ISSN 2631-4843

The British Astronomical Association

Variable Star Section Circular

No. 185 September 2020

Office: Burlington House, Piccadilly, London W1J 0DU

Contents

Cover Picture

Outburst of PQ And
June 4.45UT, iTel 0.51cm CDK@f4.5 + FLI-PL11002M. V=11.71
Martin Mobberley, Bury St. Edmunds, Suffolk UK

Ian Miller (1946-2020)

Sadly, on June 12 we lost one of our most active observers, Ian Miller. In recent years Ian focussed on CCD photometry of cataclysmic variable stars from his well-equipped observatory on the Gower Peninsular in South Wales. He contributed over 250,000 CCD observations which were always of the very highest quality. His work was used in many papers in the *Journal* and beyond and he contributed to several VSS campaigns. Earlier in his observing career he was a visual observer and contributed nearly 10,000 visual observations to the database since 1970. He also prepared sequences for the VSS database when new charts were issued (Bob Dryden has kindly agreed to take on this responsibility).

Ian Miller

I first met Ian during the joint AAVSO/VSS meeting in Cambridge in 2008. We had been in email correspondence for a few years about various dwarf novae outbursts in which Ian specialised. We were in one of the domes at the Cambridge Observatory on the Friday evening before the main meeting started and we got talking – as it was dark, I didn't realise it was Ian at first, but his gentle lilting voice soon gave him away! The last time I saw him was when he attended the AAVSO/VSS joint meeting in Warwick in 2018.

Ian's funeral on June 27 included "Music for Reflection", which was Beethoven's Moonlight sonata, and "Music on Exit", which was a piece by Chopin. Both piano pieces were recordings of Ian playing. As befitting his modest nature, he kept his piano playing skills quiet, not liking to play in public. Ian will be missed by all who knew him, and we send our condolences to his wife, Sue, and his family.

Eruptions and outbursts

It's been a busy few months for eruptions and outbursts. First of all, the dwarf nova PQ And was found to be in outburst at mag 10.5 on May 28.776 by Kenji Hirosawa of Japan. This was its first appearance for 32 years.

We have also had two recent novae in the northern hemisphere. Nova Cas 2020 was discovered at CV = 12.9 as optical transient TCP J00114297+6611190 on 2020 July 27.9302 UT by S. & K. Korotkiy. It was spectroscopically confirmed as a Fe II type classical nova. For borealites, having such a far northerly nova is a rare treat.

Nova Aquilae 2020 No. 2 was announced on August 2, discovered by Palomar Gattini-IR collaboration (PGIR) with J = 13.3, r = 15.2. This has proved to be a tricky nova to observe due to a close field star in a busy, highly reddened field.

More details of these events appear later in this Circular (and on the front cover).

Mentors needed: are you able to help new VS observers?

The Section continues to put people in touch with mentors who can provide advice about the basics as well as the intricacies of variable star observing. This covers visual, DSLR and CCD photometry, as well as data analysis and reduction. Recently, announced in the March 2020 Circular, a spectroscopy mentoring scheme has been established, with Andy Wilson, Robin Leadbeater and David Boyd volunteering as mentors.

In preparing the Annual Report to Council on observations submitted to the VSS database for the year 1 Aug 2019 to 31 July 2020, which will appear in the October *Journal*, Andy Wilson notes the following. "The Section has seen a very significant increase on the 2018 figures with nearly double the number of observations submitted, a 20% increase in active observers, and a 15% increase in the number of different stars observed….Overall the number of CCD observations was up by 105%, with DSLR up 111% and Visual by 16%. The number of active observers has seen a rise in each method, so it is not the case that digital observers are replacing visual observers as the Section is active and growing in each technique."

This is a very healthy situation, of course, and a great tribute to our observers. But with interest from new observers, we really could do with some more mentors to help them. This is especially the case for CCD photometry, where new observers really do appreciate help with using the main photometry software packages.

If you think you would like to help as a mentor, please contact the Director.

Webinars

The BAA webinar series has continued during the summer. VS topics included the recent fade of Betelgeuse, "Supernova Betelgeuse?" by Mark Kidger and "Is SS Cygni losing the plot?", by the Director. Past webinars can be watched on the BAA YouTube channel: https://www.youtube.com/user/britishastronomical

Other organisations have also been organising webinars with VS themes. In early June, Stan Walker (Wharemaru Observatory, RASNZ, Variable Stars South) gave an excellent webinar on "Miras from an Astrophysical Standpoint" organised by the AAVSO LPV section. Stan focused on Miras with two maxima per cycle, viewed against the much wider background of longer period pulsating variables. He emphasised how amateurs can contribute visually as well as by multicolour photometry and spectroscopy. While most of the stars he covered were southern objects, he did draw attention to KL Cyg (9.9 - 14.2 V, period ~535 days).

AUTUMN MIRAS

M = Max, m = min.

R And	M=Oct
R Aql	M=Nov/Dec
UV Aur	M=Oct/Nov
X Cam	M=Nov
	m=Aug/Sep
SU Cnc	M=Aug/Sep
S Cas	M=Oct/Nov
T Cas	M=Oct/Nov
o Cet	M=Sep/Oct
V CrB	M=Sep
W CrB	m=Oct/Nov
chi Cyg	m=Sep
R Cyg	M=Oct/Nov
S Cyg	m=Oct/Nov
T Dra	M=Nov/Dec
SS Her	M=Sep/Oct
R Hya	M=Oct/Nov
RS Leo	M=Oct
W Lyn	M=Sep/Oct
X Oph	M=Nov/Dec
T UMa	m=Aug/Sep

Source BAA Handbook

Although Stan and I have exchanged emails over the years, this is the first time we've seen and heard each other, courtesy of Zoom. Watching Stan's webinar was to see the late hours of a Saturday evening gently turn into a Sunday morning here in the UK.

Stan's presentation slides can be downloaded at:

https://www.aavso.org/sites/default/files/Mira%20from%20an%20Astrophysical%20Viewpoint%20-%20June%206%202020%20-%20Stan%20Walker.pdf

Fast moving White Dwarf

Professor Boris Gaensicke (University of Warwick), a great friend of the VSS, was interviewed on the BBC *Today* programme on the morning of July 15. He was speaking about a fast-moving white dwarf which he thinks might have been ejected from a partial supernova event. You can hear it on BBC Sounds catch-up, starting at 1 h 44 minutes into the programme.

The MNRAS paper on "SDSS J124043.01+671034.68: The partially burned remnant of a low-mass white dwarf that underwent thermonuclear ignition?" reporting the discovery is available from ArXiv: https://arxiv.org/abs/2006.07381. It's not often one gets to listen to an item on white dwarfs on national radio over breakfast!

SDSS J124043.01+671034.68 has g =18.4 magnitude, so is in within reach of amateur telescopes with CCDs. Paul Leyland's attempts at imaging the white dwarf are described on the BAA Forum: https://www.britastro.org/node/23263

SDSS CVs without known outbursts

I was recently reading an *Astronomical Journal* pre-print by John Thorstensen, Dartmouth College, on "Spectroscopic studies of 30 short-period cataclysmic variable stars, and remarks on the evolution and population of similar objects" (https://arxiv.org/abs/2005.02150). John discusses whether "period bouncers", CVs that have evolved though the period minimum of ~75 mins towards longer periods, might be lurking among WZ Sge systems which typically undergo outbursts at intervals of a decade or more. In the paper, John presents a table of 22 objects, reproduced here with his permission, that have never been detected in outburst.

It turns out that I have been monitoring 8 of these systems for more than a decade as part of my CV patrol, without observing an outburst. I shall continue to monitor them and will add a few more from the list to my programme. It might not sound very exciting, going back to a field night after night with a negative result, but the thrill of the chase and anticipation of discovering a rare outburst is great – and addictive! Maybe others would like to add a few of these systems to their programme. John Thorstensen said "I think it would be great if the non-outbursters were monitored more regularly, though it may try peoples' patience to see nothing for year after year!". Fortunately, we variable star observers are a patient and persistent lot!

Table 5. SDSS CVs Without Known Outbursts

Object SDSS	Ref. [a]	Type	P_{orb} [min]	ref.[b]	g [mag.]	G [c] [mas]	π [mas]	π error [mas]	PM [mas yr^{-1}]
SDSS J003941.06+005427.5	4	DN-W	91	1	20.57	20.89	−1.3322	1.9534	21.35
SDSS J004335.14−003729.8	3	DN-W	82	2	19.84	19.88	2.9876	0.5716	29.45
SDSS J023003.79+260440.3	7	DN-2	···	···	19.91	19.05	1.6944	0.3488	6.80
SDSS J080534.49+072029.1	6	DN-2	330	3	18.52	17.90	0.5133	0.1708	6.04
SDSS J083754.64+564506.7	6	DN	···	···	18.97	···	···	···	···
SDSS J085623.00+310834.1	4	DN-W	···	···	19.99	20.21	1.4812	0.9352	11.30
SDSS J090403.48+035501.2	3	DN-W	86	4	19.24	19.32	3.7443	0.6808	4.61
SDSS J090452.09+440255.4	3	DN-W	···	···	19.38	19.46	2.7236	0.4266	16.76
SDSS J101037.05+024915.0	2	DN	138	5	20.76	···	···	···	···
SDSS J110706.76+340526.8	6	DN	···	···	19.48	18.44	0.6122	0.2722	5.30
SDSS J121607.03+052013.9	3	DN	99	6	20.12	20.20	2.6277	0.9565	67.91
SDSS J121913.04+204938.3	8	DN-W	···	···	19.17	19.24	3.5769	0.3884	71.86
SDSS J125641.29−015852.0	1	DN-W	103/111 [d]	5	20.12	20.59	4.0089	1.0855	16.19
SDSS J125834.77+663551.6	2	DN	···	···	20.20	19.82	0.3555	0.3570	5.96
SDSS J143317.78+101123.3	6	DN-W	78	7	18.55	18.59	4.4539	0.2027	54.94
SDSS J145003.12+584501.9	2	DN	···	···	20.64	···	···	···	···
SDSS J151413.72+454911.9	4	DN-W	···	···	19.68	19.71	3.2272	0.3326	78.88
SDSS J155531.99−001055.0	1	DN	114	8	19.36	18.99	1.5963	0.2991	10.21
SDSS J171145.08+301320.0	3	DN-W	80	9	20.25	20.21	2.8630	0.5112	15.26
SDSS J171247.71+604603.3	1	DN-2	···	···	19.95	18.80	1.2925	0.1694	11.20
SDSS J172601.96+543230.7	1	DN	···	···	20.52	···	···	···	···
SDSS J202520.13+762222.4	5	DN-2	···	···	21.83	20.56	−0.3667	1.2581	6.01

[a] Paper in which the object was identified; 1 through 8 respectively refer to Szkody et al. (2002, 2003, 2004, 2005, 2006, 2007, 2009) and Szkody et al. (2011).

[b] References for periods: 1 : Southworth et al. (2010), 2 : Southworth et al. (2008), 3 : Thorstensen et al. (2015), 4 : Woudt et al. (2012), 5 : E. Breedt, private communication, from VLT/FORS velocities. 6 : Southworth et al. (2006), 7 : Littlefair et al. (2008), 8 : Southworth et al. (2007), 9 : Dillon et al. (2008)

[c] G magnitudes and astrometric parameters are from the Gaia Data Release 2.

[d] Two alias periods are possible.

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Request for photometry on the eclipsing CV, J194827-131733

As this Circular was being finalised, Boris Gaensicke was on an observing run at the Isaac Newton Telescope on La Palma. One of his targets was a bright (V~14.3) eclipsing CV, J194827-131733 with a period of P~5.1h. He said in an email on August 18: “I just got a first sequence of time-resolved spectra, and it would be great to get some contemporaneous time-series photometry. Either unfiltered, as fast as possible (the spectra have strong He II, so there is a chance that this might be an IP), or V & R band data to look at the colour dependence of the eclipse”.

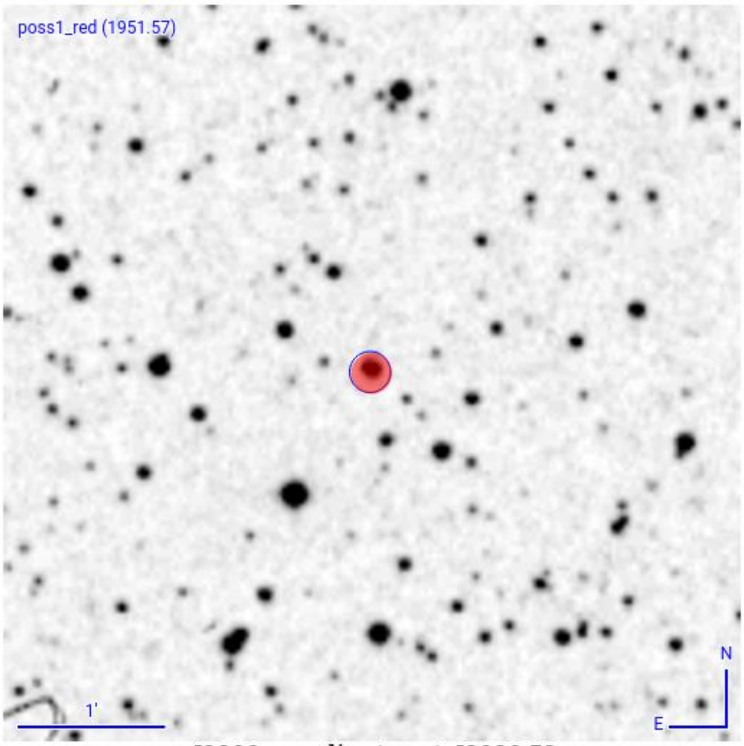
A notice was placed on *baavss-alert*. At the time of writing, time series photometry has been obtained by Tonny Vanmunster and by Richard Sabo. This shows beautiful >1.5 mag eclipses as well as a bright hump. Preliminary analysis indicates it might be an SW Sex system, but perhaps not a typical one.

Boris has said that it would be great to keep collecting observations over the next weeks, or months, though probably not need to repeat them too frequently. Plus, at some point a lower cadence light curve cycling V/R would be a useful addition.

In a dramatic turn of events, Boris and other astronomers had to evacuate the Roque de los Muchachos Observatory because of a nearby forest fire. If the firefighters get the fire under control, they might be able to continue their observing run.

Please do observe this target if you are able. It currently has no official variable star designation. A POSS image of the field and the object’s RA and Dec are shown below. It is a bit low for UK observers, but others further south should fare better. If you do obtain photometry, please send to Boris (I can provide his email if you contact me).

J194827-131733



J2000 coordinates at J2020.58

RA: 19:48:27.74 Dec: -13:17:33.85

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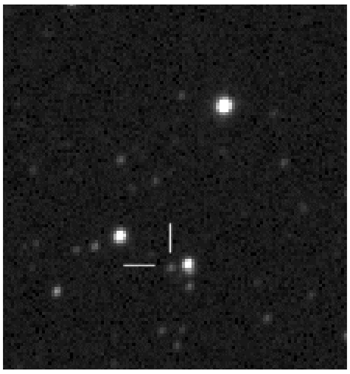
CV & E News

Gary Poyner

Latest CV news including Nova Aql 2020 No. 2 and the rise in brightness of V1413 Aql

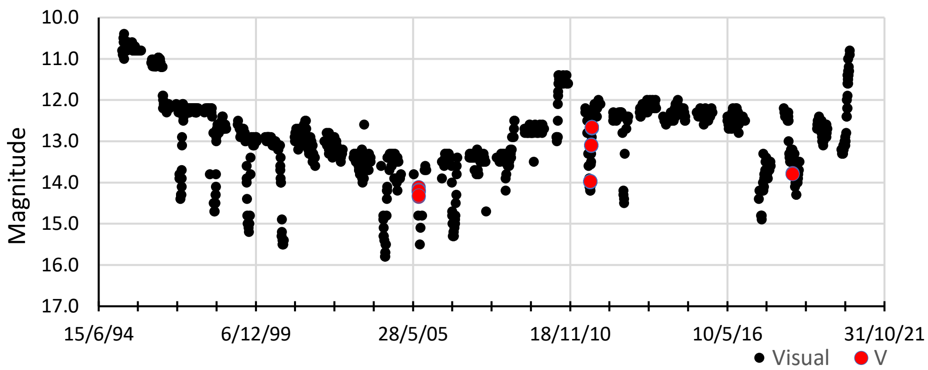
Nova Aql 2020 #2 RA 19 14 26.27 Dec +14 44 40.1

This Nova was discovered by the Palomar Gattini-IR survey on 2020 July 13.26 at J magnitude of 13.35 and announced on Atel 13914. Spectra obtained on the Palomar 60-inch telescope show the object to be a highly redenned classical Nova. AAVSO Alert Notice 713 comments that the Nova is unusual in that it has been brightening for +20 days (as of August 3), is faint but may keep brightening as a type B or C nova (or something else). Recent observations seem discrepant. The AAVSO IDB has the Nova at 13.7TG on Aug 18, yet a 60 second V-band measure from the author on Aug 23 using COAST has a measure of 16.7V (*Right*). There is an extremely close magnitude 13.0 star around 6.0 arc seconds to the west, which makes photometry extremely difficult, and I do wonder if this star is causing some ID problems for visual observers too. A chart is available from the AAVSO chart plotter by entering N Aql 2020 No. 2.



V1413 Aql

Although not one of the most popular of stars on the CV&E programme, V1413 Aql offers the observer much to get involved with. A classical symbiotic star, V1413 Aql also eclipses every 434.1 days, with the depth of the eclipse in the order of two magnitudes which also displays varying decline and recovery rates, depending on the intrinsic brightness of the system during the eclipse. [1] The next eclipse is due in February 2021, when the field will be low in the eastern sky before dawn.



In addition to eclipses, V1413 Aql also varies intrinsically with both low and high states, and undergoes rare outbursts [2]. Since May of this year V1413 Aql has been rising slowly and steadily and has reached a 25 year high of magnitude 10.7mv on Aug 20. The BAAVSS database goes back to May 1995 when the first observations were reported at magnitude 10.5mv. The AAVSO IDB goes back a further five years, with V1413 Aql fainter than the 1995 levels. The outburst mentioned in reference 2 (V1413 Aql was then designated AS 338) observed by Schulte-Laedbeck in 1983-84 (and presumably the first outburst observed) peaked around 10.3V, so we are very close to those values now. A good enough reason to add this fascinating star to your programme.

1: G. PoynerG JBAA Vol. 122, No. 6. 2012

2: U. Munari. Studies of symbiotic stars, A&A 257, 163-176. 1992

Nova Cassiopeia 2020 aka TCP J100114297+6611190

David Boyd

Nova Cas 2020 is a Fe II type classical nova, heavily reddened by interstellar extinction, which brightened slowly to a maximum V magnitude ~10.8 over 10 days before starting to fade rapidly. The amateur community has followed it with photometry and spectroscopy.

As reported in ATel 13903, TCP J00114297+6611190 was discovered as a transient source in Cassiopeia at unfiltered magnitude 12.9 by S. Korotkiy on 2020 July 27.93 UT on images taken with a 135mm f/2.0 telephoto lens. This was part of a survey of the Milky Way intended to make early detections of nova outbursts and other optical transients. 26 hours later it was spectroscopically classified as a Fe II type classical nova. It is colloquially referred to as Nova Cas 2020.

Early photometry reported in ATel 13904 shows a short initial fade before the nova started to brighten. Several observers have reported filtered photometry of the nova to the BAA and AAVSO photometric databases. These show a steady rise to a peak at V magnitude ~10.8 around August 10 followed by a rapid fade. Figure 1 shows the AAVSO B and V-band lightcurves at the time of writing (August 14). My observations (marked as squares) were obtained with a 0.35m SCT and SXVR-H9 CCD with Astrodon B and V filters and were transformed to the Johnson UBV photometric system.

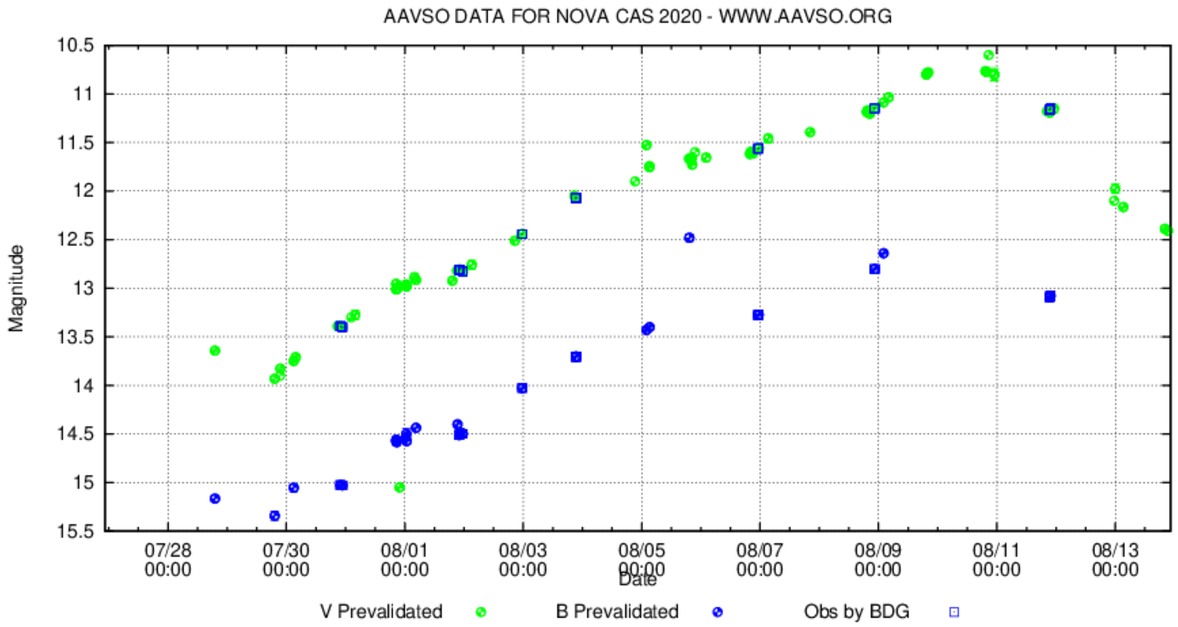


Figure 1: AAVSO B and V-band lightcurves of Nova Cas 2020.

ATel 13905 reports a colour index of B-V = 1.62 on July 30. This is consistent with my own measurements which show a mean value of B-V = 1.65 between July 30 and August 8. On August 11 as the nova started to fade, I found it had reddened to B-V = 1.93. Based on the intrinsic colour index of novae at their peak (de Bergh & Younger, A&A, 70, 125 (1987)), ATel 13905 suggests its E(B-V) colour excess is 1.39. This indicates substantial interstellar extinction and reddening.

I have recorded 5 spectra of the nova using a LISA spectrograph on a C11 with SXVR-H694 CCD which have been submitted to the ARAS and BAA spectroscopic databases. These spectra have been calibrated in absolute flux using concurrently measured V magnitudes. Figure 2 shows the change in flux of the nova as it brightened.

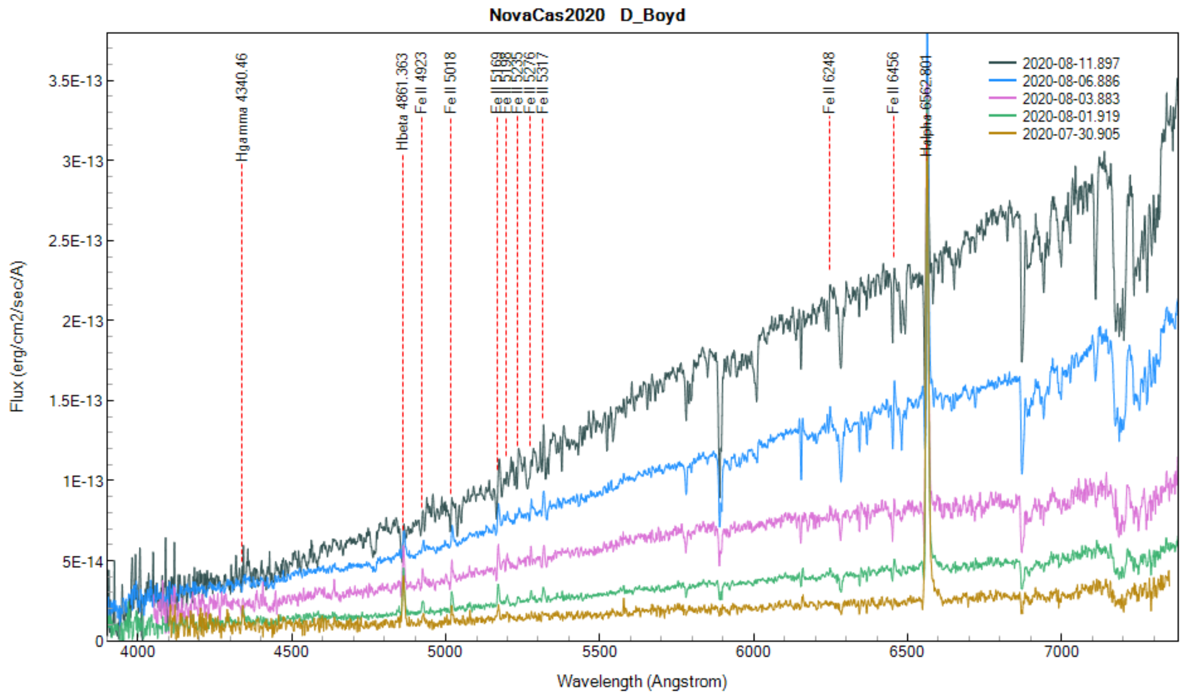


Figure 2: Spectra of Nova Cas 2020.

The spectra show strong Hα emission, weaker Hβ emission which eventually disappeared and several emission lines of singly ionised iron Fe II arising from the so-called iron curtain generated in the nova explosion. Most emission lines have a P Cyg type absorption dip on the blue side of the line due to absorption of light by the expanding nova ejecta. The short wavelength edge of the Hα dip extends to around -800 km/s relative to the emission peak indicating the maximum velocity of the ejecta. Figure 3 shows evolution of the velocity profile of the Hα line as the absorption dip grew and started to reduce the blue edge of the emission line. A report on spectra submitted to the ARAS database is given in ATel 13939.

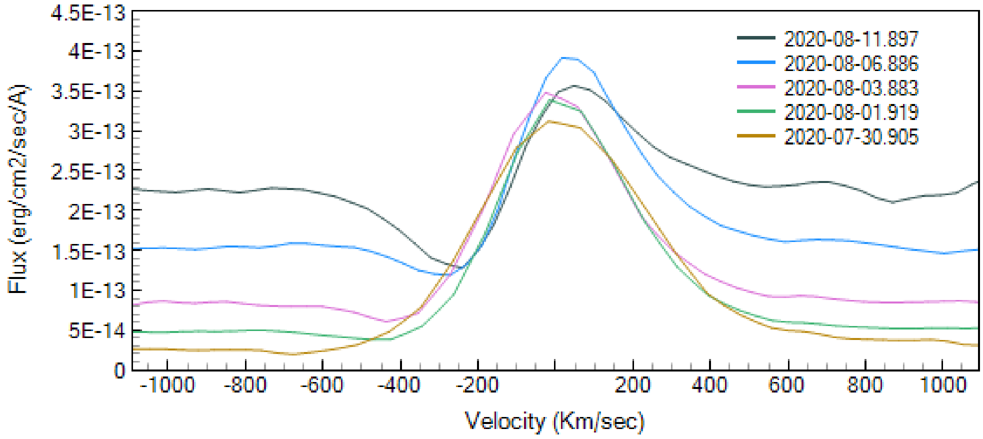


Figure 3: Velocity profile of the Hα emission line.

According to the colour excess E(B-V) = 1.39 reported in [ATel 13905,] interstellar extinction has attenuated the light of the nova by a factor of 53 and considerably reddened its spectrum. Figure 4 shows my spectrum on August 6 corrected for interstellar extinction and dereddened using this value of colour excess to arrive at the spectral energy distribution actually emitted by the nova. Dereddening amplifies the low signal to noise ratio at the blue end of the spectrum.

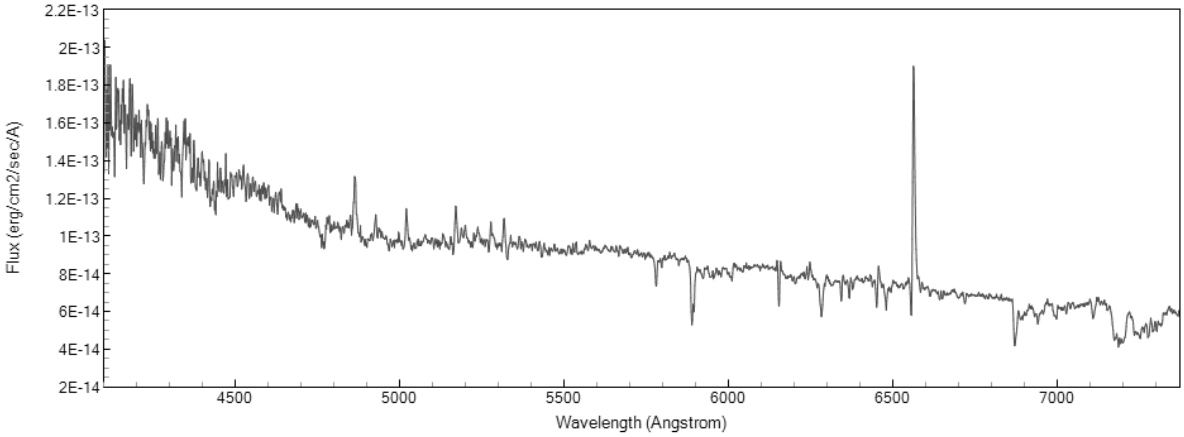


Figure 4: Spectrum of Nova Cas 2020 on August 6 corrected for extinction and dereddened.

The 2020 outburst of PQ And

Gary Poyner

The 2020 outburst of the UGWZ star PQ And has been observed by variable star observers for the first time in 32 years. Here we present the BAAVSS light curve for the current outburst and discuss the 1988 discovery outburst.

The 1988 discovery

On May 28.776 UT 2020, Japanese observer Kenji Hirosawa detected the Dwarf Nova PQ And in outburst at magnitude 10.48CG, using a 20cm telescope and a Canon X9 camera. The detection occurred thirty two years and two months following PQ And's discovery by former BAAVSS secretary Dave McAdam on March 21.900 UT, 1988.

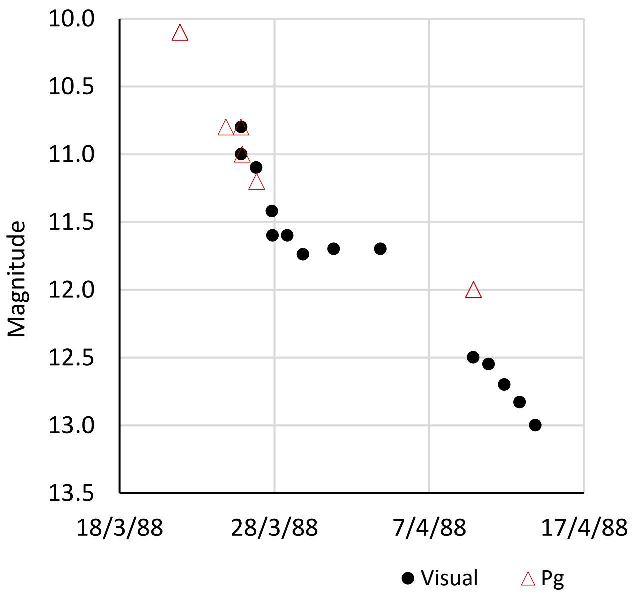


Figure 1: PQ And March-April 1988. BAAVSS database.

McAdam's discovery in 1988 was obtained with a 304mm F4 lens on 35mm film. The lens gave him a 6.75x4.5 degree field, which McAdam commented "was too large for regular nova patrol work". He developed the negatives the following evening and noted a star on the southern edge of the field which he had not recorded on his last visit to this area on January 22nd. The magnitude was measured at 10.0pv and the suspect was reported to Guy Hurst. Confirmation observations were obtained by Martin Mobberley on March 25.844 UT at magnitude 10.8pv and visually by Guy Hurst at the same time at magnitude 10.6. The new object was given a preliminary designation Nova And 1988. Following discovery, a full report was written up by Dave McAdam for 'The Astronomer' magazine, and appeared in TA Vol 24 No. 288 [1] There is also a YouTube video with Dave McAdam being interviewed about his discovery by Nick James. This can be seen here.

Observations of the 'Nova' were understandably sparce at the time, as the field for PQ And is awkward in the setting north western evening sky during the latter parts of March. Some twenty two positive observations can be found in the BAAVSS database – 14 visual and 8 photographic – from 5 observers: G Hurst, D McAdam, M Mobberley, G Poyner & M Taylor. PQ And faded by 1.6 magnitudes in 8 days to magnitude 11.5mv, then entered a 5 day 'standstill' before fading to 13.0mv by April 13 when the field was lost in twilight. (Fig. 1). Negative observations of the field of PQ And continued to be made after the outburst by VSS observers contributing to the 'Recurrent Objects Programme'

Following discovery, G.A. Richter (Sternwarte Sonneberg) searched 1725 Sonneberg plates taken between 1928 and 1989, with a plate magnitude limit of 13-14 magnitude. Two further outbursts were detected in 1938 and 1967 and announced on IBVS 3546. Richter also notes that "*PQ And, which has an amplitude of nearly 9 mag, is either a recurrent Nova or a long cyclic U Geminorum star, the latter being more probable because it's spectrum resembles that of WZ Sge…*". PQ And is now catalogued in VSX as type UGWZ, with a magnitude range of 10.0-19.2V and a Porb of 80.6m [2]

The 2020 outburst

The 2020 outburst was discovered by Japanese observer Kenji Hirosawa (Aichi, Japan) on May 28.776 UT at magnitude 10.48CG using a 20cm telescope and Canon X9 camera, and reported on vsnet-alert 24301 on Friday May 29 at 06:30 JST (Japan Standard time UTC+9). The latest positive observation we have in the VSS database was made on Dec 27, 2019 at 18.4CV. This gives an amplitude of over 8 magnitudes for the outburst at least, as we know that PQ And can reach 21st magnitude at minimum.

Despite the poor observing window in the north eastern sky before dawn, independent confirmation was achieved visually by Belgian observer Eddy Muyllaert (Ostend) on May 29.079 at magnitude 10.3, and eleven minutes later by G. Poyner (Birmingham) on May 29.088UT at visual magnitude of 10.5 with the field a mere 15 degrees above the NE horizon. This highlights the value of visual observations made with small portable telescopes, or portable DSLR cameras, in that the early stages of the outburst were well covered with observers going to unusual lengths to avoid obstructions to secure valuable observations. Only after seven days after the outburst was detected do we see the first telescopic CCD observation reported to the database.

A steady decline followed, fading to magnitude 13.1 in 22 days by June 20. At this point PQ And faded sharply, with a 5 day decline to magnitude16.4 mean by June 25. This brief decline was followed by five further brightenings before eventually fading to magnitude 18.2CV by Aug 18.069 UT. (Fig.2)

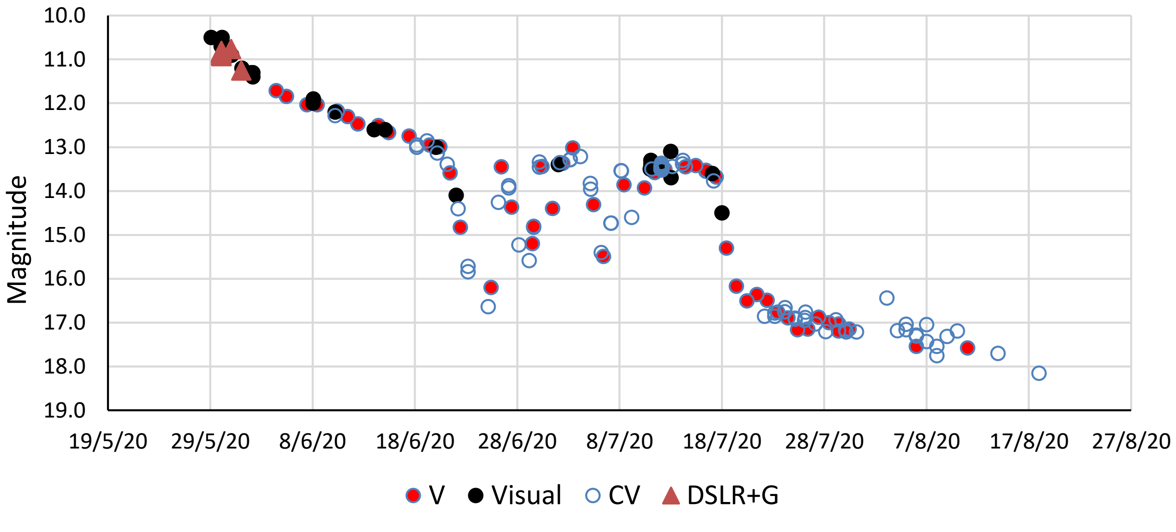


Figure. 2: The 2020 outburst – May 29 to Aug 18. BAAVSS database. 312 observations from 13 contributing observers: *visual*: S. Albrighton, K. Griffiths, G. Hurst, G. Poyner, J. Shears, T. Vale & P. Withers. *V-band*: M. Mobberley, R. Pickard. *CV*: S. Johnston, R. Pearce, G. Poyner. *DSLR+G*: J. Dawson, W Parkes

We are able to make some basic comparisons for the early decline in both of the 1988 and 2020 outbursts despite being restricted to 20 days, which is the duration of observations reported for the 1988 discovery. The 1988 outburst declined by 2.2 magnitudes in 20 days, as compared to 2.5 magnitudes for the 2020 event. The latter is a steady fade with just small scale variations in the light curve. The 1988 decline however appears somewhat different. After 5 days into the decline a short plateau appears in the plot lasting for at least 5 days. Following this there is a gap of 6 days where no data is available. By April 9 observations are picked up again with PQ And recorded at 12.0pg and 12.5mv, after which the decline resumes until the last observation on April 13. A check with the AAVSO database doesn't fill in any of the gaps between April 3 and April 9, as all but two of the datapoints at this time are BAAVSS observations.

Post outburst

One of the more interesting characteristics of the UGWZ light curve, is the activity which follows the initial outburst and decline. The wonderful outburst of EG Cnc in 1996-97 was only the second time the star had been seen in outburst (the first was 1977) and surprised everyone with a further six fainter outbursts during December and January before slowly fading back to quiescence. [2]. This was the first time a series of 'post outburst brightenings' had been observed in any detail, with CCD's producing time series observations of this phenomenon for the first time. Since then post outburst brightenings have been seen in a number of UGWZ systems, with the record holder being EZ Lyn with eleven during its 2006 outburst [3]

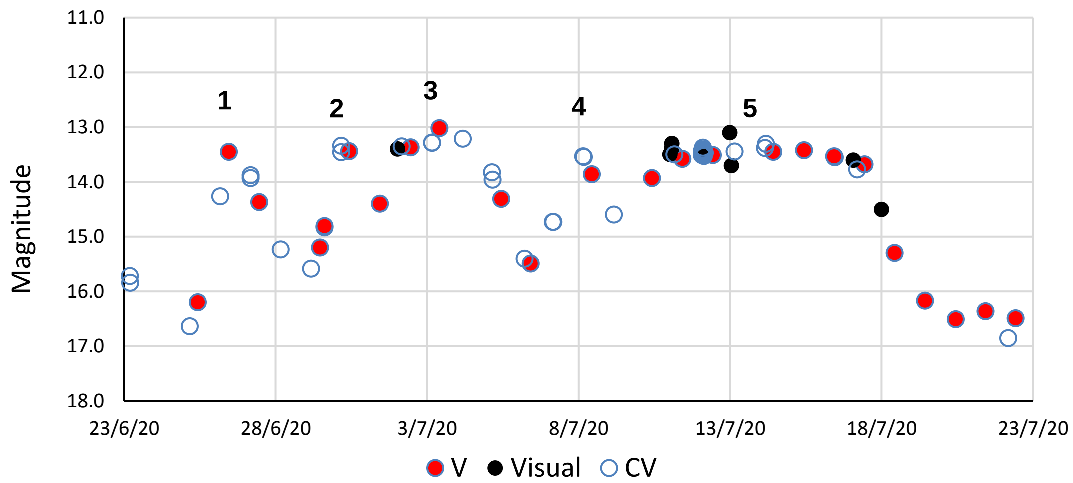


Figure 3: Five post outburst brightenings during the 2020 outburst. BAAVSS database

Following PQ And's fade to magnitude 16.6C on June 25, five post outburst brightenings were observed (Fig. 3). Three (1,2 & 4) were short events, lasting just a single day before fading, whilst the third lasted three days and the fifth and final one eight days before finally fading. Each brightening peaked at a similar magnitude of 13.4 mean, yet the amplitude varied from 1.0 magnitude to 1.7 magnitudes.

Time Series observations

Observers attempting CCD time series observations were thwarted by the encroaching twilight of dawn, particularly in the early stages of the outburst. Steve Johnston did however obtain a short run of 55 minutes between July 12.067 and July 12.105 whose results however were inconclusive. Taichi Kato reported on vsnet-alert 24455 on July 20 that "*Nataly Katysheva and Sergey Shugarov reported time-resolved observations on three nights on July 13-15 (flat part of the rebrightening). The object* *evidently shows superhump-type variations, but the period was difficult to determine. Relying on the 1.7-hr orbital period by Schwarz et al. (2004), which was suggested from a radial-velocity study on a baseline of 2.1 hr, the likely period is 0.06802(7) d, allowing aliases such as 0.06371(6) d or 0.07293(9) d. Shorter periods such as 0.05986(7) d, 0.05646(6) d are still possible*. "

Spectroscopy

Spectroscopists also struggled with the field location in the morning sky, but Robin Leadbeater did manage the low resolution spectrum shown in figure 4 below from his Three Hills Observatory in Wigton, Cumbria. Robin comments

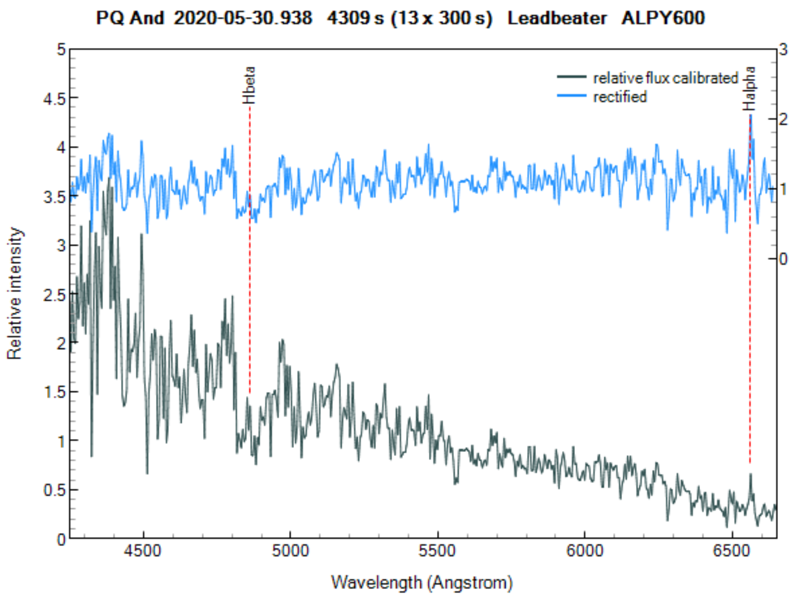


Figure 4: Low resolution spectrum obtained on May 30.938 UT

" *noisy,(signal/noise ~10) low resolution (12 Angstrom) spectrum of PQ And taken under extreme conditions in a bright sky (nautical twilight) at 5 deg. altitude (air mass 10) shows a blue continuum, a narrow H alpha emission line and a broad H beta absorption line with a hint of a central emission component, typical of a dwarf nova in outburst and consistent with the spectrum published in ATel #13776 (Keisuke Isogai et al)*

I put out an alert to other spectroscopists but as far as I am aware nobody else took up the challenge (No others in the BAA, ARAS or AAVSO databases at least)"

Despite the challenging position of PQ And in the morning sky, BAAVSS observers have made an excellent effort to cover the entirety of the 52 day outburst, including as previously stated, early visual observations of maximum and the early decline, underlining the value of visual observations and small portable instruments. Also, thanks to the use of remote telescopes around the world, the problem of our somewhat cloudy skies can be surmounted to a certain extent, and there is no doubt that remote observations have contributed greatly to the BAA light curve. The author sincerely hopes that some of the observers who contributed to this light curve will be around to see the next outburst!

1: TA Vol 24, No. 288 courtesy of Guy Hurst

2: G. Poyner, Recurrent Objects Programme news, BAAVSSC 91, March 1997

3: J. Shears BAA forum

Contrasting Observing Milestones

John Toone

Whilst I have always regarded individual star totals to be more important, I appreciate that the more widely publicised overall observer totals are appropriate means of measuring observing milestones. From a visual observer point of view the principle milestones are often reported in 100,000 increments because they are both challenging and relatively rare. My observing milestones of 100,000 and 200,000 visual observations were reached in quite contrasting locations & circumstances and are revisited here.

Background

I made my first visual observation (of Mira) on 4th January 1975 but since I did not record the light estimate it was never submitted to the VSS database. The first observation where I recorded the light estimate was of R CrB on 9th May 1975 and that became my earliest observation in the VSS database. In the next five years I developed my observing program and my output expanded to >3000 observations/year in 1981 when I acquired my C8 telescope. I moved from Manchester to Shrewsbury at the end of 1992 and the elimination of city lights allowed my output to increase to >4000/year. With growing experience and efficiency my output has since been >5000/year from 2007. Adhering rigidly to a fixed observing program and not wishing to over-observe the red stars that form the majority of the program, my annual output is theoretically capped at 7000 which I have never achieved. The gradual ramping up of the annual totals meant that the 100,000 milestone took exactly 27.5 years to achieve but the 50,000 observation mark (reached on 8th February 1992) accounted for the first 17 years.

100,000 Milestone

The 100,000 milestone was completed in Hawaii on 4th July 2002. I was in Hawaii together with Roger & Marian Pickard, Hazel McGee and Dick Chambers attending the AAVSO/HEAW2 meetings where I gave a presentation on the work of the ICWG (International Chart Working Group). I had my 12x50 binoculars with me and I was able to make nightly observations of R CrB and RY Sgr from the beach away from the hotel lights. I became aware on the 4th July that I had logged 99,998 observations so I asked Roger what star (R CrB or RY Sgr) should be the milestone observation that evening. Roger selected R CrB on the grounds that RY Sgr was not on the official observing program of the VSS. The milestone observation was made shortly after dark but just as I left the beach the sky was lit up by fireworks as the locals celebrated Independence Day. Back at the hotel I played dumb about the date and told some of the AAVSO group it was "terribly decent of them to mark my observing milestone with fireworks". That

Hawaii 6th July 2002, with Mike Simonsen & Eric Broens. The only distancing necessary was from the Kilauea lava flow which was still molten. Photo taken by Irene Simonsen.

then set up quite a discussion in the bar!!

200,000 Milestone

With a settled observing program operating at optimum efficiency wholly from Shrewsbury, meant that the 200,000 milestone came less than 18 years after the 100,000 milestone. Due to the COVID-19 pandemic I was restricted to home working from 16th March 2020 and the absence of office commuting and business trips meant that I could observe in longer spells and this accelerated me towards the milestone. In keeping with past practice, I asked the VSS Director what star should be the milestone observation. Jeremy was given a list of spring objects that I observe nightly and he chose T CrB because he had included this recurrent nova in his 2017 Presidential Address. The milestone observation was duly achieved on 12th May 2020. Normally I would observe T CrB and RS Oph as early as possible (for obvious reasons) each night but on this particular occasion I had to delay the observation of T CrB because the night was fully clear and I was running through my red stars. However, I do admit to checking the T CrB field with binoculars at the start of the night without making a light estimate.

Shrewsbury 20th June 2020, in social isolation with my telescopes. The smaller C8 telescope was used for the 200,000th observation. Photo taken by Miranda Toone.

In summary the 100,000 & 200,000 milestones were achieved on a beach in Hawaii and in my rear garden in Shrewsbury respectively. For the former I had taken a long-haul flight and was based in a busy hotel mixing with many astronomers from around the world. For the latter I was in isolation complying with the COVID-19 lockdown with no aircraft in the sky. Remarkable really how personal circumstances and the world itself can change between observing milestones.

Footnote:

My first observation in the VSS database is R CrB and the same star was also the 100,000 milestone observation. With T CrB forming the 200,000 milestone and both stars (R & T CrB) having been observed in excess of 3500 nights, there is a good chance that Corona Borealis may feature in future observing milestones. However, I am not predicting whether that might entail a further 100,000 milestone; if so, the VSS Director better be prepared to make an important selection.

Pulsating Star Programme

A ten year project to follow 20 under observed Mira variables

Shaun Albrighton

With professional astronomers once more showing increased interest in Mira variables, a new programme of 20 under observed and rewarding stars has been developed. This 10-year project will hopefully shed light on the ranges, period, and any irregularities in their light curve.

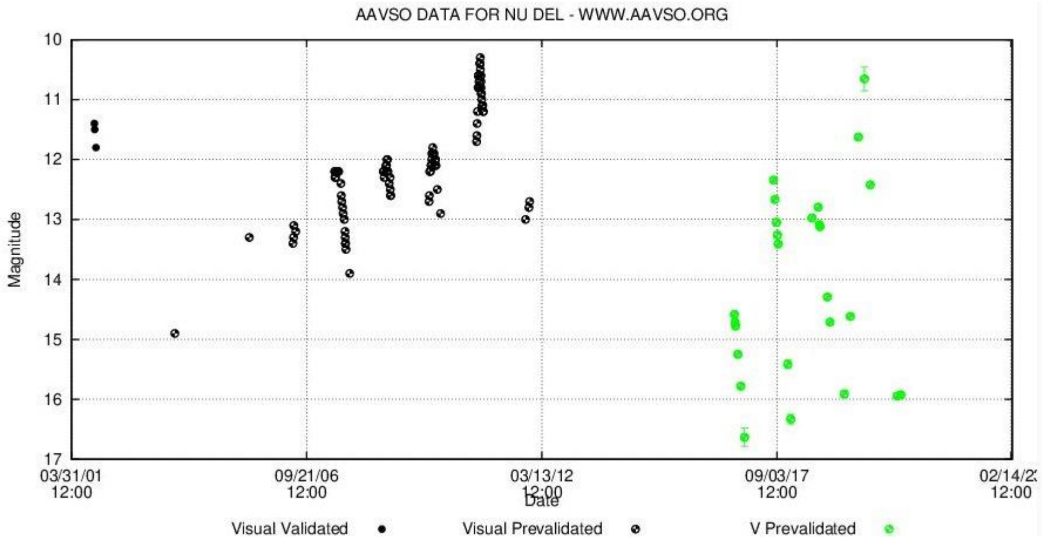
At one time professional interest in Mira variables had waned appreciably, however of late there has been a noticeable increase in the study of AGB stars and in particular Miras that show inconsistencies in their light curve and or period. To these ends I have researched both the VSX and AAVSO databases to develop a project lasting ten years, to study twenty Mira variables which are in need of observation.

The criteria for selection are that in general there is poor or inconsistent coverage and in addition that by observers covering these stars over ten years, it would produce meaningful results. Below is a table of programme stars, all of which have suitable charts and sequences available via AAVSO star plotter.

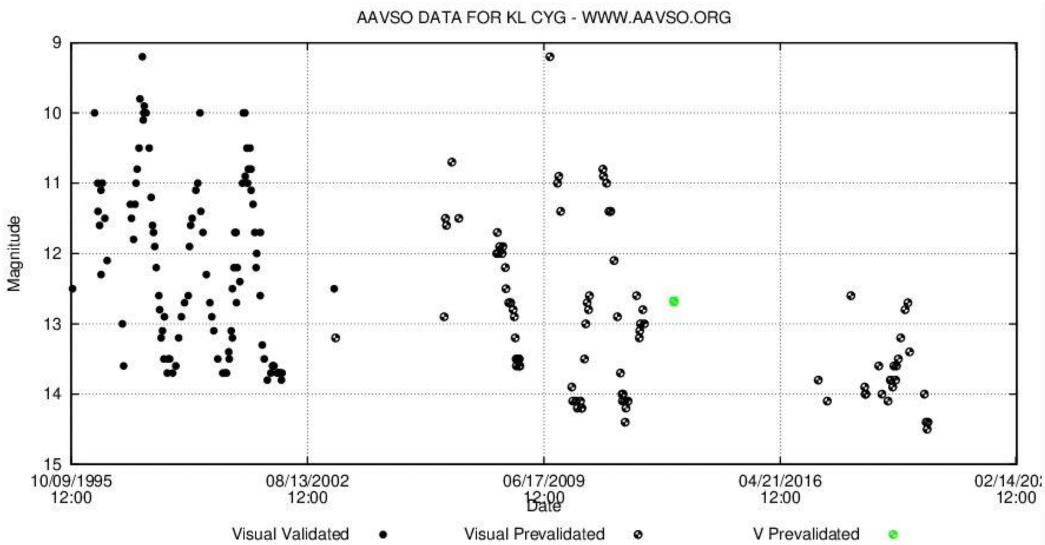
20 Target Miras				
Star	RA	Dec	Mag range	Period
AH And	02 05 54.59	+40 43 26.6	9.3-<14.5V	480.2
SZ Aur	05 41 55.97	+38 56 01.0	8.5-15.8V	456.4
VY Aur	06 09 52.07	+46 34 28.3	9.3-15.3V	405.8
AU Aur	04 54 15.00	+49 54 00.3	10.0-14.0V	400.5
GQ Aur	06 26 42.88	+47 14 23.6	10V-17V	307.8
RT Boo	15 17 14.71	+36 21 33.4	8.2-14.00V	275.5
U Cmi	07 41 20.03	+08 22 49.1	7.8-14V	412.1
X Cep	20 56 10.14	+83 03 25.4	8.1-17.5V	535.19
DU Cyg	21 12 42.94	36 44 54.2	9.8-14.2V	108.21
KL Cyg	19 57 53.47	+33 09 35.9	9.9-14.2V	535.5
V391 Cyg	19 40 52.40	+48 47 41.6	8.95-15.4V	422
Y Del	00 38 22.79	+80 21 25.8	8.8-18.0V	469.2
NU Del	21 02 07.01	+18 10 39.2	9.8-14.6p	?
AP Lyn	06 34 33.44	+60 56 28.3	10.9-14.7V	730
HO Lyr	19 20 08.75	+41 40 59.1	10.08-15.0V	100.1
QS Ori	05 45 36.70	+12 16 15.3	9.8-13.7V	473
RS Peg	22 12 16.18	+14 33 12.2	8.2-14.7V	415.4
IU Peg	22 07 16.23	+11 53 15.9	9.9-17.1V	443.9
S Sex	10 34 56.05	-00 05 01.3	8.2-13.7V	264.9
RU Vir	12 47 18.41	+04 08 41.4	8.1-14.2V	434

As will be seen, the majority of the stars are of longer period. This is because as a general rule Miras with longer periods show greater inconsistencies, be it that they present humps, potential double maxima or where the period or range are either unknown or poorly understood.

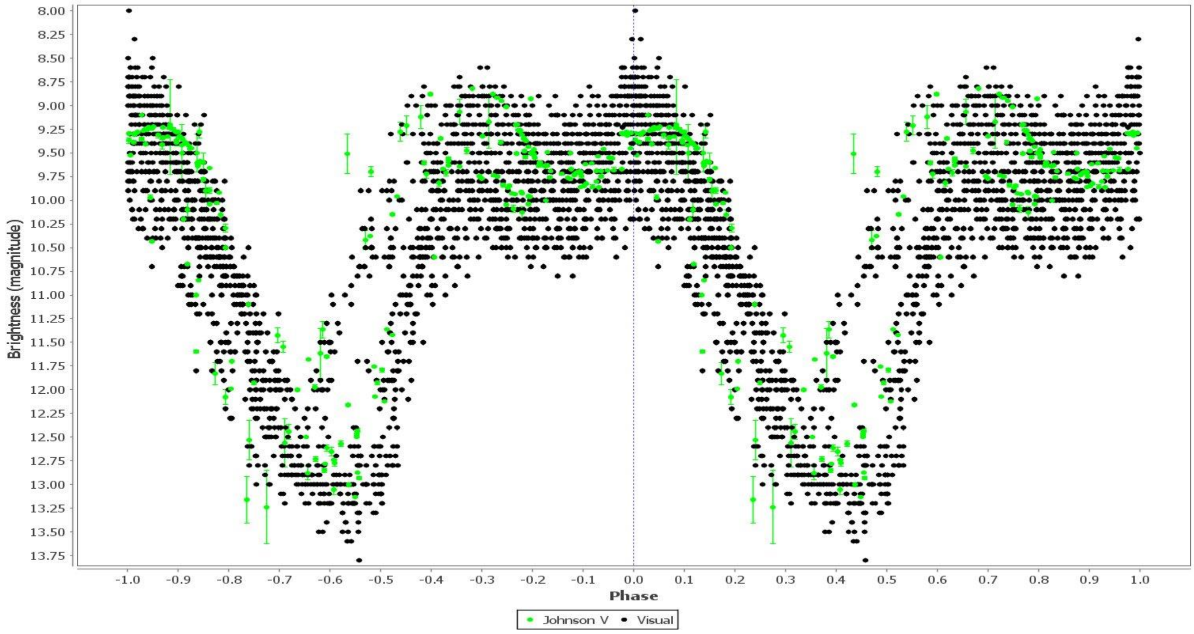
As a first example shown below, NU Del is listed in the VSX database as having a photographic range of 9.8-14.6 and having an unknown period. The few AAVSO observations recorded are insufficient to tie down the period. In addition, the range appears to be in error. It is normal for photographic magnitude estimates of red stars to be fainter than visual, hence potentially brighter than 9.8. In contrast the plot below shows maxima reaching 10.3-12.3, whilst the minima extend down to 16th magnitude. Estimates may help us better define the period and range as well as identifying any humps on the ascending/descending branches.



For a second star, we turn to KL Cyg (below). Whilst poorly observed the star's range has dramatically decreased and may now no longer be a Mira variable. Observations are needed to confirm this and help define its new type.



For our final star we turn to U CMi (below). This brighter Mira variable which can be followed near maximum with binoculars and for the majority of its cycle with smaller telescopes, clearly shows what appears to be double-maxima. The phase plot below emphasises this fascinating characteristic.



Phase plot for U CMi using AAVSO Vstar program. Period 412.1d epoch: 2453055

I wish to encourage observers, be it visual, DSLR or CCD to take on board at least some of the stars in the programme as it gives the VSS a chance to produce results which are both fascinating and valuable. I would particularly encourage observers with larger instruments or CCDs to cover minima of fainter variables and investigate any humps on the ascending/descending branches. In addition, spectroscopic observations of the star, again around the time of any hump or double maxima, may prove of value.

The author acknowledges the AAVSO International Database for the data used in this article, and LCG v1 for the light curves.

Betelgeuse – The Saga Continues

Christopher Lloyd and Mark Kidger

The recent light curve of Betelgeuse shows that the star started to fade almost immediately after recovering from its historic fade last season, and it is at V ~ 1.0 again.

It may not quite be the season of good cheer, but new observations of Betelgeuse have begun to be reported following its solar conjunction. Betelgeuse is still relatively close to the sun, so the observations have been made under challenging conditions, no doubt driven by the interest in the star's historic fade at the end of last season [1,2]. Prior to solar conjunction the last photoelectric measurements were made at the end of April although visual observations continued into the dusk and dawn with a gap of only 33 days around conjunction. In addition, three *V*-band observations have been made using the STEREO spacecraft [3] from a few days after conjunction in mid-June and during July. Going into August the number of ground-based visual and camera-based observations has also increased. Although the new observations are relatively sparse and there is some inconsistency, a picture has begun to emerge which suggests that as soon as Betelgeuse had recovered from the deep fade to *V* ~0.2 the star began to fade again, and at a very similar rate to the deep fade.

Historically, Betelgeuse varies on both long- and short-time-scales with no true periodicity, but the most persistent variation is around 400 days and for the past 25 years or so there has been little evidence of any longer time-scale variations. The light curve for the last six seasons is shown in Figure 1, with the dominant 400-day cycle and last season's deep fade clearly visible. The current fade is now at the limit of previous variability for the 400-day feature, and at 200 days it is very soon after the previous deep minimum. Complex structure has been seen in previous years, 2016 and 2018, which showed double minima, so perhaps similar behaviour will be seen again, but these latest observations portend an active year for Betelgeuse.

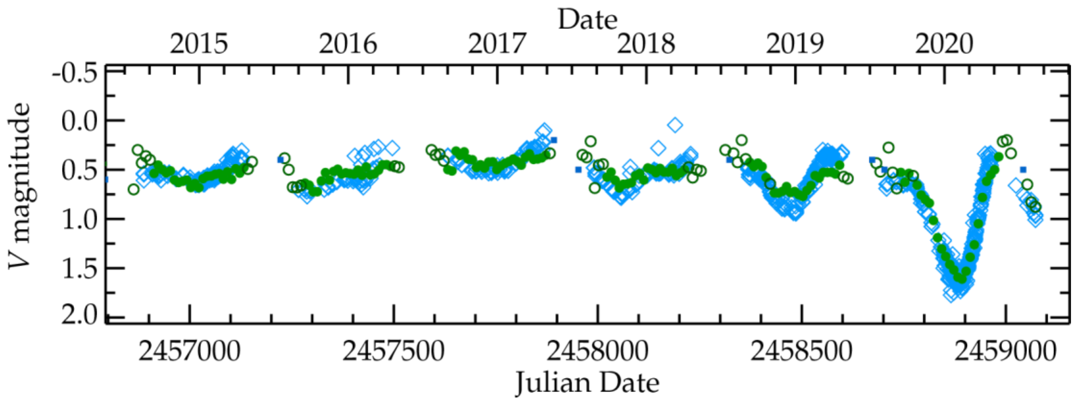


Figure 1: The *V* and mean visual light curve of Betelgeuse covering the past six seasons. The *V* data are shown as diamonds. The other symbols are 10-day bins of the visual data with single points shown as dots, up to 10 points as open circles, and more than 10 as filled circles.

References

1: M. Kidger, *VSS Circ*, **184**, 14, 2020

2: C. Lloyd, *VSS Circ*, **184**, 22, 2020

3: A. Dupree *et al.*, *The Astronomer's Telegram*, **13901**, 2020

Eclipsing Binary News

Des Loughney

There are Natural Starshades Out There, Which Would Help Astronomers Image Exoplanets

An article in Universe Today explains how eclipsing binaries are being used to find out more about exoplanets. [1]

"In the past few decades, the study of extrasolar planets has grown by leaps and bounds, with the confirmation of over 4000 exoplanets. With so many planets available for study, the focus of exoplanet-researchers is shifting from discovery to characterization. In the coming years, new technologies and next-generation telescopes will also enable Direct Imaging studies, which will vastly improve our understanding of exoplanet atmospheres.

To facilitate this process, astronomers will rely on costly technologies like coronagraphs and starshades, which block out the light of a star so any planets orbiting it will become more visible. However, according to a new study by an international team of astronomers and cosmologists, eclipsing binary stars could provide all the shading that's needed to directly image planets orbiting them."

"To test this methodology the team of astronomers selected eclipsing binaries from several star catalogs whose luminosity drops by a factor of 10 during an eclipse. They also differentiated between types of exoplanets based on whether they emit their own light – aka. self-luminous (SL) – or reflect light (RL). They then simulated how bright orbiting planets would appear based on their mass, and whether or not they'd be visible using current or future telescopes."

One of the eclipsing binaries being tested is U Cephei, which was featured in VSSC 184. At the moment it is thought possible to study, in that system, exoplanets of roughly 4.5 Jupiter masses. In the future it may be possible to study exoplanets of 1.5 Jupiter masses.

AAVSO Alert Notice 704: Exoplanet candidate observation alert for TYC 2483-160-1

On the 6th May 2020 the AAVSO issued an alert notice calling for measurements of the primary eclipse of an eclipsing binary. This was at the request of exoplanet researchers.

Measurements were called for the whole of the primary eclipse which was predicted to last 6.7 hours. It was to provide data on an exoplanet that was orbiting the eclipsing binary which was of magnitude 10.141 at maximum.

There seems to be developing a new area in the study of eclisping binaries, at least for those who can make CCD measurements.

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The end of an eclipsing binary - evidence of the merger of two white dwarfs.

A massive white dwarf star with a bizarre carbon-rich atmosphere could be two white dwarfs merged together according to an international team led by University of Warwick astronomers, and only narrowly avoided destruction. [2, 3]

The first ever pulsating white dwarf in an eclipsing binary.

The discovery of the first ever pulsating white dwarf star in an eclipsing binary by physicists at Sheffield means the team can see how binary evolution has affected the internal structure of a white dwarf in detail for the first time. [4 &5]

1: https://www.universetoday.com/147230/there-are-natural-starshades-out-there-which-would-help-astronomers-image-exoplanets/>

2: An ultra-massive white dwarf with a mixed hydrogen–carbon atmosphere as a likely merger remnant M. A. Hollands et al.

3: Universe Today

4: http://www.sci-news.com/astronomy/pulsating-white-dwarf-eclipsing-binary-system-08231.html

5: Nature Astronomy volume **4**, pages 690–696(2020)

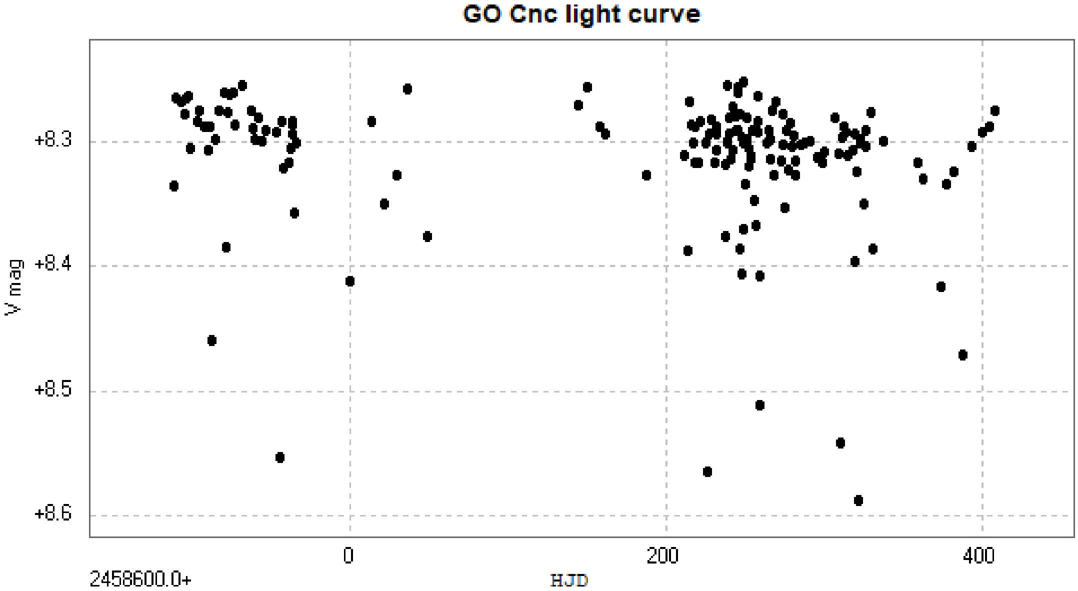
Some more observations of variable stars using online telescopes

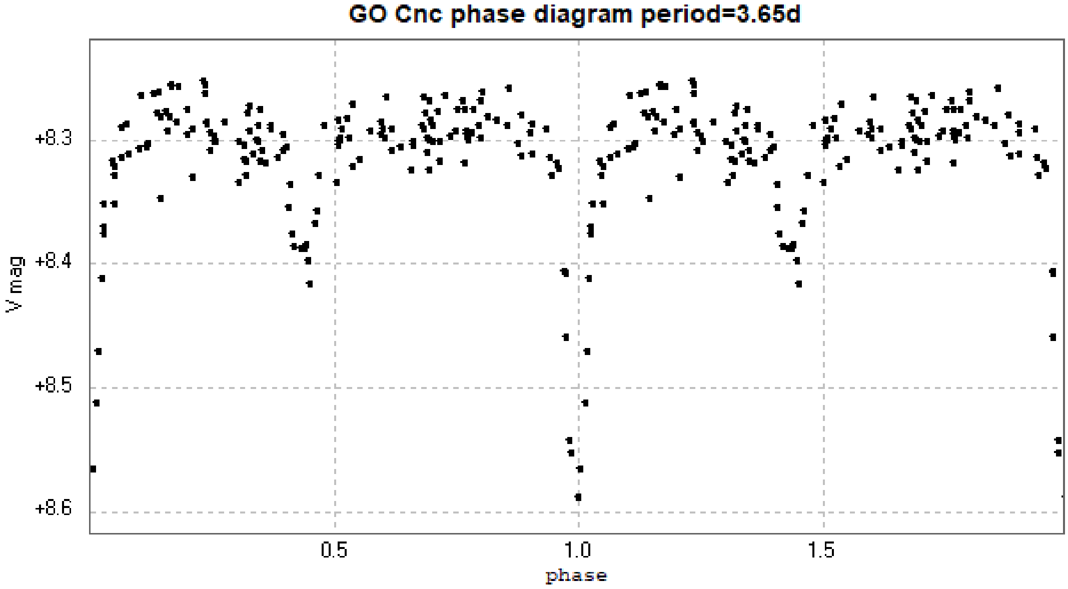
David Conner

More results from an ongoing project to observe stars which are catalogued as eclipsing binaries with the Open University COAST telescope located on Mt Teide in Tenerife. Details of the system types and periods are from the AAVSO VSX.

GO Cnc (EA p=3.649969d)

A series of 159 images were taken with the Open University COAST telescope, using a V filter, between 2019 January 5 and 2020 June 7.





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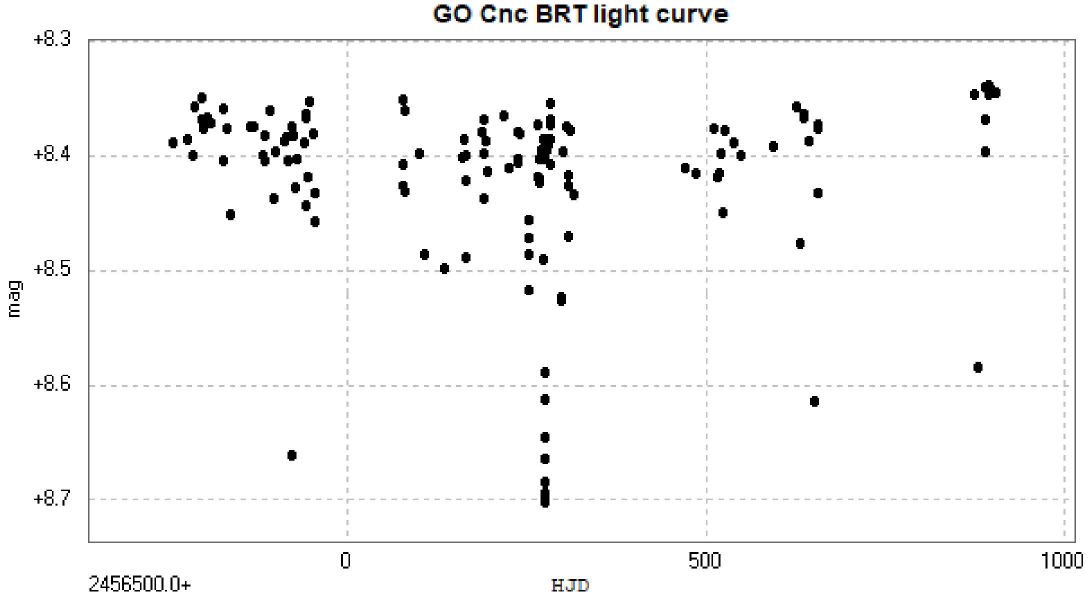
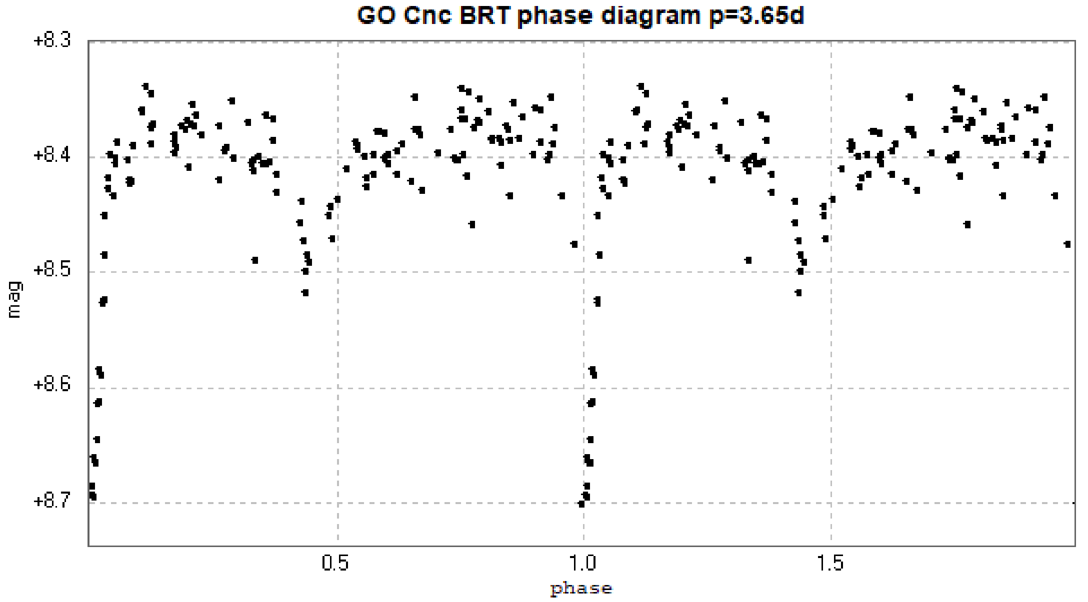
The catalogue period is 3.649969d (GCVS, AAVSO VSX, accessed 2020 August 12.) The secondary minimum is displaced from phase 0.5 due to it being an eccentric system. For these observations, the phase of the secondary minimum appears to be approximately 0.43.

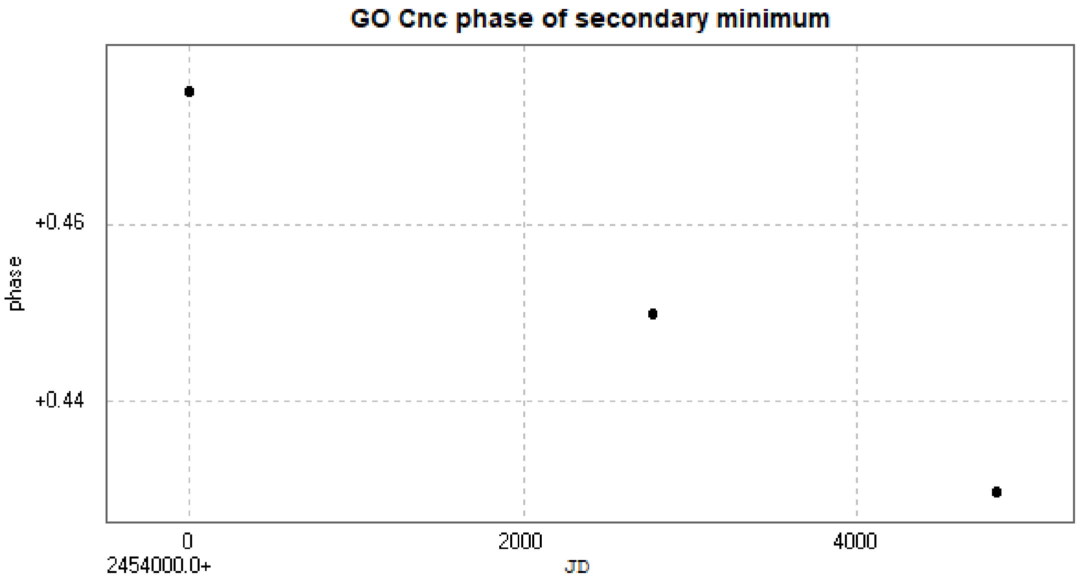
I had previously requested observations with the Bradford Robotic Telescope (BRT) and obtained a series of 144 (unfiltered) images between 2012 November 24 and 2016 January 16. The light curve and phase diagram are below (see also my previous article on this system VSSC 160).





Here, inspection using Peranso suggests that the secondary minimum is at approximately phase 0.45.

The current (2020 August 12) AAVSO VSX value for the phase of the secondary minimum is 0.475, which is consistent with ASAS3 data for the period 2002 and 2009. Taking approximate mid-points of the three sets of data and plotting the associated phase of the secondary minimum results in the following.

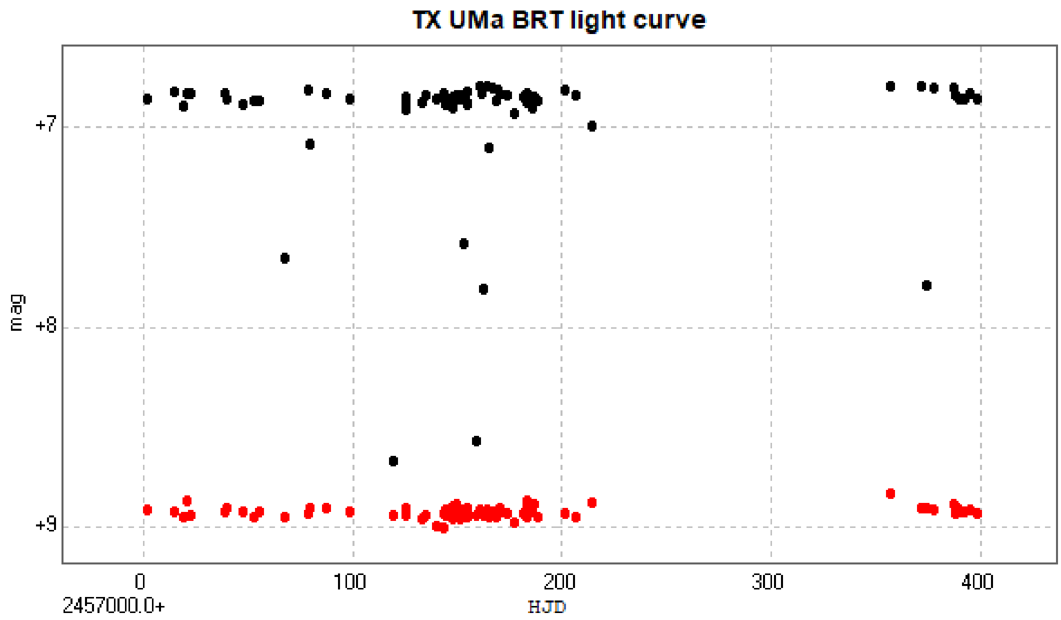


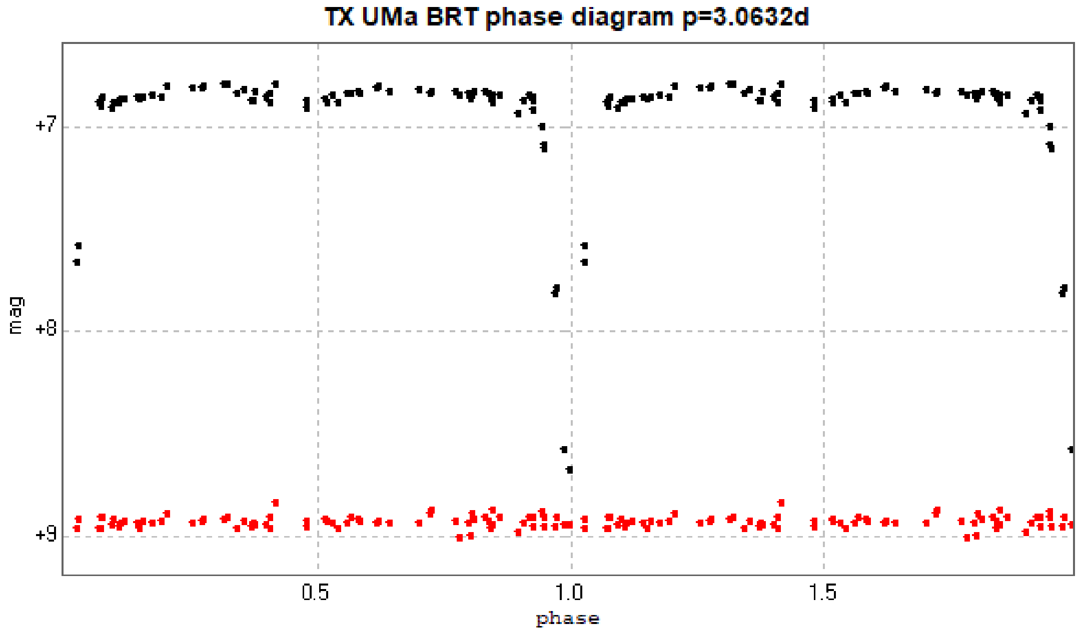
This suggests apsidal precession of the eccentric orbits of the system, but three data points are not sufficient to draw any firm conclusions. I hope to observe primary and secondary minima from Somerby to obtain accurate timings to test this conclusion.

TX UMa (EA/SD p=3.0632382d)

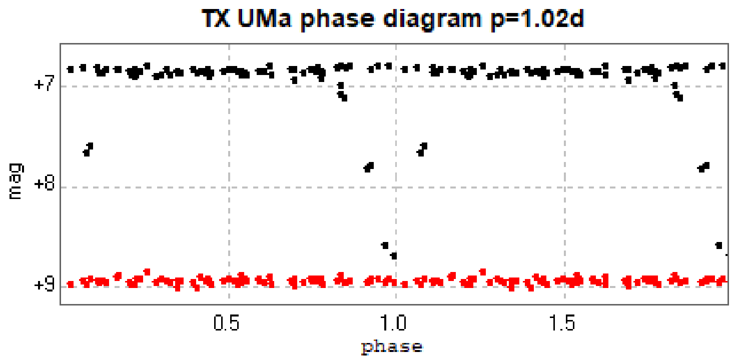
Following on from a recent article about TX UMa (Screech, VSSC 184), I had previously obtained the following light curve and phase diagram of this star, constructed from photometry of 72 images taken with the Bradford Robotic Telescope Cluster Camera (BRT) between 2014 December 10 and 2016 January 11. These were through a tricolour green filter. (The raw data is in the BAAVSS database.)

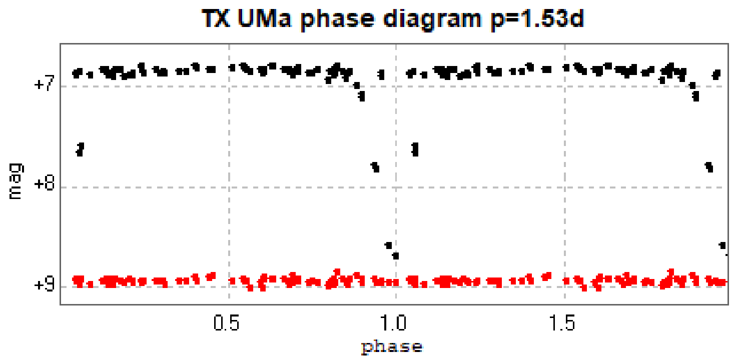
TX UMa is in black, the check star (AUID 000-BBR-602, V=9.005) is in red.





The cadence of the telescope was *very* approximately one image per night, randomised somewhat by weather conditions and the number of other jobs waiting in the queue. Significantly, this did not favour a three day period based on the catalogued period for this star. The best fit period for my observations alone, obtained by Peranso/ANOVA, is the 3.0632 day period used in the above phase diagram. This is similar to the catalogue values for the period; 3.0632382d (GCVS , AAVSO VSX) and 3.0633391d (Kreiner) (Data accessed 2020 August 12).



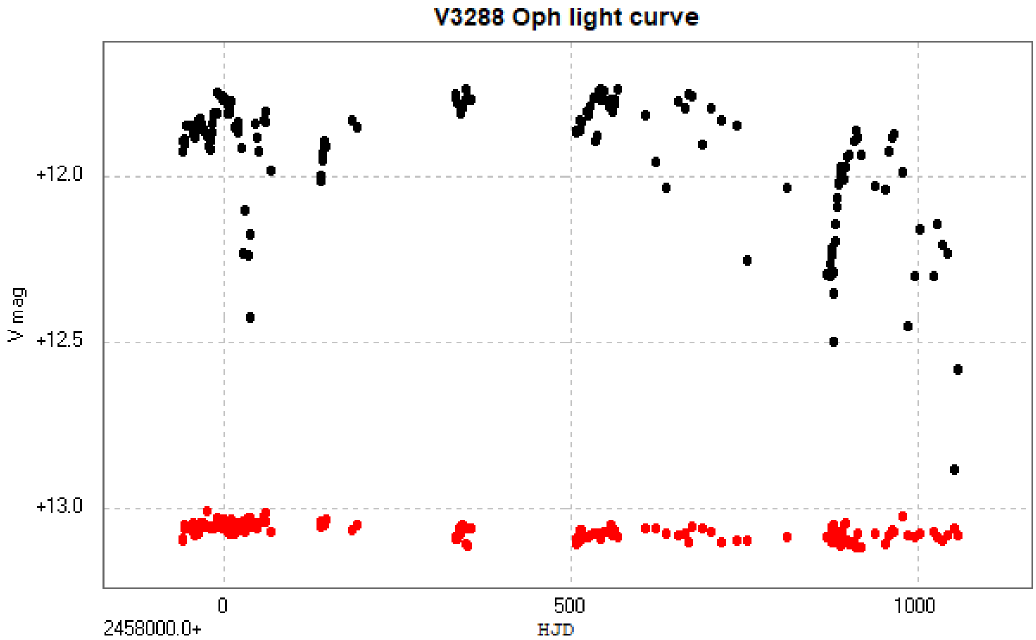


A search of other periods does not generate any convincing phase diagrams with this particular set of data. For example, a period of 1.02 days produces the following phase diagram. Unless all the data points at maximum magnitude within the 'eclipse' are all in error, then this is probably not a significant period. Similarly, a period of half the catalogue value results in the following, which again has several points at maximum within the erstwhile eclipse.

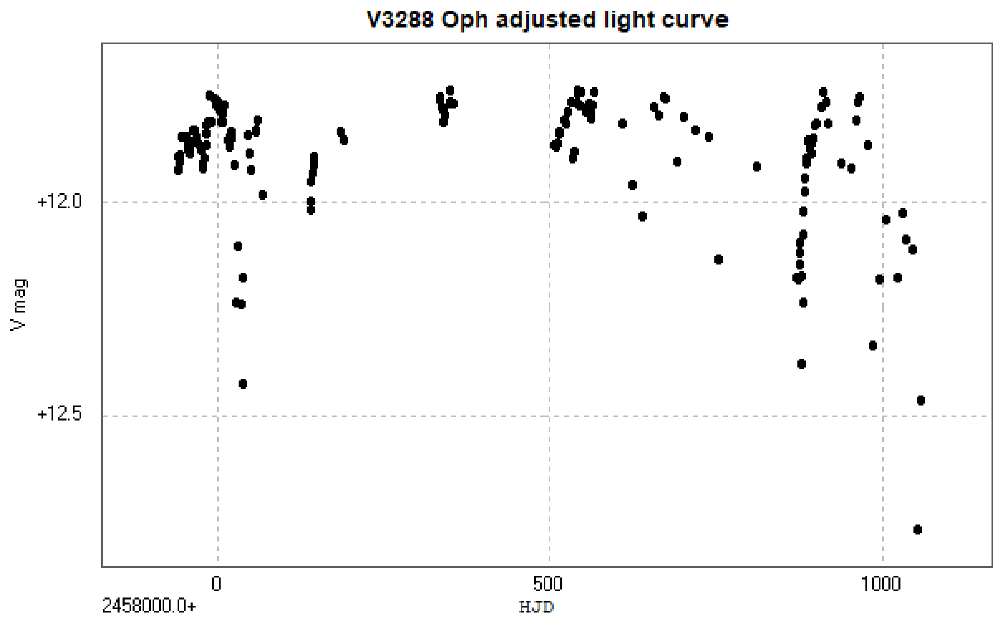
It would therefore appear, at least from this data set, that the correct period is indeed the approximate 3 day period which appears in the catalogues. However, of itself this would not preclude other factors from possibly affecting the period obtained from later observations.

V3288 Oph (EA+ZAND 704d)

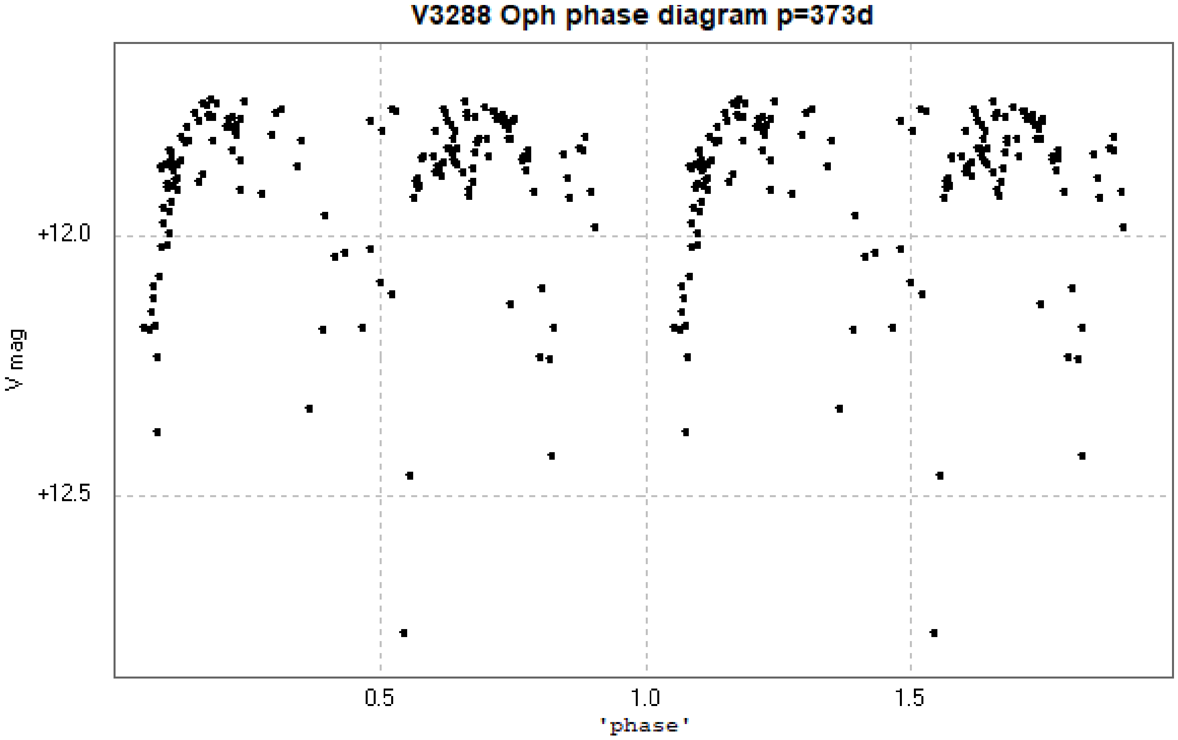
Light curve and phase diagram of the eclipsing binary (type EA+ZAND) V3288 Ophiuchi. (This star has previously been catalogued as NSV 10028.) These were constructed from photometry of 161 images taken with the Open University 14 inch Schmidt-Cassegrain COAST telescope taken between 2017 July 5 and 2020 July 27 with the V filter. V3288 Oph is in black, the check star (AUID 000-BJW-563 V=13.11) is in red.



A general decrease in brightness of the variable is notable from HJD 2458700 or thereabouts, while the comparison remains constant. This suggests that the decrease is 'real', probably due to ZAnd type variability rather than systematic or other errors. Removing this decrease (by arbitrarily brightening the later values by 0.12 mags) generates the following light curve.



This is not a *prima facie* candidate for an eclipsing binary with a 704 day period, even allowing for other factors such as Z And activity confusing the issue ('variations at maximum…support a symbiotic classification' ref AAVSO VSX). However, a plot with approximately half this period (i.e. 373 days) results in the following, which is perhaps slightly less chaotic.



As ever, more observations needed, and this star remains in my ongoing COAST observing program.

Further information about these and other eclipsing binaries in this project can be found on my website.

Period behaviour of eclipsing binaries: TX Ursae Majoris, U Cephei and SZ Piscium

Christopher Lloyd

The period behaviour of the bright eclipsing binaries, TX UMa, U Cep, and SZ Psc is discussed, together with some of the difficulties in observing these systems.

The three stars discussed here are all bright, short period systems, and all have recently had some question, large or small, raised about their period. TX UMa and U Cep are both on the VSS Eclipsing Binary Programme [1] while SZ Psc although a similar system, is not. The period behaviour of TX UMa has been discussed previously in the paper on the Winter Eclipsing Binaries [2].

In the June edition of the *Circular* Screech [3] suggested that the period of TX Ursae Majoris, which is close to 3 days had been mistaken for the true period of close to one day. It is not unknown for periods that were determined largely from one longitude to be incorrectly assigned to a 1-day alias of the true period, due to selective observation. Those that are very close to integral multiples of a day can be particularly difficult to pin down, so it is a legitimate question to ask. However, in this case the period is actually close to 3 days, and the best evidence for this comes from the spectroscopic orbit, which has P = 3.06324 d, see *e.g.,* Glazunova *et al.*,[4] and similar values have been found for the previous orbital solutions. It should also be said that all the photometric solutions give similar results. Although the period is close to 3 days it is not *that* close. In fact, from one observing site the eclipse cycles in ~50 days, so it is possible to observe the whole light curve perhaps two or three times in one observing season.

Observations out of eclipse are crucial in identifying the correct period as those of eclipses are made at multiples of the true period will always find an eclipse. The *V*, *CV*, and *TG* measurements from the AAVSO and recent BAA data have been folded on the mean period and are shown in Figure 1. The eclipses obviously align, and the upper envelope of points also outlines the low out-of-eclipse variation of the system, and there are no embarrassing bright points in the eclipse. Earlier light curves by Koch

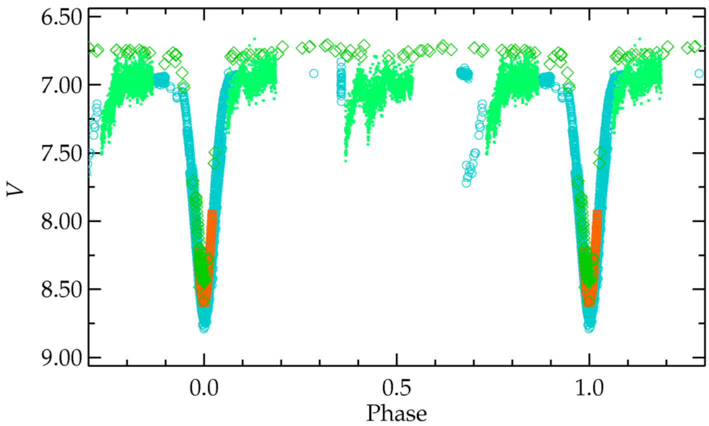


Figure 1: The *V* (circles), *CV* (squares) and *TG* (diamonds) light curve of TX UMa showing the deep minima, the low out-of-eclipse variation, and the very weak secondary eclipse. The small dots are the data discussed by Screech.

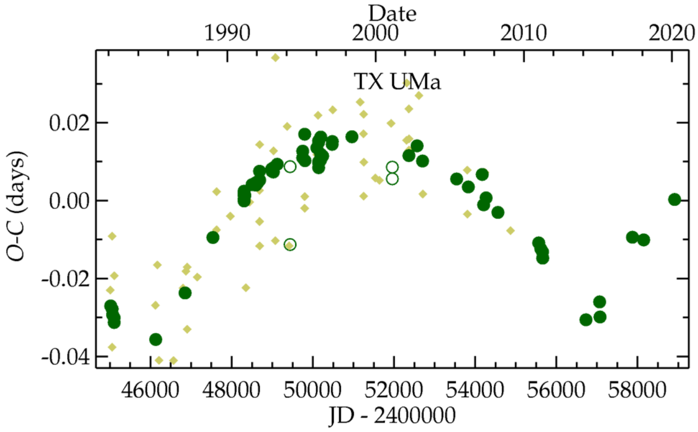


Figure 2: The *O*−*C* diagram of TX UMa showing the recent period changes, with the current, apparently linear section. CCD/PEP data are shown as filled circles, visual data as dots, and open symbols are secondary minima.

[5], and Oh & Shen [6] amongst others show the same features and have more complete coverage. The data discussed by Screech form the clusters of points at intervals of about a third of a cycle, and the problem with them is covered elsewhere in this issue.

TX UMa is a hot, Algol-type eclipsing binary with a spectral type of B8V + G0III–IV, and is a very active system, showing small but generally smooth changes of period. There is evidence of 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 [4]. Although times of minima date back for over a century it is only since 1965 that the period changes have become well defined. Nevertheless, it is clear that the system shows complex variations which have been attributed to a secular decrease in period and a series of discrete period changes [7]. These variations are typical of deeply eclipsing Algol systems. The period behaviour since 1980 is shown in Figure 2 and although the variations are small there is a clear evolution of the period over that time. The large excursions in the historical *O* − *C* diagram has been discussed previously in the *Circular* [2]. Figure 2 also shows the recent period change in about 2014 which mirrors that seen in the 1980s. The current ephemeris of primary minimum from JD = 2456000 is

$$HJD_{MinI} = 2456727.4806(20) + 3.063338(5) \times E$$

TX UMa is an interesting and useful target for DLSR and Titan-like cameras but it is challenging to observe. With the period near 3 days it means that the eclipse is relatively long, but it is deep, $1^{m}.7$, and the deepest $\pm 0^{m}.5$ is covered in 3 hours. So, providing that the equipment can retain precision at 9th magnitude it should be possible to observe an eclipse in one session. As mentioned earlier the eclipse cycles slowly through the season so there will be only limited opportunities to make a timing. Further details about the star and links to other resources, such as the AAVSO VSX [8] page, the Simbad database, and a chart can also be found in the list of EB Programme Stars [1].

U Cephei is another well-known hot Algol system and in the last Eclipsing Binary News Loughney [9] wondered if its period from twenty years ago was still valid. It is one of the most active and extensively studied classical Algol systems and shows a large long-term increase in period. The system contains a main sequence B7-8V primary and a G5-8III–IV subgiant that fills its Roche lobe. The primary eclipse is total and is a prodigious $2^{m}.5$ deep reaching $V = 9.2$. The period is very close to 2.5 days so all the earlier comments about observing challenges apply equally to this system. Although the period is

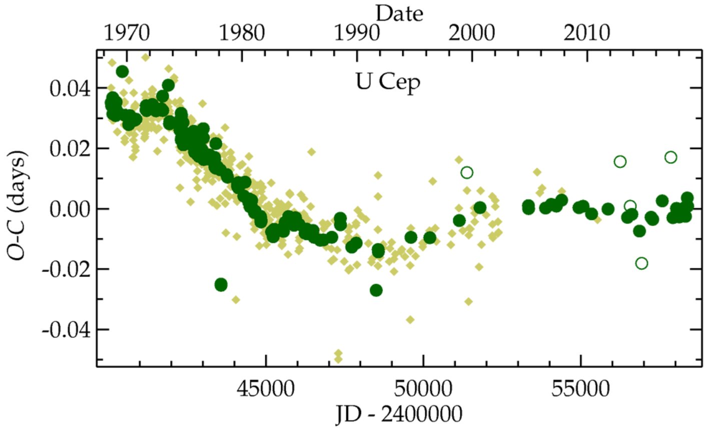


Figure 3: The recent *O*−*C* diagram of U Cep showing a small part of its extensive historical range. The large overall variation is composed of many short, linear, or coherent sections, some of which can be seen in detail here. Despite some minor weaving about the period has been effectively constant for the past 20 years or so. The secondary minimum is weak and unreliable so should be avoided. Symbols as in Figure 2.

shorter, eclipses at one site repeat every 5 days so perversely the visibility constraint is stronger, and this means that the eclipse is only visible for one part of the observing season. Further details about the star and links to other resources can also be found in the list of EB Programme Stars [1]. For a recent review and extensive bibliography see Tupa *et al.*, [10] and Burnett *et al.*, [11] for a light curve and photometric solution.

Times of minima extend back to 1880 but almost all the data prior to 1940 are visual with very few photographic minima. Since then timings from modern detectors have become available but the system has remained a popular target for visual observers until about 20 years ago. The historical *O*−*C* diagram is dominated by a substantial lengthening of the period resulting in a large excursion of ±0.8 days in the residuals. In detail this is composed of many short constant-period segments with both positive and negative differences. The *O* − *C* diagram from about 1970 is shown in Figure 3. The star is known to cycle through periods of active mass exchange on a very approximate time scale of 9 years but some of the segments last for only a year or two, so the relationship is not clear. The most recent discussion of the period changes suggests that there is a magnetic cycle of 16.4 years and a mean mass-transfer cycle of 9.8 years, [12] but this does rather ignore the short-lived abrupt changes clearly visible in the early part of Figure 3. Despite the importance of the system it has been neglected and even recent coverage still under samples the complex variations. The question raised about the period of U Cep is a legitimate one as the period is always changing, but equally it is often constant. As far as having an ephemeris that allows the eclipses to be predicted, it would be ridiculous to follow every twist and turn of the star, but it does need to be sufficiently reliable. The observing window is almost invariably tight, so the ephemeris needs to be within 30 minutes or 0.02 days of the eclipse. There is nothing worse than discovering that the observations were started too late, except perhaps discovering that they finished too early. So, with that in mind the mean ephemeris of primary minimum from JD = 2450000 is

$$HJD_{MinI} = 2450203.4036(29) + 2.4930872(12) \times E$$

As it happens a single ephemeris would probably have been sufficient for the past 40 years despite the ups and downs in the meantime. Both the VSX and the Krakow database also provide a modern ephemeris which is consistent with the one derived here. At some point the system will give in to the inevitable pressure of the long-term period increase and a change, perhaps like that seen about 1980 will happen again, and then a new ephemeris will be needed.

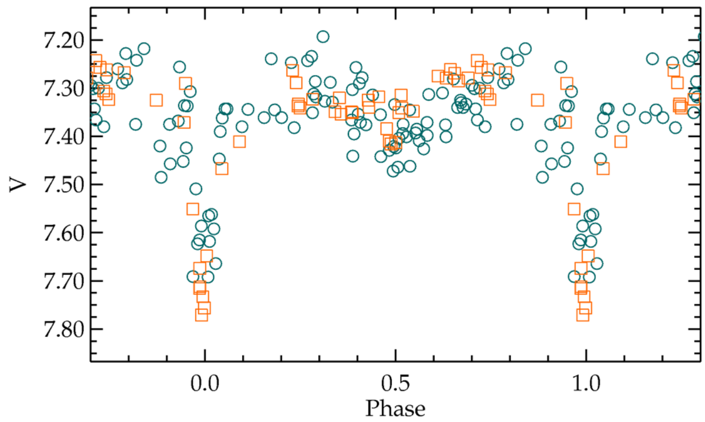


Figure 4: *V* (circles) and *TG* (squares) light curve of SZ Psc showing the narrow primary and broad secondary minima. There is no obvious sign of the distortion wave which itself is very variable.

Also mentioned in the last Eclipsing Binary News [10] is SZ Piscium, and although it is not on the programme it is a potentially useful target for DSLR observers. Although it is bright, $V \sim 7.3$, it is a tricky object to observe as the range of variation is low, only $0^{m}.45$, and the period is annoyingly close to 4 days. The relatively long period means the primary eclipse takes 4 hours to fade and recover $0^{m}.1$, and also the time of eclipse moves only slowly from night to night, so there are times when an eclipse is not observable for about two months. In the UK there will be a window of opportunity this year in late August and another in mid-December. The *V*, and *TG* data from the AAVSO are shown in Figure 4 and illustrate the difficulties.

SZ Psc is a detached RS CVn-type system containing an evolved K1IV-V primary that does not fill its Roche lobe, and an F8V main-sequence secondary. The system is chromospherically active with multiple moving spots on the primary that cause severe distortions of the light curve. The movement of these and their effect on the light curve have been tracked over time [13-16] and tend to produce a distortion wave that persists over some years that can modulate the light curve by about half the depth of the eclipse. The secondary eclipse is broad and shallow and is much more susceptible to the distortion wave, but the primary must also be perturbed although because it is narrow the effects are less noticeable.

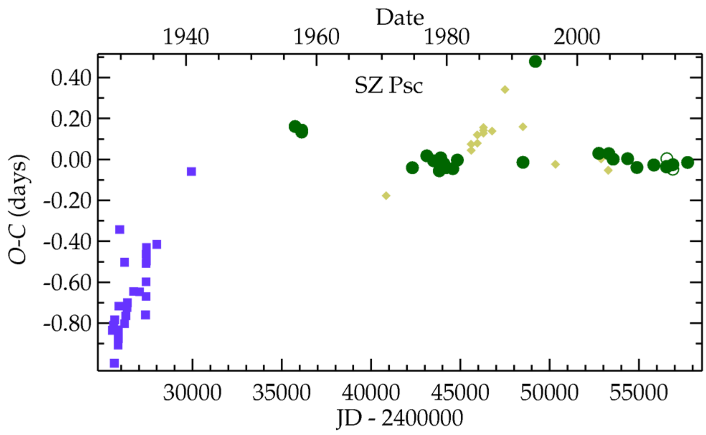


Figure 5: The historical *O−C* diagram of SZ Psc showing the obvious change in period between the early photographic (squares) and the later data. The isolated high point is usually treated as discrepant but there is a curious run of visual measurements in that direction.

Times of minima are available for about a century, but they are very sparse with some early photographic data, some more recent visual observations, and some isolated photoelectric and CCD measurements (see Figure 5). Exactly what the period behaviour of SZ Psc has been is not clear, but the variations have been very large. The dominant feature is the large change between the photographic and later data, which have been effectively constant for the past 50 years or so. Even so the scatter is relatively large and there are possibly coherent variations in the residuals, all of which may be tied to the distortion wave. There must have also been another period change in the 1960s, but this is almost completely undefined. How the various sections are related is not clear and none of the published scenarios have survived the addition of new data, see *e.g.,* Lanza *et al.*,[16] and Wang *et al.*,[17] who also cite the earlier attempts. As the system is nominally detached there must be a way of transferring angular momentum other than by mass exchange, and that usually involves magnetic effects. As the system is as an RS CVn it obviously qualifies but magnetic cycles are usually thought to produce relatively small changes, so there is probably something else involved here.

The mean ephemeris of primary minimum since JD = 2442000 is

$$HJD_{MinI} = 2442308.807(32) + 3.965670(13) \times E$$

1: C. Lloyd, *VSS Circ*, **176**, 39, 2018

2: C. Lloyd, *VSS Circ*, **182**, 22, 2019

3: J. Screech, *VSS Circ*, **184**, 36, 2020

4: L. V. Glazunova, D. E. Mkrtichian & S. I. Rostopchin, *MNRAS*, **415**, 2238, 2011

5: R. H. Koch, *AJ*, **66**, 230, 1961

6: K. D. Oh & K. Y. Chen, *AJ*, **89**, 126, 1984

7: S. Qian, *AJ*, **122**, 2686, 2001

8: C. L. Watson, A. A. Henden & A. Price, *Society for Astronomical Sciences Annual Symposium*, **25**, 47, 2006

9: D. Loughney, *VSS Circ*, **184**, 33, 2020

10: P. R. Tupa *et al.*, *ApJ*, **775**, 46, 2013

11: B. J. Burnett, P. B. Etzel & E. C. Olson, *AJ*, **106**, 1627, 1993

12: D. Manzoori, *Ap&SS*, **318**, 57, 2008

13: J. A. Eaton *et al.*, *Ap&SS*, **82**, 289, 1982

14: Z. Tunca, *Ap&SS*, **105**, 23, 1984

15: G. Bakos & J. Tremko, *Bulletin of the Astronomical Institutes of Czechoslovakia*, **38**, 356, 1987

16: A. F. Lanza *et al.*, *A&A*, **376**, 1011, 2001

17: X.-L. Wang *et al.*, *PAS Japan*, **62**, 671, 2010

James Screech comments on TX UMa: "*I have carried out a review of my processing and analysis of TX UMa and now believe my report in the last circular was incorrect. I thought that I had MuniWin configured to ignore measurements of saturated stars and on checking although I have this set correctly for my CCD/CMOS configurations it was set incorrectly for my DSLR. TX UMa was a secondary field variable in the same field as GW UMa my primary target on these nights which is significantly fainter than TX UMa and I was using ISO / exposure settings for GW UMa and assumed MuniWin would only analyse un-saturated frames. My observations started in twilight and the brightness of the sky was enough to saturate some pixels in TX UMa until the sky darkened. The error was entirely mine and I offer my sincere apologies to all members of the BAA VSS".* June 12, 2020

Get involved in research into star and planet formation

Roger PIckard

You may have seen the article on the BAA VSS front page about Hunting Outbursting Young Stars with the Centre of Astrophysics and Planetary Sciences (HOYS-CAPS) by Dr Dirk Froebrich (https://britastro.org/vss/froebrich.htm) but not given it much thought, perhaps because you don't even have a telescope!?

Well, now you can give it some thought, as this is the place to go if you don't have your own telescope or your location doesn't allow you to observe, and you would like to do some real observing!

You can do this by contributing to the Hunting Outbursting Young Stars (HOYS*1) project using time that has been allocated to them on the Las Cumbres Observatory (LCO*2) global network of telescopes. Amateurs without access to suitable equipment can use the LCO telescopes to gather data and get involved in analysis of young star and planet forming regions, if they so desire. If eligible, you will receive training on all aspects of the project including setting up your observations on the LCO telescopes, interacting with the images and analysing light curves. If you are interested in this unique opportunity then please get in touch through their website (HOYS*3). HOYS is a citizen science project which works with amateur astronomers to provide observational data for their research into star and planet formation. They have been selected as a Global Sky Partner of the Las Cumbres Observatory for the next year.

1: https://hoys.space
2: https://lco.global/education/partners/
3: https://hoys.space/lco-project

FOR SALE

Following the sad death of Ian Miller, his family wish to dispose of his equipment and I have offered to assist with this. The equipment, which is all in VG condition, may be viewed here https://furzehillobservato.wixsite.com/furzehillobservatory, and the guide price, ONO, is as follows:-

Meade 14" SCT OTA: £3,000
Paramount ME: £6,000
Pillar: £200
SXV-M9: £50
SXVF-H16: £700
SXVR-H16: £700
Filter wheel: £150
Adapters: £70
Cabling: £20

Buyer(s) to collect and in the first instance please contact Roger Pickard (roger.pickard@sky.com).

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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.

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Deadline for the next VSSC is November 15th, 2020

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