ISSN 2631-4843

The British Astronomical Association

Variable Star Section Circular

No. 181 September 2019

Retiring Director Roger Pickard (right) hands over to Jeremy Shears after a record 20 years in the job. (*Photo G. Poyner*)

Office: Burlington House, Piccadilly, London W1J 0DU

Contents

From the Director — *Jeremy Shears*

Greetings from the new Director

As this is my first contribution since becoming Director, I would like to start by reiterating what I wrote in the last Circular in conveying thanks to Roger Pickard for the sterling service he has given to the Association over the past 20 years. I can only hope that the Section will be in equal good health when the time comes for me to hand on the responsibility. Roger will remain as Assistant Director, which will be a tremendous support for me. The specific tasks he has agreed to continue are inputting historical data to the VSS database and approving new visual charts & sequences. Thank you again for everything you have done, Roger!

I thought I'd say a few things about my own interest in variable stars. Strangely enough, I suppose it goes back to a secondary school English Literature lesson when I was about fourteen. "Eng. Lit." was never my strong point mainly because I found most of the text selected tedious and I am an incredibly slow reader. However, on one occasion we were encouraged to take a book from the library to read for pleasure. It was not allowed to be a textbook. That seemed to rule out my favourite subject of astronomy, that is until I saw in the Biography section *Starlight Nights* by the doyen of variable star observers, Leslie Peltier. Through his writing he conveyed the sheer joy of observing variable stars.

Thus, in the second half of the 70s I received my first VS charts from Doug Saw, which included U Boo, RS Her & SS Cyg, and I set about observing them with my 6-inch Fullerscopes Newtonian. Then, as so often happens, life got in the way. Astronomy was always present, but there were so many other things. Finally, in 2004, having lived overseas for 12 years, I had the chance to realise my dream of setting up a permanent observatory at my home in Cheshire. In 2004 May I attended the VSS workshop on CCD variable star observing held in Northampton. This was the catalyst that I needed: the observatory was ready in time for the transit of Venus in June and I started observing a few CV's including V1363 and V1454 Cyg that summer. This was mainly patrolling for outbursts of dwarf novae. The event that changed everything occurred in the early hours of 2005 Apr 9 when I spotted CG Dra in outburst at mag 16.1. This was on the Recurrent Objects Programme as a very infrequently outbursting dwarf nova, so I phoned Gary Poyner to report it. Well, it turned out this was the first of many calls over the next few months as I spotted CG Dra having "gone off" – and eventually Gary, Roger and I wrote a paper for the *Journal* which explained that CG Dra outbursts every 11 days or so. With that first outburst I was hooked! And the rest, as they say, is history.

Whilst most of my observing is via CCD, I do like to carry out visual observations with binoculars from time to time, especially when away from home. I want to reassure members that I value the continued contribution of visual observers to variable star astronomy. So much of what we have learnt about variable stars in the last 129 years of the VSS's existence has been due to visual observers and I hope this will continue. But I sounded a warning in my 2017 BAA Presidential Address. In reviewing data on the bright dwarf nova VW Hyi, I noticed a rather worrying trend: in recent years rather fewer visual observations of the star have been made, at least compared with earlier epochs. The consequence is there is now the very real possibility that future outbursts will not be fully characterised and if the observations become too sparse, it may become difficult to be certain whether an outburst is a normal one or a superoutburst. It is true that more CCD data

From the Editor

In future, authors are asked to include a short abstract with their work. The Circulars are available through ADS, where a short abstract greatly enhances our inclusion.

are available in recent years, but these are often short time series photometry runs, over a few hours, which do not add much to defining the overall profile of the light curve. These trends are by no means unique to VW Hyi – this is merely one example. I cannot stress how important continued visual observing is.

Therefore, as Director I aim to promote all types of VS observing, both for pleasure and for science. I would like to intensify links with professionals, to encourage people to contribute to the Section's observing programmes and occasional campaigns (here a shameless plug for the campaigns on HR Lyr and HS 0229+8016 discussed later in this Circular – although the latter is officially over, please do keep an eye on this star!), and to promote the VSS, and the joy of the variables, to the broader BAA membership and beyond. In this regard, I was able to give a short talk on observing variables during the BAA Summer meeting held at the Rutherford Appleton.

Returning to my earlier comments on *Starlight Nights*. I re-read this hugely engaging book every summer to remind myself about why I love variable stars (I now have two of the original editions, plus the paperback reprint and a Kindle version). But Leslie ends with this ominous warning:

"I feel it is my duty to warn others...that they approach the observing of variable stars with the utmost caution. It is easy to become an addict, and as usual, the longer the indulgence is continued the more difficult it becomes to make a clean break and go back to a normal life."

- Leslie Peltier (1900 – 1980)

….but this warning it is too late for me and I know for many of you, too!

Officers meeting

The VSS Officers met on August 10 to discuss the work of the Section and future plans, as well as taking the opportunity of saying farewell to Roger. Many thanks to Gary for allowing us to use the Heart of England AS's meeting room for the day. The photo below shows the Officers relaxing during the afternoon tea break; unfortunately, Andy Wilson and Guy Hurst were unable to attend the meeting.

I am very grateful to the Officers for all the work they do and will be relying on them heavily as I take on the Directorship.

L to R. Des Loughney, John Toone, Jeremy Shears, Bob Dryden, Roger Pickard, Shaun Albrighton and Gary Poyner. Photo. G. Poyner/James Dawson.

VSS meeting on 2020 May 9

As announced in the last Circular, the next VSS meeting will take place on Saturday 9 May 2020 at the Humfrey Rooms in Northampton, courtesy of the Northamptonshire Natural History Society. This will be a great opportunity for Section members to present their work, so please do consider if you would like to give a talk.

RAS National Astronomy Meeting 2019 (NAM)

I participated in a most enjoyable session on Pro-Am Collaborations in Astronomy at the 2019 NAM, held at Lancaster University in July. The session was organised by a good friend of the VSS, Dirk Froebrich (University of Kent), and Callum Potter (BAA President). There were four talks with a VS theme: “Confirming and Classifying Supernovae Spectroscopically Using Amateur Equipment” by Robin Leadbeater, “M31N 2008-12a - A remarkable system and an equally remarkable Pro-Am collaboration” by Matt Darnley (LJMU), “The HOYS-CAPS Citizen Science Project” by Dirk Froebrich and I spoke on “Amateur astronomers and cataclysmic variables”. Roger Pickard prepared a poster highlighting the work of the VSS and Richard Miles had one on “Pro-Am Collaborations and astronomical literature: Opportunities for amateur astronomers to contribute”. Sky & Telescope published a summary of the meeting on their website: https://www.skyandtelescope.com/astronomy-news/from-lunar-flashes-to-variable-stars-pro-am-astronomy-projects/ . Philip Jennings is preparing a piece for the *Journal* about the meeting where you will be able to read more.

Request for assistance to observe the pulsating white dwarf G28-38

On the subject of pro-am collaboration, Boris Gänsicke reports that Odette Toloza (University of Warwick) has an HST program scheduled to observe the pulsating white dwarf G28-38 (aka ZZ Psc). G28-38 is the prototype of white dwarfs which are accreting from a planetary debris disc. Boris says:

"To make this program a success, as dense as possible optical time-series photometry is required, which will allow us to model where the pulsations heat the white dwarf surface during the HST observations. TESS will observe G29-38, which is great as it's in space and hence not affected by weather, but its two-minute cadence is not really fast enough to resolve the pulse profiles.

.... hence our request: would you be able to help out with time-series photometry for a ~10-day period during which HST will observe the star over and over again - currently scheduled for Sept 29 - Oct 7?

- let's go for unfiltered photometry, and cadence 15sec if you can manage - otherwise as fast as you can go while staying well above the read-out noise, and the read-out time is not starting to dominate the duty cycle.

- duration: currently STScI plans the observations for Sept 27 – Oct 9. That's ~165 HST orbits, and Odette's program will get 35 of those, so HST will have a duty cycle of ~20% over these 11 days. Because the light curve is horrendously complex, we do really need as much (ideally gap-less) time-series photometry to know what happens in the gaps between the individual HST observations.

We'll be back once the detailed HST schedule is known, probably mid-September."

Further details, including comparison stars and background information on the object, are given in BAAVSS alert (https://groups.yahoo.com/neo/groups/baavss-alert/conversations/messages/5305) and any updates will be posted there too.

Workshop on AM CVn binaries, Armagh, Sept 2020

Gavin Ramsay (Armagh Observatory & Planetarium) has announced this workshop planned for next year. The aim is not only to bring together the active community working on AM CVn binaries, but also to forge and strengthen links with related topics such as detached compact binaries, gravitational waves, post common-envelope systems, helium rich systems and related theory and modelling. Topics include:

- Population characteristics of the currently known systems
- The formation and evolution of double white dwarf binaries and related systems
- AM CVn progenitors and alternative end-products
- Long-term studies including period evolution and variability
- Hydrogen-deficient accretion
- Sub-10min systems
- Donor star evolution
- Connections with CVs, (ultra-compact) XRBs and Type Ia progenitors
- Gravitational Wave emission from compact binaries
- Exploiting upcoming facilities, surveys and missions

The organisers expect to maintain the workshop format from the previous meetings with a relatively small number of participants and ample time for discussion and small group splinter sessions. The workshop will be held at Armagh's Observatory and Planetarium, with nearby hotel accommodation and working facilities available for participants.

At this stage the organisers request interested participants to email AMCVn@armagh.ac.uk to indicate how likely they are to attend. In particular they ask people to express a preference for the conference taking place between 31 Aug - 4 Sept or 7 - 11 Sept 2020.

A web page can be found here: https://armagh.space/research/meetings/amcvn-armagh/

AGB News

Do you subscribe to this monthly electronic newsletter? AGB News covers "Asymptotic Giant Branch stars and less and more luminous red giants and supergiants; dealing with their structure, behaviour, evolution or mass loss, with their impact on the dynamical and chemical evolution of galaxies or their use as tracers of intermediate-age populations". The editors are Jacco van Loon (Keele University, UK), Ambra Nanni (Padova, Italy) and Albert Zijlstra (The University of Manchester, UK). It includes abstracts of recent papers and notes & comments about the field. You can view it at

https://www.astro.keele.ac.uk/AGBnews/.

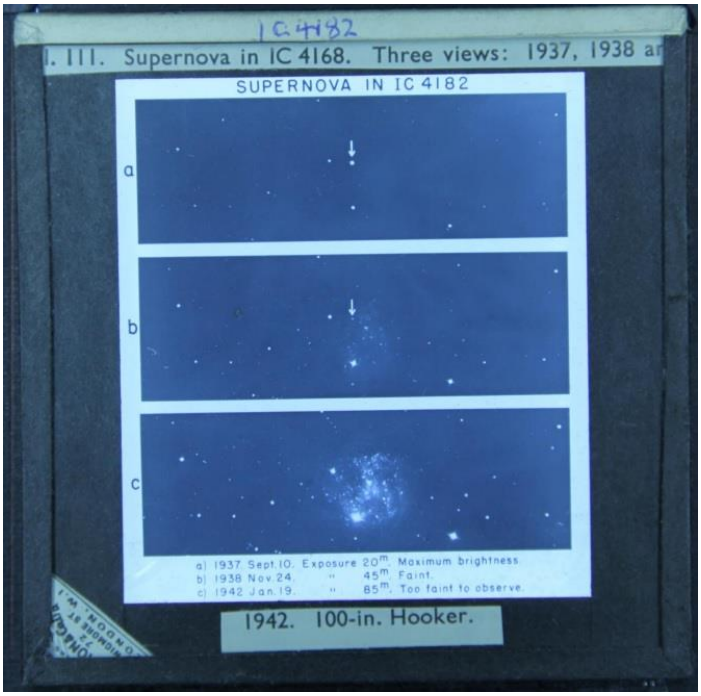
If you register online, you will receive an email on around the 1st of the month announcing the release of each new edition.

BAA lantern slide collection

The BAA Lantern Slide Collection has slides on all sort of astronomical objects going back a century or more, including a few on novae and supernovae. John Chuter, the Association's joint archivist, has made PDFs of many slides available online at

https://britastro.org/downloads/11924.

Right is a slide showing the 1937 SN in IC 4182. Have a browse!



From the (Semi-) Retiring VSS Director

Although by the time you read this, I will no longer be Variable Star Section Director, I will become Assistant to the Director, who is now Jeremy Shears of course. As his Assistant, I will have responsibility for helping John Toone by looking at each new chart he produces. In addition, I shall continue with the process of seeing old data into the database as well as that that is submitted by the remaining few of you that don't have access to the Internet.

But just a couple of notes before I spend a few moments reminiscing over the last twenty years.

AUTUMN MIRAS

M = Max, *m* = min.

R And	*M*=Aug/Sep
W And	*m*=Nov/Dec
R Aql	*m*=Oct
UV Aur	*M*=Oct
X Cam	*M*=Sep
	m=Nov
SU Cnc	*M*=Aug/Sep
RT Cnc	*M*=Oct/Nov
o Cet	*M*=Oct/Nov
V CrB	*M*=Sep/Oct
W CrB	*M*=Oct
R Cyg	*M*=Aug/Sep
T Dra	*M*=Sep/Oct
RU Her	*m*=Oct
SS Her	*M*=Nov
	m=Sep
R Hya	*M*=Oct
SU Lac	*M*=Aug/Sep
RS Leo	*M*=Aug/Sep
W Lyn	*M*=Nov/Dec
X Lyn	*m*=Nov

Source BAA Handbook

Firstly, it has been brought to my attention that some of our visual observers are persisting in observing stars what are now deemed constant or stars with a very small range. Whilst I do accept that some pulsating stars only display small fluctuations at times, surely there are more profitable stars for an observer to add to their programme?

The Mentoring list has been updated - see www.britastro.org/vss/Mentoring.htm.
Further, if you're not on the list but would you like to be added, please advise your speciality (e.g. visual, photometry or analysis etc) to Jeremy.

Now, if you'll bear with me, a little reminiscing, if I may. These notes have been taken from the VSS Circulars which have proved most interesting to read again as many are still very much relevant today. I do recommend that you take a little time to re-read some of the Circulars again.

It is sad, that during my time we have lost some great observers or others who have helped the Section over the years, such as Melvyn Taylor, although now is not the time to dwell on such matters.

I've always been fascinated by gadgets, and the technique of photoelectric photometry was to grab my attention in the early eighties. Later, (with much help from Richard Miles) I progressed into CCD photometry, and I've tried to encourage others with similar equipment to try variable star observing.

It was interesting to recall that, on 1999 Dec 19 I made my first CCD observation, which was of RT And, and was chosen as it was part of an observing campaign organised by Professor Jim Sowell of the Georgia Institute of Technology to re-determine the times of minimum of a number of these stars.

"HIGH ENERGY ASTROPHYSICS WORKSHOP" - On the 13th and 14th of April 2000, I was lucky enough to attend this Workshop in Huntsville, Alabama, US - the home of the Marshall Space Flight Centre (MSFC). The workshop had been organized by the AAVSO, NASA and MSFC and along with myself, Guy Hurst, his wife Anne, and John Toone were also in attendance. The aim was to encourage amateur observations of gamma-ray bursters (GRB) and other such exotic objects! This may seem a little farfetched at first and, of course, amateurs cannot expect to see anything of these

objects at such short wavelengths, but we can and do, observe them at visual and similar wavelengths.

In the June 2003 Circular, I announced that, after 33 years at the same address, in Kent I had moved to a quiet village in Herefordshire, close to the Welsh border; and some 16 years later we're still here!

In Dec 2005, a friend of mine from Crayford, Martin Crow wrote an article describing his fortuitous discovery of TYC 848-966 (now known as ASAS J111138+0959.5) which he found whilst observing the asteroid 218 Bianca. Martin adds, "All this begs the question, how many other unlooked-for variables are just sitting in archived sets of CCD images sitting on people's hard drives? I for one will be setting some time aside to do a bit of trawling".

Then, in VSSC 132 for June 2007 we read "200,000 Variable Star Observations! On April 17th, 2007 at 2 hours 55 minutes UT, Gary Poyner made his 200,000th visual variable star estimate . . . ". But this was to be updated just a few years later, but more of that in due course!

In VSSC 134 for Dec 2007, you learnt that I was honoured to be President of the BAA and this included a picture of me with Richard Miles handing over the Presidency to myself, with an added question "- who will be next!". (It was to be David Boyd).

Then in the same issue, there is a note as follows: - Visual Observing - again: There have been a number of emails of late, stemming from an article in an American publication stating that the era of visual observing is just about dead, due to the large number of professional surveys being undertaken nowadays. From the flood of emails that followed, this is obviously not the case. As with the AAVSO, the number of visual observations reported to the VSS over the last several years has not dwindled. More people may be using CCDs and the like, but they are very much in the minority. CCD observers also tend to concentrate on fainter objects than the visual observer and on objects requiring time-series observations. In addition, it quite often happens that a visual observer will confirm a CCD observation and vice versa. Therefore, the visual observer should not feel despondent but encouraged that their observations are being backed up, not just by CCD observations, but by some very large surveys as well! And that was written almost 12 years ago and remains just as true!

Stars you no longer observe - I was intrigued to read Tony Markham's article about stars he rarely, if ever, observes nowadays and feels it would be interesting to get other observers' comments about any stars they no longer observe. So, don't be shy, we'd love to hear from you. But as far as I could see, we never did!

In VSSC 149 we returned to the subject of "Frequency of Observing" which reminds me, we are still finding that several observers are tending to over-observe a particular star or stars. Do be careful of this as it's wasting valuable observing time when you could be moving on to a more worthwhile target.

VSSC 151 brought a plea for help. In an effort to rectify the problem of missing data I would like to ask all observers to check whether they feel their data is all in the database. I then go on to describe how you can do this. It might be an idea for observers to do this again (or even for the first time!).

In VSSC 174 for December 2017 there was a call by Tracie Heywood for missing nova observations: can you fill in the gaps? These were for Nova (QU) Vul 1984 No 2, a few observations by Shanklin and Markham; Nova (OS) And 1986, a few observations of the fade to ~9.5 then nothing until negative observations from 1991 on and finally, Nova (QV) Vul 1987 with only four observations by Markham and Mobberley!

300,000 Visual Variable Star Observations! We read the reports by Rod Stubbings and Gary Poyner of their amazing feats in making VS observations in VSSC 178 for December 2018. Quite astonishing to my mind.

And finally, before some special thanks, have another read of the VSS Meeting Reports in the Circulars, they're great!

So, now my grateful thanks to you the observers and especially to all those who have helped, and in many cases, continue to help, by undertaking some aspect of VS work such as: -
The Secretary; Dave McAdam, John Saxton, Clive Beech, Bob Dryden;
The Chart Secretary; John Toone;
The Binocular Secretary; Melvyn Taylor; Pulsating Stars Co-ordinator, Shaun Albrighton;
Recurrent Objects Co-ordinator; CV's & Eruptive Stars co-ordinator, Gary Poyner;
Nova/Supernova Secretary; Guy M Hurst;
Eclipsing Binary Secretary; Tony Markham, Des Loughney;
Database Secretary; Andy Wilson;
CCD Advisor; Richard Miles, Jeremy Shears;
Circulars Editor; Karen Holland, Janet Simpson, Gary Poyner;
Webmaster; Peter Moreton, David Grover, Callum Potter, Gary Poyner.

Mentors; Dave Storey, Jeremy Shears, Tracie Heywood, Gary Poyner, Chris Jones, John Howarth, Guy Hurst, John Toone and Des Loughney.

My thanks also to Ian Miller for checking sequences of new and updated charts prepared by John Toone. And also, to Phil Busby who kindly prepared an updated Index to the Circulars (and further updated it).

A note now for those of you who have been to Meetings (including Winchester) since 2003 and seen our (portable!) Display Boards and how one of them in particular has collapsed in more recent years when attempting to erect/take it down. Plans are afoot to get some much lighter ones now I'm stepping down!

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

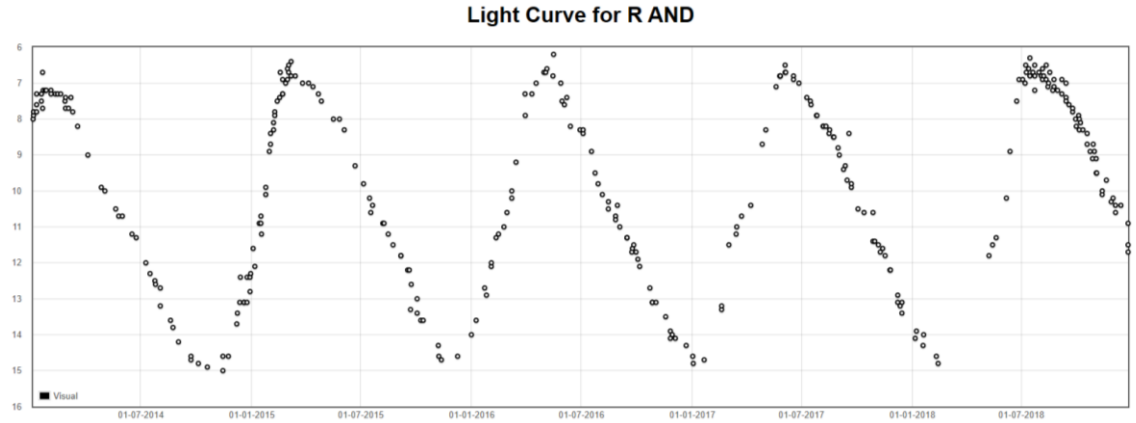
BAAVSS Pulsating Star Programme

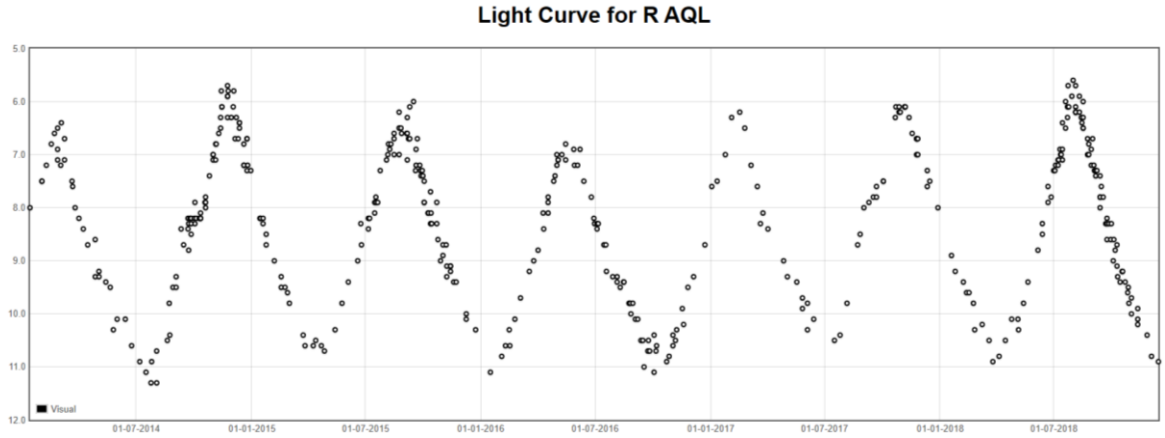
Shaun Albrighton

Light curves are produced for six Mira variables over a five-year period between 2014 and 2018.

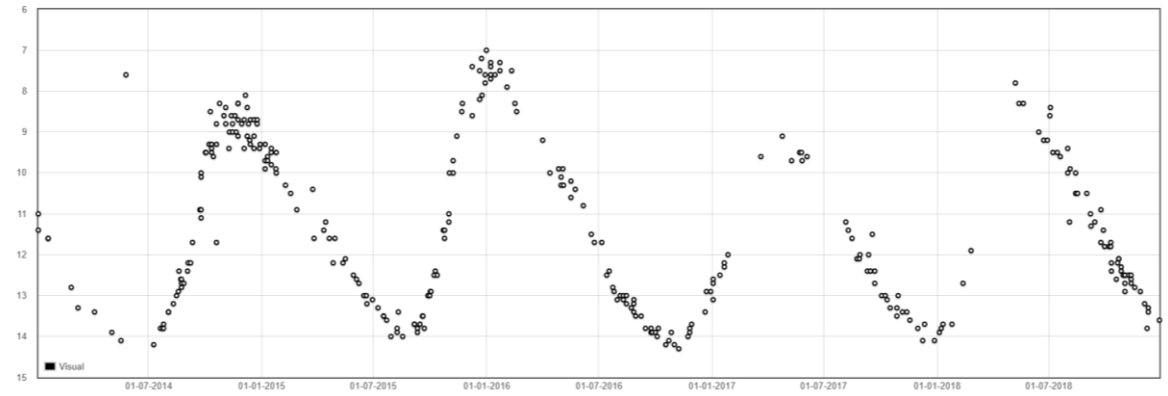
Whilst Mira variables show systematic variations, with timings of maxima and minima being able to be predicted within a matter of several days, they do display considerable variations. Of note are: -

- R And large 8 magnitude range in brightness.
- R Aql displays variation in both it's max and min magnitudes.
- R Cyg, note the large range in maximum during the 5 year period, between mag 7 and 9.
- U Ori, variation in maximum magnitude.
- R UMa has been recently re added to the programme, so additional observers are sought to cover this star, especially around minima.
- T UMa displays considerable variation in both range, brightness at max/min and shape of the light curve. Of particular interest is the very bright minima around Jan 2015.

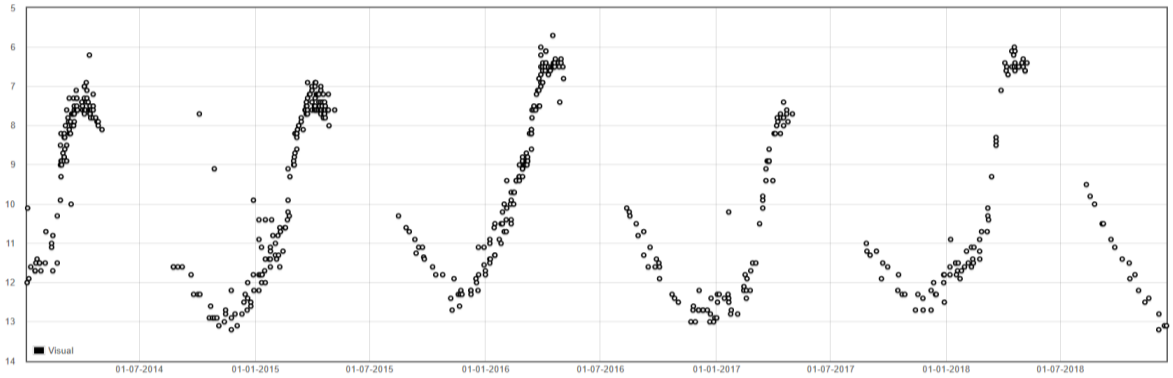




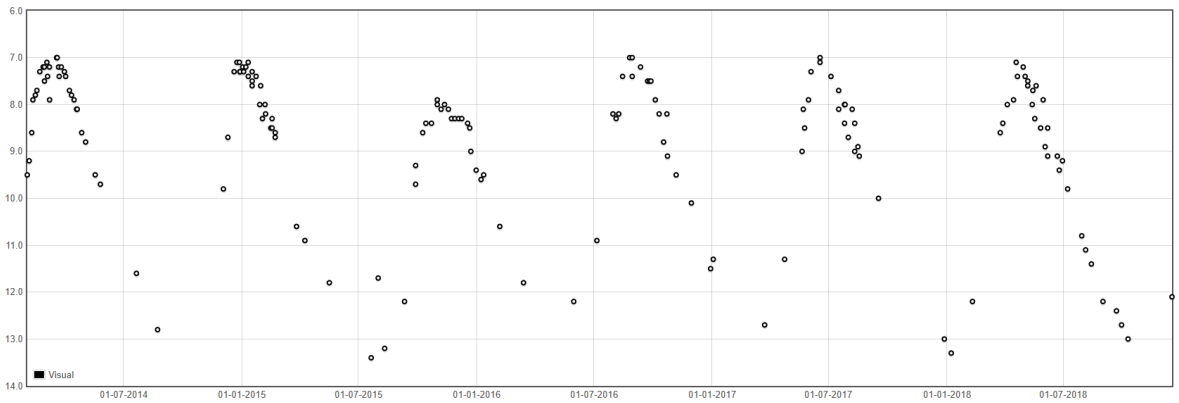
Light Curve for R CYG

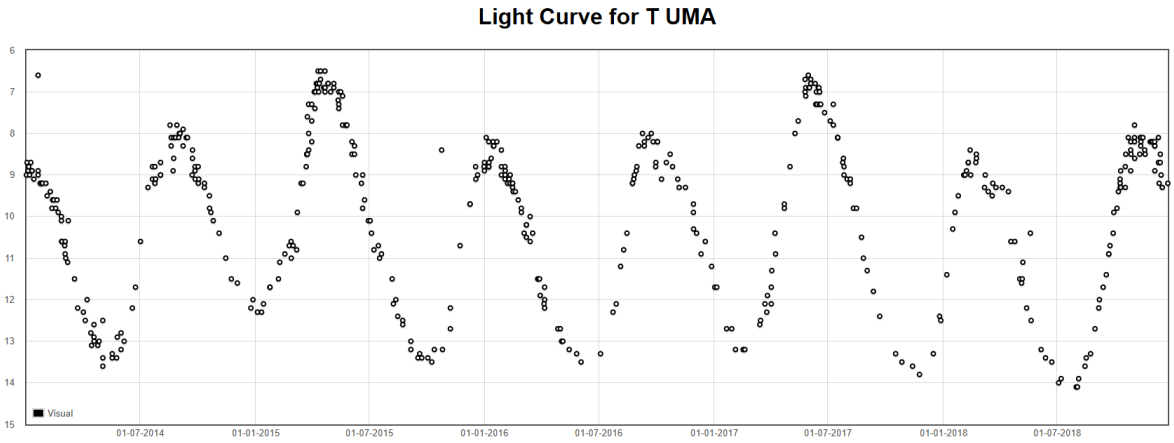


Light Curve for U ORI



Light Curve for R UMA





The range and period of V513 Per

Don Matthews

The range and period of Mira variable V513 Per has been reviewed, using data in the BAAVSS database. It has been concluded that there are reasonably reliable observations between 1998 and early 2019 spanning the range 11.3-13.6V. This review supports a previously suggested period of 423 days.

Mira variable V513 Per has been one of the poorly observed BAA stars in the author's observing programme since February 2017. Previous observations of this star held in the BAAVSS database date mainly from the 1998 to 2008 period and its range and period are not very well defined by this historical data. Both the BAAVSS Pulsating Star Programme and the AAVSO's Variable Star Index give its range as 10.4 to 13.0 V, with the latter also giving a period of 359 days. Adding recent data to the historical set in the BAAVSS database has enabled a review of both its range and period.

Review of Historical Observations

A brief description and chart were provided for V513 Per in the November 1990 edition of *The Astronomer*, identified there as TAV 0329+41 (Figure 1).

5) TAV 0329+41 = Q1989/106 mag 10.4-13? Sp N 03h29.1m +41 16'. Bright in Feb. 1989. Identified as IRAS 03291+4116 = Dearborn 9974 = CCS 149. Dave McAdam archive has been used to derive ephemeris JD max = 2447559 + 423E. Sequence: A 10.7, B 11.2, C 11.6, D 11.8, E 12.1.

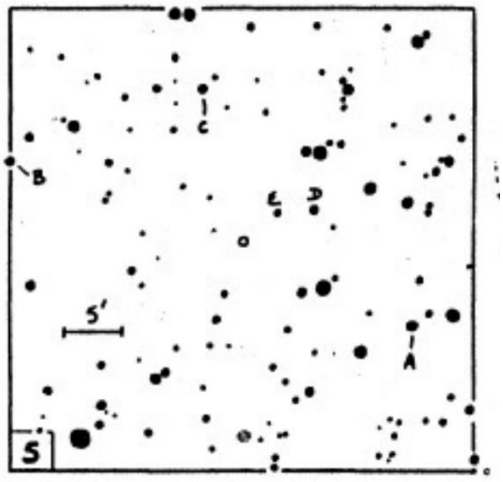


Figure 1

The period was given at that time as 423 days. Unfortunately, the data then in the 'Dave McAdam archive' have not been found in the current BAAVSS database. With regard to the chart and sequence, it can be seen that the comparison stars only covered the magnitude range from 10.7 to 12.1.

The 164 observations for the period 1998 to 2008 in the BAAVSS database were all visual ones based on the comparison star sequence from *The Astronomer*. The derived magnitudes varied between 11.5 and 14.6 and almost all estimates were based either on comparison stars D and E or just E. When the variable was fainter than 12.1 (E), substantial extrapolation could be required, of 2 magnitudes for the 14.1 estimates and 2.5 magnitudes in the case of the one 14.6 estimate. The fainter observations must therefore be regarded as approximate.

The accuracy of the comparison star magnitudes is mainly confirmed by modern APASS measurements. A, B and E agree within 0.1 but on the basis of APASS, C (11.6) would become 11.2 and D (11.8) would become 11.4, both 0.4 brighter. If the APASS figures were used, the bright end of the range of variation during the 1998 to 2008 period would become 11.3 rather than 11.5, based on two observations given as C(1)V(1)D and two as D+1. The faint end of the range would not be affected, though as noted above this is in any case approximate.

After the 1998 to 2008 observations there are three visual ones in 2010 based on a new chart. The reference stars are given as 132, 135 and 137, which match the AAVSO chart. Recent AAVSO magnitudes for these three stars (in a chart dated 2016) are a good match with the APASS ones and it seems likely that this was also the case in 2010. After 2010 there is a gap in recorded observations until 2017.

Recent Observations

The only recent observations are those made by the author, based on photometry using a DSLR fitted with a V filter and attached to a 200mm SCT. The AAVSO chart was used but with APASS magnitudes for the comparison stars.

So far, these recent observations have spanned two cycles, with a magnitude range of 11.5 to 13.6 V and a period of close to 14 months. Maxima were reasonably well captured in December 2017 and March 2019 and a minimum in July 2018. The minimum in mid-summer 2017 was missed, however.

The November 2016 maximum appears to have been brighter than the more recent ones as a green-channel measurement on 1 November 2016 (made before the author acquired a V filter) came out at 11.2.

Evaluation of Historical and Recent Observations

If the modern APASS magnitudes for comparison stars are used rather than the older ones in the 1990 *The Astronomer* chart, there are reasonably reliable observations between 1998 and early-2019 spanning the range 11.3 to 13.6 V. Due to the short period of observation, this observed range is likely to be conservative and the maximum range larger at both maximum and minimum. The present published figure of 10.4 for the bright end of the range still seems reasonable but the faint end of the range extends to at least 13.6 and possibly into the 14th magnitude. More observations are needed of this variable in order to better establish its full range.

With regard to period, the following graph (Figure 2) spanning the period since 1998 shows the observations matched with maxima (the crosses) based on the 423-day period and JD 2447559 datum given in the 1990 *The Astronomer*. The visual fit with the data is very good and the 423-day period is therefore supported by this present analysis.

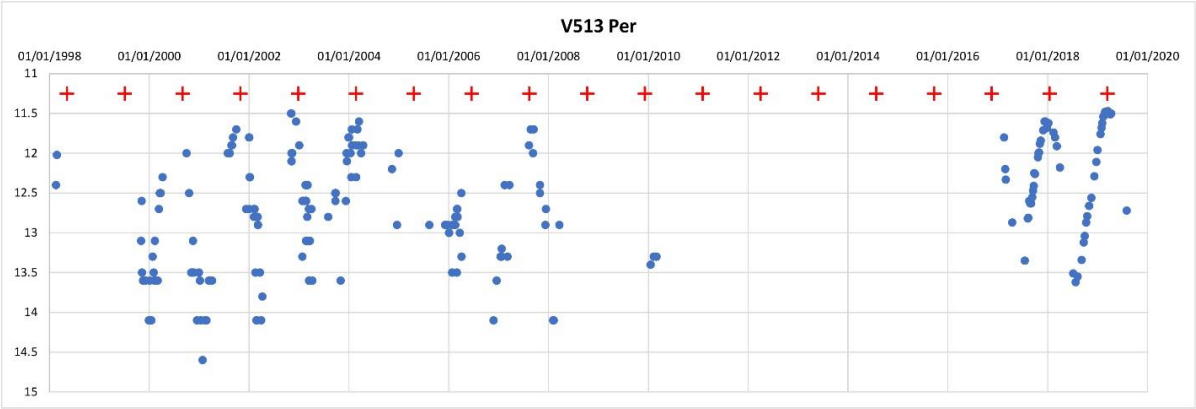


Figure 2

1 G.M. Hurst, *The Astronomer* 27, No.319, 149, 1990.

Observations of the suspected variable USNO-B1.0 1267-0564371

Christopher Lloyd and Roger Pickard

Time-series photometry and observations from automated photometric surveys show that the suspected variable USNO-B1.0 1267-0564371 has no periodic variations above a semi-amplitude 0.^{m}01.

The inconveniently named USNO-B1.0 1267-0564371 is discussed briefly in the *Circulars* by Pickard [1] in a paper describing the UGSU star 1RXS J231935.0+364705 (now known as V776 And) and two other variables in the same field; the EB V634 And and this one. According to a private communication from Denisenko [1] this star was originally suspected as a variable by Etienne Morelle but there is apparently no other discussion of it in the entirety of the internet. The suspect has V = 15.6 from APASS [2] and lies at 23 19 30.812 +36 43 39.43 (J2000) [3] and is also catalogued as the equally snappy UCAC4 634-127112, amongst others.

The original paper gives a light curve from one night with a rather optimistic line showing a possible variation with a semi-amplitude of perhaps 0.^{m}015 in V on a time scale of ~ 0.^{d}05. In fact, time-series data are now available from four nights, three in September and October 2011 and one from last July. These were all taken using a 0.35-m SCT with an SX V-H9 camera and a V filter. They have been analysed using a Discrete Fourier Transform (DFT) periodogram in an effort to search for any periodicity, the first three nights together and then including the last one. Individually the light curves show no real suggestion of any coordinated variation but on the other hand the DFTs are dominated by two clusters of peaks at f ~ 28 and 55 c/d which do not have the appearance of noise. The main feature at f = 28.7 c/d (p = 0.^{d}035) however is very weak, the semi-amplitude, a = 0.^{m}008 and the phase diagram (see Figure 1) is unconvincing.

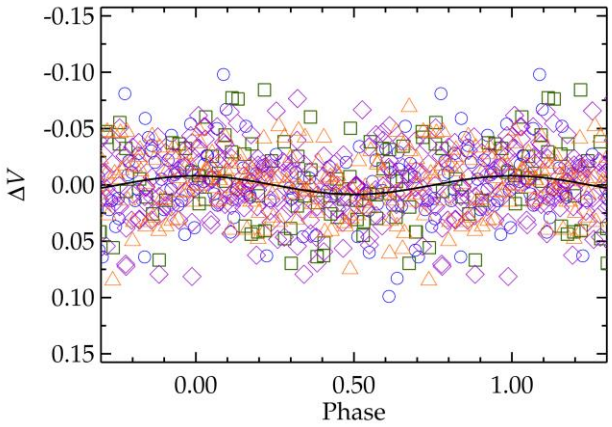


Figure 1: Phase diagram of the time-series data folded on f = 28.7 with each run shown as a separate symbol. The semi-amplitude of the variation is 0.^{m}008.

The suspect appears in several of the recent automated photometric surveys, including ASAS-SN, CSS and Pan-STARRS. The ASAS-SN data set is the largest with ~ 1000 V and 440 g-band measurements. Even excluding the most obviously discrepant points there is no clear periodic signal above a semi-amplitude of 0.^{m}03 and the general noise level is ~ 0.^{m}025. The CSS data set is considerably smaller at ~ 240 points and again excluding the few discrepant points there is no clear periodic signal above a semi-amplitude of 0.^{m}02 with the high-frequency (f > 20 c/d) noise level at ~ 0.^{m}01. However, in this case all the dominant frequencies are aliases of 1 c/d which suggests that

there is some (semi-) diurnal calibration issue at this level. The Pan-STARRS data set is even smaller with only 72 points and is further complicated by the measurements being distributed more or less evenly between five bands, *g*, *r*, *i*, *z*, and *y*. Nevertheless, by merging the data using mean offsets between the different bands it is possible to construct a combined set which has the lowest noise level of all three. The DFT periodogram has much more of the appearance of noise but it does have a clear peak at f = 19.5 c/d (p = 0.^{d}051) with a semi-amplitude of 0.^{m}01. While this is not obviously above the noise it is rather suggestive, and it also produces a not entirely unconvincing phase diagram (see Figure 2). The same feature would not be visible in the periodograms of the ASAS-SN or CSS data due to their higher noise levels. Unfortunately, it would also not be obvious in the time-series data so all that can be said is that there is no periodic variation with a semi-amplitude above 0.^{m}01.

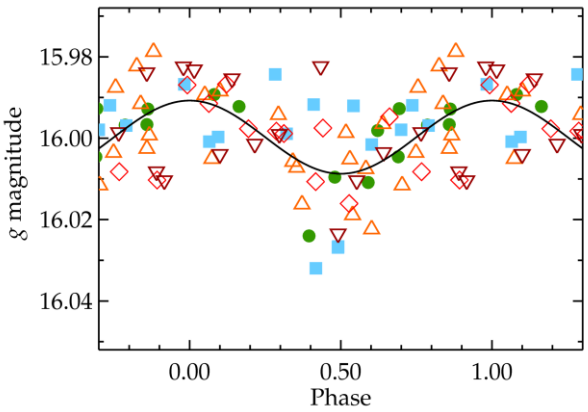


Figure 2: Phase diagram of the Pan-STARRS data folded on f = 19.5 c/d with the different bands shown as different symbols. Each band has been shifted by the optimum amount to align with the g-band data to minimise the residuals. The semi-amplitude of the variation is 0.^{m}009.

Little else is known about the star. Its galactic latitude, b = 36.°7, and its distance (from Gaia [3, 4]), d = 2100±330 pc places the star over 1 kpc above the galactic plane. The reddening in this direction is low, E_{B-V} = 0.11 [5,6] giving A_V = 0.3-0.4 with R_V = 3.1. Using the V magnitude, the distance and the reddening lead to an absolute magnitude, M_V = +3.6, corresponding to a *main-sequence* star of spectral type mid-F. Although this is prime delta Scuti territory being so far from the plane, if it was variable, it would have to be a metal-poor relation such as an SX Phoenicis *star*. Most likely it's an ordinary metal-poor F dwarf.

References

1. Pickard, R., 2011, *VSS Circ.*, **150**, 14
2. Henden, A. et al., 2015, AAS Meeting **225**, 336.16; VizieR
3. Gaia Collaboration, 2018, *A&A*, **616**, 1; VizieR
4. Bailer-Jones, C. A. L. et al., 2018, *AJ*, **156**, 58
5. Schlafly, E. F., & Finkbeiner, D. P., 2011, *ApJ*, **737**, 103
6. Schlegel, D. J., et al., 1998, *ApJ*, **500**, 525

CV & E News

Gary Poyner

Fading episodes of Z UMi and DY Per are discussed, alongside news on the standstill in Z Cam

It seems to be the year for RCB stars. We have seen R CrB return to maximum after 11 years. SV Sge has nearly recovered from its deepest ever recorded minimum (December 2018), U Aqr is slowly recovering from a deep 18th magnitude minimum, and ES Aql is slowly recovering from a June 15 magnitude minimum. Now as Summer moves into Autumn, we have two more RCB stars which look as if they will provide us with interest over the coming months.

The circumpolar RCB star Z UMi has begun its first fade since May 2015, with a drop in magnitude from maximum 11.3 in July to magnitude 14.7 by August 25th (time of writing). (Figure 1).

Z UMi is a cool (~5000K) RCB star which results in a very active light curve for this type of object. Unlike classical RCB stars which can spend many years at maximum magnitude, the longest Z UMi has been recorded at maximum (11.0V) is the period Jan 01, 2017 – July 01, 2019 which was the start of the current fade. The previous longest is 13 months (2004-15). This is for the period 1994-present, as prior to 1994 Z UMi was thought to have been a Mira star, and received no attention at all from VS observers anywhere. (Figure 2)

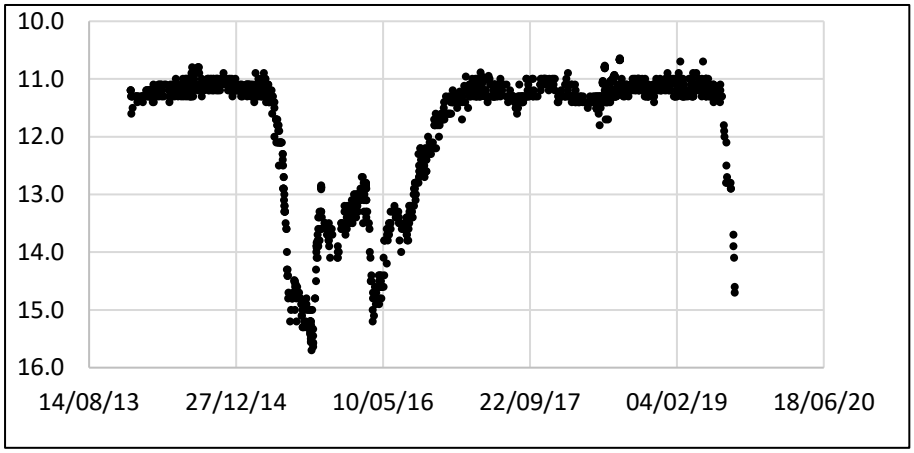


Figure 1: Z UMi. January 2014 to present. BAAVSS database

Recovery rates are also slightly more rapid than 'classical' RCB's, so that in some cases they appear very close to that of DY Per (see below) recovery symmetry. Z UMi also has a large amplitude of ~8 magnitudes. Previous to 2007, the amplitude

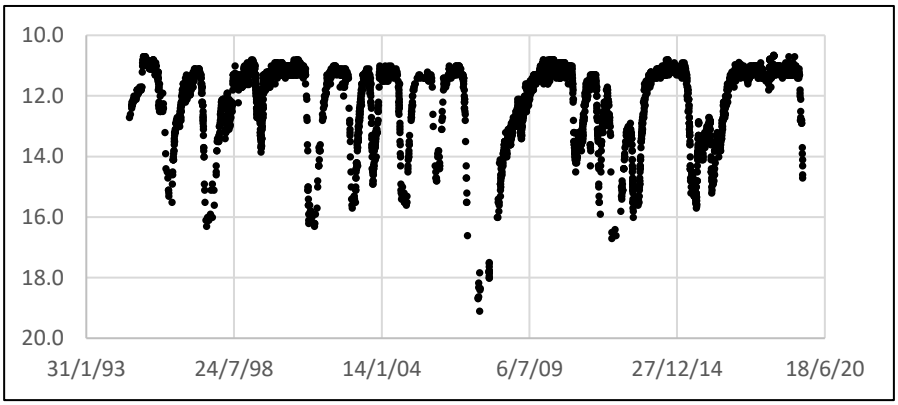


Figure 2: The complete BAAVSS light curve for Z UMi – 1994 to present

was thought to be 5.5 magnitudes, but in August 2008 a very deep minimum of 19.0CV was recorded, followed by an unsurprisingly long recovery (for this star) of 27 months.

With its declination of +83 degrees, Z UMi is circumpolar from the UK and can be observed throughout the year if you have a semi-decent view of the northern sky – although it can be a little difficult in the Winter months. Both visual and CCD observers are asked to monitor the current fade closely at every possible opportunity, and to report their observations to the BAAVSS database.

Once thought to be a classical RCB star, but now the prototype of a new type of Carbon star, DY Per is also entering an active state. The fade began sometime between June 29 and July 29, 2019 (1), fading from 11.3-12.8 during this time, and has continued to 13.9 visual by Aug 25. This is the first fade detected since January 2017 when DY Per reached 14.5 visual in April of that year, before recovering slightly to 12.4 in August and then fading again to 14.0 visual in December before slowly recovering to maximum in January of this year. DY Per can reach magnitude 16.0V at minimum.

The low temperature of DY Per manifests itself in the very unusual and active light curve (Figure 3). The *RCB* type decline and recovery are symmetrical, unlike classical RCB's where the recovery is usually a protracted affair, and usually take longer than classical RCB stars. Fades also occur more frequently than RCB stars. DY Per stars also pulsate, and DY Per itself displays SR type variations over a 792d period - which is well defined in the BAAVSS data. These are extremely rare stars, and only nine are confirmed as this type, four of which are observable from the northern hemisphere – ASAS J065113+0222.1, DY Per, EROS2-CG RCB-2 & ASAS J182658+0109.0.

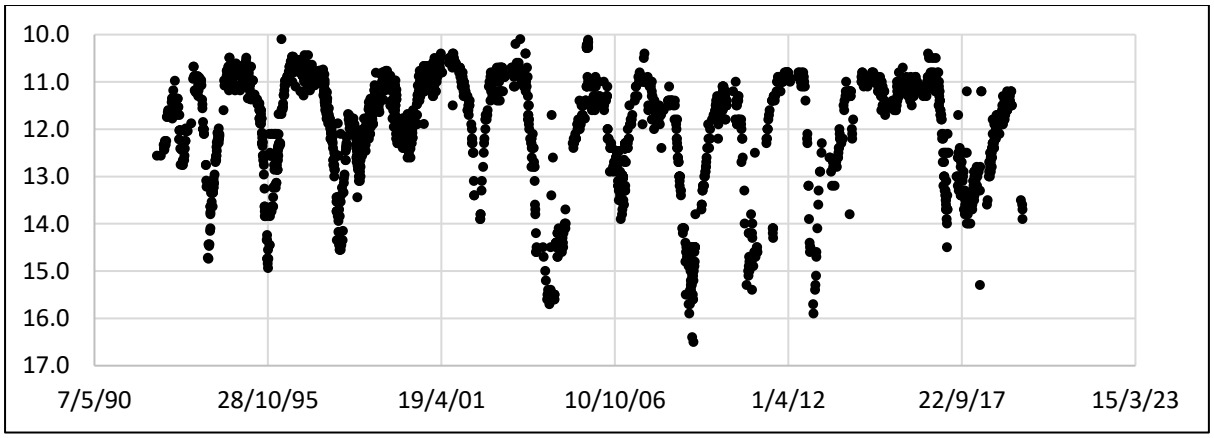


Figure 3: DY Per from BAAVSS database. Note the similarity with the plot for Z UMi

The field lies on the periphery of the open cluster Trumpler 2, but at 1500 lyrs, DY Per is much more distant then the cluster. Close by within 4 degrees are the CV's TZ and UV Per as well as the SR stars in the Perseus double cluster.

The prototype UGZ star Z Cam is now approaching 12 months in standstill. Of course, the magnitude is always varying during this phase, and some standstills show greater variation than others. This current period of 'inactivity' has seen Z Cam varying between 11.2-12.2 with a mean magnitude of 11.64 (Figure 4)

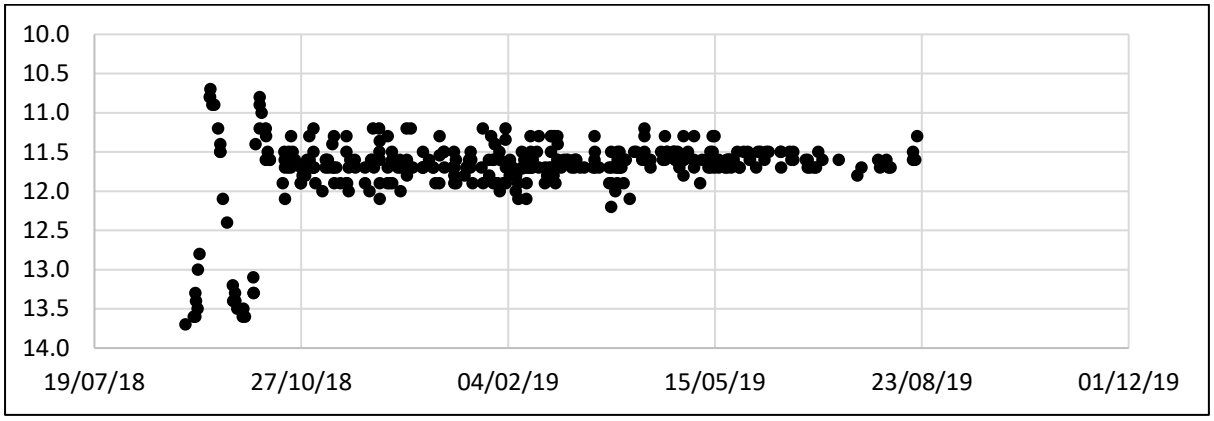


Figure 4: 2018-19 standstill in Z Cam from the BAAVSS database

Standstills are quite common in Z Cam itself (some UGZ stars hardly ever show standstills) and this current one is the 7th observed this century, and at this time is the second longest observed (table 1). On each occasion, the standstill ended with a decline to minimum. The unusual phenomenon of ending a standstill with a rise to outburst has not yet been seen in Z Cam, and I remain a little skeptical on this behavior (despite *apparently* seeing it myself in HX Peg and possibly AT Cnc) as the exact time of the end of the standstill is very difficult to determine. A very rapid decline followed by a rapid rise to outburst is possible without it being observed!

Standstills are impossible to predict as to when they begin or end, and observers are asked to monitor Z Cam on every occasion whilst low in the Northern sky over the Autumn period to see if the standstill continues or to observe closely how it ends!

Start	End	Duration
Oct 12, 2018	ongoing	316d
Apr 02, 2017	Dec 08, 2017	250d
Dec 04, 2012	Jun 02, 2013	180d
Jly 16, 2010	Dec 03, 2012	139d
Aug 05, 2007	Oct 29, 2007	86d
Sep 14, 2003	Jan 10, 2005	485d
Apr 11, 2001	Aug 02, 2001	112d

Table 1: Standstills in Z Cam 2001-present.

1: AAVSO IDB

Photometric observations of TCP J21040470+4631129 – the bright outburst of a previously unknown WZ Sge dwarf nova in Cygnus

David Boyd

Photometric observations of the first recorded outburst of a WZ Sge dwarf nova in 2019 July and August followed its gradual decline and subsequent rebrightenings.

Discovery

A bright transient was discovered in Cygnus by Hideo Nishimura in Japan on images obtained with a DSLR camera and a 200 mm telephoto lens. His discovery was reported on 2019 July 12.190 on the CBAT Transient Object webpage under the name PSN J21040470+4631129. The discovery image was subsequently posted on the same webpage.

Its unfiltered magnitude was reported as 8.9 and although initially described as a possible supernova, it quickly became clear from an early spectrum taken by Francois Teyssier and reported in ATel 12936 that it was a dwarf nova. It was informally rechristened TCP J21040470+4631129. The likely progenitor is a blue star USNO-A2.0 1350-13375367 (B magnitude 17.7) with Gaia DR2 position 21h 04m 04.688s, +46° 31' 13.75" and distance 109.2 ± 1.4 pc.

The large outburst amplitude suggested it was a WZ Sge type dwarf nova. These have long intervals between outbursts but, when outbursts do occur, they tend to have large amplitudes. Their reluctance to outburst is usually attributed to a low mass transfer rate from the donor star to the white dwarf. There is a short review of the properties of WZ Sge stars here. WZ Sge stars often experience a series of rebrightening events after the initial outburst is over.

Photometry

I recorded B and V-band photometry of TCP J21040470+4631129 on 20 nights between July 13 and August 24 using a 0.35m SCT and SXVR-H9 CCD camera. At the request of Dr Vitaly Neustroev at Oulu University in Finland who is coordinating amateur observations of the object, I added Rc and Ic-band photometry from July 24. Comparison star magnitudes were obtained from the APASS DR9 catalogue on Vizier. All observations have been reported to the BAA Photometry Database and to the AAVSO.

Further photometry was reported to the BAA by Ian Miller on July 13, 16 and 20 (mainly V-band) and by John Rock on July 13, 14 and 18 (CV-band). Gary Poyner reported visual estimates on 15 nights between July 13 and August 25, in several cases covering nights on which there were no photometric observations. Figure 1 shows the light curve from the BAA database.

The outburst slowly declined from magnitude 9.1 on July 13 to magnitude 11.7 on August 3 before dropping rapidly to magnitude 13.7 on August 6. It then rebrightened three times to magnitude 12 on August 8 (not covered by BAA observers), August 15 and August 25. It may well experience further rebrightenings on its slow fade back towards quiescence so continued observation is worthwhile. A more extensively populated V-band light curve can be found at the AAVSO website.

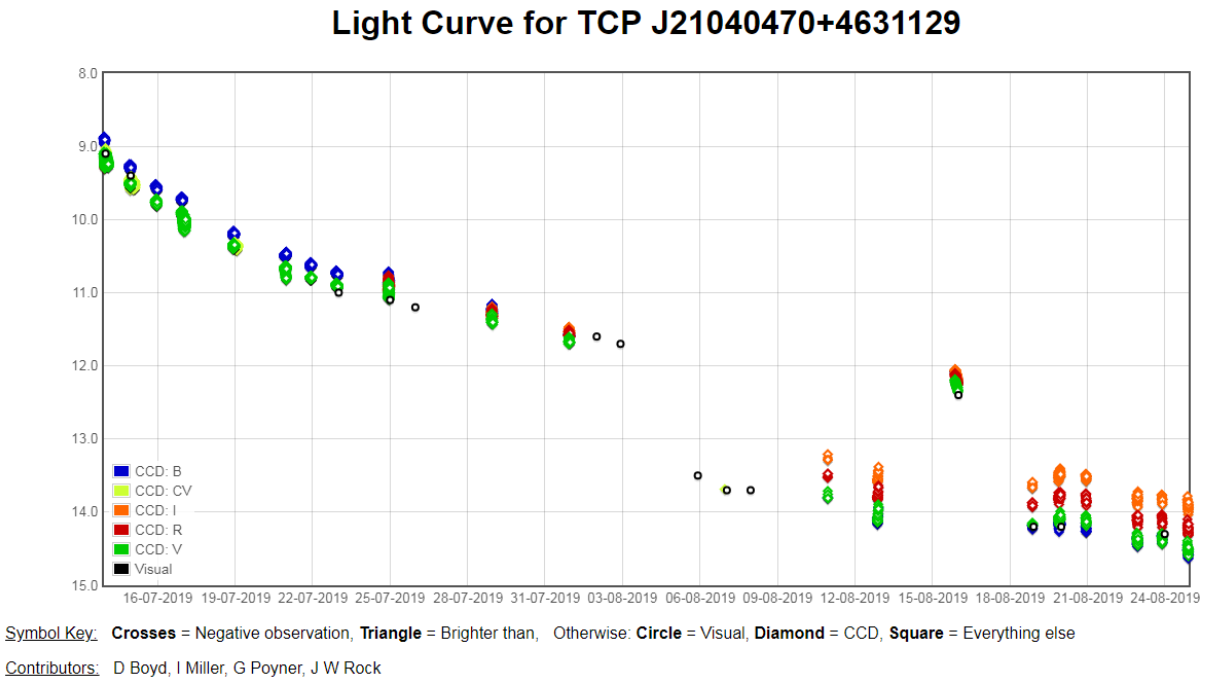


Figure 1. Observations reported to the BAA database between July 13 and August 24.

Figure 2 shows the B-V colour index following a linear trend becoming steadily redder as the object faded to magnitude 11.7 during the main outburst and later as the star reached magnitude 14 and beyond (black points). However, during the second rebrightening at magnitude 12.3 it was significantly bluer relative to this trend (red point).

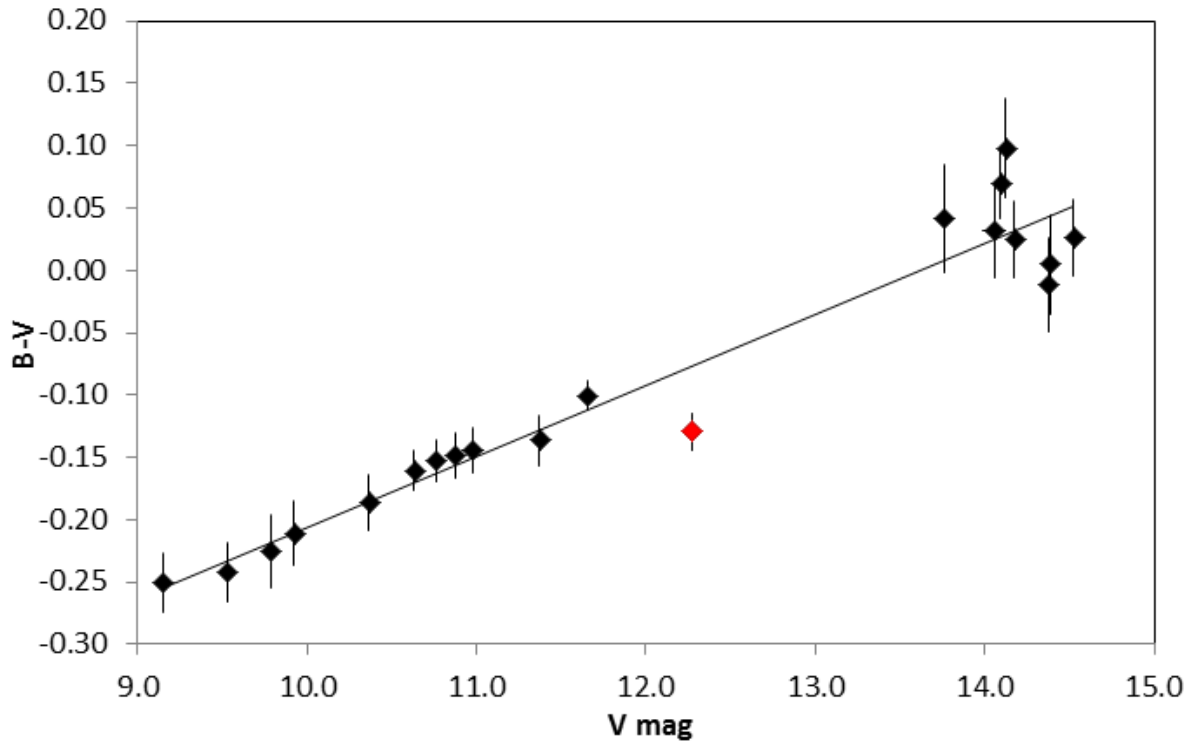


Figure 2. B-V colour index as a function of V magnitude during the main outburst and later as the star reached magnitude 14 and beyond (black) and during the second rebrightening (red).

Period analysis

WZ Sge stars in outburst show regular light variations known as superhumps in their light curves. These are caused by the enlarged accretion disc developing a 3:1 resonance with the secondary star. During the initial stage of the outburst these early superhumps are double-humped and their period is assumed to be identical to the orbital period. Later in the outburst, as the disc becomes eccentric and starts to precess, the period of superhumps increases and their amplitude grows.

I performed a period analysis of my V-band photometry between July 13 and 22 using the PDM method in Peranso. The strongest signal among the expected ±1 cycle/day aliases was at a period of 0.05349 ± 0.00009 d with peak-to-peak amplitude 0.03 magnitude. This is consistent with the period 0.535 ± 0.0003 d reported in ATel 12947. Figure 3 shows my detrended V magnitude light curves between July 13 and 22 folded on this period and has the characteristic double-humped profile of early superhumps.

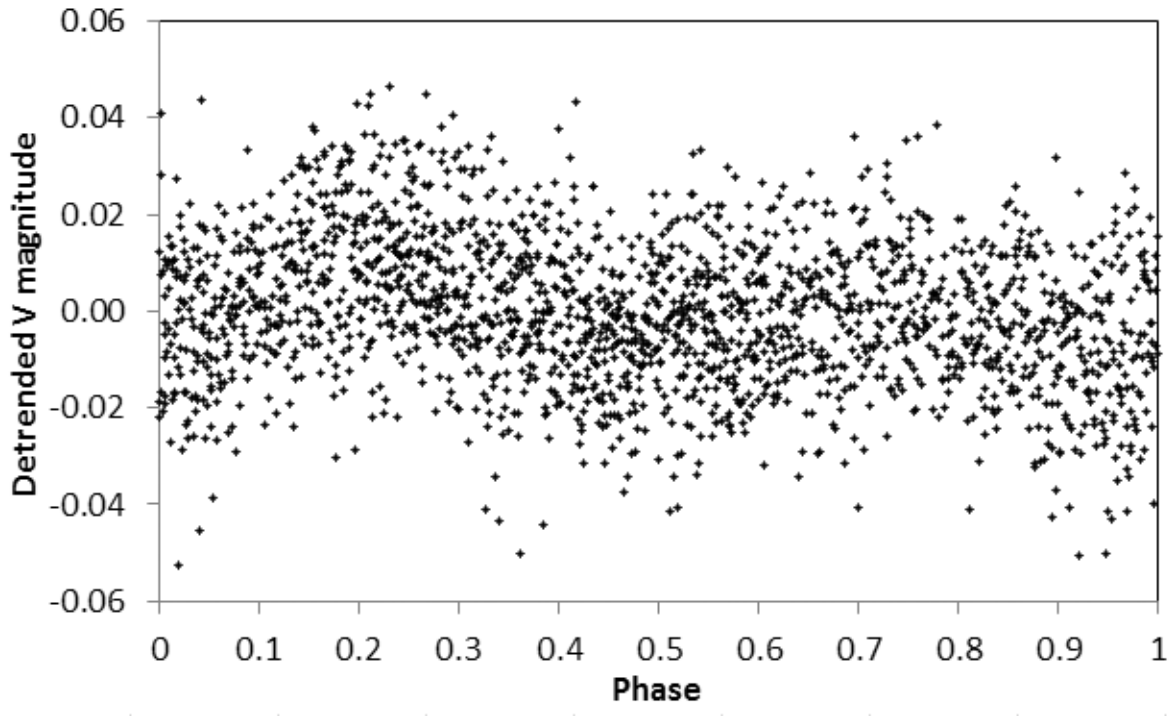


Figure 3. Detrended V magnitude light curves between July 13 and 22 folded on a period of 0.05349 d showing the double-humped profile typical of early superhumps.

By July 24 full amplitude superhumps had developed as reported in ATel 13009. Period analysis of the V-band data between July 24 and 31 gave a period of 0.05414 +/- 0.00015 d with mean peak-to-peak amplitude 0.23 magnitude. Analysis of the data between August 12 and 24 gave a slightly longer period of 0.05532 ± 0.00007 d and reduced peak-to-peak amplitude of 0.06 magnitude.

Spectroscopy

Concurrently with photometry, I also recorded spectroscopy of the object. An analysis of these data will be reported in the BAA Journal.

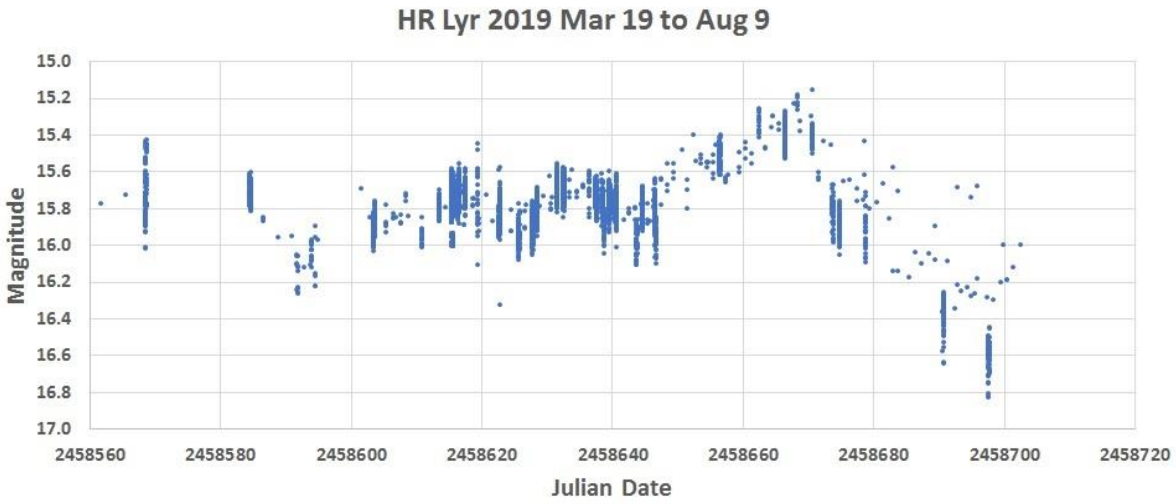
Update on the VSS campaign to observe the old nova HR Lyr

Jeremy Shears

Recent observations of HR Lyr are discussed and a light curve from 2019 Mar 19 to Aug 9 is presented.

Results so far

We are now over 4 months into the HR Lyr campaign [1] and we have a nice light curve of this old nova developing. This is shown below and is regularly updated on the VSS website. It was brightening steadily during June, leading Gary Poyner to comment on the BAA Forum: “I've been monitoring HR Lyr since the early 1990's, and on June 29 this year I recorded it at 15.1 visual - the brightest I've ever seen it”. Well, it must have heard Gary because it promptly began to fade! At the time of writing (Aug 9) it had faded by at least a magnitude. This is consistent with the longer-term behaviour previously noted [2], where the light curve variations often take the form of nearly linear rises and falls of about 100 days with occasional ~0.6 mag mini outbursts. The event in June might well have been one of these outbursts.



Time-resolved photometry continues to show various humps and bumps in the light curve with an amplitude of ~0.15 mag. These appear to be fairly regular for a few cycles (~1.5 h), but they do not appear to be consistent. Moreover, the shape of the bumps is quite variable.

A couple of requests

1. Please keep the once-or twice per night snapshot photometry going. New observers are always welcome, of course.

2. Some really long photometry runs (several hours) over a few nights would help us to understand the short-term variations and see whether a coherent signal emerges. From the time you receive this Circular onwards would be a good time for this as the nights are becoming longer.

Many thanks to all the observers who have supplied visual and CCD photometry:

Chris Allen, David Boyd, Walter Cooney, Pavol Dubovsky, Sjoerd Dufoer, Carlo Gualdoni, Kevin Hills, Steve Johnston, Mel Joslin, Paul Leyland, Michael Linnolt, JH Mallett, Ian Miller, Ken Menzies, Martin Mobberley, Roger Pickard, Gary Poyner, Jeremy Shears, Dave Smith, Richard Sabo, David Storey, Tonny Vanmunster, Ivan Walton

[1] The campaign and its objectives are described on page 6 of VSSC 180 (2019 June)
[2] Honeycutt R.K., Shears J., Kafka S., Robertson J.W. & Henden A., AJ, 147, 105 – 113 (2014)

Update on the VSS campaign to monitor the cataclysmic variable HS 0229+8016

Jeremy Shears

The recent VSS campaign on this nova-like CV has enabled a detailed light curve to be drawn which shows that it undergoes almost continuous ~0.6 mag amplitude brightenings with a typical duration of ~9.5 days. Although the campaign has officially ended, further observations of this intriguing star are encouraged.

HS 0229+8016 was identified as a cataclysmic variable star during follow-up observations of optically selected CV candidates from the Hamburg Quasar Survey by Aungwerojwit et al. [1]. Its orbital period is 232.550 ± 0.049 min (0.16149 d).

The light curve over the last 12 years appears to show almost continuous low amplitude very small outbursts of ~0.6 mag for much of the time. Each event lasts ~10 days and the star varies between mag ~13.6 and 14.3. There are two intervals of 100 - 200 days when these appear to reduce or even stop.

Following encouragement from Boris Gänsicke at Warwick University, a VSS campaign was launched at the end of 2018 November and was originally intended to run until the end of 2019 February. However, many people continued to monitor it after that time. The light curves which accompany this article show that excellent coverage of HS 0229+8016's behaviour was obtained during the campaign. Once again, they reveal almost continuous ~0.6 mag amplitude brightenings with a typical duration of ~9.5 days. These similar to the "stunted" outbursts seen in a few other nova-like CVs such as UU Aqr.

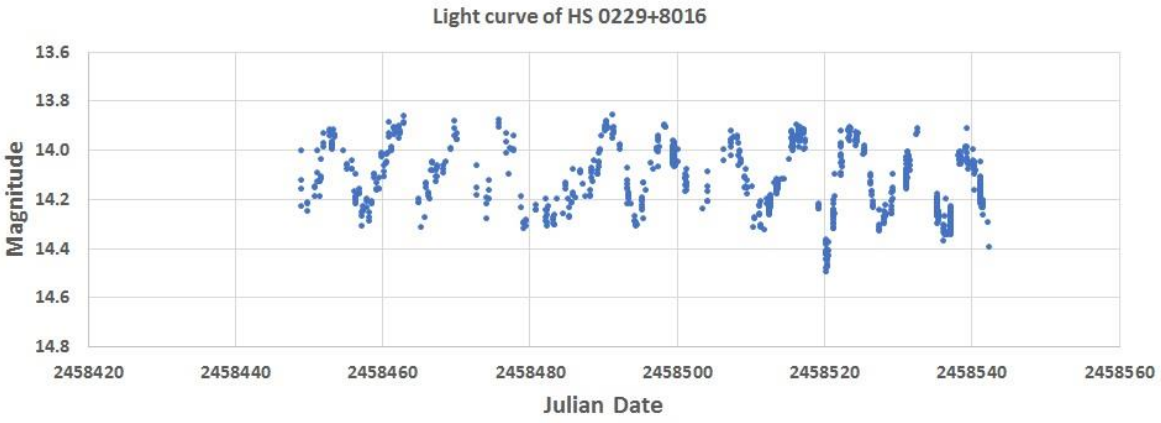
Many thanks to everyone who has contributed data during the campaign: Richard Sabo, Ken Menzies, Gary Poyner, David Boyd, Dave Smith, Ian Miller, David Storey, Sjoerd Dufoer, Martin Mobberley, James Boardman, George Fleming, Mel Joslin, William Kautter, Erik Schwendeman, Tamas Tordai, Mario Morales Aimar, David Swan & Tonny Vanmunster.

A paper on HS 0229+8016 is in preparation for the *Journal*. Although the campaign is officially over, I hope that observers will continue to monitor this object whenever they can as the light curve, we have established during the campaign is intriguing. Nightly observations, either visual or CCD, as part of your routine observational programme would be most welcome. Please upload your data to the VSS or AAVSO database.

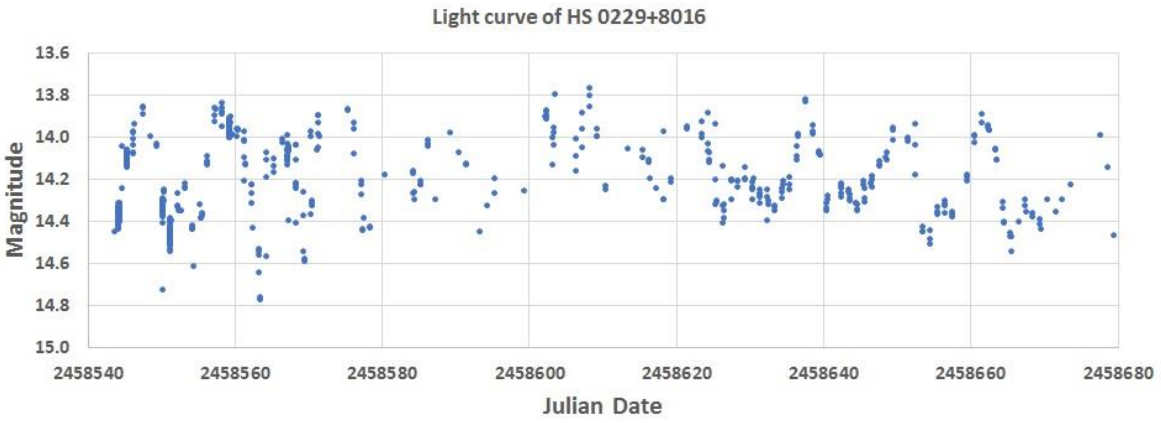
HS 0229+8016 is a far northerly object in Cepheus at RA 02 35 58.23, Dec +80 29 44.2 (J2000.0), conveniently circumpolar for many.

If you have any questions, please contact me. bunburyobservatory@hotmail.com

[1]. Aungwerojwit A., Gänsicke B.T., Rodríguez-Gil P. et al., A&A, 443, 995-1005 (2005)



Obs from 2018 Nov 26 to 2019 Feb 28



Obs from 2019 Mar 1 to 2019 Jul 15

Uranus = Vermin

John Toone

I have written previously about Variable Stars & Vermin (VSS Circulars 114 & 155) where I have stumbled upon asteroids passing through variable star fields; now I can add the planet Uranus to the list.

In the 1980's I regularly undertook visual photometry of Uranus & Neptune in order to see what extent they varied, both at and away from opposition and also throughout their lengthy orbits. To aid this work I included comparison stars on the finder charts drawn for the BAA Handbook and the data was submitted to the Asteroids & Remote Planets Section. Not much variation was seen so the work was discontinued in 1992 and since then I have not paid much attention to either Uranus & Neptune.

In July/August 2019 I took a two-week holiday in Corfu where there was only one night of cloud and I found a suitable observing point on a south facing beach. Jupiter in Ophuichus illuminated the Ionian Sea and the Milky Way was prominent especially in Sagittarius and Scutum. Since I was restricted to binocular work I concentrated nightly on AB Aur, R CrB, CH Cyg, AG Peg & RY Sgr (plus the empty fields of T CrB & RS Oph) and covered my regular binocular variables just twice apart from R Sct (commencing a deep fade) & Z UMa (rising from a faint minimum) that required more frequent monitoring.

I also looked at some variables only occasionally observed and at 0105GMT on the morning of the 6th August I turned my 12x50 binoculars towards V Ari. Initially I was confused because I could not recognise the field, then it all made sense when I eliminated a 6th mag star positioned just 1-degree NF of V Ari. I watched the "suspect star" carefully for 10 minutes to confirm that it was stationary. I was aware that the position was close to the Ecliptic so I thought it's most likely to be an asteroid, but I reckoned only Vesta could get this bright. It was fainter than iota & xi Ari and brighter than 19 Ari but I didn't have their magnitudes to hand so I could not reduce my light estimates. Then I decided to use the nearest VSS sequence to hand which was that of Mira and my estimate reduced to mag 5.7. I knew that was the normal brightness of Uranus but since I didn't have my BAA Handbook available, I could not obtain verification. I decided to google "Uranus 2019 position" on my phone but all the webpages that came up where of an astrological nature and completely useless. Then I tried "Uranus RA & DEC" and finally got the information required, the "suspect star" was confirmed as Uranus.

Because of the distraction of Uranus, that I now consider to be vermin, I never made the intended observation of V Ari.

Eclipsing Binary News

Des Loughney

EB Predictions and the revised EB Programme

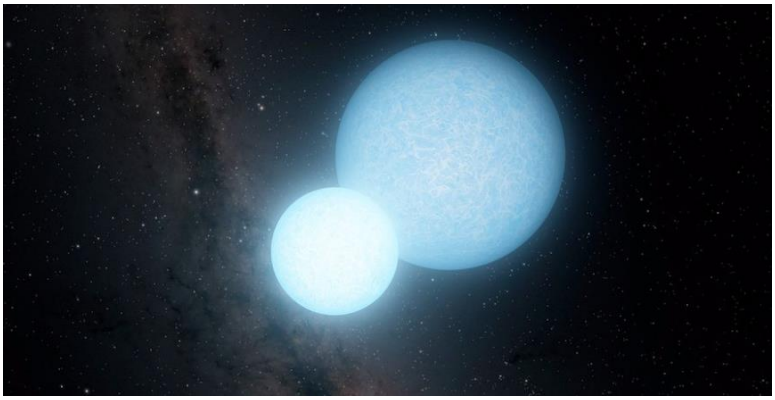
There has been a revision of predictions. The predictions are available on the BAAVSS website. The predictions have been based on elements that are in many cases decades old. All the predictions have been looked at and up to date elements inserted into the software. The predictions for October will be based on the new, updated elements.

The revision of the EB programme has now been completed. The additional information provided by Chris Lloyd has now been incorporated into the programme. I hope that everyone will find the information useful.

Fastest Eclipsing Binary: a valuable target for gravitational wave studies (1)

Observations made with a new instrument developed for use at the 2.1-meter (84-inch) telescope at the National Science Foundation's Kitt Peak National Observatory have led to the discovery of the fastest eclipsing white dwarf binary yet known. Clocking in with an orbital period of only 6.91 minutes, the rapidly orbiting stars are expected to be one of the strongest sources of gravitational waves detectable with LISA, the future space-based gravitational wave detector.

A Strong Source of Gravitational Waves



Closely orbiting white dwarfs are predicted to spiral together closer and faster, as the system loses energy by emitting gravitational waves. The systems orbit is so tight that its orbital period is predicted to become measurably shorter after only a few years. Burdges' team was able to confirm the prediction from general relativity of a shrinking orbit, by comparing their new results with archival data acquired over the past ten years. Above is an artist's visualisation of the system according to astroengine https://astroengine.com/tag/eclipsing-binaries/

V643 Orionis - a detached, devolved, post mass exchange eclipsing binary (2)

This is an EA/DS system that varies between 10.7 and 11.5 and it has a period of 52.415 days,

Discovery of a New Possible Quadruple Star Consisting of Two Eclipsing Binaries with Periods Close to a 3:2 Ratio (3)

CzeV16403 is a new candidate for a quadruple star system, consisting of two close eclipsing detached binary stars (EA + EA), further referred as CzeV1640A and CzeV1640B. CzeV1640 was

discovered in the course of long-term photometric study of a field in the Auriga constellation. The study was performed at a private observatory near Zlín, Czechia, using 0.3 m custom-build telescope optimized for wide field of view and Moravian Instruments G4-16000 CCD camera.

Kepler Eclipsing Binaries

A paper (4) has analysed Kepler data on eclipsing binaries. Kepler has measured near continuous light curves for hundreds of thousands of stars over a period of four years. About 2600 of these stars have been discovered to be eclipsing binaries. The paper, which deals with 4 of these EBs describes the combination of photometry and spectroscopy that is used to analyse EBs.

The diagram below, taken from the paper, shows what the Kepler data (which is available to the public) can reveal in relation to one of the systems which is KIC 9821078.

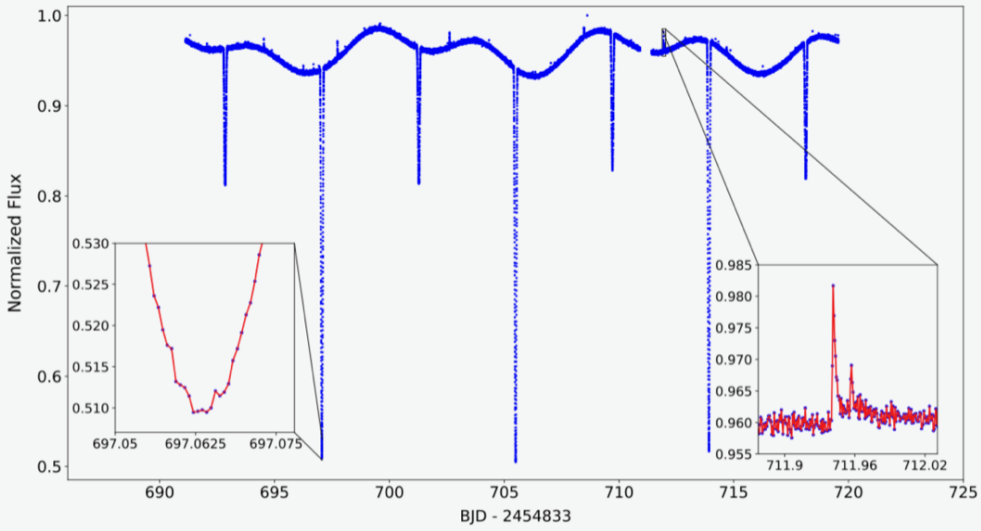


Figure 1. Example of the *Kepler* short-cadence data showing eclipses of KIC 9821078 from quarter 7. The panel on the lower left corner contains a closer look at the primary eclipse. The other panel on the lower right corner contains a closer look at an abrupt increases in flux, likely caused by flares on the photosphere of either the primary or secondary component. The out-of-eclipse flux modulation is also shown, which we attribute to rotating star spots on the photosphere of either component star. The modulation period is consistent with star spots and spin-orbit synchronous rotation of either the primary or secondary component star, or both. The 1-min exposure times of *Kepler* short-cadence data provide ample coverage across each individual eclipse event.

The light curve shows sharply the depth of the primary and secondary eclipses. It also shows the spikes on the light curve which apparently represent out of eclipse flares. The out of eclipse flux modulations, which can be seen, are attributed to rotating star spots on the photosphere of either component star.

(1) Burdge et al. General relativistic orbital decay in a seven-minute-orbital-period eclipsing binary system. *Nature*, 2019 DOI: 10.1038/s41586-019-1403-0

(2) Anderson, Torres and Clausen, A&A, Volume 264, 2019, A88,

(3) Pevel Cagas, Research Notes of the AAS, Volume 3, Number 6 , 2019

(4) Eunkyu Han, Philip S Muirhead, Jonathan Swift. 'Magnetic Inflation and Stellar Mass IV, Four Low Mass Kepler Eclipsing Binaries Consistent With Non Magnetic Stellar Evolutionary Models' arXiv:1907.07190 [astro-phSR]submiited 15/7/19

A period study of the early-type contact binary V1061 Tau

Christopher Lloyd and Des Loughney

The bright but neglected early-type eclipsing binary V1061 Tau is found to have had an abrupt period increase probably as a result of intermittent contact and mass transfer between the two components.

V1061 Tau (04 58 52.754 +24 29 44.56, *V* = 7.9 – 8.3) is a bright, low-amplitude and neglected variable that was selected as one of the targets for a DSLR eclipsing binary observing programme by the BAA VSS (Loughney, 2015) after a survey of candidates on the Krakow website (see also Lloyd, 2018). It is a short-period, 1.^{d}38 days, β Lyrae system with eclipses of 0.^{m}35 and 0.^{m}3. V1061 Tau was discovered relatively recently by Kaiser (1990) and a preliminary light curve was published by Williams et al. (1990). The single light curve analysis performed to date is by Terrell et al. (1995) but that is only in the *V* band, so a full multi-colour solution is still waiting to be done. However, there were two important conclusions from this analysis. The first is that the primary eclipse is probably total, and the second is that there is a significant contribution to the combined light by a third body. There are a small number of isolated radial velocities but no orbital solution.

New observations were made from Edinburgh with a standard Canon 550D DSLR with a Canon 200mm lens at f/3.2 on a fixed tripod and operated via a remote switch. The exposures were 4 seconds at ISO 800 and the frames were dark subtracted and flat fielded. Twenty individual frames were tracked and stacked with AIP4WIN, which was also used for aperture photometry on the summed image. Each final measurement is the average of three summed images. The instrumental green-channel magnitudes were converted to Johnson *V* using the standard coefficient of B–V of 0.08 for this system. The procedure is described in detail by Loughney (2010). The magnitude of the variable was measured relative to a sequence of comparison stars HIP 23384 (V = 8.06, B-V = 0.69), HIP 23259 (V = 8.04, B–V = 0.68) and HIP 23333 (V = 7.78, B–V = 0.17).

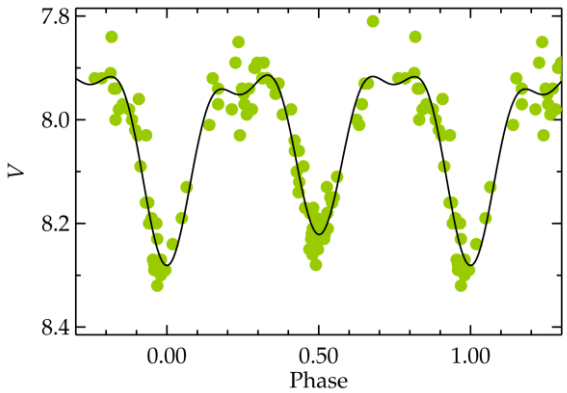


Figure 1. The light curve of the DSLR data folded using the ephemeris given in Equation 2.

A total of 102 measurements were made between 2015 November and 2016 March and these are shown in Figure 1 as a phase diagram using the ephemeris given as Equation 2 determined later. The light curve is shown with a four-term Fourier fit which is intended to show the general fit to the eclipses; the details around the maxima are not real. The standard deviation of the residuals to the fit is 0.^{m}040 and that is typical of the uncertainties with this equipment. The light curve is relatively well sampled and shows the two slightly dissimilar eclipses. Although the data are not suitable for a

photometric solution, they can be used to provide new times of minima and composite times have been determined for both minima from the Fourier fit.

Other times of minima are available from the standard repositories but since 1993 only three timings of V1061 Tau have been made and one of those is suspect. However, the star has been covered by several automated programmes including *Hipparcos/Tycho*, the All-Sky Automated Survey (ASAS3) and SuperWASP. The *Hipparcos* data were taken between 1990 and 1992 and although some parts are well covered unfortunately the eclipses are not, particularly the secondary, so these data are of limited use.

The ASAS3 data were taken from 2002 to 2009 and provide a well-covered and consistent light curve. Composite timings were determined for primary and secondary eclipse for three sections of the data, 2002-2004, 2005-2007 and 2008-2009 by using a Fourier fit to the data.

By far the most extensive set of data comes from SuperWASP but unfortunately systematic problems mean that it's difficult to construct a reliable composite light curve. There are some long time series but again few of these are of sufficient quality or cover the necessary phases to give accurate timings. Ultimately SuperWASP provided four independent timings of three eclipses. One primary eclipse was very high quality and supports Terrell et al.'s contention that the primary eclipse is total.

The new times of minima were added to those already published to produce an up-to-date O-C diagram which is shown in Figure 2. Photographic timings reach back over 100 years but there is a long interval, from ~ 1930 – 1980, when it was hardly observed, so it is difficult to be sure of the period behaviour during this time. It is clear that the period has changed but not obvious when this happened.

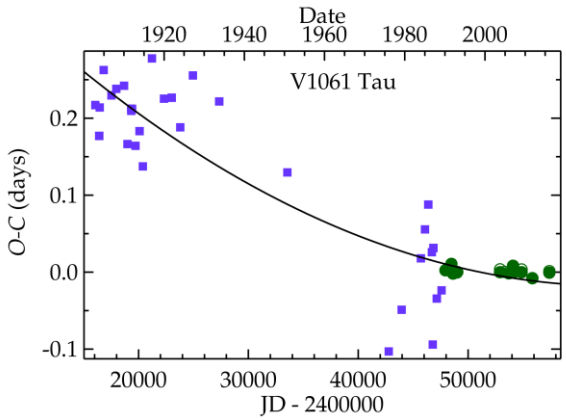


Figure 2. Historical O-C diagram showing the photographic data (blue) and the modern data (green). The line is the best fit continuous period change which on this plot does not look too unrealistic.

The line shows the best fit continuous period change, but it is clear from the plot of the modern data in Figure 3 that they do not fit. The period has been constant since at least 1990 and the last photographic observations are also consistent with the same period. It seems most likely that there was an abrupt period change during the gap in the photographic data between two constant periods. The linear ephemeris of the photographic data alone is

$$HJD_{MinI} = 2416061.829(14) + 1.3852187(11) \times E \quad \ldots(1)$$

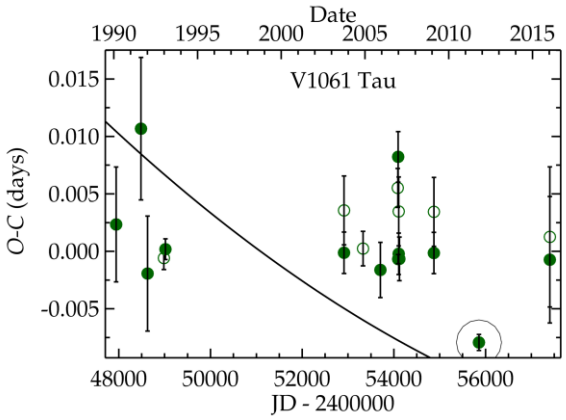


Figure 3. O-C diagram of the modern data alone showing the same fit as in Figure 2. The circled point has been rejected from the solution. Both plots were constructed using Equation 2.

but this must include some data after the period change so the true period during this interval will be shorter. Similarly, the linear ephemeris of the modern data is

$$HJD_{MinI} = 2447942.6527(8) + 1.38522984(20) \times E \quad \ldots(2)$$

From Terrell et al.'s light curve analysis it seems almost certain that there is a third body in the system, but these usually introduce a continuous period change of some sort. So, in this case the period change is most likely due to intermittent mass exchange between the two components. Terrell et al. found their solutions were driven towards the overcontact configuration, but the period behaviour suggests that the mass losing component is only occasionally in contact with its Roche lobe.

V1061 Tau is an interesting system; it is a short-period early-type β Lyrae variable and although it cannot have a truly common envelope it is clearly an active system. It is possibly 60 years since the last period change so it might not be too long a wait for the next one. It is in desperate need of a multi-colour photometric solution.

References:

Kaiser, D. H., 1990, IBVS, 3480 ADS
Lloyd, C., 2018, VSS Circ., 176, 39 PDF
Loughney, D., 2010, J.BAA, 120, 157 ADS
Loughney, D., 2015, BAA Eclipsing Binary Observing Guide PDF
Terrell, D., Williams, D. B., & Kaiser, D. H., 1995, PASP, 107, 653 ADS
Williams, D. B., Wood, J. E., & Kaiser, D. H., 1990, IBVS, 3481 ADS

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 this Circular. 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 this circular.

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 November 15th, 2019

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**.