRc	9.60 – 10.50	700
BI Cyg	Lc	8.40 - 9.90	
W Ori	SRb	5.50 – 6.90	212
RY UMa	SRb	6.49 – 7.94	310

AQ And

Despite scatter, (AQ And is a carbon star) this under observed star shows variations in the range of 8.0 – 9.0. Use of larger binoculars in the range of 80mm would be beneficial, whilst it would appear that care is needed to correctly identify the variable.

Light Curve for AQ AND



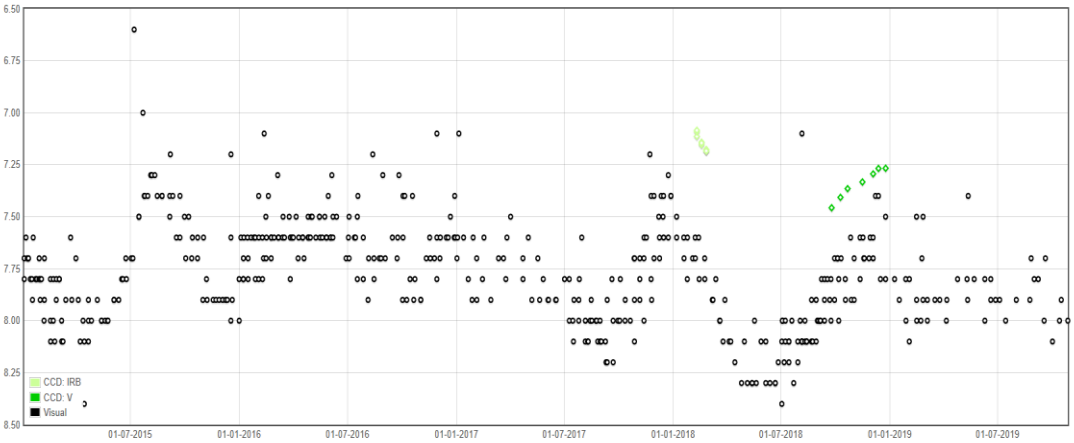
Symbol Key: **Crosses** = Negative observation, **Triangle** = Brighter than, Otherwise: **Circle** = Visual, **Diamond** = CCD, **Square** = Everything else

Contributors: S W Albrighton, M Barrett, D Gavine, T L Heywood, R K Hunt, T Markham, R Pearce, M D Taylor, J Toone

W Cep

During the period under review W Cep clearly demonstrates typical behaviour of an SRc. The variable fluctuating between times where the star shows distinct variations, whist at other times the range is much reduced, with no clear period. The VSX lists Hipparcos data as showing a possible secondary period of 2,090 days. Further analysis of BAA data is to be conducted.

Light Curve for W CEP



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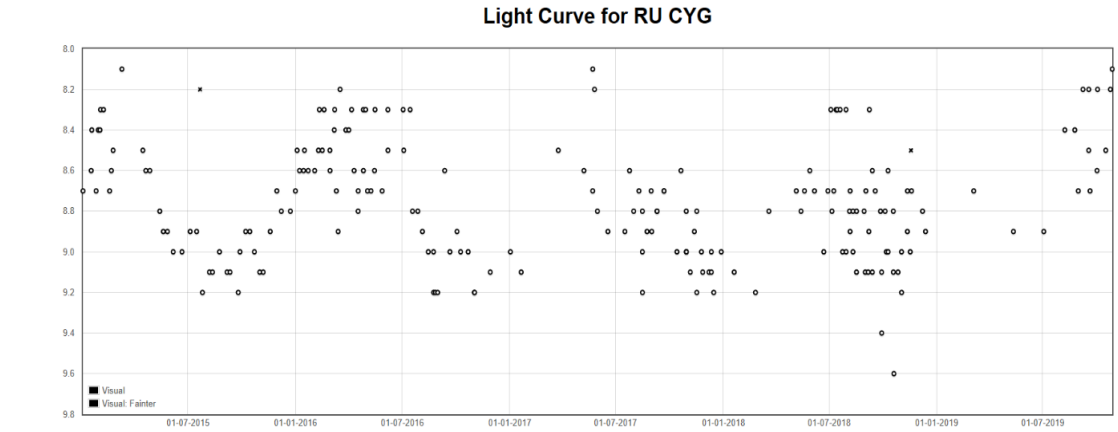
Contributors: S W Albrighton, M Barrett, G Fleming, K Griffiths, T L Heywood, T Markham, R Pearce, G Stefanopoulos, M D Taylor, J Toone, J Whinfrey, N White

RU Cyg

This under observed SRa type semi regular variable, comes highly recommended to observers using larger binoculars in the range of 80mm. The light curve shows distinct variation (be it with scatter) in the range of 8.2-9.2.

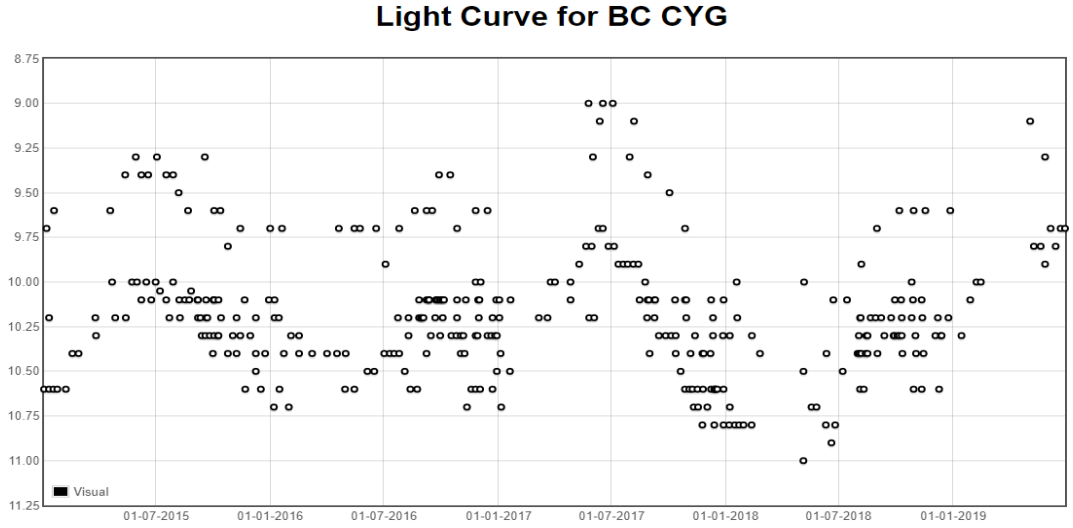


Symbol Key: **Crosses** = Negative observation, **Triangle** = Brighter than, Otherwise: **Circle** = Visual, **Diamond** = CCD, **Square** = Everything else

Contributors: S W Albrighton, M Barrett, T L Heywood, R K Hunt, T Markham, R Pearce, G Stefanopoulos, M D Taylor

BC Cyg and BI Cyg

I have included recent plots of these two stars as they demonstrate the importance of consistent observations by individual observers. Both stars clearly show observers tend to fall into two distinct categories, in that they are either bright or faint red observers. It should be noted however that the light curves for both sets of observers closely mimic one another. Because we have long runs of observations by observers, we are able to make allowances for such differences when conducting analysis. Both these stars make ideal objects for telescopes in the range of 100-150mm.



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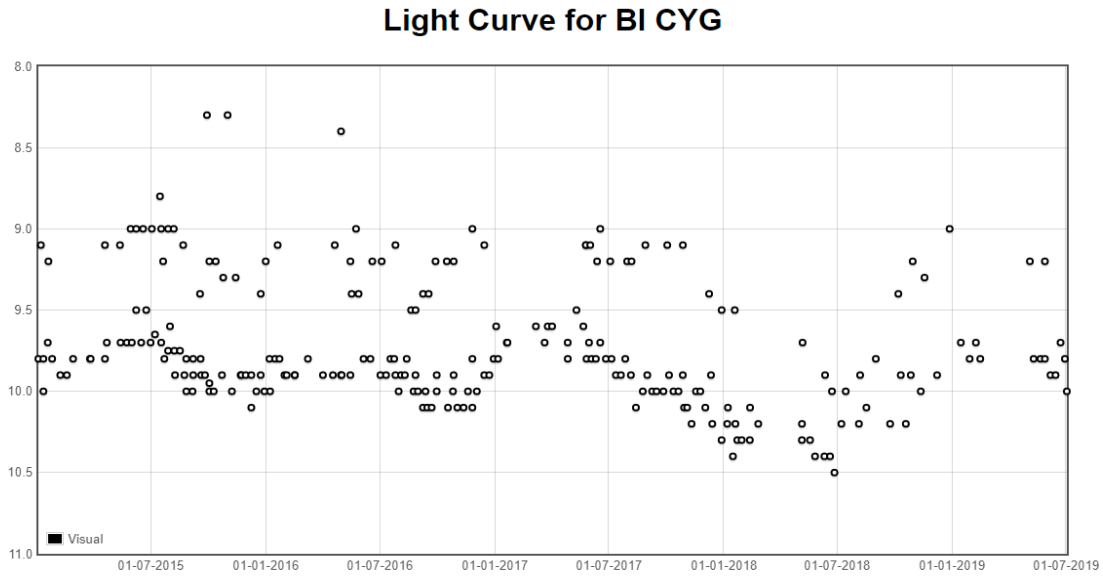
Contributors: S W Albrighton, L K Brundle, R C Dryden, R A H Paterson, P B Withers

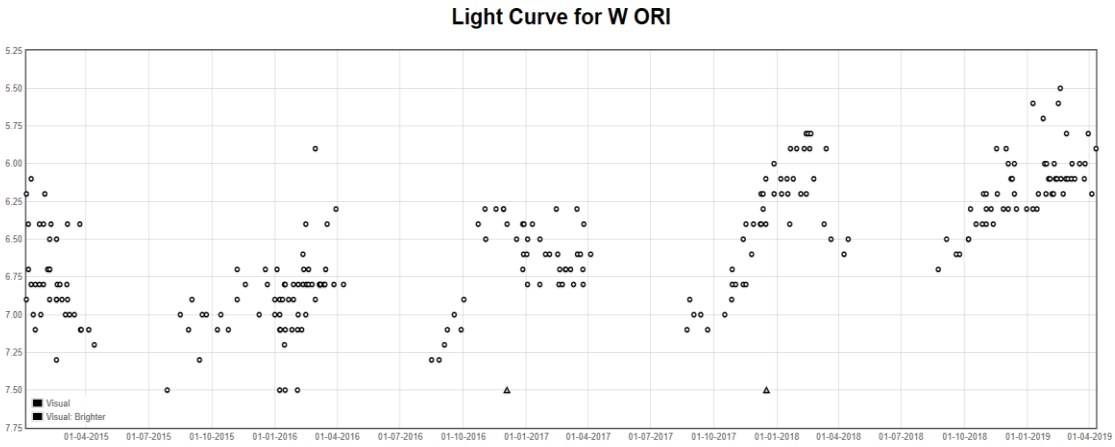


Symbol Key: **Crosses** = Negative observation, **Triangle** = Brighter than, Otherwise: **Circle** = Visual, **Diamond** = CCD, **Square** = Everything else

Contributors: S W Albrighton, L K Brundle, R C Dryden, R Pearce, P B Withers

W Ori

This SRb type variable is listed in the VSX as having a period of 212 days, with a note that the mean magnitude varies over a period of 2,450 days. Observers are encouraged to conduct early morning observations of the star during Sep/Oct to help reduce the seasonal gap in observations.

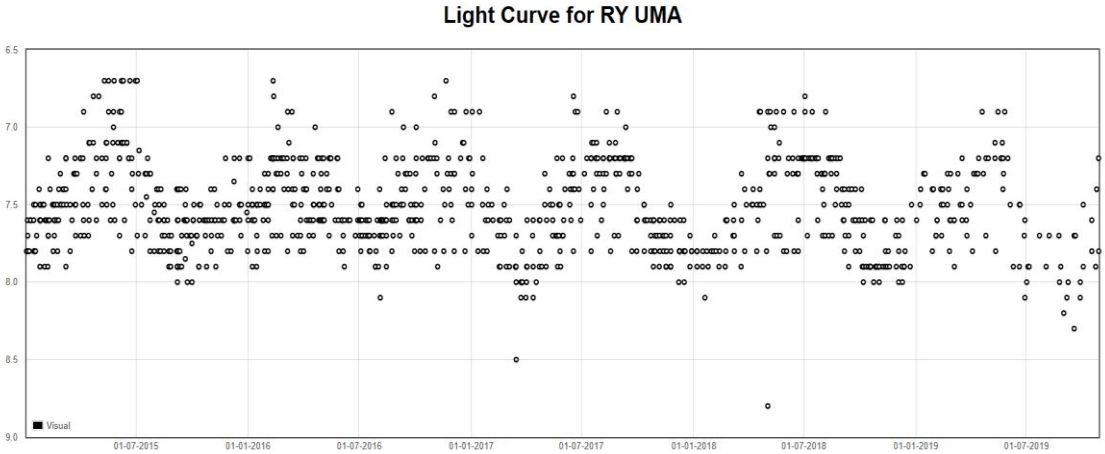


Symbol Key: **Crosses** = Negative observation, **Triangle** = Brighter than, Otherwise: **Circle** = Visual, **Diamond** = CCD, **Square** = Everything else

Contributors: S W Albrighton, M Barrett, R B I Fraser, K Griffiths, T L Heywood, J Meacham, P Mulligan, R Pearce, D Scanlan, G Stefanopoulos, M D Taylor, J Thorpe, J Toone

RY UMa

RY UMa is classic SRa type variable in that it shows regular and more predictable variation than compared to SRb types. The VSX lists no secondary period.

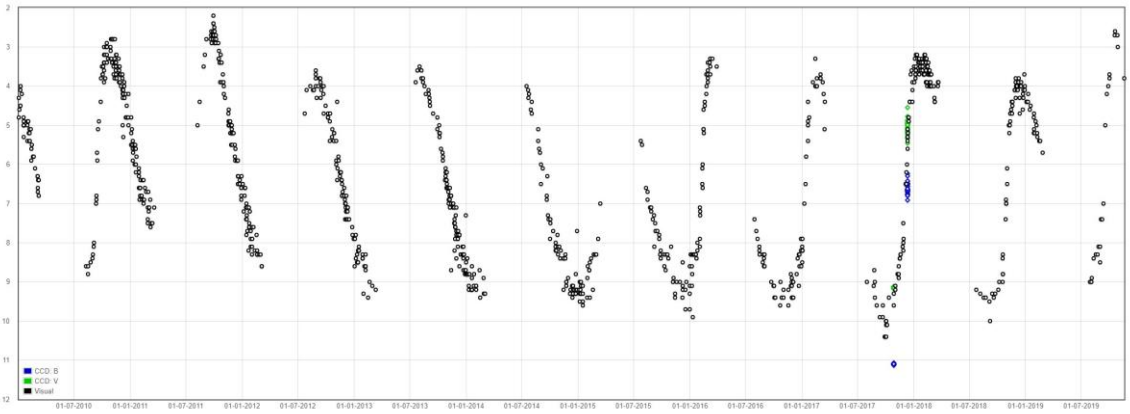


Symbol Key: **Crosses** = Negative observation, **Triangle** = Brighter than, Otherwise: **Circle** = Visual, **Diamond** = CCD, **Square** = Everything else

Contributors: S W Albrighton, M Barrett, P Bishop, L K Brundle, M Crook, R B I Fraser, D Gavine, T L Heywood, G M Hurst, M L Joslin, T Markham, R Pearce, J D Shanklin, M D Taylor, J Toone, T Vale, N White, A J Wilson

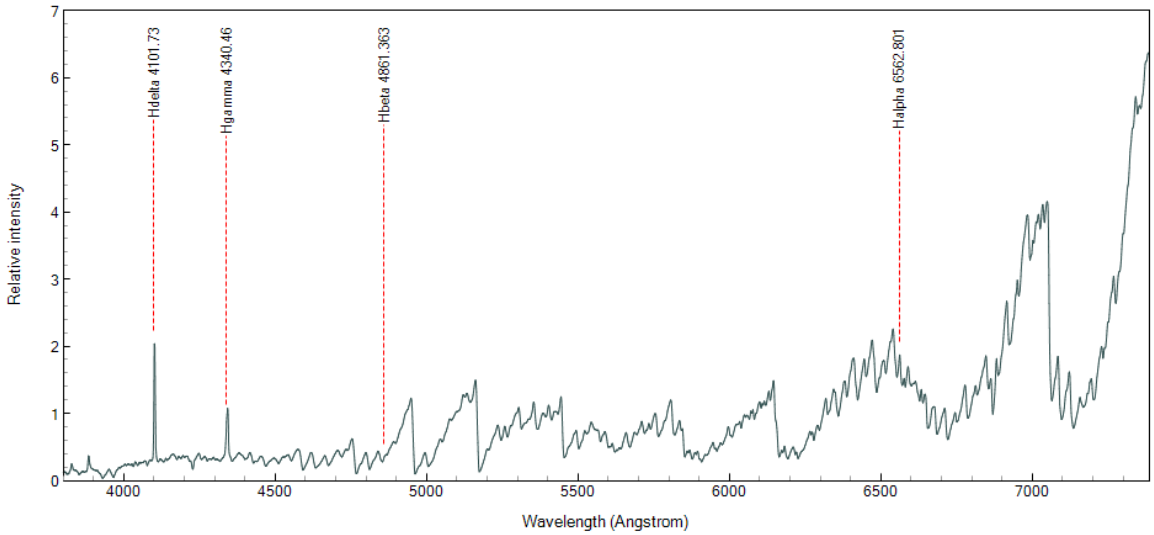
omicron Cet (Mira)

The 2019 maximum of Mira was the brightest observed since 2011. From the very few datapoints submitted to the database (poor weather or late reporting?), maximum occurred on Oct 24 at a mean magnitude of 2.75. At the time of writing (Nov 21), Mira had faded to magnitude 3.8 by Nov 19.9.



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

Contributors: S W Albrighton, B J Beesley, D Boyd, R C Dryden, N A Foster, R B I Fraser, M J Gainsford, K Griffiths, T L Heywood, M K Kidger, B MacDonald, B MacDonald, T Markham, J Meacham, G Poyner, D Scanlan, J D Shanklin, G Stefanopoulos, M D Taylor, J Thorpe, J Toone, T Vale



Spectrum of Mira taken by David Boyd on 2019 November 11. Total exposure of 120 sec with a LISA spectroscope on a C11 scope. The prominent hydrogen Balmer H-delta and H-gamma emission lines are generated by shock waves inside the atmosphere of pulsating red giants like Mira towards the maximum of their pulsation cycle. The rest of the spectrum is composed of saw-tooth-like features produced by absorption by TiO molecules in the cool atmosphere of the star.

CV & E News

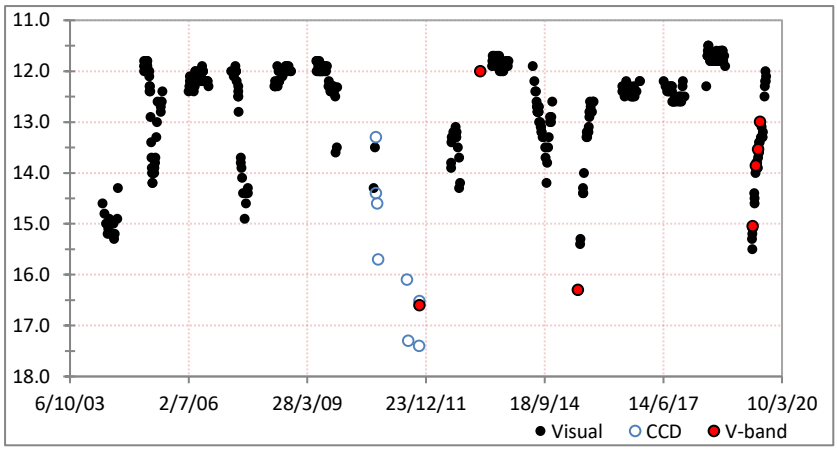
Gary Poyner

Recent activity in programme stars Z UMi, R CrB, SV Sge, ES Aql, CH Cyg and 3C 382 is covered, along with a selection of lightcurves.

In VSSC 181 I described the fading events of two currently active RCB stars – Z UMi and DY Per. Z UMi continued to fade throughout August to November, finally reaching magnitude 16.1 visual on Oct 2nd – the deepest fade observed since July 2012. Poor weather throughout late October and most of November has greatly reduced the number of observations made, but it's clear that the star has been varying between 15.5-15.8 visual, with no sign of a recovery to date (Nov 23). The minima of Z UMi all seem to be short duration episodes, and it's likely that a recovery will begin over the next few weeks.

DY Per also continued to fade throughout August until finally halting it's decline at the end of September at 14.8 visual. Up to the present time (Nov 26), DY Per is slightly brighter at 14.3V, and a recovery looks likely throughout the winter period, where the field will be well placed for observation.

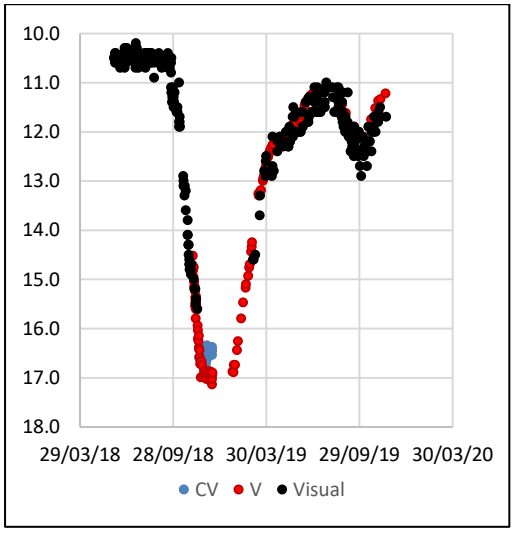
Coming to the end of its observing season for 2019, the under-observed RCB star ES Aql is close to returning to maximum magnitude, after reaching a medium faint minimum of 15.5 during early July this year.



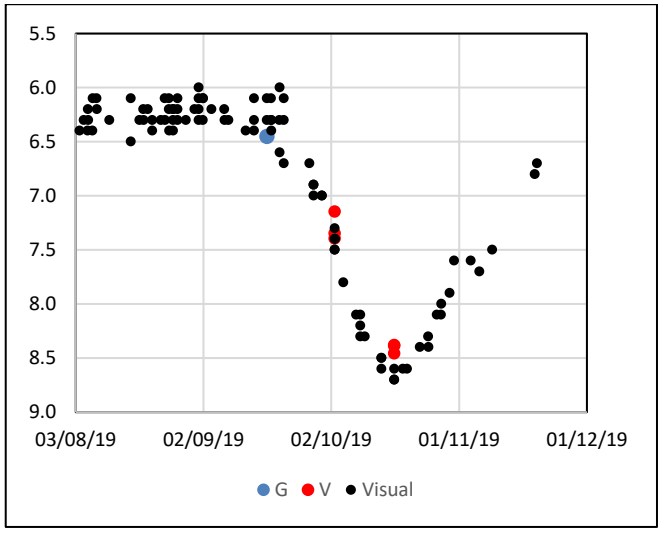
ES Aql 2004-2019

Maximum magnitude lies around 11.5-12.0, and the last estimate in the database is 12.1 made on Oct 24. Minimum magnitude can get below 18.0V, and rather like Z UMi & DY Per, long minima seem to be absent from the light curve.

Both R CrB and SV Sge have undergone secondary fading events and recoveries after recovering from deep minimum – the former from a twelve-year period of activity of course. The two light curves below show both events well. Observers are asked to monitor R CrB closely in the morning sky over the course of the winter period to see how this current period of activity develops. Likewise, observations of SV Sge in the late Winter/early Spring sky will also be welcomed.



SV Sge. March 2018-November 2019



R CrB. August-November 2019

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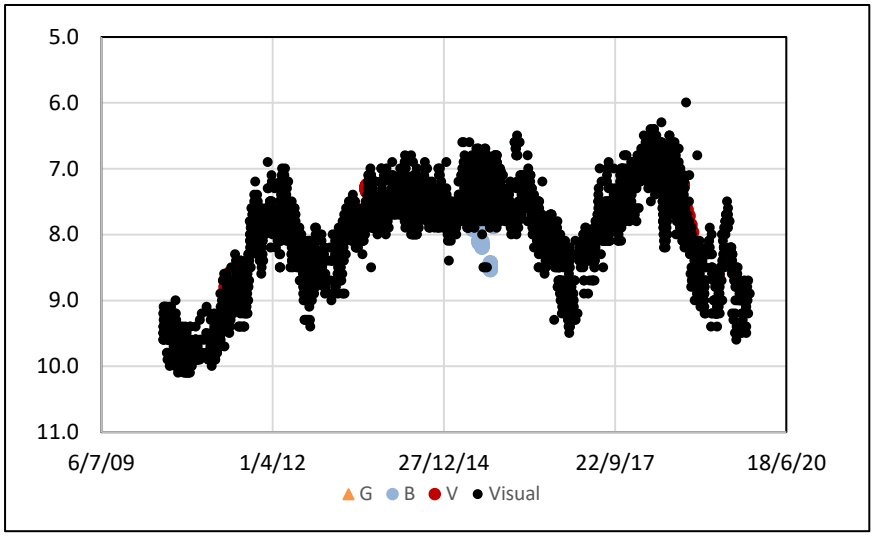
The symbiotic star CH Cyg (type ZAND+SR) is currently at its faintest level since October 2010, reaching a visual magnitude of 9.6 during September and October, with minor variations of ~0.5 mag. present in the light curve. A slight recovery is evident in late November, but observations are a little thin on the ground due to the poor weather conditions in the UK. The field is circumpolar from the UK and will therefore be visible in the evening and morning sky throughout the winter period.



CH Cyg 2010-2019. 4,846 observations BAAVSS database.

The CH Cyg system contains two, possibly three stars, where the red giant secondary star varies as a semi-regular variable over a period of ~97 days. Superimposed on these variations are irregular, unpredictable outbursts attributed to the hot component and/or disc. The whole range (5.6-10.1V) is visible in medium sized binoculars and presents the observer with a fascinating opportunity to study the unpredictable nature of a Cataclysmic Variable with the most modest of equipment.

CH Cyg was Variable Star of the Year for 1998

And finally, if you are a visual observer and have a moderate sized telescope or use a CCD and are looking for a new object to observe in the new year, then you could do no worse than add 3C 382 to your observing programme.

3C 382 is a broad line radio source identified as a Quasar where the luminosity is low enough for the host elliptical galaxy to be seen. Also present are supergalactic-scale biconical radio lobes, with a prominent superluminous jet extending to the north eastern lobe [1]

Professional research into the galaxy has been undertaken at wavelengths from Radio to X-ray, yet the object is highly variable in the visible part of the spectrum, and this of course is our territory. 3C 382 has however been much neglected by amateur VS observers since it's discovery. The AAVSO IDB contains 1,156 observations from 12 observers going back to 2001, and our own DB just 543 observations from two observers (Pickard 9 V-band and Poyner 534 visual) dating to 2004 (Figure 1). Despite this, the light curve shows the degree of variability which can be detected, and one can establish a visual range of 12.8 – 15.3. In addition to the high variable range, 3C 382 has been in a slow steady decline in optical brightness since 2010, fading from 13.5-15.3 in that time. Superimposed on this decline are short-term flare like activity (from the jet?), as well as occasional short-term variations of several tenths of magnitude in just several days. Prior to this decline, 3C 382 varied by over two magnitudes in the period 2004-2008. (Figure 1).

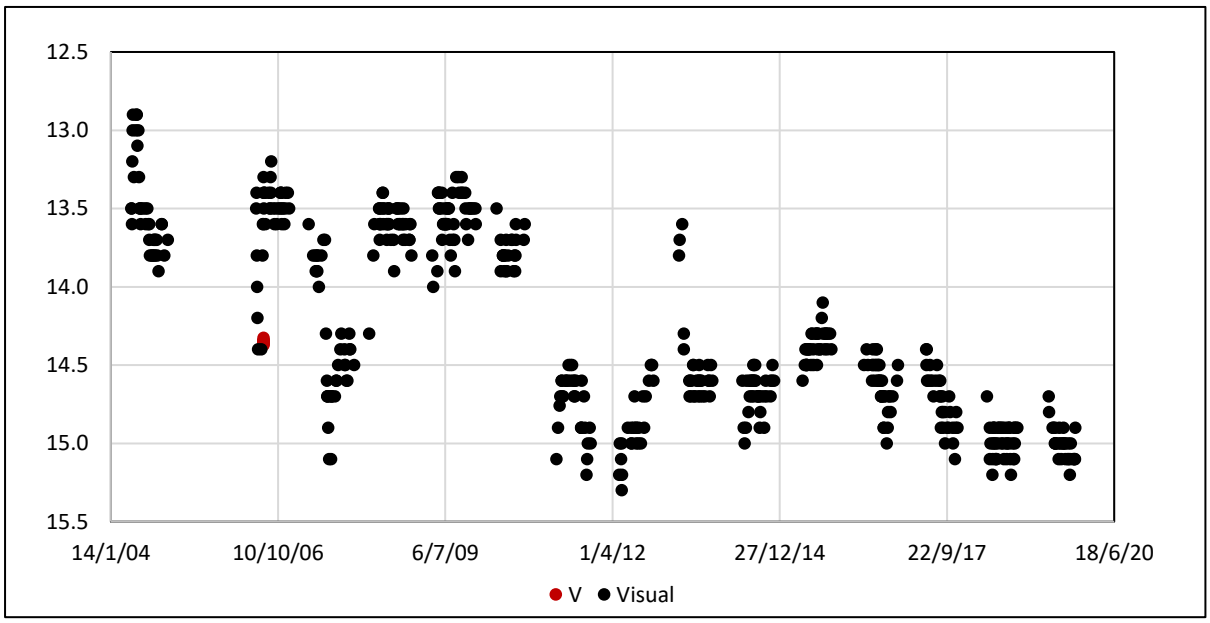


Figure 1: 3C 382, 2004-2019. BAAVSS database

3C 382 can be found in the constellation of Lyra at 18 35 03.38 +32 41 46.8, which puts the field three degrees west of beta Lyr. A chart and sequence to below magnitude 16.0 can be downloaded from the AAVSO

With so few observations of this AGN in our database, it's surely a tempting target for anyone interested in expanding our knowledge of an interesting and highly variable object over a prolonged period.

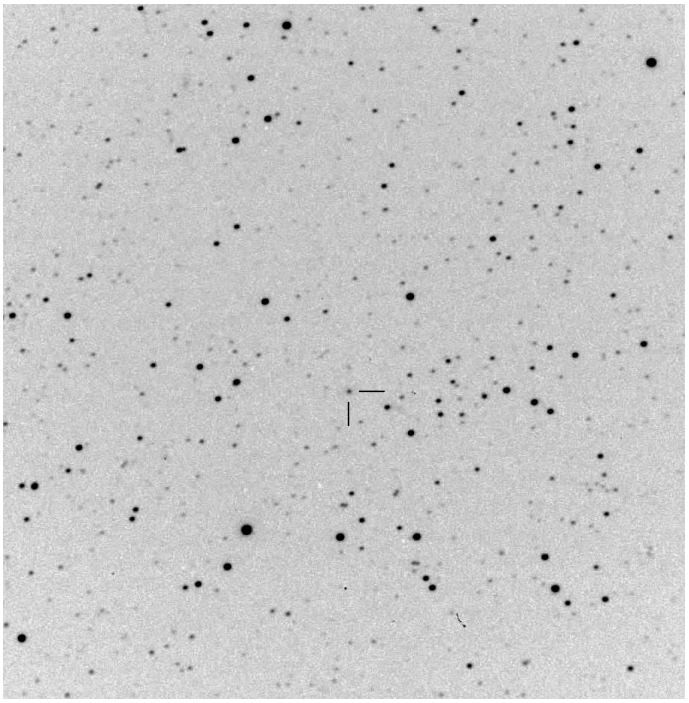


Figure 1: Field of 3C 382. N bottom, W left, field 25 arcmin. V-band image 2011 Jun 04.13UT BRT.

1: Subarcsecond mid-infrared atlas of local AGN

Eclipsing Binary News

Des Loughney

Information Bulletin on Variable Stars

Some news from László Molnár Editor-in-Chief of IBVS…

We announce with regret that after careful deliberation we made the decision to end the active phase of the journal, and, from March 10th, 2019, we no longer accept new submissions. The journal has been facing mounting challenges both in term of human resources and IT background and was getting harder and harder to maintain. At this point, we feel that resuscitating the journal would require expensive investments that are not justified by the number of papers we publish.

We are thankful of the many editors and production staff, board members, and referees, for their hard work over the decades, and for the authors who chose IBVS to publish their results. We strive to process all remaining manuscripts and to maintain the archive of the journal here (https://konkoly.hu/ibvs/) , and to make the papers and data files available at external sources.

If you are looking for alternative places to publish, we may suggest the following places**:**

- Astronomical Notes, New Astronomy, Astrophysics and Space Science, for more in-depth papers;
- Journal of the AAVSO, Open European Journal on Variable Stars, and Peremennye Zvezdy/Variable Stars are field-specific journals for variable star research;
- Research Notes of the AAS, for rapid publication of short or time-critical works;
- The AAVSO databases VSX and AID to deposit observational data of variable stars.

(*Editors' Note to authors. In addition to the journals mentioned above, please also consider the Journal of the British Astronomical Association and this Circular for publishing outlets. Details on how to contribute to the BAA Journal can be found here*)

IQ Persei

This is an EA/DM system that is on our observing list. It has a period of 1.743562 days. It varies from magnitude 7.73 to 8.37. The primary eclipse has a depth of 0.6 magnitude and the secondary minimum 0.1 magnitude. Despite having a short period, the light curve seems to be of a fully detached system.

A study in 1997 (1) which found that the main interest of the system was apsidal motion so that the secondary eclipse was occurring at phase point 0.542 (instead of 0.5). It is hoped to do a study of the secondary minimum using DSLLR photometry to find out its current displacement.

David Conner (2) obtained an excellent light curve of the system earlier this year (30/1/19) and measured the time of primary minimum (see figure 1 right). One can also see from the light curve that the primary eclipse is 'total'. The predicted time of the eclipse was HJD 2458514.3865078 (as quoted on the Krakow website). The difference between predicted and observed is only 4.32 minutes which is probably within the margin of error or within the margin of natural variation. There does not seem to have been a significant change in the period for over 20 years.

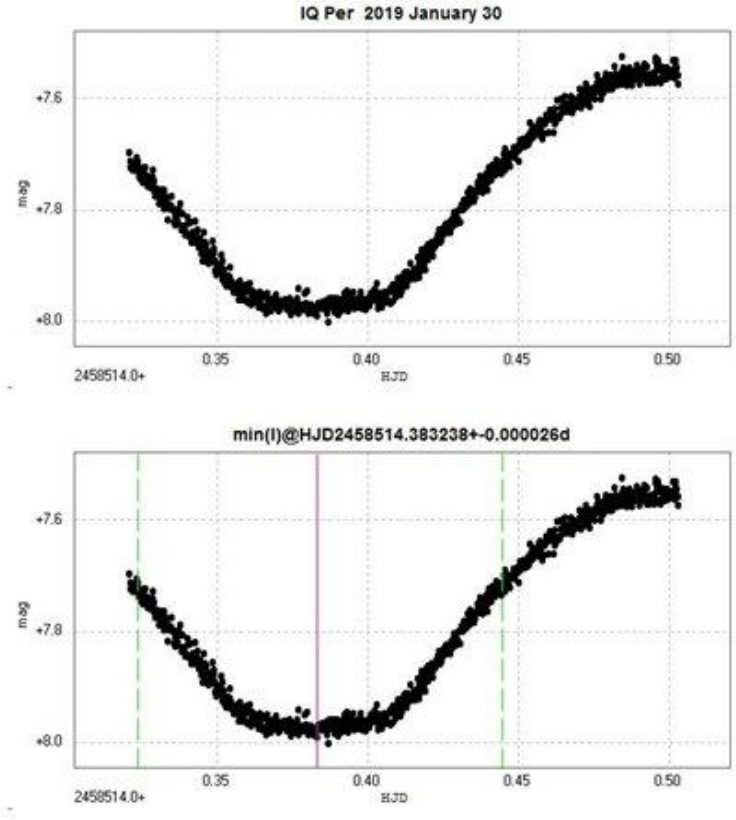


Figure 2: A primary minimum observed with the 2" Titan at Somerby Observatory on 2019 January 30, constructed from photometry of 818 unfiltered images. David Conner

1: O.L.Degirmenci 'Photometry and Analysis of the Eclipsing Binary IQ Persei' Astrophysics Space Science, October 1997, Vol 253, Issue 2, pp 237 - 252.

2: https://davidsconner.weebly.com/iq-persei.html

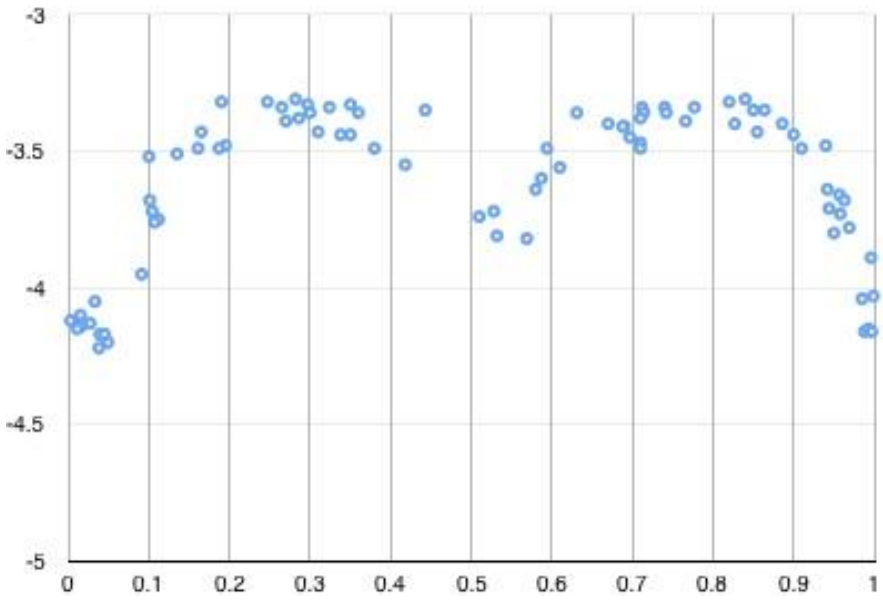
beta Lyrae

The period of beta Lyrae in Wikipedia is quoted as 12.9414 days. The period quoted on the Krakow website is 12.9423 days. The latter period was determined 17.28 years ago. An older period quoted on the Krakow website, dating from 138.53 years ago is 12.91563 days. It can be seen from these figures that the period is lengthening.

According to Wikipedia: "The amount of mass being transferred between the two stars is about 2×10^{-5} solar masses per year, or the equivalent of the Sun's mass every 50,000 years, which results in an increase in orbital period of about 19 seconds each year."

I think that beta Lyrae is an interesting enough star to monitor on a long-term basis using DSLR photometry. Below is a figure which illustrates my measurements in 2019. Magnitude is plotted against phase where the phase diagram is based on the Krakow period of 12.9423 days. The diagram represents work in progress because there are not enough measurements to cover the 0 to 0.1 part of the phase diagram or the 0.5 to 0.6 so that a reasonable calculation can be made of when the primary and secondary minimum is occurring in terms of the phase diagram.

At the moment the phase diagram is suggesting that primary minimum is occurring at around 0.05 of the phase and the secondary minimum at around 0.55. The phase diagram is suggesting the period continues to lengthen. The minima seem to be occurring around 15.53 hours later than predicted.



I would be grateful for guidance from mathematicians on whether this is consistent with the period increasing by 19 seconds per year (as mentioned earlier the Krakow period is 17.28 years old). If it is consistent then the average rate of mass transfer is confirmed.

Winter Eclipsing Binaries

Christopher Lloyd

Recent O-C diagrams showing the period behaviour of stars from the BAA VSS Eclipsing Binary Programme are presented together with current ephemerides. Six of the most interesting stars are discussed here; W UMa, TX UMa, AW UMa, UV Leo, AP Leo, and Z Dra

Introduction

The British Astronomical Association Variable Star Section (BAA VSS) has a recommended list of 85 eclipsing binaries, including 29 priority stars, that are accessible to observers with small telescopes or DSLR cameras, or in most cases even binoculars. All the stars lie north of Declination $\delta = -9^{\circ}$ with half north of $\delta = +45^{\circ}$. They are distributed rather unevenly in RA with on average about three times as many stars in the summer and autumn skies (RA ~ 18 – 6 hours) as during the winter and spring. The Winter eclipsing binaries covering the RA range 6 – 12 hours contains only 11 stars of which the most interesting and variable are discussed here. The complete listing also contains links to other resources. Follow the links to the previous two articles covering the Summer and Autumn binaries.

The purpose of this article is to provide some information about the period changes of a selection of the more interesting or unusual systems and also to provide a current working ephemeris to enable useful predictions of minima. The link on the variable name leads to the CDS Simbad listing which contains further links to data and references, and the VSX link connects to the VSX database and other resources at the AAVSO.

W UMa 09 43 45.47 +55 57 09.1 VSX EW/KW 7.75 8.48 $0^{m}.73$ $0^{d}.334$

W Ursae Majoris is one of the three stars on the list that is the prototype of a major class of eclipsing binaries. These are contact binaries with short periods, $P < 1$ day. The light curves are continuously variable, mostly due to eclipses but ellipsoidal distortion and reflection effects also contribute. Generally, the eclipses are similar in depth and are usually < $0^{m}.8$. The light curve maxima are often not equal (the O'Connell effect) and the sense can change over time in the same system. The maxima and minima can also be displaced slightly from their usual phases and other small distortions of the light curve can be seen. All these effects are attributed to cool spots that slowly migrate around the surface of the star and they are almost invariably included in the photometric models. Chromospheric activity can also been seen in the form of photospheric Hα and CaII. H and K emission lines.

The components share a common envelope to a greater or lesser extent which means that there is usually a relatively small temperature difference between them, typically $\Delta T < 500$K. Systems are often referred to as near contact, which are generally semidetached, shallow-contact, contact or overcontact depending on the depth of the envelope, but these descriptions are open to interpretation. Despite the similarity of the temperatures the components tend to have dissimilar masses with the median mass ratio, $q = m_2/m_1 \sim 0.4$ and they are thought to evolve towards lower mass ratios. The periods are short with a median of $P \sim 0^{d}.4$ and only 5% have $P < 0^{d}.30$ or $P > 0^{d}.85$. The observed lower limit to the period is at $0^{d}.20$.

In the case of W Ursae Majoris itself it is a bright, V = 7.7, W-type system with eclipses of $0^m.65$ and $0^m.55$. It shows a variable O'Connell effect and displacement of the maxima, together with other distortions of the light curve and minima. Both components are spectral type F8Vp with temperatures of 6100 and 5875K, but the less massive, smaller component is the hotter. The system has a typical mass ratio with q = 0.49.

Times of minima are available for over a century and show small but significant and complex period changes. See Figure 1. Overall there has been a shortening of the period but the changes have been both positive and negative on a variety of time scales. Other W UMa systems show similar behaviour. Generally, the period migrates slowly from one relatively constant period to another, but these intervals are variable and there is significant short-term detail. Currently the period has been effectively constant since 2015 and the ephemeris of primary minimum from JD = 2456000 is

$$HJD_{MinI} = 2456006.3358(5) + 0.33363203(14) \times E$$

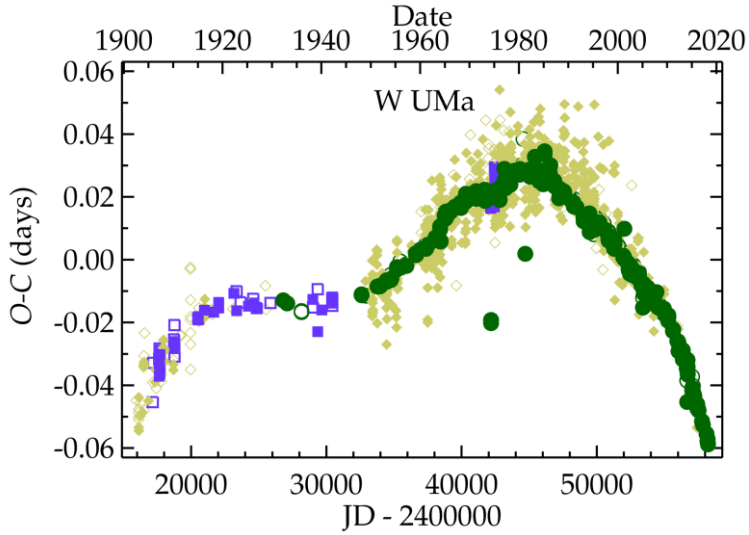


Figure 1: The complex period variations of W UMa showing a general secular decrease in period together with more discrete changes on various time scales.

UV Leo 10 38 20.77 +14 16 03.6 VSX EA/DW 8.90 9.56 $0^m.66$ $0^d.600$

UV Leonis is a short-period detached main-sequence Algol-type binary containing two solar type stars. It is probably more correctly described as an RS CVn system as the secondary has large, cool spots and shows emission lines indicating chromospheric activity. The eclipses are almost equal in depth at $0^m.7$ and the light curve shows a variable O'Connell effect and other photometric distortion indicative of spots. Otherwise the two components are practically identical with similar masses, radii and temperatures.

Times of minima are available from 1930 and these indicate a change in period between two approximately constant values around 1985. See Figure 2 for the $O - C$ diagram. In detail though the constant sections undergo a clear but very slight sinusoidal variation with a period of 29.6 years. Other cyclic variations in the orbital period and also brightness are found with time scales of 24 and 23 years, respectively.

The amplitude of the sinusoidal component is ~ $0^d.002$ and no attempt has been made to account for this in the ephemeris which is the mean from *JD* = 2448000 (1990)

$$HJD_{MinI} = 2448277.32527(27) + 0.600086880(30) \times E$$

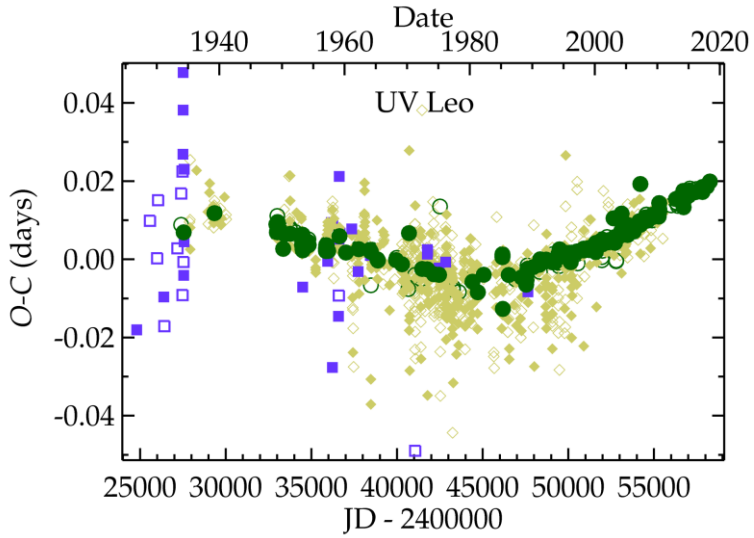


Figure 2: Historical O-C diagram of UV Leo showing the secular increase in period largely through one discrete period change around 1985. The low-amplitude cyclic variation can also be seen.

TX UMa 10 45 20.50 +45 33 58.8 VSX EA/SD 7.06 8.80 $1^m.74$ $3^d.063$

TX Ursae Majoris is a classical Algol-type eclipsing binary with a deep primary minimum of $1^m.7$ and a shallow secondary of only $0^m.06$ in *V*. The components are B8V and G0III-IVea. There is evidence of a complex interaction between the components in the form of gas streams, photospheric emission and an extended primary and it also shows some similarities to the W Serpentis stars.

Although times of minima date back for over a century it is only since 1965 that the period changes become well defined (see Figure 3). Nevertheless, it is clear that the system shows large and complex variations which have been attributed to a secular decrease in period and a series of discrete period changes. These are typical of deeply eclipsing Algol systems. It appears that the period has recently undergone another significant change and since 2014 has reverted to one similar to that is seen during the early 1980s. Although the ephemeris is based on only 5 timings it is the best available, so from *JD* = 2455600

$$HJD_{MinI} = 2456727.4798(22) + 3.063343(8) \times E$$

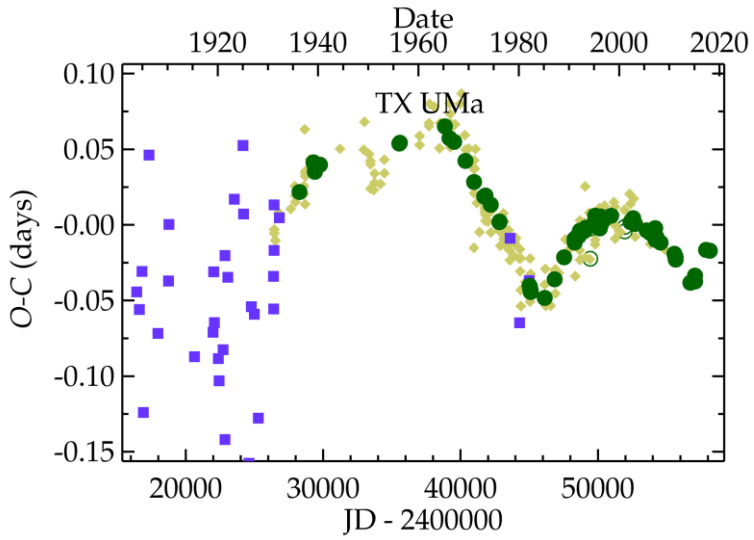


Figure 3: Historical O-C diagram of TX UMa showing the large variations in period and the most recent increase over the past few years.

AP Leo 11 05 05.02 +05 09 06.4 VSX EW/KW 9.32 9.91 $0^m.59$ $0^d.430$

AP Leonis is an overcontact W Ursae Majoris system with both eclipses having a depth of $0^m.6$. The system shows a variable O'Connell effect and other time dependent distortions of the light curve. Times of minimum are available from 1900 but it is only with modern timings since 1980 that the period change has become clear (See Figure 4). However, the available period analyses do not correctly describe the more recent variations. Over perhaps 5 years around 2010 the period changed between two relatively constant values, so the ephemeris of primary minimum had been calculated from *JD* = 2456000 as

$$HJD_{MinI} = 2456010.17514(48) + 0.43036407(17) \times E$$

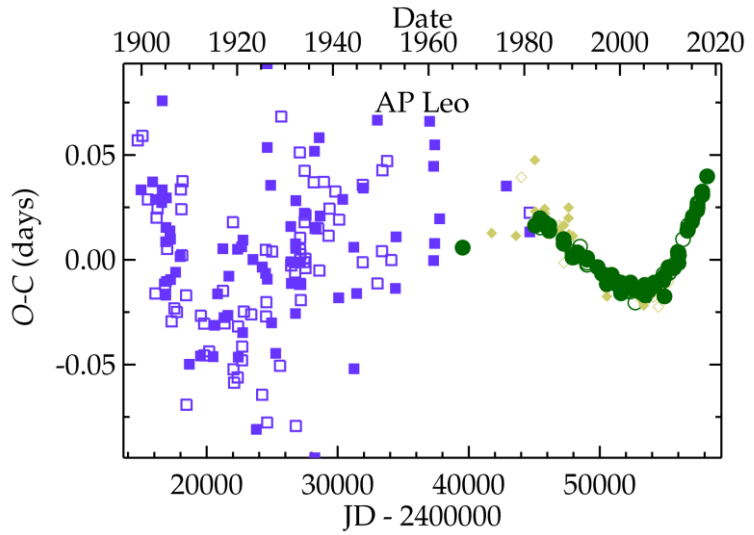


Figure 4: Historical O-C diagram of AP Leo showing the effects a possible cyclical change in period, but this is not simply due to a third body.

AW UMa 11 30 04.32 +29 57 52.7 VSX EW/KW 6.83 7.13 $0^m.30$ $0^d.4387$

AW Ursae Majoris is a bright and unusual or even anomalous W Ursae Majoris system containing components of very unequal masses, with q = 0.1. The system has only shallow eclipses, the primary is $0^m.25$, and the secondary $0^m.2$ and is effectively total so timings are only available with modern detectors.

The $O - C$ diagram is dominated by a significant period decrease which probably is comprised of a number of constant period segments. Evidence of a third body has been found in the $O - C$ residuals but this is based on limited data. The period has been apparently constant since 2010 so the ephemeris of primary minimum from JD = 2455000 is

$$HJD_{MinI} = 2455248.6455(7) + 0.43872303(20) \times E$$

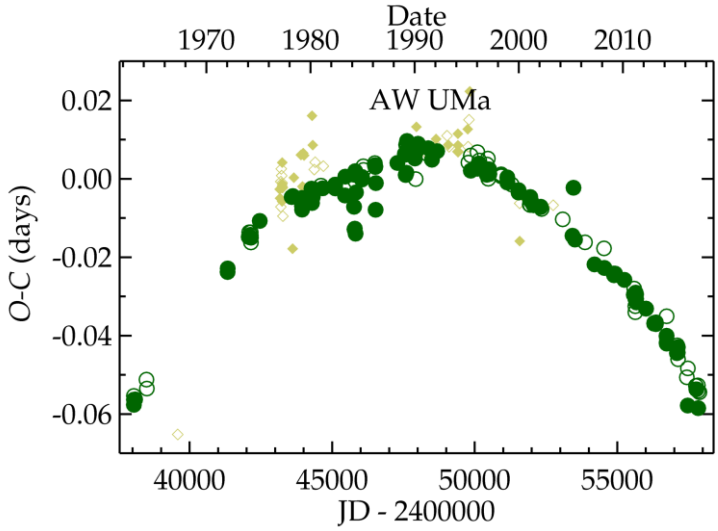


Figure 5: Historical O-C diagram of AW UMa showing the effects of the secular decrease in period through a number of constant period segments.

Z Dra 11 45 29.21 +72 14 58.4 VSX EA/SD 10.80 14.10 $3^m.30$ $1^d.357$

While Z Draconis is a classical Algol-type system it is unusual in that the prodigious depth of the primary eclipse which at $3^m.3$ makes this system easily the faintest on the list at minimum. It also has a short period for an Algol system. The system is semi-detached with an F4V primary and a very cool evolved secondary which fills its Roche lobe.

The $O - C$ diagram (see Figure 6) shows timings dating back over a century but the vast majority of these are visual and it is only in the last 20 years that timings with modern detectors have become available. Nevertheless, it is clear that the system has a very variable period which the visual observations delineate well. Many attempts have been made to describe the variations which usually involve a secular decrease in period and one or more additional bodies however there is no evidence of any third body in the system which makes these suggestions very unlikely.

Having been essentially constant since 2009 the period is currently morphing to a new value. In the past this process has taken a few years and may still be under way. So, the ephemeris of primary minimum from JD = 245770, which may be fragile in the longer term is

$$HJD_{MinI} = 2457809.83345(10) + 1.35742927(44) \times E$$

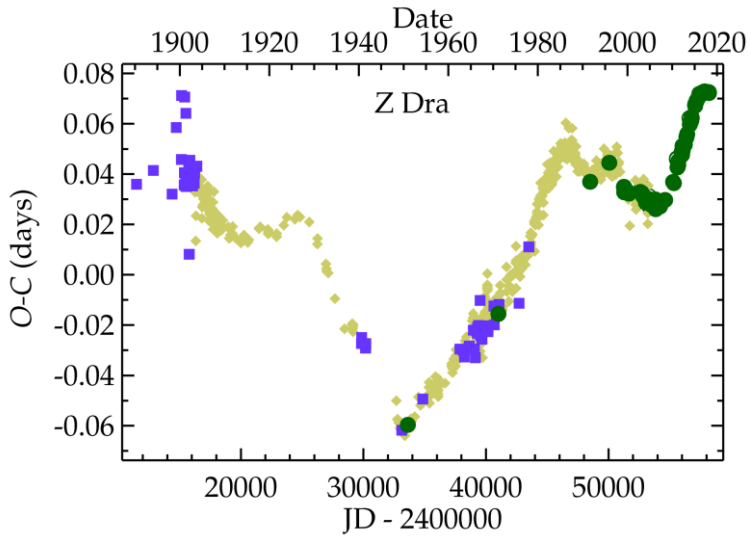


Figure 6: Historical O-C diagram of Z Dra possibly showing the effects of the secular increase in period together with a number of discrete positive and negative period changes.

A date for your diary

BAA VSS Section Meeting

Saturday May 9th, 2020

The Humfrey Rooms,
10 Castilian Terrace,
Northampton NN1 1LD.

Further details in due course

VSS Officers Meeting, 2019

Bob Dryden

Some of the major points raised at the August 2019 VSS officers meeting are listed.

There was a meeting of Section officers on 10th August 2019. While much of the agenda was routine administrative things, the major items the Section membership might be interested in are briefly listed below.

If you have any ideas, suggestions, feel like volunteering or offering help in some way, please let the Director know.

- The issue of reverse charts for use with Schmidt-Cassegrain telescopes was raised but it was noted that there had been no demand at all so far and if needed in the future the AAVSO chart plotter could be used to print a chart that could be marked up with the BAA sequence.

- There was a discussion about possible help for Andy Wilson in managing the database. A person skilled in managing large databases would be ideal.

- Suggestions for modern software for eclipsing binary star predictions was discussed. AIJ Photometry software was one suggestion.

- Eclipsing Binaries: An idea to get spectroscopy, CCD observers, & visual observers to combine for specific projects to produce scientific results was possible.

- There is a continual problem getting front page material for the VSS website.

- Attracting new observers: To attract new Facebook members we need to pro-actively ask BAA members and possible interested parties to join our Facebook group. Also, possible classes/talks on VS for schools or groups. Possible emphasis on technology in talks, etc as young people are attracted to kit.

- Regular items in Journal about VS would raise profile of the VSS within the BAA. VSS should aim to write a piece in the 'News & Notes' section in future. Volunteers needed for this.

- VSS Publications were discussed. There is 1 publications available to buy (Binocular VS Charts Vol 2). Ideas for future publication are required, suggestions included 'VS with a camera', a simpler format for DSLR use for beginners, compilation of VS papers, possibly themed.

- We would like to increase Pro-Am Links. While we have several good links with professionals, we should be looking for more. Ideas for future contacts were discussed.

Next VSS Section Meeting will be on May 9th, 2020 at Northampton Humphrey Rooms. The BAA is paying for the meeting so there will be free entry. It is proposed we have a professional speaker or two, and short talks by amateurs. Volunteers and possible professional speaker suggestions required.

There is BAA money available for the Section. Discussion about how the VSS could possibly make use of such funds.

Section Publications

Please make cheques payable to the BAA and please enclose a large SAE with your order.

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 American 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.

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.

Notes for readers: *All text bookmarks, www and e-mail links are active. Clicking on an image with a blue border will take you to a relevant image or text elsewhere in this Circular.*

Deadline for the next VSSC is February 15th, 2020

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

Section Officers

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

Assistant Director
Roger Pickard
3 The Birches, Shobdon, Leominster, Herefordshire HR6 9NG
Tel: 01568 708136 E-mail roger.pickard@sky.com

Secretary
Bob C. Dryden
21 Cross Road, Cholsey, Oxon OX10 9PE
Tel: 01491 652006 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.demon.co.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
12, Barnard Close, Yatton, Bristol BS49 4HZ
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 Roger Pickard or post to BAAVSS-Alert – **but please make sure that the alert hasn't already been reported**.