British Astronomical Association

VARIABLE STAR SECTION CIRCULAR

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Contents

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Office: Burlington House, Piccadilly, London, W1J 0DU

BAAVSS SECTION MEETING,

Sparsholt College Westerly Lane, Sparsholt, Hampshire, S021 2NF.

Saturday April 8th 2017

14:15 Welcome and Introduction - Roger Pickard, Director

14.20 Dr Poshak Gandi, Physics and Astronomy Department, University of Southampton, Black holes that go bump in the night.

15:20 Dr David Boyd, Measuring the components of the binary Mira X Ophiuchi

15:55 Tea

16:15 Gary Poyner, Star hopping around eta Cyg

16:45 Andy Wilson, How to Submit Variable Star Observations to the BAA VSS

17:00 Roger Pickard, Hunting Outbursting Young Stars

17:20 Stan Waterman, A Search for Variable Stars in Cygnus and Auriga

17:30 End

The cost will be £10 and will include refreshments. However, this will not entitle you to stay for dinner nor the evening lecture which is one of the highlights of the weekend.

A little more informations about Dr Poshak Gandi: He was born in India, educated in India and the UK and worked in Chile and Japan, before settling in Southampton in 2014. He investigates the growth of black holes, large and small and likes nothing better than a good hot cup of chai and a lively discussion.

An abstract of his talk is: Accreting black holes are amongst the most luminous and rapidly variable compact objects in the Galaxy. A new generation of fast mutiwavelength detectors is giving us fresh insight into how these objects grow through cycles of accretion and ejection of matter. I will show some of the latest observations of these enigmatic objects from X-rays to the radio band, reviewing what we have learnt and what more remains to be done, and emphasise the important role that dedicated amateur astronomers can play.

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FROM THE DIRECTOR

ROGER PICKARD

Variable Star Section Circulars to be in PDF format only - Reminder

In the last Circular (No 170, December 2016), it was announced that from the middle of 2017 VSS Circulars will only be available in PDF format, but they will be free to everybody, whether they are BAA Members or not.

We realise that there are still some members who do not have access to a computer or whose Internet connection is so poor as to preclude them receiving the Circulars this way and therefore, for a very limited number of people, we will endeavour to make a paper copy available, but they need to advise me if they wish to take advantage of this.

Now, for a number of people and organisations we still do not have an email address, so therefore, if you are one of them and still wish to receive the Circulars, could you please send me your electronic contact details.

Roger Pickard, Director BAA VSS
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VSS Circulars

I am delighted to advise that thanks to the efforts of Sheridan Williams VSS Circulars nos. 21- 52 have now been scanned and added to the web site. Indeed, before you readthis I suspect that the outstanding Circulars to be converted to pdf format, nos. 53 - 87 will also have been scanned and added to the web site. Thank you Sheridan.

MUNIWIN

This is free software for users of CCDs and DSLRs wishing to undertake photometry. It is available from *http://c-munipack.sourceforge.net/* I have not yet used it myself as I have a fully working copy of AIP4WIN and apparently this will be available again later this year. However, we have had several new members to the Section recently (as well as some existing ones) who wish to try photometry and who have struggled with other software. However, I have had several reports saying how easy Muniwin is to use. Therefore, if you are thinking of using your CCD or DSLR camera on varaible stars, this could be the way to go.

It is not as exhaustive as AIP4WIN but it is easy to generate a txt output file for up-loading to the VSS database.

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ECLIPSING DWARF NOVAE PROGRAMME: Update February 2017
Roger Pickard

As I wrote back in 2011(!) this programme has not been updated for some time, but I feel that it is now time to draw it to a close.

Continued page 4.

Eclipsing Dwarf Novae Programme: Update February 2017

As I wrote back in 2011(!) this programme has not been updated for some time, but I feel that it is now time to draw it to a close.

The revised programme was:

Object Name	Coordinates (J2000.0)		Type	Min	Max	T1	P_orb(h)	T2	P_shu(h)
KU Cas	01 31 02.4	+57 54 12	UGSS	18.0p	13.3p	60	?		
V1060 Cyg	21 07 42.2	+37 14 09	UGSS	18.1V	13.3V	?	?		
LL Lyr	18 35 12.8	+38 20 04	UG	18.5V	12.9V	~190	5.978		
V426 Oph	18 07 51.7	+05 51 48	IP?	13.4V	11.2V	17-55	6.847		
FY Vul	19 41 40	+21 45 59	NL	15.9V	13.4V	?	?		
PY Per	02 50 00.1	+37 39 23	UGZ / VY	19.8V	13.8V	----	3.715		

Key: Data taken from VSX, The Z Cam List, AAVSO data and BAA VSS data.

p photographic magnitude

T1 Normal outburst interval (days)

T2 Superoutburst interval (days)

UG Dwarf Nova, U Gem type

UGSS Dwarf Nova, SS Cyg type

UGZ Dwarf Nova, Z Cam type

UGSU Dwarf Nova, SU UMa type

NL Dwarf Nova, Nova-like

IP Intermediate Polar

So, there has been no evidence that any of these remaining stars show eclipses and therefore the programme is now closed. However, two stars in particular deserve further attention.

On the first of those stars, V426 Oph, I carried out a number of observing runs over 2013-15 which have been analysed by Chris Lloyd. He suspects it may be an IP, but we need more observations from around the world. We tried for this last year, but sadly the weather let us down so we will be trying again this year.

The second star, PY Per, is a SUSPECTED Z CAM star, requiring further observation to determine its type. There is quite a list of SUSPECTED Z CAMS requiring further observation to determine their type - see:*https://sites.google.com/site/thezcamlist/the-list*
It would be good if observers could add some of these to their observing programmes.

Of course, you are still welcome to make observations of all or any of these stars.

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KRAKOW AND THE PERIOD OF BETA PERSEI

CHRISTOPHER LLOYD

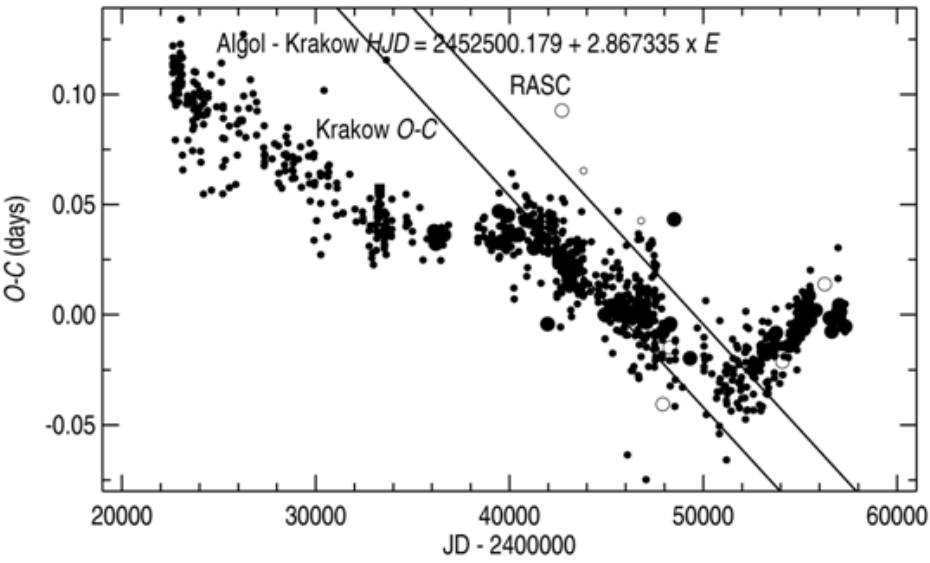
In the Eclipsing Binary News in the previous issue of the Circulars, Loughney[1] related a query by Jean Meeus about the ephemeris of beta Persei used in the "BAA Handbook 2017", which gives eclipse timings about 2 hours later than those found in the RAS of Canada "Observers Handbook 2016". A difference of 2 hours is potentially disastrous for observers, as the FWHM of the eclipse is only about 4.2 hours. So, how has this arisen and what ephemeris should people use?

The BAA Handbook uses the ephemeris provided by the Krakow web site, which is an important resource and has a long history of association with the GCVS. These days, the Krakow site is largely built on data provided and maintained by Kreiner[2] and collaborators.
On the eclipse predictions page for beta Per:

(http://www.as.up.krakow.pl/minicalc/PERBETA.HTM)

the most obvious feature in fact is an *O-C* diagram showing all the data available, and in this case that goes back to before 1800. The ephemeris used to plot that diagram is the mean for all the data, during which time the period has changed several times, so this is not the one to use for predictions, and that is obvious as the *O-C* at the present time is over 0.1 days.

Figure 1: *O-C* diagram of the times of minimum for beta Per for the past century constructed using Equation (1). The *O-C* = zero line is shown both for the mean Krakow ephemeris for data for over 200 years, and for the RASC predictions ephemeris. The latest data follow the Krakow predictions well, but the historical data do not.



Further down the page is another ephemeris, $HJD = 2452500.179 + 2.867335 \times E$, which is used to generate predicted times of eclipse for the near future. The problem is that there is no associated *O-C* diagram so it is impossible to see what it is based on. Rather confusingly, there is another *O-C* diagram on the beta Per data page:

(http://www.as.up.krakow.pl/o-c/data/getdata.php3?BETA%20per)

which is plotted using the same ephemeris as the previous plot, but for some reason the modern cut off is much earlier than on the other plot. There is also a third period mentioned in the Perseus constellation table which is probably an updated period, but its origin is not clear.

The only way to resolve the issue is to plot the *O-C* diagram with the different ephemerides and see what they show.

Figure 1 is a plot of the times of minimum using the ephemeris from Krakow used for their predictions, namely,

$$HJD = 2452500.179 + 2.867335 \times E \quad \text{..... (1)}$$

not the one used for their *O-C* diagrams. At first glance this is an appalling fit to the data, and it is, but the important point is that it does fit the most recent data from about *JD* = 2455000, when there seems to have been a significant period change. It is a case of the tail wagging the dog.

The two lines represent the X-axis (*O-C* = zero) of the *O-C* diagrams constructed using the Krakow *O-C* ephemeris and the RASC ephemeris,

$$HJD = 2440953.4657 + 2.8673075 \times E \quad \text{..... (Krakow } O\text{-}C\text{)}$$
$$HJD = 2457388.91 + 2.8673075 \times E \quad \text{..... (RASC)}$$

The lines are parallel because they both use the same period, but the RASC ephemeris uses an updated T_0 determined in some unknown way. It can be seen from the plot that the *O-C* residual from the RASC ephemeris for the current epoch is about 0.08 days, which accounts for the approximately 2 hour difference between predictions from the respective handbooks.

So, the moral of this tale is do not believe an ephemeris unless you have seen the *O-C* diagram that goes with it. Also, the Krakow and hence the BAA predictions look sound. However, given the past behaviour of beta Per, it is quite possible that the period will shorten dramatically so it is well worth observing.

References

1: Loughney, D., 2016, VSS Circulars 170, 11-13
http://www.britastro.org/vss/vssc170c.pdf

2: Kreiner, J.M., 2004, Acta Astronomica, **54**, 207-210
http://adsabs.harvard.edu/abs/2004AcA....54..207K

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THE CURRENT EPHEMERIS OF RW TAURI

CHRISTOPHER LLOYD

Introduction

RW Tauri is a bright Algol-type eclipsing binary containing a B8Ve primary and a K0 subgiant secondary. It has a deep total primary eclipse from V = 8.0 to 11.6, and a weak secondary eclipse of 0.07 magnitudes. The period is just short of 2.77 days. In the previous issue of the Circulars[1], the question of whether the period of RW Tauri is increasing or decreasing was raised, as a recent accurate timing of primary eclipse did not help decide the matter. The purpose of this note is to try and answer that question.

History

It turns out that RW Tau has a long history, with times of minimum going back to 1887, and during that time the period has shown many twists and turns. The *O-C* diagram, shown in Figure 1, is dominated by an overall shortening of the period, but positive period changes also occur. The variations are so complex that it is not obvious if the period changes are instantaneous or continuous, or a combination of the two. They are difficult to interpret in terms of apsidal motion, or light-travel-time effects caused by the presence of a third body which produce slow, predictable essentially sine-like variations. Apsidal motion also requires the eclipsing system to be eccentric, which does not appear to be the case here. Simple (conservative) mass transfer from the secondary to the primary would also drive the period to longer values, so a more complicated scheme would be necessary.

Table 1: Recent times of minimum either taken from the Lichtenknecker Database of the BAV or determined directly from the data in the AAVSO archive. The *O-C* is from the ephemeris given in Equation (1) for data after *JD* = 2456000

HJD	error	*O-C*	Observer	Timing
2454873.74010	0.00008	n/a	Bialozynski	This paper
2456188.91370	n/a	0.00097	Sabo	BAV
2456573.77560	n/a	-0.00081	Manske	BAV
2456634.68930	n/a	-0.00078	Samolyk	BAV
2456723.29140	n/a	-0.00039	Schmidt	BAV
2457326.89200	n/a	0.00107	Menzies	BAV
2457390.57410	n/a	0.00070	Samolyk	BAV
2457686.83529	0.00006	-0.00008	Samolyk	This paper
2457761.59237	0.00008	-0.00069	Samolyk	This paper

In the most comprehensive study of the period changes to date Šimon[2] concluded that they are most likely instantaneous, so the *O-C* diagram is made up of straight-line segments. The scale of the period changes are thought to be consistent with the effects of changes in the structure of the outer atmosphere of the secondary, which could produce both positive and negative period changes. These could be random, but it is not clear how this process would work, and it must occur against a background of evolutionary mass transfer and/or loss. More recently Richards et al.[3] have revealed a complex picture of gas streams, accretion discs, impact (emission) regions and magnetic activity, which could all influence the dynamics of this and similar systems.

The current ephemeris

The data archives contain three new light curves capable of giving times of minimum, that are not currently included in the published compilations (BAV: German Workgroup for Variable Stars). Two are very recent and the other is from 2009. The new timings calculated using the Kwee-van Woerden method are given in Table 1, and the recent part of the *O-C* diagram is shown in detail in Figure 2.

There has clearly been a period change around *JD* = 2454000, following a long constant phase with some more complicated variation at the end. There appear to be two more short sections up to *JD* = 2456000, which seems to mark the start of the latest period. So the current linear ephemeris for primary eclipse is

$$HJD = 2456188.9127(6) + 2.768804(2) \times E \ldots (1)$$

and the residuals are limited to about 0.001 days. Given the nature of this star, the ephemeris may already be out of data but it should be sufficient for now. In fact the last two clumps of points suggest that the period may have already shortened again but it is too early to tell. When the residuals reach ± 0.005 days then it will be time to look at the ephemeris again.

RW Tau is clearly an interesting and unpredictable system and deserves to be observed more frequently. It would be particularly useful to have more observations at the beginning and end of the season to help reduce the gaps in the data in what is a very active system. For those interested in observing the star the eclipse below magnitude 9.0 lasts for about 4 hours, but a reliable eclipse timing can be obtained from data below magnitude 10.5 which last for about 2 hours of which the central 85 minutes is total at V = 11.6. Depending on the equipment used this may be a challenge for DSLR observers but it should not pose too much of a problem for CCD observers with even relatively small telescopes.

References

1. Loughney, D., 2016, VSS Circular:
http://www.britastro.org/vss/vssc170c.pdf

2. Šimon, V., 1997, Astron. Astrophys., 319, 886-893:
http:adsabs.harvard.edu/cgibinnphbib_query?db_key=AST&bidcode=1997binnph-bib_query?db_key=AST&bibcode=1997A&A...319..886S

3. Richards, M.T., et al., 2014, Astrophys. J., 795, 160(+18):*http://iopscience.iop.org/article/10.1088/0004-637X/795/2/160/pdf*

4. BAV Lichtenknecker Database:
http://www.bav-astro.eu/index.php/veroeffentlichungen/lichtenknecker-data
lkdb-b-r

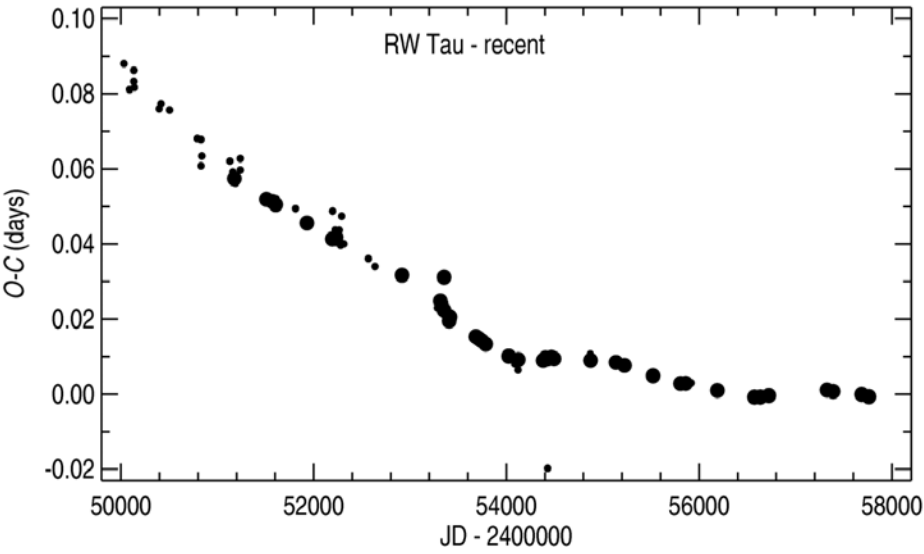

Figure 1: The *O-C* diagram of the recent data plotted using the ephemeris given in Equation (1) for data after *JD* = 2456000

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2016 OFFICER'S MEETING 26th NOV 2016 at GP'S CLUB

ROGER PICKARD

Members Present RP, BD, JT, SA, DL, AW, GP + Tracie Heywood by invitation

1. Minutes of last meetings in 2013 - See item 3 below.

2. Action Points – all covered by Minutes

3. Charts and sequences including drafting

RP to check with Rod Lyon if charts had been completed. Done, but RP still has a query with JT re R UMa.

JT explained his way forward for charts and sequences to maximise their value.

From previous meeting

The sequences are being progressively revised to adopt accurate V photometry with a minimal colour range. Once all charts are updated the focus will shift to updating the sequence files so that all legacy BAAVSS data can eventually be transformed.

JT to update charts more in accordance with the numbers of people observing the stars involved.

End

Also check if AAVSO produce charts with V etc sequences. They do.

SA would like more stars added to Binoc Prog. Gary suggested looking at brighter stars for spectroscopic people to follow.

RP offered to assist DL with sequences for DSLRs.

Then some discussion on how many people actually observed EBs. Conclusion was there were several.

4. Database related including online submission and software (AIP, MUNIWIN etc)

AW suggested an AAVSO upload format for CCD observers. Other formats such as MUNIWIN would then be available. Note: MUNIWIN already produce a suitable BAA format! RP also noted that MUNIWIN was free!

AW then discussed how to present our data if some of it could be transformed by doing a recalculation – either showing the original + new or what? It was suggested a note on webpage will suffice as to what is shown/can be shown.

AW added that phase plots would take another year or two to add, as would other improvements.

DP LEO'S PROPOSED CIRCUMBINARY GIANT PLANET IS NOT LOOKING SO HEALTHY

DAVID BOYD

DP Leo is an 18th mag eclipsing polar with an orbital period of 90 min. It is a binary system in which hydrogen-rich material is being drawn in an accretion stream from a cool low mass star onto the pole(s) of a magnetic white dwarf. As there is no accretion disc, eclipses are of the white dwarf only and are very short (~3 min), steep sided and deep in which the star fades to below 20th mag.

Since its discovery by Biermann et al. in 1985, DP Leo has been extensively observed from the ground and from space with a variety of instruments. It shows large apparently cyclic eclipse time variations with respect to a linear ephemeris. These could in theory arise from the effect of a magnetic cycle in the cool star or apsidal motion of the binary orbit or from the presence of a third body orbiting the binary system.

In recent years, the hypothesis of a giant planet in an elliptical orbit around the binary system has gained traction, see Qian et al. (2010) and Beuermann et al. (2011). It is argued that neither of the other mechanisms could explain the observed behaviour of DP Leo. If it does exists, this planet may have formed around the original binary system and survived the common envelope phase as the initially more massive star evolved into a white dwarf, or it may have formed only recently from material ejected during the common envelope phase. In either case it is a potentially interesting object for studying the formation and evolution of circumbinary planets.

Observations of the eclipses with amateur-sized telescopes are difficult because the star becomes so faint during the eclipse. I observed an average of 7 eclipses in each of 2012, 2013, 2014 and 2016. During 2015 DP Leo became much fainter making eclipse measurements impossible. The times of all magnitude measurements were converted to BJD(TT) for consistency with published times and then converted to orbital phase using the linear ephemeris based on the binary orbital period derived in Beuermann et al. All the eclipses in each season were then combined into a single phased eclipse profile for that season. From that relatively well-defined eclipse profile, the mid-eclipse phase could be found and converted to a mid-eclipse time for an eclipse located in the centre of the observing season using the Beuermann et al. ephemeris. The O-C (Observed-Calculated) value for each of these four mid-season eclipses was then calculated with respect to the Beuermann et al. ephemeris.

As a check on this procedure, the individual, relatively poorly defined, eclipses in each season were analysed to estimate mid-eclipse times where possible and O-C times calculated for these with respect to the Beuermann et al. ephemeris. Although they had a much larger uncertainty, they were consistent with the single eclipse O-C times for each season calculated as described above. The four seasonal O-C times also showed a consistent trend from year to year which strengthened their credibility.

When these four new eclipse O-C times are included in an O-C plot along with all previously published eclipse times and the prediction of the circumbinary giant planet model in Beuermann et al., they show a trend which clearly diverges from the predictions of the giant planet model.

I look forward to adding a further data point for 2017. Observations can only be made under excellent sky conditions with no moon in the sky in order to try to record as much of the very faint eclipse as possible.

References

Biermann P. et al., Astrophysical Journal, 293, 303 (1985)
Qian S.-B. et al., Astrophysical Journal Letters, 708, L66 (2010)
Beuermann K. et al., Astronomy & Astrophysics, 526, A53 (2011)

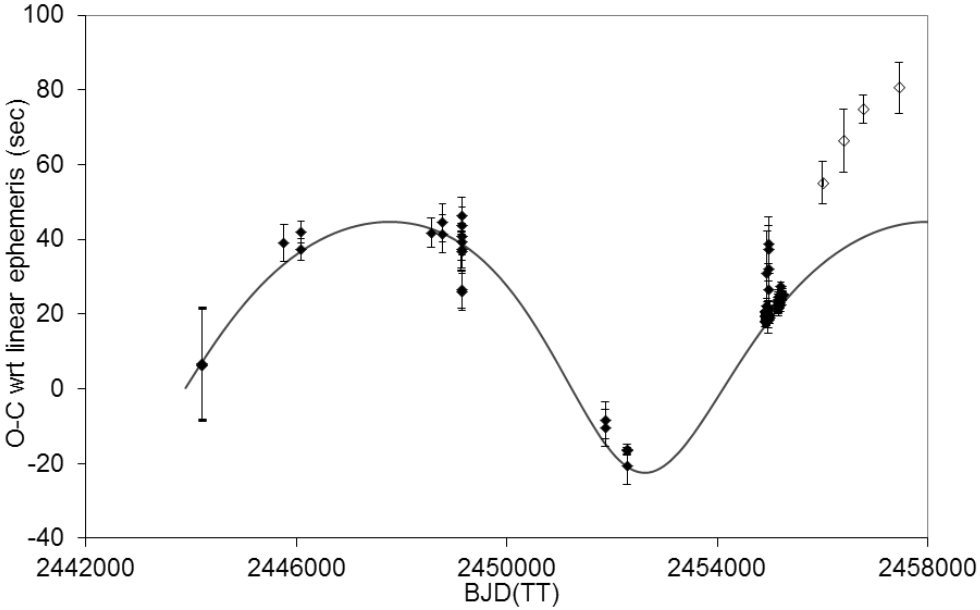

Figure: Plot of eclipse O-C times with respect to the ephemeris in Beuermann et al. Previously published times are shown as solid diamonds and my four recent measurements as open diamonds. The line is the prediction of the circumbinary giant planet model of Beuermann et al.

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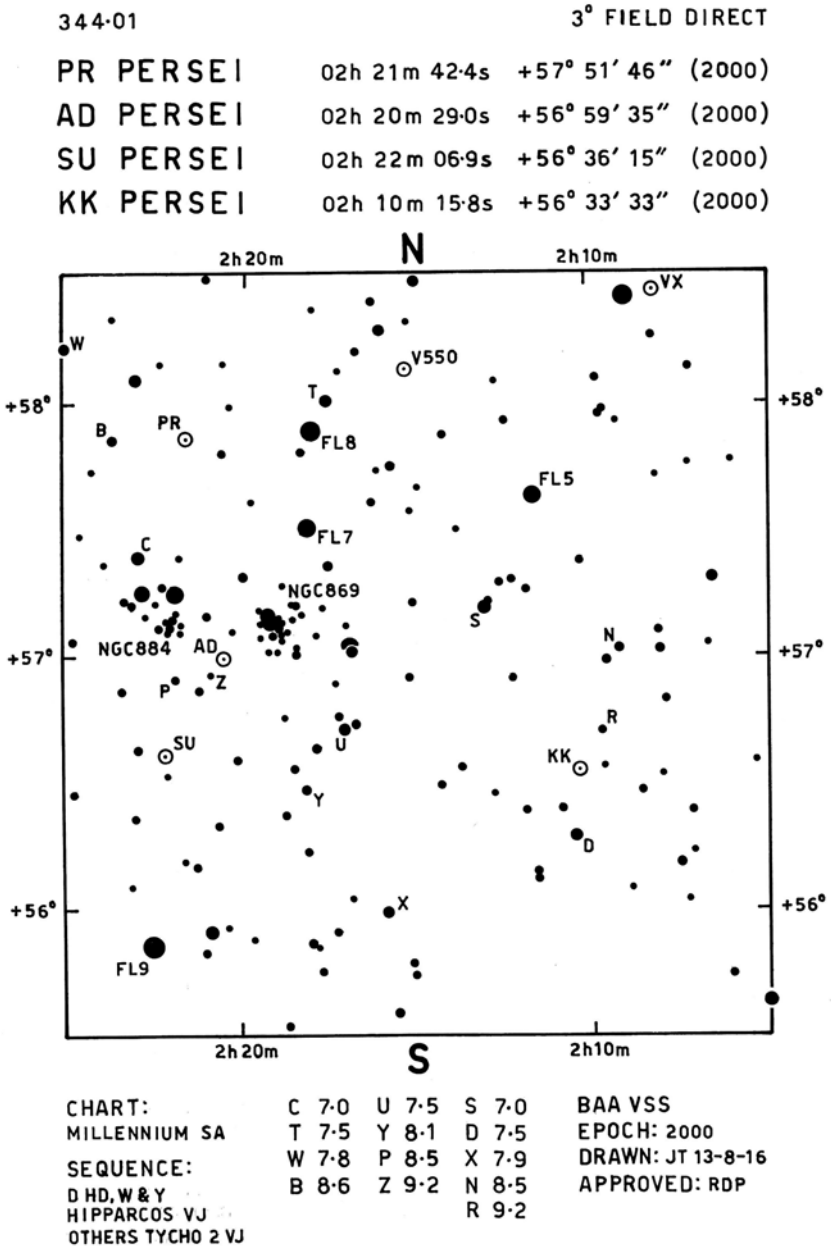
CHART FOR PR, AD, SU, & KK PERSEI

JOHN TOONE



AN ALTERNATIVE WAY TO LIST OBSERVING PROGRAMMES

TRACIE HEYWOOD

Historically, observing programme listings have tended to be based around the underlying science regarding why stars vary in brightness in particular ways. Newcomers to variable star observing are met with terminologies such as "intrinsic", "extrinsic", "pulsating", "eruptive", "cataclysmic", … However, the question that new observers really want answering is "which are good stars for me to observe?" – they want to see stars going up and down in brightness. Any science can come later.

Programme Listings have often also grouped stars according to the type of instrument (naked-eye, binocular, telescope) that observers might possess. This can help, but what is observable with a particular instrument will be influenced by local light pollution, and many variable stars have brightness ranges that cross such arbitrary boundaries.

In the days of the Junior Astronomical Society (JAS), the Variable Star Section focused on "naked eye" variables. Shortly after I started my first session as its Director in 1992, I changed this to add around a dozen "binocular" variables, such as RZ Cas, R Sct and R Tri (at around the same time, the JAS also became the SPA). These stars were more interesting than many of the "naked-eye" variables – and in any case, light pollution issues meant that few stars could by then be easily followed with the naked-eye!

My second stint as Director began in January 2015 and I decided to take a more radical approach to the programme listing. No longer would the programme listing include headings such as "Cepheids", "Eclipsing Binaries", or "Semi-Regulars". Instead, I went for a "lifestyle-based" approach. This would focus on how often an observer would be able to go out and observe, and how long they could observe for on a particular night.
More "binocular" variables were added and "naked-eye" variables that showed little variation (e.g. Gamma Cas, Beta Peg, Rho Per) were dropped.

The surviving stars were split into five categories:

One-Nighters – Stars that can go through most of their brightness variations in the course of a single (reasonably long) night. Examples include Algol, RZ Cassiopeiae and RR Lyrae. These would suit **people who can only observe occasionally, but can stay out well into the night.**

One-Weekers – Stars that vary a bit more slowly, but which go through a cycle of variation over a week or two. Examples include Beta Lyrae and Delta Cephei. These would suit **people who can observe for a short while on (nearly) every clear night.**

Medium-Rangers – Slower variables whose brightness will change significantly over several months or a year. Examples include AF Cygni, RW Bootis, R Scuti and Z Ursae Majoris. These would suit **people who can observe several times per month, but not necessarily on every clear night.**

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*tracieheywood832@gmail.comtracieheywood832@gmail.com**Big-Rangers*** – Stars that whose brightness will change by many magnitudes over the course of a year. These would also suit **people who can observe several times per month, but not necessarily on every clear night**. They would especially appeal to **observers who also possess telescopes**. Examples are the Mira type variables, such as Chi Cygni, R Leonis, R Serpentis and R Ursae Majoris.

Rebels - Stars that are totally unpredictable. These variables would mostly appeal to **people who can observe on every clear night**, but **other observers may also enjoy monitoring them when their circumstances permit**. Currently the programme only lists R Coronae Borealis, but novae would also fall into this category.

You can read more about the SPA VSS programme at:
http://www.popastro.com/variablestar/observingprogramme/index.php

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LONG TERM TRENDS IN BINOCULAR VARIABLE LIGHT CURVES (PART 2)

TRACIE HEYWOOD

Here are some more (see also VSSC No 169, September 2016) long term light curves, accompanied by a few comments which consider (based on a quick visual inspection) whether the variables are sticking to their catalogued ranges and whether there are signs of any long term trends and/or periodicities.
Given that the accompanying light curves cover, in most cases, the interval from 1971 to late 2016, catalogued periods of just a few months in duration will not be visible. The magnitude ranges will also be exaggerated by differences in red sensitivity between observers.

Once again, we have to also remember that over the years there may have been factors not related to the star itself that impact the light curve. Not only will observers have come and gone but in some cases there will also have been changes to the comparison star sequence. The latter factor, if present, can lead to sudden jumps upwards or downwards in the light curve.

The light curves and their relevant comments are given as follows:

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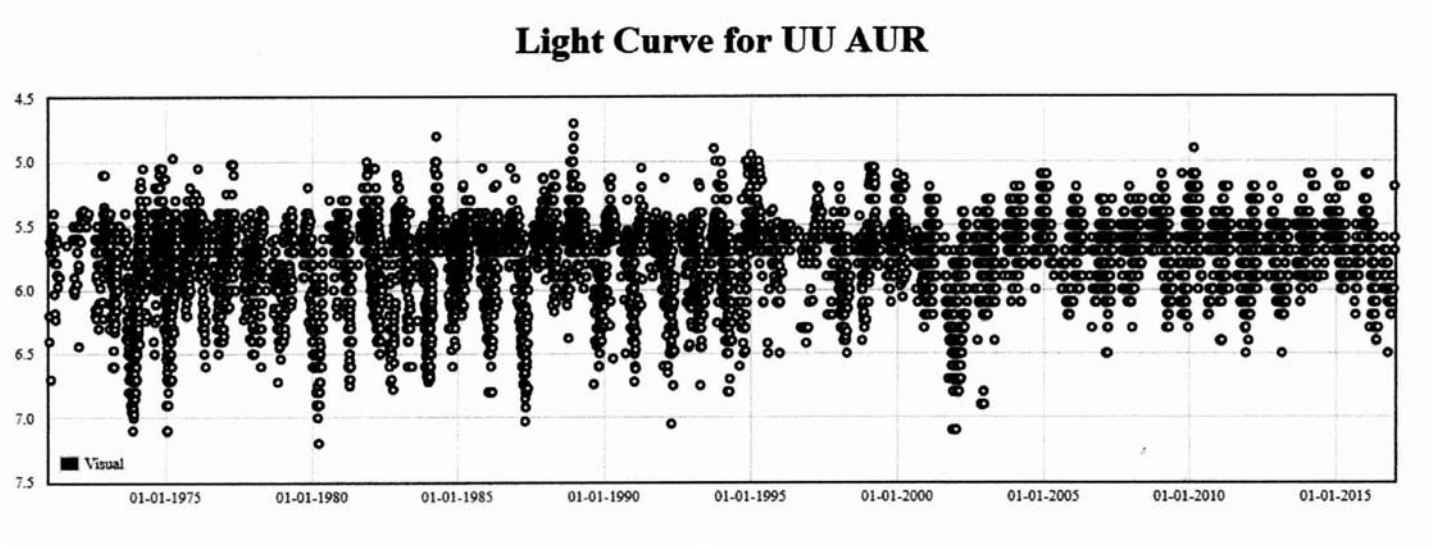
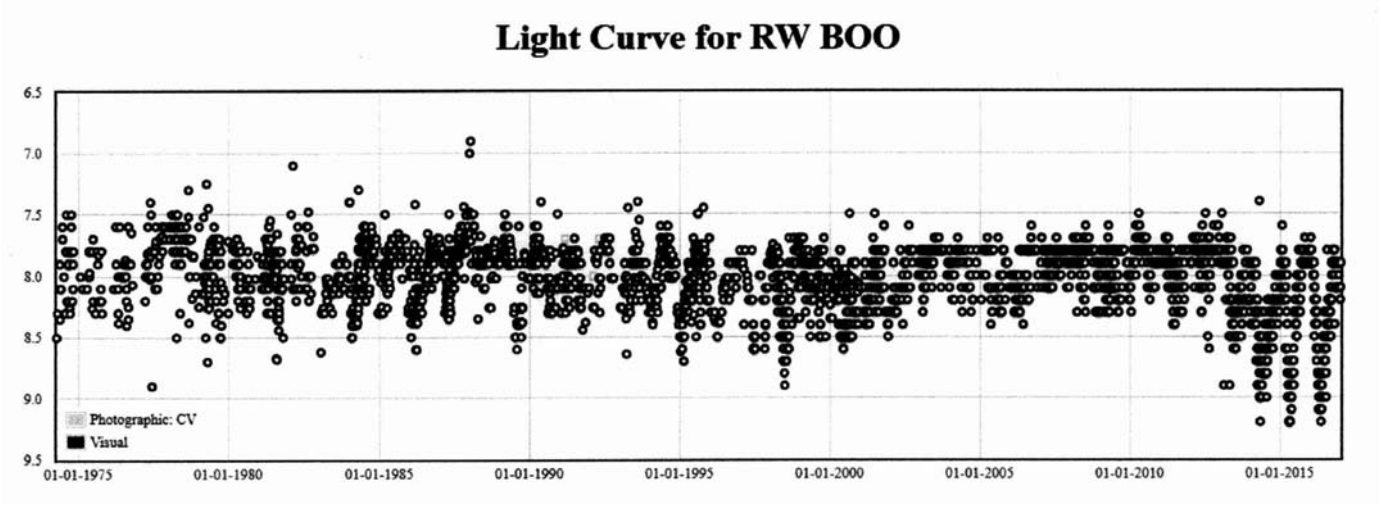
Figure 1: UU Aur (catalogued range 5.1-6.8, type SRb, listed period 234 days)



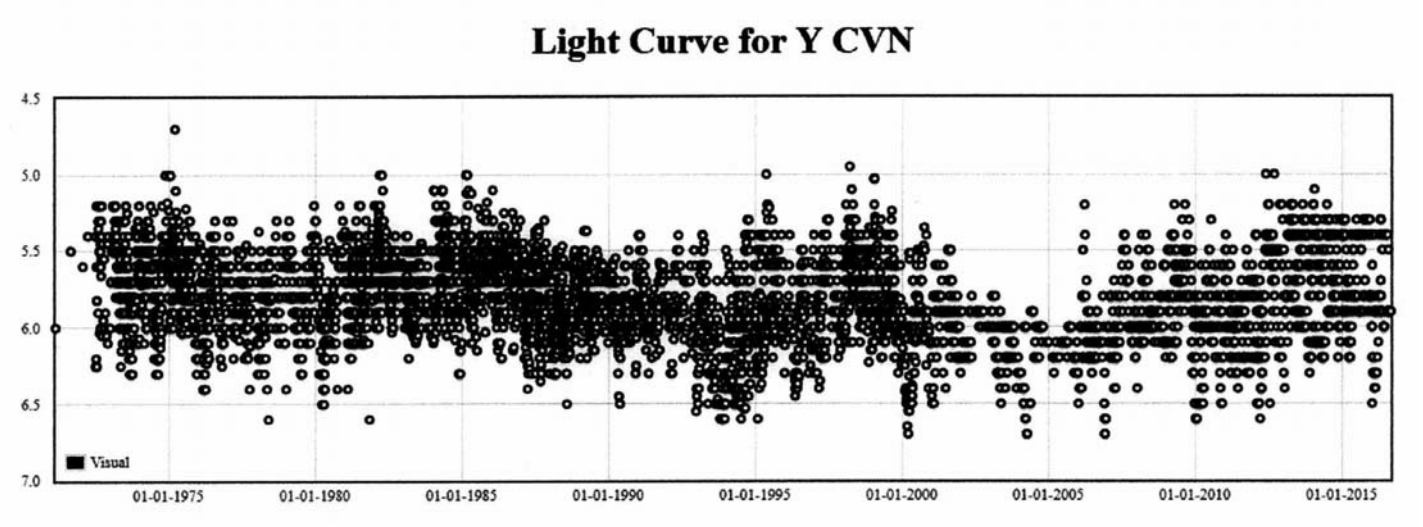
UU Aur seems to be largely sticking to its catalogued range, with only the deepest minima breaking through the lower limit. The gaps between these minima seem to be at intervals of around double the catalogued period.

Figure 2: RW Boo (Catalogued range 7.4-8.9, type SRb, period 209 days)



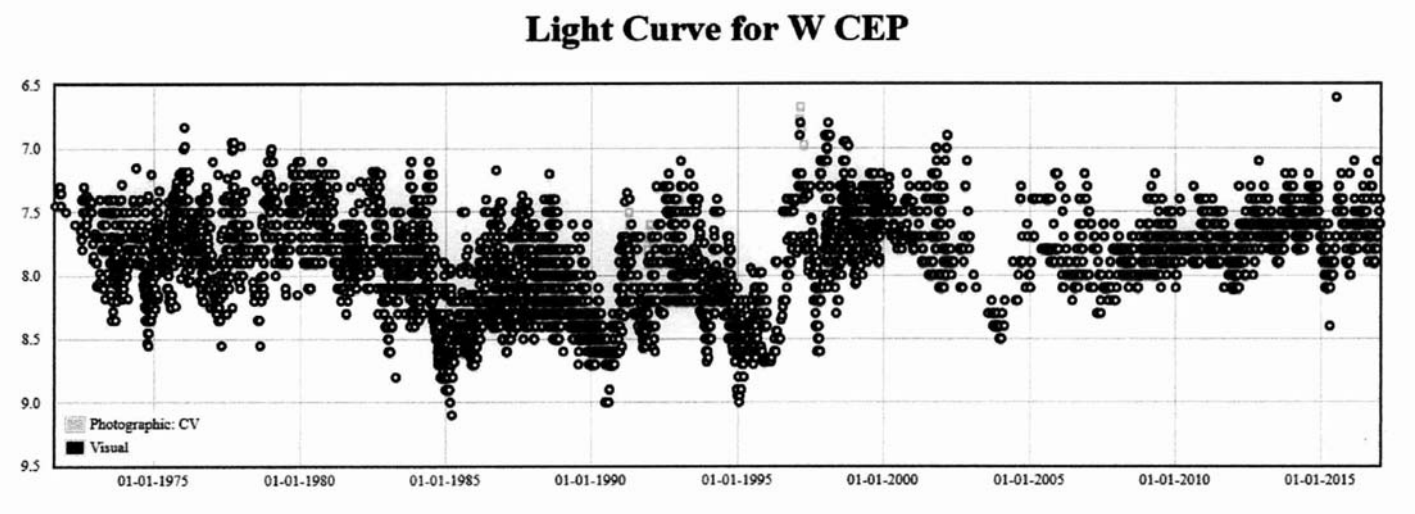
For most of this interval, the brightness variations of RW Boo seem to have comfortably fitted within a 7.5-8.5 range, although there is a suggestion of a small dip in the late 1990s. In recent years, the amplitude has increased, with the minimum magnitude dropping below magnitude 9.0, and the period appearing to be around 10-11 months rather than 209 days.

Figure 3: Y CVn (Catalogued range 5.2-6.6, type SRb, period 157 days)



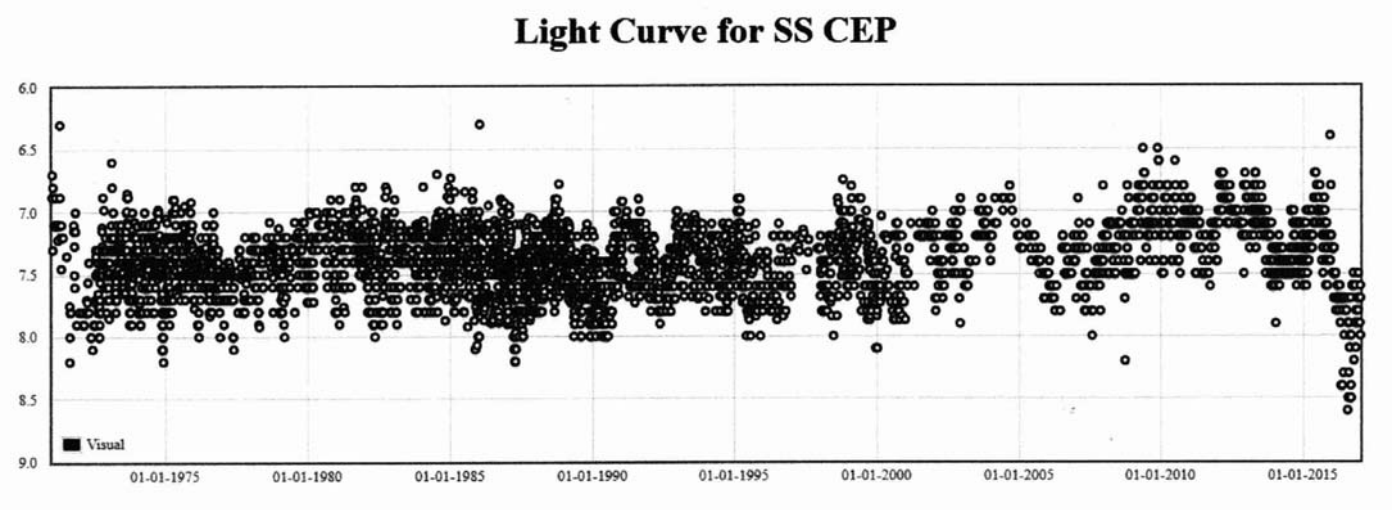
There are clearly some long term rises and falls in the average brightness, possibly with a period in the 10-15 year range. The dip in average magnitude (and also amplitude?) around 2005 is very obvious. The brightness changes seem to have largely stayedwithin the catalogued range.

Figure 3: W Cep (Catalogued range 7.0-9.0, type SRc)



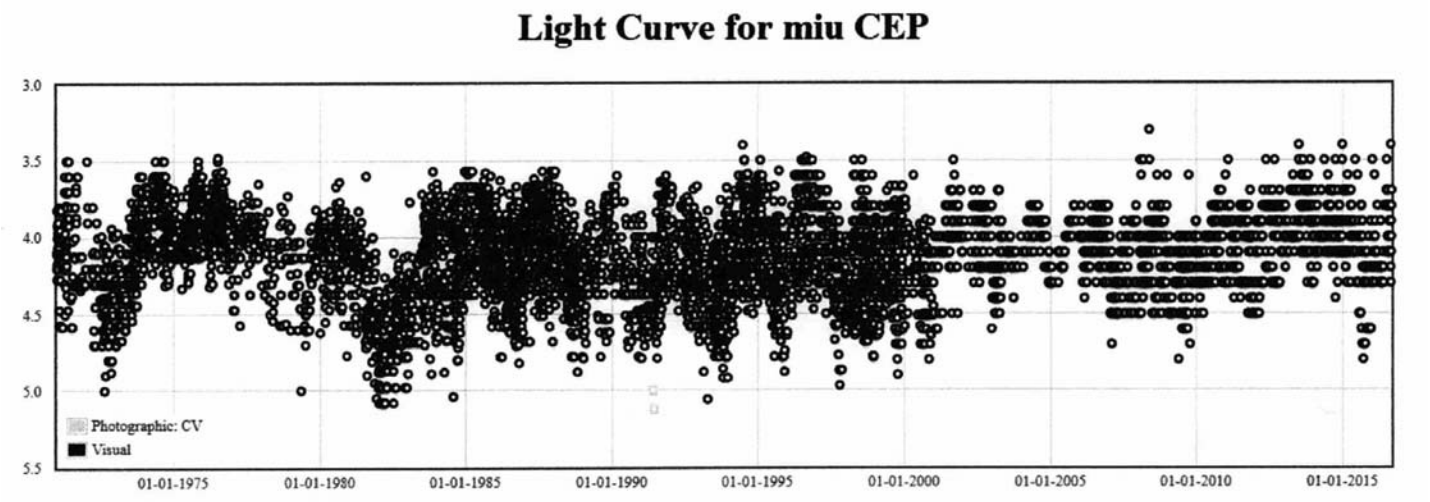
W Cep spends most of the time in the upper half of its listed brightness range, but there have been some dips down to the lower limit, most notably in 1985 and 1995. There are clearly some longer-term trends here but it is not clear whether they are occurring with any periodicity. In 2007 a sequence update introduced mostly minor adjustments, although one comparison star (M) saw its magnitude increased by 0.3 mag.

Figure 5: SS Cep (Catalogued range 6.7-7.8, type SRb, period 90 days)



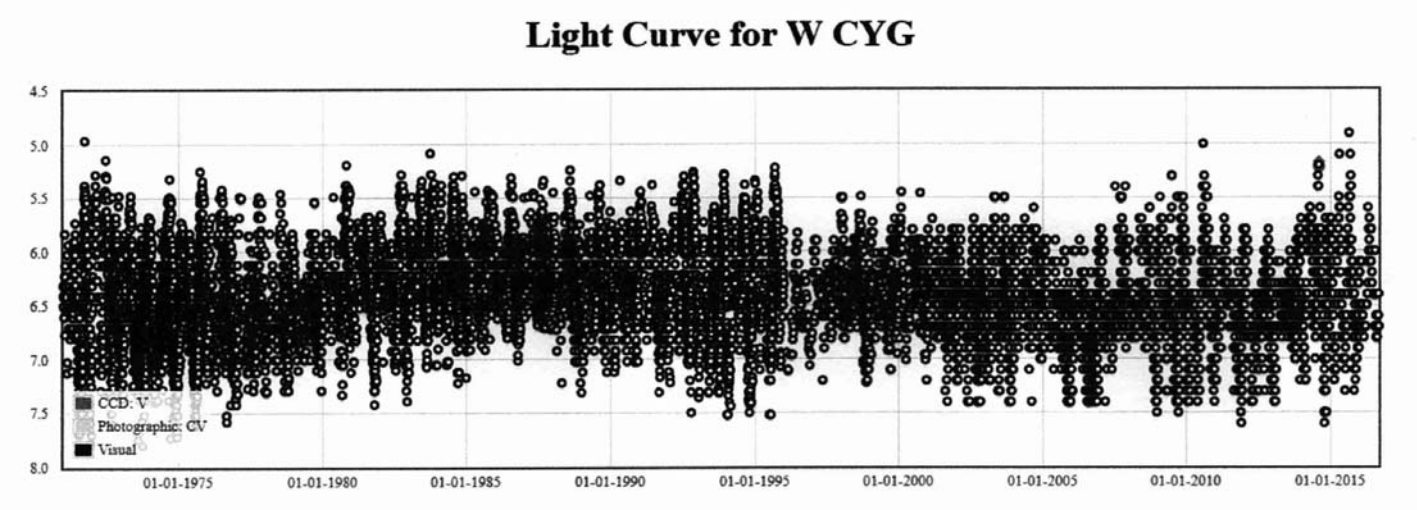
Over the years, SS Cep has varied over most of its listed brightness range. Prior to 1998, most observations were actually within a slightly fainter 7.0-8.0 range, but the more recent observations fit the listed range better, albeit with a notable minimum in 2016.

Figure 6: Mu Cephei (Catalogued range 3.4-5.1, type SRc, listed period 730 days)



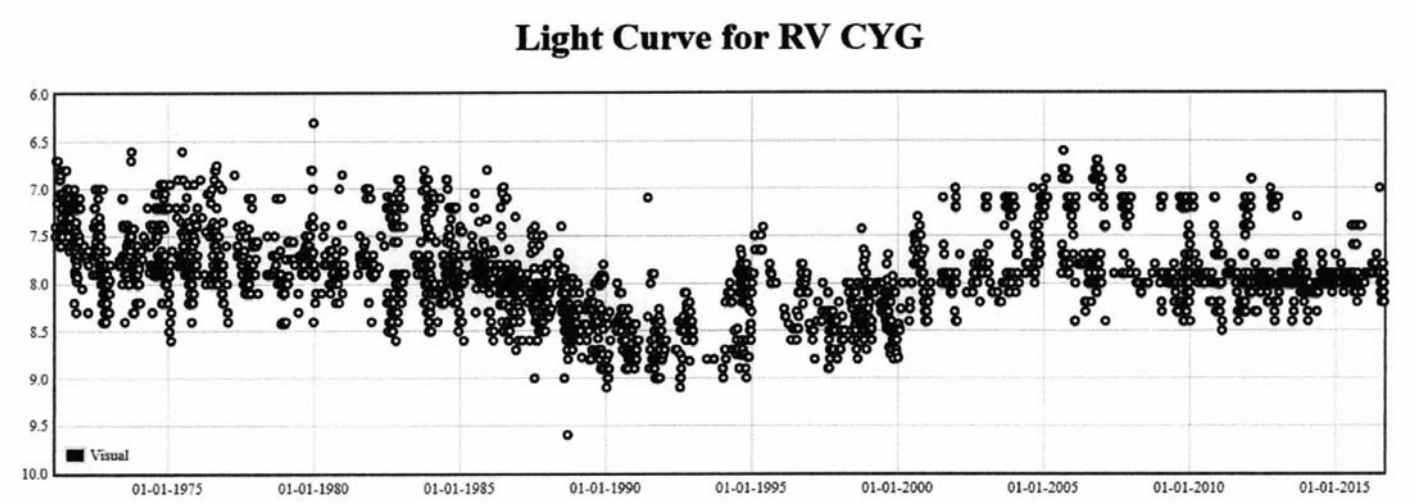
The reported observations cover the whole of the listed brightness range, but it should be noted that this is a very red star, and some observers routinely report Mu Cep to be brighter by as much as half a magnitude compared with other observers. Approaches to the listed lower limit are seen, but are less common. Strong signs of a period close to the listed 730-day value during the 1980s, but less sign of this at other times.

Figure 7: W Cyg (Catalogued range 5.0-7.6, type SRb, period131 days)



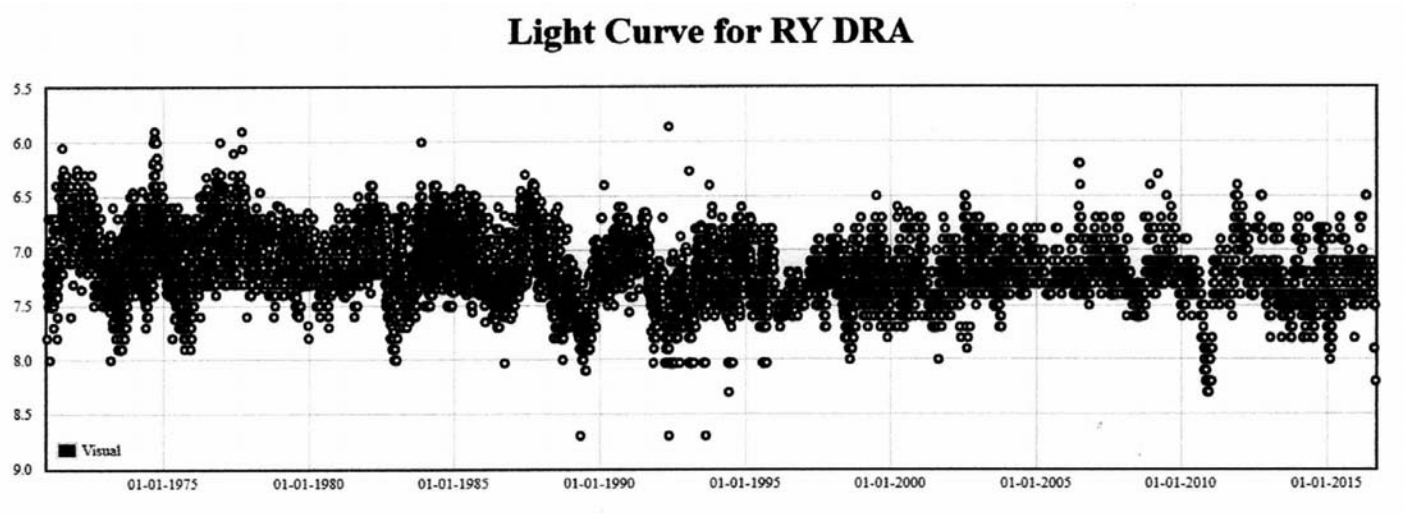
The observed upper brightness limit seems to be about half a magnitude below the listed value, but W Cyg does often approach the listed lower limit. There are signs of some long-term trends but no obvious long term periodicity. The most notable features are some sudden drops in amplitude, such as that seen in 1998.

Figure 8: RV Cyg (Catalogued range 7.1-9.3, type SRb, period 263 days)



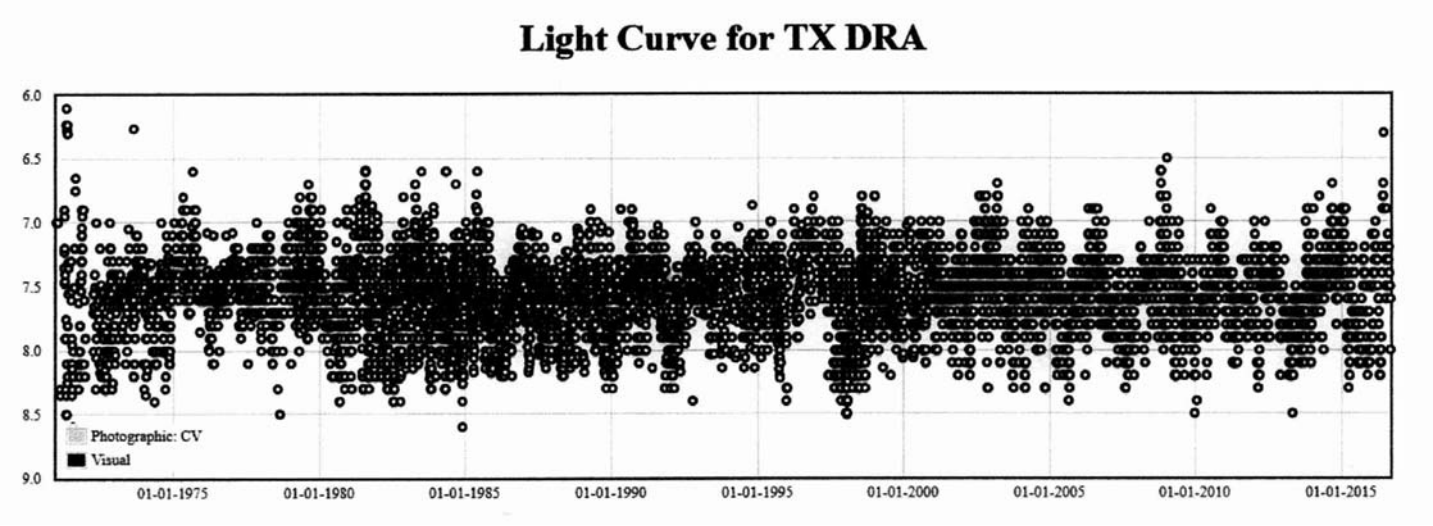
The most obvious feature is the 1990s broad minimum. Although there is an impression in this light curve of a period of about a year at certain times, this is an illusion caused by the annual near-conjunction observational gaps. The 1990s minimum took RV Cyg down close to the listed lower brightness limit, but apart from that it seems to spend most of its time in the upper half of its range, with individual observers only seeing a range of a few tenths of a magnitude.

Figure 9: RY Dra (Catalogued range 6.0-8.2, type SRb? period 200 days?)



It is rare for RY Dra to approach within half a magnitude of the listed upper limit. Approaches lower limit from time to time. There are hints at times of 2-3 year period, but these are not particularly convincing. A few notable dips in brightness in 1971, 1973, 1975, 1982, 1989, 1991, 1998 and 2010.

Figure 10: TX Dra (Catalogued range 6.6-8.4, type SRb, period 78 days?)



Varies over most of its listed brightness range. The 78-day period is too short to be seen on the scale of this light curve, but there are hints of a 2-year period.

BINOCULAR PROGRAMME

Shaun Albrighton

The various priority levels of the Binocular Programme can now be found on the VSS web site at: ***http://www.britastro.org/vss/bin_prog_priority_191013.htm*** or for a full listing in constellation order at: ***http://www.britastro.org/vss/chartcat_binoc.htm***
These listings can be viewed in Circulars 157 - 160, and can be obtained in paper format from Shaun Albrighton and Roger Pickard (Contact details under Director and Binocular Secretary on back page of the Circular).

ECLIPSING BINARY PREDICTIONS – WHERE TO FIND THEM

Des Loughney - *desloughney@blueyonder.co.uk*

The publication of Eclipsing Binary Predictions is now discontinued in the VSS Circular. Predictions for RZ Cas, Beta Per and Lambda Tau can still be found in the BAA Handbook. Predictions, completed on a monthly basis, are available on the BAA VSS website at:
http://www.britastro.org/vss/dpredict.html

If readers require paper copies of the predictions please contact me.

The best source for predictions for Eclipsing Binaries is the Mt. Suhora Astronomical Observatory, Cracow Pedagogical University website (known as the Krakow website)at:
http://www.as.up.krakow.pl/o-c/index.php3

Click on 'Constellation List', choose your constellation and then choose your system.

A webpage will then appear with lots of useful information regarding the system. In the section entitled 'Light Elements' there is a link entitled 'current minima and phase'. When you click on this link, in the example of Beta Lyrae, you get predictions of primary and secondary eclipses for a period of three months. For systems with very short periods such as RZ Cas the predictions are for one week. For a system such as SW Cyg, with a period of around 4.57 days, the predictions are for a month.

The Krakow website does not tell you how much of an eclipse will be observable at a particular time of the year at your latitude and longitude. However, it has some useful literature references for each system, although they may not necessarily be up to date.
Nor are references to the 'Information Bulletin on Variable Stars' included, but these can be found at:
http://www.konkoly.hu/IBVS/IBVS.html

Although the Krakow website lists the depth of eclipses it does not list the actual V magnitudes at maximum and minimum. For an indication of these magnitudes you will need to visit the 'General Catalogue of Variable Stars' website at: ***http://www.sai.msu.su/groups/cluster/gcvs/gcvs/***

Click on 'GCVS Query Form', type in a designation such as SW Cyg, and click on 'Search'. The resulting information displayed shows that maximum is 9.24V, primary minimum 11.83V, and secondary minimum 9.30V. These magnitudes, however, may have been determined some time ago.

The GCVS website gives SW Cyg a period of 4.57313411 days but the Krakow website lists the period of SW Cyg as 4.572986 days. The latter is more likely to list the most up to date period. It must always be borne in mind that small changes in a period can result in significant changes in the times of minima if the period was determined a few years ago.

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If you would like to prepare an article for consideration for publication in a Variable Star Section Circular, please read the *Notes for Authors*, published on the web pages at:
http://www.britastro.org/vss/circs.htm; reproduced in full in VSSC132 p 22, or contact the editor (details on back cover) for a pdf copy of the guidelines.

If you are unsure if the material is of a suitable level or content, then please contact the editor for advice.

The **deadline for contributions** to the next issue of VSSC (number 172) will be 7th May 2017. All articles should be sent to the editor (details are given on the back of this issue).

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