British Astronomical Association

VARIABLE STAR SECTION CIRCULAR

No 93, September 1997

Contents

ISSN 0267-9272

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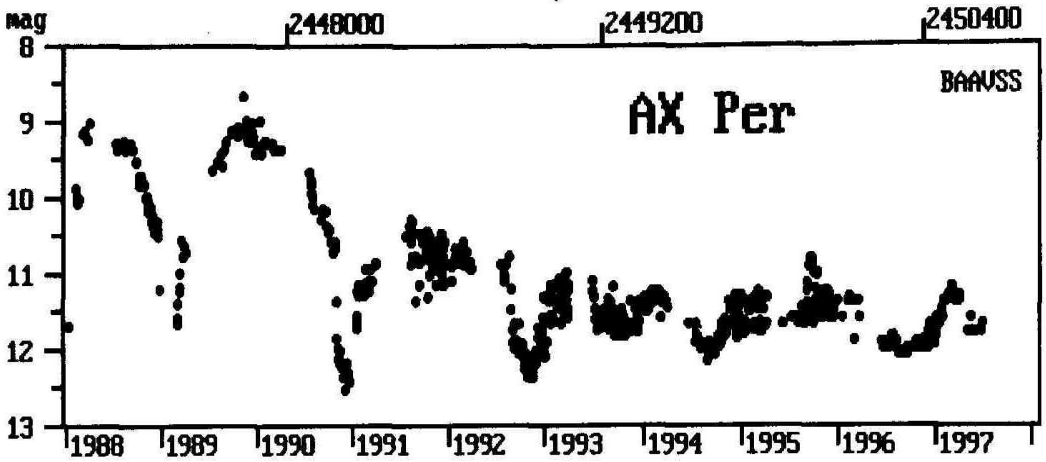
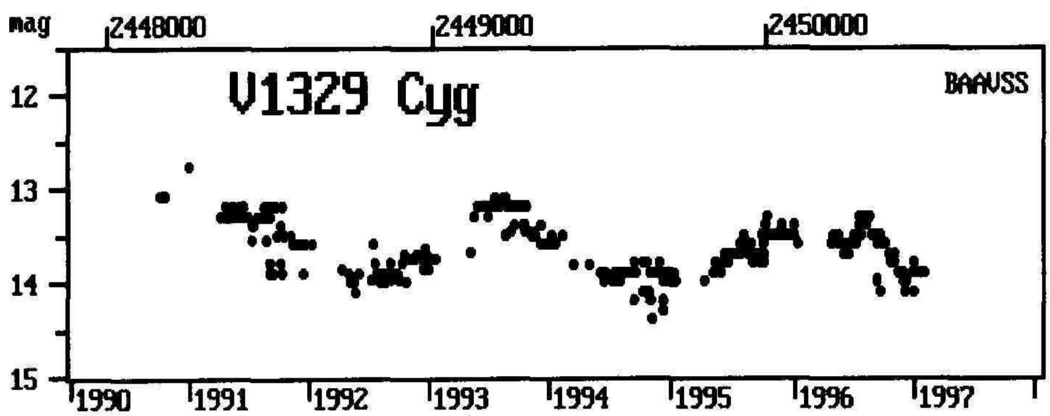
LIGHT CURVES

DAVE MCADAM



AX Per 1988 to 1997. 742 observations by;-
S W Albrighton, L K Brundle, H J Davies, B H Granslo, J E Isles, S Koushiappas, R W Middleton, Roy Mitchell, G Poyner.



V1329 Cyg 1990 to 1997. 400 observations by;-
G M Hurst, G Poyner.

1996 RESULTS:

Gary Poyner

Reports received from Melvyn Taylor and Dave McAdam reveal that 43,800 observations were reported to the VSS during 1996. This includes (for the first time) those observations reported to Dave McAdam for inclusion in TA, and observations reported by the SPA VSS and RASNZ. Observations were reported on 522 stars, 377 telescopic and 145 binocular.

The TA observations are flagged as provisional in the database if they are sent without the full estimate. This now also applies to observations received from VSS members. It has been noted that some observers are sending their reports and are not including the full estimate. The VSS database is unique in that it includes complete details of the estimate

made at the telescope, which is invaluable when it comes to checking reduced magnitudes, sequence entries and updating sequences automatically within the archive. It is our intention to keep the VSS database as accurate and as complete as possible, and this can only be achieved by archiving observations that are reported in full! Please be sure to include the estimate when submitting your reports to either secretary, otherwise your hard work during the year will only be regarded as provisional until full details of the observation are forthcoming.

The following table lists the main contributors and approximate totals during 1996. Thanks to everyone for a fine effort.

OBSERVER	TOTAL	OBSERVER	TOTAL
G. Poyner	12,800+	M. Westlund	250+
		L. Jensen	
M. Gainsford	2,000+	D. Gill	
W. Worraker		A. Baransky	
		L. Monard	
T. Markham	1,500+	J. Stubbings (RASNZ)	
M. Talyor		G. Salmon	
J. Toone		W. Albrecht (RASNZ)	
J. Day		J. Greaves	
S. Albrighton		N. Bone	
		J. Meacham	
R. Patterson	1,000+	M. Clarke (SPA)	
L. Brundle			
I. Middlemist		S. Godwin (SPA)	100+
		K. Barnewll (SPA)	
R. Bouma	750+	C. Henshaw	
M. Nicholls		J. Coates (SPA)	
		E. Horsley (SPA)	
M. Gill	500+	K. Andersson	
G. Hurst		D. Overbeek	
R. Dryden		M. Barrett	
D. Storey		R. Fraser	
C. Munden		J. Andujar	
		J. Thorpe	
		R. Livesey	

A further 29 observers each reported less than 100 estimates.

Not surprisingly, the best observed star was R CrB, with 1,181 estimates. Other stars with over 500 estimates each were...V723 Cas (N Cas 1995), T CrB, SS Cyg, RX And, Z Cam, CH Cyg and RU Peg. More importantly, the following 24 stars were not observed during 1996. Would observers please make a special effort to include some of these stars in their observing programmes.

CG CMa	**V686 Mon**	**V2110 Oph**	**V1172 Sgr**	**V745 Sco**	**AS 289 (Ser)**
TV Crv	**V2204 Oph**	**T Pyx**	**V3645 Sgr**	**FR Sct**	**RW Vir**
EX Hya	**Hen 1341**	**V1017 Sgr**	**AS 245 (Sgr)**	**V443 Sct**	**RX Vir**
PW Vul	**QU Vul**	**QV Vul**	**NSV 2537**	**RW Hya**	**EX Hya**

The following stars were *grossly* under-observed, with less than 20 estimates each during 1996.

SU And	**AQ And**	**BZ And**	**R Aqr**	**Mark 509**	**UW Aql**
SU Cnc	**RT CVn**	**W CMa**	**DM Cep**	**WX Cet**	**R Com**
TT Crt	**IS Gem**	**SX Her**	**R Hya**	**U Hya**	**BL Lac**
RS Leo	**W UMi**	**SS Lep**	**W Lyn**	**X Lyn**	**V651 Mon**
TX Psc	**XY Psc**	**SS Vir**	**SW Vir**	**BK Vir**	

The response to the addition of a selection of Mike Collin's new and recovered variables to the programme has been somewhat disappointing, despite several observers frequently asking for more stars to be included within the 8-12 magnitude range. Well most of these are within that range! And what's more, close monitoring of these objects is vital in order to determine a range and period. No other observing group is monitoring these stars, so it's down to us to produce the observations. Please add some or all of these stars to your programme. Charts are available from John Toone.

Mike Collin's Stars:

1950.0
2000.0

RA	Dec	desig	Range	notes	Chart
00 33.9 00 35.9	+59 24 +59 40	TAV 0033+59	10.3-11.9	Be-type	TA901114
00 42.2 00 44.9	+53 10 +53 26	TAV 0042+53	10.3-12.4	C-rich	TA900913
01 36.5 01 39.5	+60 39 +60 54	TAV 0136+60	7.3- 8.3		TA890714
02 16.9 02 19.4	+48 01 +48 14	TAV 0216+48	9.5-11.4	C star	TA891126
03 46.7 03 49.4	+38 38 +38 47	TAV 0346+38	10.3-11.6	C star	TA910222
05 59.1 06 01.7	+06 38 +06 38	TAV 0559+06	10.5-11.6		TA910616
06 26.2 06 29.4	+34 44 +34 42	TASV 0626+34	9.8-11.9		TA891010
07 14.4 07 17.0	+17 59 +17 54	TAV 0714+17	10.5-11.9		TA910623
18 12.3 18 13.7	+40 25 +40 26	TASV 1812+40	9.5-10.3	360d?	TA890908

18 31.6	+19 00	TAV 1831+19	10.7-[12.2		TA911025
18 33.3	+19 02				
19 33.1	+53 46	TAV 1933+53	10.3-11.4		TA910202
19 34.2	+53 53				
19 46.4	+00 22	TASV 1946+00	10.0-11.9?	330d?	TA890908
19 48.6	+00 30				
20 34.2	+61 38	TAV 2034+61	9.6-11.2		TA890628
20 34.9	+61 48				
22 04.8	+59 15	TASV 2204+59	10.1-11.5		TA891104
22 05.8	+59 30				
22 30.6	+58 21	TAV 2230+58	9.8-10.8	C star	TA901020
22 31.9	+58 36				

TAV Stars which are named in GCVS

1950.0
2000.0

RA	Dec	GCVS	Range	Notes	TA desig.	Chart
03 29.1	+41 16	V513 Per	10.3-12.6	423d C*	TAV 0329+41	TA900121
03 32.4	+41 26					
04 51.8	+69 22	CC Cam	10.8-[12.3		TAV 0451+69	TA920510
04 56.5	+69 27					
18 36.1	+11 08	V2303 Oph	11.1-[15.2?		TAV 1836+11	TA930930
18 38.4	+11 11					
19 21.1	+24 24	V335 Vul	10.1-12.7	C star	TAV 1921+24	TA900827
19 23.1	+24 30					
19 41.7	+34 22	V1990 Cyg	9.8-13.0	C star	TAV 1941+34	TA891102
19 42.9	+34 29					
22 51.2	+61 00	V386 Cep	9.2-11.0	S star	TAV 2251+61	TA900125
22 53.0	+61 16					

LANNING 17: A New addition to the Recurrent Objects Programme

Gary Poyner

Attention to this neglected variable star was brought by Taichi Kato, who noted it in a literature search of Lanning's galactic plane survey (PASP 85, 70). Kato comments that Lanning's paper shows the object around mag 15, accompanied by a hint of nebulosity, while the POSS shows only a ~20 mag star. Howard Lanning has subsequently commented that "sporadic attempts to check the field for any evidence of the object have been made from time to time by colleagues without success. I agree that a more systematic monitoring to recover the nova-like? object would be very useful. It would also be very interesting to obtain a deep CCD image of the field in search of a possible remnant".

Lanning 17 is located at the following position...
18h 23m 00s.39 (J2000.0)
-04 37' 09".6

BAAVSS and TA charts have been issued, and are available from John Toone or Guy Hurst respectively. Please ask for BAA Chart No. 234.01 when ordering from John Toone.

A CALL FOR OBSERVATIONS OF EM CYGNI

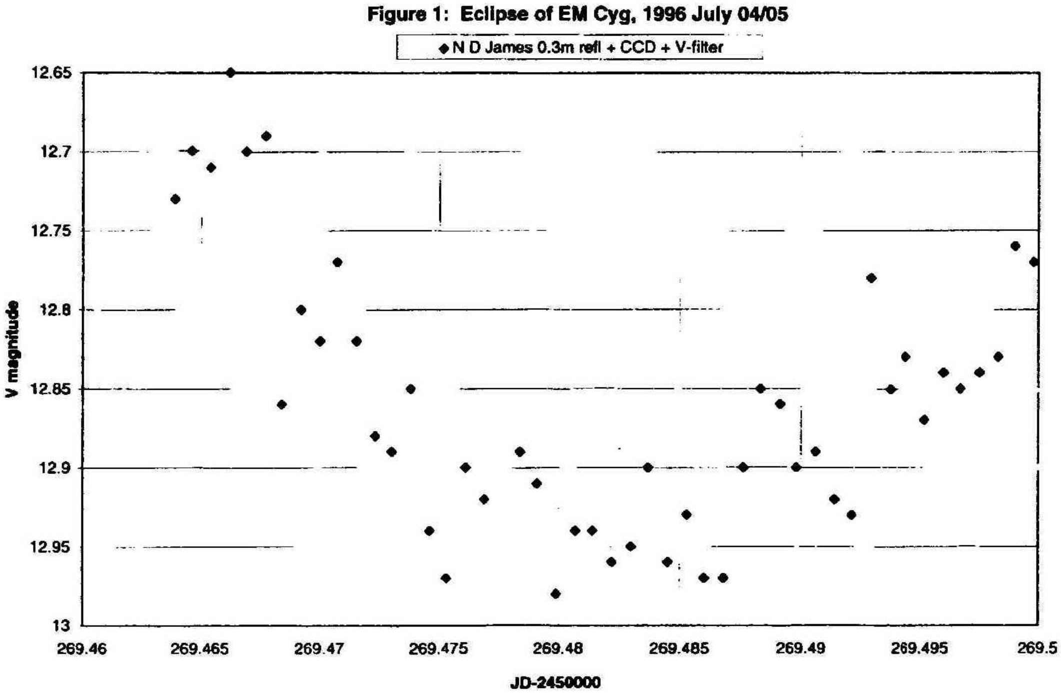
DR WILLIAM WORRAKER

EM Cygni is a dwarf nova, currently classed as a Z Cam-type star, which can easily be observed in a telescope of 8" aperture or larger, even at minimum light. Although it has been followed by AAVSO observers for a number of years, until recently it had received little attention from UK observers.

EM Cyg, however, is astrophysically interesting because it displays eclipses due to the orbital passage of the secondary star in front of the accretion disk and white dwarf primary of the system. As in other eclipsing dwarf novae (e.g. U Gem, IP Peg, Z Cha, HT Cas) eclipse light curves can provide valuable information on the state of the accretion disk and any bright spot due to the impact of the gas stream from the secondary on the disk. Thus eclipse observations can be used to correlate changes in the disk and bright spot, with the quiescence-outburst light cycle of the system, which can in turn aid understanding of the dwarf nova outburst mechanism. EM Cyg is unique in being the only recognised Z Cam star to show eclipses, and Warner (1995) notes that it provides the only current opportunity to study the intensity distribution, across a disk in standstill, though this has yet to be done.

The light cycle of EM Cyg can readily be followed by amateurs; in quiescence it is normally about magnitude 13.5 visual, in outburst mag 12.5. Observations in 1996 suggest that the average interval between outbursts is probably about 20 days. In view of the small range care is especially needed in making visual estimates; at around mag 13.0 it is not always

Figure 1: Eclipse of EM Cyg, 1996 July 04/05



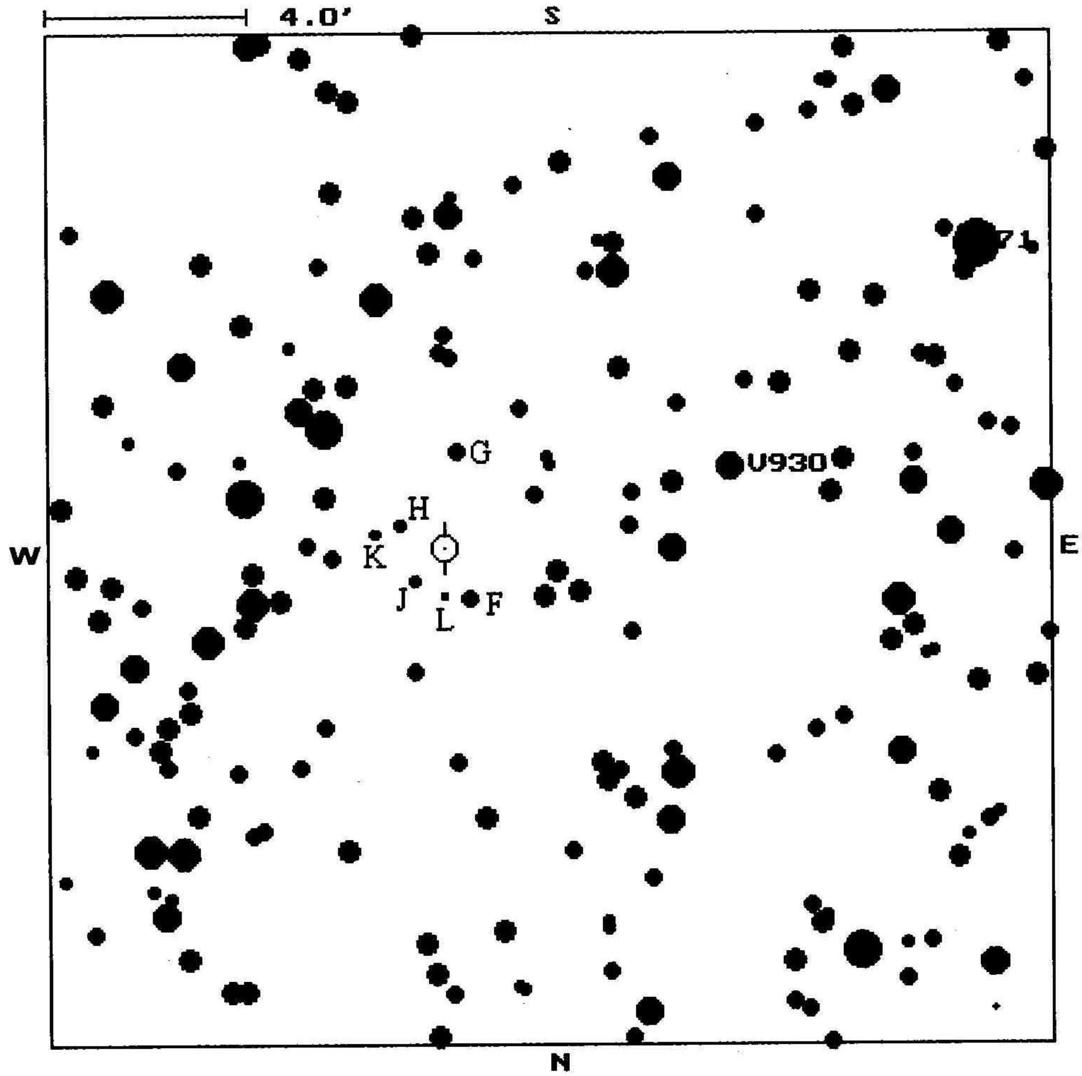


Chart for EM Cyg

The sequence:

F = 12.8
G = 13.11
H = 13.49
J = 13.54
K = 13.76
L = 14.30

clear from isolated estimates whether the star is at faint maximum, bright minimum or in standstill! When EM Cyg is in outburst eclipses are shallow, about 0.3 mag deep, and when it is in quiescence they are still only about 0.6/0.7 mag deep. Thus visual eclipse light curves are unlikely to be useful for further analysis; at most they can provide estimates of eclipse depth and the approximate time of minimum light.

Useful eclipse light curves can, however, be obtained using CCD cameras with suitable photometric filtering, usually V-band. Sample results obtained in 1996 by Nick James using a 30cm reflector with a CCD and V-filter are shown in Fig. 1; EM Cyg was in outburst at the time. A project to observe eclipses of EM Cyg in this way through 1997 at all possible stages of its light cycle (including, it is hoped, at least one standstill) has been initiated at Keele University. It is important to Les Thomas, the research student observing the eclipses, to know at what point in the light cycle his observations are being made. Thus Keele have requested the cooperation of amateurs in providing as much visual coverage of the light cycle as possible. This information does not need to be reported daily; monthly reports to Dave McAdam in the usual way are sufficient. Observers who do not normally report each month are encouraged to send their EM Cyg observations monthly to Dave or to myself for the duration of this project.

A critically important stage for eclipse observations of a dwarf nova is the rise from quiescence to outburst, which typically takes 1-2 days. Keele have therefore also asked for Les to be alerted when EM Cyg is seen to be starting an outburst. Any observer noticing a sudden increase in brightness of EM Cyg should therefore telephone either myself (01235 812181 up to 10:30 PM daily), or Gary Poyner (0121 605 3716) as soon as possible.

The chart and sequence included on page 6 of this circular are intended to replace BAA 216.01 (alias TA960515), which is based on the current AAVSO sequence. In 1996 various observers noted obvious inaccuracies, e.g. that the magnitude gap between F and G was much too large. The revised sequence is based on two recent pieces of work, (i) the paper by Misselt (1996) on secondary photometric standards in selected dwarf-nova fields, which includes EM Cyg and gives V-band measurements of some of the comparisons. Misselt gives V=12.80 for star F, which is the reference point for the new sequence; (ii) 40 V-band eclipse frames of EM Cyg made by Nick James in July 1996 have been combined to give V-band measurements of high internal accuracy (probably less than +/-0.02 mag) of most stars in the sequence. Whilst lacking any colour correction for true visual magnitudes, these are believed to give a much better sequence than before.

Observers reporting estimates of EM Cyg should quote the sequence and the individual estimates, including the comparisons used, as in all reporting of variable star estimates. This will help to maximise the scientific value of our contribution to this interesting Pro-Am project.

Bill Worraker, 65 Wantage Road, Didcot, Oxon. OX11 0AE. Internet address: bill.worraker@aeat.co.uk

References

B. Warner, “Cataclysmic Variable Stars”, Cambridge University Press, 1995.
K. A. Misselt, Pub. Astr. Soc. Pacific, 108, pp.146-165, 1996.

CHART NEWS

JOHN TOONE

The following charts are now available from the Chart Secretary (see back cover)

219.01 RX Boo

Formally MDT 1972 Aug 12. A Lettered sequence has been introduced eliminating the 70 star (SAO83375) which is spectral class M1 and introducing star B (SAO83431) at mag 6.9 as a replacement.

220.01 RR & SW CrB

Formally JEI 31-1-69. A lettered sequence has been introduced eliminating the 76 star (SAO64873) which is spectral class M1 and introducing stars B (SAO64841) and E (SAO64944) as replacements.

221.01 CK Ori

Formally MDT 72-08-12. A lettered sequence has been introduced. FL21 (NSV1922) is retained as comparison star A as the extreme range of this suspect is probably not detectable visually.

222.01 RY Leo

New 9 and 1 degree field charts adapted from the AAVSO (b), (c) and (d) 1942 charts which introduce a lettered sequence and reduces the overall number of comparison stars.

223.01 X & ST Her

Formally MDT 1982 Feb 07 and DAP 71-05-01, but now combined as these two stars are less than 2.5 degrees apart. A lettered sequence is introduced for X Her, whilst a re-numbered sequence has been adopted for ST Her. The overall number of comparision stars has been reduced.

224.01 30 Her (also known as g Her)

Formally MDT 1982 Feb 07 combined with X Her. A New 18 degree field chart introducing a lettered sequence and reducing the overall number of comparison stars. V637 (FL52)) is retained as comparison B as the extreme range of this alpha CVn star is a mere 0.07 mag. A warning to observers with the old g Her chart: do not use the 51 star (FL42) as this is NSV7896 of spectral class M3.

225.01 RY Dra

Formally MDT 11 Jun 1983 combined with VW & VY UMa. The sequence has been re-lettered broadly in accordance with the earlier 10 Sept 1977 chart. Stars V (SAO16014) and S(SAO16018) on the 11 Jun 1983 chart have been eliminated as they are too close to easily separate with binoculars.

226.01 VW &VY UMa

Formally MDT 11 Jun 1983 combined with RY Dra. The sequence has been re-lettered broadly in accordance with the earlier 10 Sep 1977 chart. Star L (EP UMa) is retained as a comparison star as the extreme range of this alpha CVn star is just 0.02 mag

227.01 TT Cyg

Formally MDT 72-09-16. A nembered sequence has been introduced which reduces the overall number of comparison stars. Star 67 (SAO68529) has been eliminated as it is a small range irregular variable (V1919 Cyg, spectral class M2)

228.01 U & EU Del

Formally MDT 1983 Oct 01. The chart has been redrawn eliminating star D (LU Del, 6.2-6.5, SR). The magnitude assigned to F has been adjusted following an analysis by Melvyn Taylor of 231 pogson step estimates received within the past 7 years. The new value of 6.6 now also coincides with the AAVSO value for this star.

229.01 Y Lyn

Formally MDT 1978 Jul 14. The sequence now consists wholly of letters with the assigned magnitudes remaining unchanged.

232.01 AF & V 973 Cyg

Formally MDT 1983 Oct 2. The existing sequence is retained with the exception of D (SAO48842) which is of spectral class gM!.

233.01 V465 Cas

Formally MDT 1983 Oct 1. The chart has been redrawn retaining the existing sequence.

SOFTWARE PITFALLS FOR THE UNWARY

Roger Pickard - Crayford Manor House Astronomical Society

Recently, Kevin West asked if we could use the Jack Ells APT to observe AE Auriga, not a star we would normally look at, as it is a semi-regular and we tend to concentrate on eclipsing binaries.

Kevin had observed it following a report in an earlier Circular and had obtained some 20 or so observations showing about 0.03 maximum magnitude range and wondered whether it was actually variable.

Malcolm Gough duly observed AE and after the initial reduction I needed to apply the necessary extinction and transformation coefficients. To do this I looked up the B-V values for the check and comparison stars using the Guide software which I had recently purchased. Now, it just so happened the last time I'd used Guide I'd really zoomed in on whatever I'd been looking at with a field of view of only a few minutes of arc. As Guide remembers this fact it also zoomed into 19 Aur = comparison star when I entered it into the "Goto" menu and revealed it to be a very close (seconds of arc) double with a suspected variable, NSV 1925. No range is given for this star, only an average mag of 5.09, compared with 5.03 for 19 Aur itself. Not much, but a possible source of error in one's observations.

But worse was to come!

When I came to look up the check star, I found that that too, is a very close double, this time with a known variable IQ Aur. This is an Alpha CVn type star with range 5.35 - 5.41 and period 2.4660. Again not a lot, but along with the error in the comparison it could add at least 0.12 mag error to the observations of AE.

I e-mailed this information to Kevin and also to John Isles as I happened to be writing to him about another topic at the time anyway. John then looked into it and reported as follows:-

"As promised, I looked into Kevin West's comparison and check stars for AE Aur. NSV 1925 and IQ Aur are not close companions, they are in fact identical with 19 Aur and HD 34452 respectively, according to the Hipparcos Input Catalogue and other sources. No doubt the Guide program misleadingly produces apparent double stars because it plots the variable stars separately, using the less accurate GCVS co-ordinates.

The reported variability of NSV 1925 is doubtful or erroneous according to the NSVS. I have found no other references to it.

AE Aur is certainly worth observing, and NSV 1925 is probably OK as a comparison star, but Kevin might like to choose a different check star."

Caveat emptor, (let the buyer beware!)

(Having just criticised Guide I must make some effort to put the record straight. I believe it is a brilliant piece of software, and not just because at the current exchange rate it is less than £50! For those observers who also follow asteroidal occultations Richard Miles has reported how accurate it is in plotting the positions of those bodies. It certainly does just about all I want it to do in giving references to nearly all star catalogues - although not the Hipparcos, that is due to be added in the next version - and for making VS charts for PEP. It also lists innumerable galaxies and etc., but for the moment at least, they are of less interest to me).

VSS MEETING, NORTHAMPTON, 1996 OCTOBER 5TH

(CONTINUED FROM VSSC 92)

TRISTRAM BRELSTAFF

Kevin West then spoke on Photoelectric Photometry. First he described how he had become dissatisfied with the results he was getting making visual observations through binoculars. He experimented with using a variable artificial star but found it even harder to use than making visual estimates. He then made an equalisation photometer by fixing a camera iris in front of one side of a pair of binoculars. Again this was not very successful. When he heard that Malcom Porter was wanting to sell his Optec SSP3 photometer, Kevin jumped at the chance, even though he didn't yet have a telescope to mount it on. He now has a 20cm Newtonian reflector in a run-off roof observatory. Over the past 3 years he has made 1700 observations, which equates to about 42 hours at the eye-piece. These observations are now in the BAA Computer Archive (the AAVSO would not accept them because he did not use their designated comparison stars).

Kevin explained that his choice of objects to observe was limited by several factors such as the size of his telescope, the type of photometer, the sky brightness at his observing site and the weather. These all restricted the magnitude range for which he could get reasonable counts. He had selected an observing program with the need to get good observational coverage in spite of these circumstances. This meant relatively slowly varying stars at high declinations. This minimises the effects of gaps due to bad weather, and to seasonal invisibility. Kevin had a priority system within his program. Priority 1 were the semiregular variables Mu Cep, HD 116475, UX Dra, Delta^2 Lyr and RR UMi, and the Cepheids Eta Aql, RT Aur, SU Cas and V473 Lyr.

Originally Kevin's observing sequence consisted of making measurements in the order Comparison star - Variable star - Comparison star. However, at the suggestion of Chris Lloyd, he now includes a check star and uses the sequence Comp-Var-Comp-Var-Comp-Check-Comp. This whole sequence takes 10 to 15 minutes.

The biggest source of error is variations in sky transparency. Kevin said that the photometer often detected cloud before he could see them. He also said that he occasionally saw sudden increases in his counts for no apparent reason. Someone had suggested that this might be due to cosmic rays hitting the detector. He went on to say that it is possible to transform the results to the Johnson system and to correct for extinction and for colour differences. However, it is always best to minimise these corrections by chosing comparison stars that are close to the variable and similar in colour.

Kevin then showed some of the light-curves he had obtained. HD 116475, the recently discovered red variable near V CVn, is definitely semiregular and shows a period of about 73d. Observations by the Hungarian Laszlo Kiss agreed to within 0.02 mag with Kevin's results. His light-curve of UX Dra showed clearly the 168d period listed in the GCVS. RR UMi is important in that it is one of the few semiregular variables in a binary system with a well-known orbit (and hence a well-determined mass). Analysis of Kevin's observations by Chris Lloyd showed no evidence for the 43d period listed in the GCVS but did show periods of 34d and 61d. Kevin's observations of VY UMa confirmed the 120d period found by Ofek et al. (JBAA, 105, 33-34, 1995). This period is apparently absent from earlier AAVSO data. Kevin had also, along with Roger Pickard, contributed observations of X Per to a paper by Paul Roche that was published in the Monthly Notices of the RAS.

For light relief, Kevin started observing Cepheids. He was inspired to do this by seeing visual light-curves published by John Isles. However, he was now producing useful results for these stars too. He was observing RT Aur at the request of Laszlo Kiss who was studying Cepheids for his PhD, and was observing V473 Lyr at the request of Don Fernie in Canada. The latter star varied between mags 6.0 and 6.3 in 1994 but in 1996 its amplitude was below 0.01 mag.

Kevin rounded off by showing a set of observations of Comet Hyakutake that he had made at the suggestion of Jonathan Shanklin to monitor for possible very rapid variations. These were made at rather low altitude and the results were inconclusive, but they were good practice for Comet Hale-Bopp!

Gary Poyner then introduced the next speaker as someone who only a year ago had said he was a visual observer who would never turn to CCDs. **Tonny Vanmunster** then got up to speak on The Center for Backyard Astrophysics.

First of all he outlined the current models for cataclysmic variables (CVs).These are close binary stars in which gas is flowing from a cool component into an accretion disk around a hot component. In the so-called 'intermediate polars' the magnetic field of the hot component is relatively weak and the disk has only a small hole at the centre. This disk is thought to suffer from two kinds of instabilities: thermal instabilities which lead to normal dwarf nova outbursts, and tidal instabilities which lead to SU UMa type superoutbursts. In the 'polars', on the other hand, the magnetic field of the hot component is strong enough to prevent the disc from forming and gas can only approach the hot component via its magnetic poles. Being binary stars, many CVs also show eclipses which allows details of the structure of the system to be determined.

Tonny has been a keen visual observer of CVs for several years. However, he was recently asked by Professor Joe Patterson of Columbia University in the USA if he would be willing to take part in a CCD monitoring of CVs. Joe was running what he called the Center for Backyard Astrophysics (CBA - not to be confused with CBAT). The objectives of CBA were to create an international, multi-longitude telescope network that addresses the entire range of research issues in the photometry of CVs and X-ray binaries.

The CBA grew out of a collaboration in 1984 between Patterson and David Skillman, an amateur who had built an automatic photometric telescope. It now has amateur 'stations' in the USA, Denmark, Belgium, Japan and New Zealand, as well as professional ones in Chile, Israel, Japan and South Africa. This spread in longitude enables them to combine results to get much better coverage of the rapid variations of CVs. The results obtained by the CBA are published in the Publications of the Astronomical Society of the Pacific and in other Journals. These are then used to support applications for funding grants for further work.

Joe Patterson has stated that he thinks that the leadership in variable star research will soon return to amateur astronomers, where it was before 1900. The problem for professional astronomers was that the closure of small observatories and the increasing competition for time on the remaining facilities means that practically all of their observations have to be done in short single-shot observing sessions. Some professionals even suspect that variable star research might enter a dark age.

Tonny then described the set-up he used at his CBA station. He has a 25cm Meade SCT equipped with an SBIG ST7 CCD in a run-off roof observatory. He does not use filters because the aim of his work is just to detect periodicities. He has automatic pointing (using the GSC) so he doesn't even have to know the constellations! He described how he sets up the telescope at the start of the night and then leaves it to follow the variable round the sky by itself, taking one image every minute. This leaves Tonny free to get on making visual observations of other CVs.

In a single night, the CCD records about 50 megabytes of data which is stored on ZIP drives. At the end of the night, he uses a program written by Patrick Wils to run through the images, identify the variable and comparison stars and produce a preliminary light-curve. This shows if anything interesting has been recorded. He performs more detailed analysis later, at his leisure.

The aim of the work Tonny is involved in is to study the physical properties of CVs through the periodicities they display in their light-curves. These periodicities can be orbital (ie: eclipses), rotational, or superhump periods. Eclipse timings over several decades can be used to show how the orbital periods change. Joe Patterson then has to come up with a physical model to explain these changes. The superhump periods are close to the orbital period determined spectroscopically but are usually slightly longer.

The work of the CBA has revealed new superhump periods in 12 stars including V1159 Ori, RZ LMi and HS Vir. It has also produced a few surprises, for example the discovery that in CN Ori superhumps are present both during superoutbursts and during normal outbursts. In RZ LMi the superhumps are apparently present at minimum, in between superoutbursts. The old nova V603 Aql shows superhump periods that are both longer and shorter than the orbital period at different times. This phenomenon is referred to as 'negative superhumps'. Apparently superhumping is much more widespread amongst CVs than was previously thought.

Tonny went on to outline the future plans of the CBA. They hoped to discover new DQ Her stars (X-ray sources). Joe Patterson suspected that superhumping CVs with orbital periods greater than 3.9 hours should exist, but none had been found so far. They hoped to discover some. They also want to further investigate the negative superhumping phenomenon. Collaboration with spectroscopists should lead to more precise orbital periods. The CBA hoped to have robotic observations at all of its stations. This would allow remote operation but, Tonny pointed out, would require rain detectors. They hoped to set up 2 new CBA stations each year to bring the total up to 10-15.

Summing up, Tonny said that the leadership in variable star research may well pass to amateurs, but only if they work in very close collaboration with professionals.

In answer to a question, Tonny said that the ST7 does have two CCD chips, one for guiding, but the supplied software was no good for guiding while taking serial images. Mark Kidger pointed out that it was OK to use unfiltered CCD photometry for looking for periodicity, but that if you want to demonstrate the existence of something unusual then you must use filters. He added that the CCD equipment that Tonny was using was much better than that which he had been using as a professional only 10 years ago. The gap between professionals and amateurs is closing!

Then **Bill Worraker**, the final speaker of the day, spoke on Eclipsing Dwarf Novae. After giving a brief outline of the cataclysmic binary model for dwarf novae, Bill described the geometry of eclipses in these systems. Observations of the light-curves of the eclipses can show how the size and structure of the accretion disk changes during an outburst, and so can be used to test the various mechanisms that have been proposed for dwarf nova outbursts. Of these proposed mechanisms, the mass-transfer instability model has now failed several observational tests but the thermal instability model appears to work quite well.

Several techniques can be used to interpret eclipse light-curves. One is just simple visual inspection of its shape. Another is to construct possible models for the system and then compute the eclipselight-curve that they would give. A third method is to start with the observed eclipse light-curve and then try to reconstruct the structure of the system by deconvolution.

Bill went on to describe the results of several observing campaigns he had been involved in. During the superoutburst of HT Cas in November 1995 an eclipse was observed that was 15 mins long and 1 mag deep. A few days later the eclipse was only 8 mins long but 2 mags deep (at minimum the eclipses are only 6 mins long). This suggests that, in this star, the accretion disk is wider early on in the outburst. This in turn suggests that the disk instability associated with the outburst starts at the edge of the disk and moves inwards. This sort of behaviour is referred to an 'outside-in' outburst and the rise in ultraviolet light (which comes from the inner parts of the disk closest to the white dwarf) usually lags behind that in the visual.

By contrast, during the August 1994 and 1996 September outbursts of IP Peg the eclipses were 2.5 mag deep very early in the outburst but were only about 1.5 mag deep the following night and stayed at that depth for the next 10 days. This suggests that early on the light is concentrated at the centre of the disk but quickly spreads out leaving the disk in a quasi-steady state - an 'inside-out' outburst. This has been successfully modelled by researchers at Keele University. In stars such as IP Peg the ultraviolet and visual light rise together.

Bill then showed some eclipse light-curves of the Z Cam star EM Cyg. CCD observations by Nick James and visual observations by Bill himself showed only shallow eclipses (about 0.3 mag deep) at maximum. Visual observations by Gary Poyner suggested they may be slightly deeper at minimum (about 0.5 mag). There is quite a bit of interest in this star because Brian Warner has suggested that it may show eclipses in standstill. However, this has yet to be confirmed as standstills in this star are rather infrequent.

Bill then discussed observations of the September 1996 outburst of the recently discovered dwarf nova HS1804+6753. CCD photometry by Nick James showed that eclipses 1.6 mags deep in quiescence but 3 mags deep in outburst. This is apparently the first dwarf nova found in which the eclipses are deeper in outburst. Bill said that Tom Marsh (Southampton University) had been planning to use the Hubble Space Telescope to observe this star at about the same time.

In the future, Bill said, we needed to get better coverage of IP Peg, HT Cas and, if possible, DV UMa. In addition, we needed intensive coverage of HS1804+6753 and S10932. There was also the discovery of new eclipsing dwarf novae. The possibility that there are still quite a lot of these remaining to be discovered is suggested by the small proportion of the known dwarf novae that show eclipses. At less than 3% this is much less than the 20% that would be predicted from simple geometric arguments. This deficit could be caused by a selection effect arising from the disks in eclipsing systems being more edge-on than in non-eclipsing systems. This would mean that the changes in disk luminosity that produce outbursts are less noticable in eclipsing systems and so the observed outburst amplitudes are smaller. Continuous runs of observations of poorly observed dwarf novae at minimum light might well reveal new eclipses or other periodicities.

Gary Poyner said that he had heard that Tom Marsh was upset when HS1804+6753 went into outburst because it made it too bright for the HST to observe. He then thanked Bob Marriot and the NNHS for organising the meeting and all the speakers for their excellent talks. He then closed the meeting.

ANALYSES OF VARIABLE STAR OBSERVATIONS

TONY MARKHAM

Light curves that are published are usually the ones that look the best. In reality, not all light curves are so photogenic.

If all of the estimates made of a large amplitude variable are plotted in a single light curve then, even though there will be some scatter, it is usually quite straightforward to see the general pattern of variation.

The same is not true, unfortunately, for lower amplitude variables. Plotting one observers estimates of a low amplitude variable will hopefully show up some pattern of variation. However, combining the observations of more than one observer can be more complicated.

The SPA VSS programme includes several relatively low amplitude variables (e.g. Gamma Cas, Mu Cep, Zeta Gem, Alpha Her, etc). The following notes illustrate some of the factors that I have to allow for when analysing the observations of such variables.

Systematic Differences

These are most common in red variables. Typically, each observer will see the variable consistently several tenths of a magnitude brighter or fainter than will other observers. This is not the fault of the observers ! In some cases the systematic differences between observers may be larger than the observed amplitude of variation.

Experience has shown that I often see red variables as being fainter than other observers. A few years ago Melvyn Taylor sent me a comparison of BAA VSS estimates of TX Piscium (cat range 4.8-5.2). Whereas most observers were reporting it as around mags 5.2/5.3/5.4, my estimates were 5.9/6.0/6.1 !. Fortunately, systematic differences, once quantified, are easy to correct for. Experience shows, however, that the corrections required for a given observer do sometimes drift over a number of years. Various factors could account for this - changing light pollution, moving house, changing which comparison stars are used, ...

Although these effects are most common for red variables, they can show up in estimates of other variables. For example, whereas most SPA VSS observers see Gamma Cas as mag 2.2/2.3, one reports 2.0/2.1 and another reports 2.4/2.5.

Reporting the results of analyses

Someone who is new to variable star observing will probably not be aware of the above problem. If the observer has seen R Lyrae varying between mags 3.9 and 4.3, they may well be disheartened if it is subsequently stated in print that R Lyrae was varying between mags 4.4 and 4.8. It is much better to quote a range of 0.4 mag and, if possible, avoid quoting specific magnitudes.

Observed Amplitude

Although systematic differences are fairly easy to correct for, complications arise if different observers observe different amplitudes of variation. For example, one observer of Mu Cep might observe a range of 3.8-4.3 (0.5 mag) whilst another is observing a range of 4.2-4.4

(0.2 mag).

Comparison Stars

Systematic Differences and differing Observed Amplitudes can be influenced by the choice of comparison stars when making an estimate.

Everyones eyes respond slightly differently to the different colours of light. Thus we will never all agree as to the exact magnitude differences between comparison stars. Thus there is no guarantee that two observers will make the same estimate of a variable when both use comparisons A and B, let alone if one of them uses A and C !

For historical reasons, the SPA VSS sequences for the brighter variables use V magnitudes. For Delta and Mu Cephei, these place Zeta Cep somewhat brighter than either Eta and Iota. In contrast, the BAA VSS sequence for Mu Cephei attempts to convert these to a closer approximation to visual magnitudes. This places Zeta fainter than Eta, but brighter than Iota. Personally, I would agree with the BAA VSS order of Eta, Zeta, Iota - but no SPA VSS members have reported problems.

In the SPA VSS sequence for Zeta Gem, the V magnitudes for Nu Gem and 1 Gem are only 0.01 mag apart. This does get queried. However, taking into account the other comparison star magnitudes, some observers would prefer a brighter magnitude for Nu Gem whereas other observers suggest a fainter magnitude for 1 Gem.

The most troublesome comparison is comparison G in the U Orionis sequence. Originally, the SPA VSS sequence used the same comparison star magnitudes as used in the BAA VSS sequence, with G=7.17, H=7.61, etc. However, this led to problems since, in reality, G seems to be slightly fainter than H. When U Orionis was similar in brightness to G and H, observers who used comparison G typically reported magnitudes half a magnitude or more brighter than those who used comparison H. However, some observers who used both G and H did report it as fainter than G and brighter than H ! (I believe that this is also true of BAA VSS estimates).

Comparisons close to other stars

These can be troublesome in that they can affect the apparent brightness of the comparison. Most of the comparisons in the Lambda Tauri sequence are so afflicted. This probably accounts for the large systematic differences between observers. Typically, one observer will see a range of 3.4-3.8 whereas another will see 3.8-4.2. Thus, if an observer reports an isolated estimate of mag 3.8, I don't know whether or not Lambda Tauri was seen in eclipse by that observer !

Problems also occur when Mira is near minimum. The faintest comparison in the SPA VSS sequence is very close to Mira and when estimates only use the next brighter comparison there is uncertainty as to whether the estimate is really of Mira itself or of the comparison.

Altitude Effects

These are a particular problem for naked eye variables, especially those for which the comparisons are located some distance from the variable. Although variables such as Beta Pegasi and Alpha Herculis are sometimes affected in this way, the problem tends to be greatest for Betelgeuse. Estimates made during August and September when Aldebaran is much higher than Betelgeuse, and Procyon is either very low or has not risen, typically show enormous scatter.

Distribution of Estimates

Inevitably, variables tend to be much better covered when well placed in the evening sky than when they are only visible in the morning sky. In addition, the summer months tend to get better coverage than do the winter and spring months - a consequence of both the holiday season and the better weather.

Cepheid and Eclipsing variables, for which observations from many different cycles may be combined into a single light curve covering just one cycle, generally do not need an even spread of observations throughout the year - but an even spread throughout the cycle of variation does help, otherwise some parts of the light curve will be based on more estimates than are other parts.

However, when 300 estimates of a variable are split into 30 divisions of equally sized phase ranges, it is not unusual for some of the phase ranges to have as few as 2 estimates whilst others have as many as 20 ! As an example, Beta Lyrae has a period of approx 12.913 days. In practice, because the period is fairly close to a whole number of days, this means that it will not be observable in a dark sky at certain phases for many weeks during the summer. Certain phases will occur near Full Moon when observers are less likely to be out observing. And then there is the weather .... These factors lead to some phases being poorly represented in the data. On the other hand, if it is clear across the UK on a moonless Saturday night in August, many observations will be received for a particular narrow range of phases.

Errors

We all sometimes make mistakes.

Some are introduced when transcribing estimates from the log book to the report form. Some occur when converting the light estimate into the deduced magnitude. Some occur when making the estimate itself.

No-one seems to be immune. Even the most experienced observers occasionally report class 1 estimates whereby, for example, they see Beta Lyrae at maximum when everyone else sees it at minimum.

But, as has been illustrated earlier, just because the estimates of two observers do not agree does not necessarily mean that one observer is right and the other is wrong. Although it is generally accepted that, under good conditions, visual estimates can be accurate to +/ - 0.1 mag, we have to be careful in how we interpret this accuracy.

IBVS's No. 4452 - 4492

GARY POYNER

4452 CCD Photometry of Eclipsing Binary AL Ophiuchi. (Sarounova & Wolf, 1997)
4453 HR 7674: A low amplitude Cepheid? (Manfroid et al, 1997)
4454 Photoelectric observations of X Persei. (Engin & Yuce, 1997)
4455 Orbital period of the eclipsing variable V1147 Cygni. (Chinarova, 1997)
4456 Photoelectric VIc observations and new elements for V399 Carinae = HR 4110. (Berdnikov & Turner, 1997)
4457 Variable Stars in the Globular Cluster NGC 6266. (Malakhova et al, 1997)
4458 New variable stars in the northern milky way. (Dahlmark, 1997)
4459 Identifications for Baade's variables in Sagitta and Cygnus. (Skiff, 1997)
4460 On the name "Over Contact Binary Systems". (Rucinski, 1997)
4461 UBV observations of T CrB. (Zamanov & Zamanova, 1997)
4462 A flare event detected in the eclipsing binary CM Dra. (Kim et al, 1997)
4463 A new suspected variable in Pisces. (Reimann & Freidemann, 1997)
4464 Detection of fast flares of EV Lac in 1994-96. (Zalinian & Tovmassian, 1997)
4465 Observations of flare stars EV Lac, V577 Mon and YZ CMi. (Tovmassian et al, 1997)
4466 SA98-185 (=HD 292574) - A new eclipsing binary among Landolts standard stars. (Kim et al, 1997)
4467 Sorting out W Bootis and it's comparison stars. (Percy et al, 1997)
4468 Improved ephemeris and new observations of NSV 02980. (Moschner et al, 1997)
4469 Photometric results of three Hipparcos variables: The new eclipsing binary systems HD 125488 and HD 126080, and the star HD 341508. (Gomez-Forrellad & Garcia-Melendo, 1997)
4470 Photometric observations of T Tauri type stars: DI Cep, T Tau, V410 Tau, GW Ori, V649 Ori. (Ismailov, 1997)
4471 The 73rd Name-List of Variable Stars. (Kazarovets & Samus, 1997)
4472 Photoelectric Minima of selected eclipsing binaries and maxima of pulsating stars. (Agerer & Huebscher, 1997)
4473 GSC 4540_1533 is a new binary star. (Jang, 1997)
4474 The eclipsing binary star MS 1428.2+0732. (Robb, 1997)
4475 Discovery of an eclipsing binary star in Auriga. (Hasan, 1997)
4476 Improved positions for Sonneberg Variables: Part 1. (Manek, 1997)
4477 Eclipse observations of AB Andromedae. (Nellermoe & Reitzler, 1997)
4478 Correct position of MX Sagittae. (Manek, 1997)
4479 FUOR V1057 Cyg - Two years in local minimum. (Ibrahimova & Ibrahimov, 1997)
4480 Aldeberan: Discovery of small amplitude light variations. (Wasatonic & Guinan, 1997)
4481 New elements of V694 Aquilae. (Frank et al, 1997)
4482 UBV Photometry of the W UMa star BH Cas. (Metcalfe, 1997)
4483 HD 102541: A Pulsating candidate lambda Bootis star. (Kaschnig et al, 1997)
4484 Radial velocity curves and first calculations of the radii for four double-mode Cepheids. (Sachkov, 1997)
4485 A new double mode Cepheid in Scutum. (Antipin, 1997)

4486 The eclipsing binary star RX J1326.9+4532. (Robb & Greimel, 1997)
4487 The first photoelectric observations for the double mode Cepheid BD -10.4669. (Berdnikov & Turner, 1997)
4488 Photoelectric observations for two misclassified variables: AF Crucis and CG Sagittarii are not Cepheids. (Berdnikov & Turner, 1997)
4489 Revealing of a new SU UMa type variable star Var21 Coronae Borealis.(Novak, 1997)
4490 Two new variable stars near the variable WR 7 (=HD 56925) and the constant WR 18 (=HD89358). (Veen et al, 1997)
4491 More flares of HY Andromedae. (Alksnis et al, 1997)
4492 New water maser in L 1251. (Toth & Kun, 1997)

Please note that the deadline for the December circular will be 1st November. All articles and letters are welcome, and should be sent to the editor - address is given on back cover of this circular. If authors have access to a PC, electronic submission is preferred. Guidelines for authors are available on request.

ECLIPSING BINARY PREDICTIONS

TRISTRAM BRELSTAFF

The following predictions are calculated for an observer at 53 degrees north, 1.5 degrees west but should be usable for observers throughout the British Isles. The times of mid-eclipse appear in parentheses with the start and end times of visibility on either side. The times are hours GMAT, that is UT-12h. 'D' and 'L' are used to indicate where daylight and low altitude, respectively, prevent part of the eclipse from being visible. Charts for all of the stars included in these predictions (17 in all - see VSSC 90 for a list) are available from the Eclipsing Binary Secretary at 10p each (please enclose a large SAE).

1997 Oct 1 Wed
S Equ D07(04)09
RZ Cas D07(05)07
ST Per D07(05)09
TX UMa D07(11)09L
Z Per 07(12)17
RW Tau L08(09)14
U Sge 09(15)13L
TX UMa L11(11)16

1997 Oct 2 Thu
U Cep D06(10)15
RZ Cas 07(10)12
Z Vul 11(16)14L
X Tri 17(19)17D

1997 Oct 3 Fri
Z Dra D06(09)11
RZ Cas 12(14)17
RW Gem 13(18)17D
SW Cyg 14(20)17D
X Tri 16(19)17D
ST Per 17(21)17D

1997 Oct 4 Sat
Y Psc 07(12)16L
RW Tau L08(04)09
TX UMa 08(13)08L
Z Per 09(13)17D
S Equ 09(15)13L
TX UMa L11(13)17D
TW Dra 14(19)17D
Z Dra 15(17)17D
X Tri 15(18)17D
RZ Cas 17(19)17D

1997 Oct 5 Sun
Z Vul D06(03)09
X Tri 15(17)17D
SS Cet 17(22)17D

1997 Oct 6 Mon
ST Per 08(12)17
RW Gem L10(15)17D
X Tri 14(17)17D

1997 Oct 7 Tue
RZ Cas D06(04)07
U Cep D06(10)15
Z Dra 08(10)13
TW Dra 09(14)17D
Z Vul 09(14)13L
Z Per 10(15)17D
TX UMa L11(14)17D
X Tri 13(16)17D

1997 Oct 8 Wed
S Equ D06(01)06
Y Psc D06(06)11
U Sge D06(09)13L
SW Cyg D06(09)15
RZ Cas 07(09)11
X Tri 13(15)17D

SS Cet 16(21)17D
Z Dra 17(19)17D
1997 Oct 9 Thu
ST Per D06(04)08
RW Gem L10(12)17
RZ Cas 11(14)16
X Tri 12(14)17
RW Tau 12(17)17D
U Cep 17(22)17D
1997 Oct 10 Fri
Z Vul D06(01)07
TW Dra D06(09)14
TX UMa 11(16)17D
Z Per 11(16)17D
X Tri 11(14)16
RZ Cas 16(18)17D
1997 Oct 11 Sat
S Equ 06(11)13L
Z Dra 10(12)15
X Tri 11(13)16
U Sge 12(18)12L
V640 Ori L12(10)13
ST Per 15(20)17D
SS Cet 16(20)17D
1997 Oct 12 Sun
U Cep D06(09)14
Z Vul 07(12)13L
RW Tau L07(11)16
RW Gem L10(08)14
X Tri 10(12)15
SW Cyg 17(23)17D
1997 Oct 13 Mon
RZ Cas D06(04)06
TW Dra D06(05)10
X Tri 09(12)14
V640 Ori L12(11)13
TX UMa 12(17)17D
Z Per 13(17)17D
1997 Oct 14 Tue
Z Dra D06(05)08
RZ Cas 06(08)11
ST Per 07(11)15
X Tri 09(11)14
SS Cet 15(20)17D
U Cep 16(21)17D
1997 Oct 15 Wed
U Sge D06(03)09
RW Tau L07(06)10
X Tri 08(10)13
RW Gem L09(05)10
RZ Cas 11(13)16
Z Dra 12(14)16
V640 Ori L12(11)14
Y Psc 14(19)15L
1997 Oct 16 Thu
X Tri 07(10)12
Z Per 14(19)17D
TX UMa 14(19)17D
RZ Cas 15(18)17D
1997 Oct 17 Fri
ST Per D06(03)07
U Cep D06(09)14
Z Vul D06(10)13L
X Tri 07(09)11
SW Cyg 07(13)17L
V640 Ori L12(12)14
SS Cet 15(19)17D
1997 Oct 18 Sat
Z Dra D06(07)10
X Tri D06(08)11
S Equ D06(08)12L
U Sge 07(12)12L
TW Dra 14(19)17D
1997 Oct 19 Sun
X Tri D06(08)10
Y Psc 09(13)15L
V640 Ori L12(12)15
Z Dra 13(16)17D
ST Per 14(18)17D
Z Per 15(20)17D
TX UMa 15(20)17D
U Cep 16(21)17D
1997 Oct 20 Mon
X Tri D06(07)09
RZ Cas D06(08)10
RW Tau 14(19)17D
SS Cet 14(19)17D
1997 Oct 21 Tue
X Tri D06(06)09
TW Dra 10(15)18D
RZ Cas 10(13)15
V640 Ori L12(13)15
1997 Oct 22 Wed
SW Cyg D06(03)09
X Tri D06(06)08
Z Vul D06(08)12L
U Cep D06(09)14
ST Per D06(10)14
Z Dra 06(09)11
RZ Cas 15(17)18D
Z Per 17(21)18D
TX UMa 17(22)18D
1997 Oct 23 Thu
X Tri D06(05)07
Y Psc D06(08)12
RW Tau 08(13)18D
V640 Ori L12(13)16
SS Cet 13(18)18L
RW Gem 14(20)18D
Z Dra 15(17)18D
1997 Oct 24 Fri
X Tri D06(04)07
TW Dra D06(10)15
U Cep 16(21)18D
1997 Oct 25 Sat
X Tri D06(04)06
S Equ D06(05)11
U Sge D06(07)12L
V640 Ori L12(14)16
1997 Oct 26 Sun
RZ Cas D06(07)10
RW Tau L06(07)12
Z Dra 08(11)13
SW Cyg 10(16)17L
RW Gem 11(16)18D
SS Cet 13(17)17L
1997 Oct 27 Mon
Y Psc D06(02)07
TW Dra D06(06)11
Z Vul D06(06)11
U Cep D06(08)13
RZ Cas 10(12)14
V640 Ori L11(14)17
ST Per 13(17)18D
Z Dra 17(19)18D
1997 Oct 28 Tue
U Sge 10(16)11L
S Equ 10(16)12L
RZ Cas 14(17)18D
1997 Oct 29 Wed
Z Dra D05(04)06
RW Tau L06(02)07
RW Gem L08(13)18D
Z Vul 11(17)12L
V640 Ori 12(15)17
SS Cet 12(17)17L
U Cep 15(20)18D
1997 Oct 30 Thu
TW Dra D05(01)06
ST Per D05(08)13
Z Dra 10(12)15
1997 Oct 31 Fri
SW Cyg D05(06)12
V640 Ori 12(15)18
RW Tau 16(20)18D
1997 Nov 1 Sat
U Sge D05(01)06
Z Per D05(01)06
TX UMa D05(02)07L
S Equ D05(02)08
Z Vul D05(03)09
RZ Cas D05(07)09
U Cep D05(08)13
RW Gem L08(10)15
SS Cet 11(16)17L
TW Dra 15(20)18D
1997 Nov 2 Sun
Z Dra D05(05)08
RZ Cas 09(11)14
V640 Ori 13(16)18D
1997 Nov 3 Mon
Z Vul 09(14)12L
RW Tau 10(15)18D
Y Psc 10(15)14L
Z Dra 12(14)16
RZ Cas 14(16)18D
U Cep 15(20)18D
1997 Nov 4 Tue
Z Per D05(03)08
TX UMa D05(04)06L
U Sge D05(10)11L
S Equ 07(13)11L
RW Gem L08(07)12
TW Dra 11(16)18D
SS Cet 11(15)17L
ST Per 11(16)18D
V640 Ori 13(16)18D
SW Cyg 14(20)16L
X Tri 18(20)18D
1997 Nov 5 Wed
X Tri 17(19)18D
1997 Nov 6 Thu
Z Vul D05(01)07
Z Dra D05(07)10
U Cep D05(08)13
RW Tau L05(09)14

V640 Ori 14(17)18D
X Tri 16(19)18D

1997 Nov 7 Fri

Z Per D05(04)09
TX UMa D05(05)06L
RZ Cas D05(06)09
ST Per D05(07)11
Y Psc D05(09)14
TW Dra 06(11)16
RW Gem L08(03)09
TX UMa L09(05)10
SS Cet 10(15)17L
Z Dra 13(16)18D
X Tri 15(18)18D

1997 Nov 8 Sat

Z Vul 07(12)11L
RZ Cas 08(11)13
V640 Ori 14(17)18D
X Tri 15(17)18D
U Cep 15(20)18D

1997 Nov 9 Sun

RW Tau D05(04)08
SW Cyg D05(10)16
RZ Cas 13(16)18
X Tri 14(17)18D

1997 Nov 10 Mon

Z Per D05(06)10
TW Dra D05(06)11
TX UMa D05(07)06L
Z Dra 07(09)11
TX UMa L09(07)11
SS Cet 10(14)16L
X Tri 13(16)18L
V640 Ori 15(18)18D
RZ Cas 18(20)18D

1997 Nov 11 Tue

Y Psc D05(04)08
U Sge D05(04)10
U Cep D05(07)12
S Equ D05(10)11L
X Tri 13(15)18
Z Dra 15(18)18D
RW Tau 17(22)18D

1997 Nov 12 Wed

ST Per 10(14)18D
X Tri 12(15)17
V640 Ori 15(18)18D
RW Gem 16(21)18D

1997 Nov 13 Thu

TW Dra D05(02)07
RZ Cas D05(06)08
Z Per D05(07)12
TX UMa D05(08)06L
Z Vul D05(10)11L
TX UMa L08(08)13
SS Cet 09(14)16L
X Tri 11(14)16
U Cep 14(19)18D
SW Cyg L17(23)18D

1997 Nov 14 Fri

SW Cyg D05(<<)05
U Sge 08(13)10L
RZ Cas 08(10)13
Z Dra 08(11)13
X Tri 11(13)16
RW Tau 12(17)18D
V640 Ori 16(19)18L

1997 Nov 15 Sat

ST Per D05(06)10
X Tri 10(13)15
RW Gem 13(18)18D
RZ Cas 13(15)17
TW Dra 16(21)18D
Z Dra 17(19)18D

1997 Nov 16 Sun

U Cep D05(07)12
Z Per D05(08)13
TX UMa 05(10)06L
TX UMa L08(10)15
SS Cet 08(13)16L
X Tri 09(12)14
V640 Ori 16(19)18L
RZ Cas 17(20)18D

1997 Nov 17 Mon

Z Dra D05(04)06
RW Tau 06(11)16
X Tri 09(11)14
ST Per 17(21)18D

1997 Nov 18 Tue

S Equ D05(07)10L
Z Vul D05(08)11L
SW Cyg 07(13)15L
X Tri 08(10)13
RW Gem 09(14)18D
Z Dra 10(12)15
TW Dra 11(16)18D
Y Psc 12(16)13L
U Cep 14(19)18D
V640 Ori 17(20)18L
SW Cyg L17(13)18D

1997 Nov 19 Wed

RZ Cas D05(05)07
Z Per D05(10)14
X Tri 07(10)12
SS Cet 08(12)16L
TX UMa L08(11)16

1997 Nov 20 Thu

RW Tau D05(05)10
X Tri 07(09)12
RZ Cas 07(10)12
ST Per 09(13)17
V640 Ori 17(20)18L

1997 Nov 21 Fri

Z Dra D05(06)08
U Cep D05(07)12
U Sge D05(08)10L
X Tri 06(08)11
TW Dra 07(12)17
RW Gem L07(11)16
RZ Cas 12(14)17

1997 Nov 22 Sat

X Tri 05(08)10
Z Per 06(11)16
Y Psc 06(11)13L
SS Cet 07(12)16L
TX UMa 08(13)18
Z Dra 12(14)17
RZ Cas 17(19)18D

1997 Nov 23 Sun

SW Cyg D05(03)09
ST Per D05(05)09
Z Vul D05(06)10L
X Tri D05(07)10
U Cep 14(19)18D

1997 Nov 24 Mon

X Tri D05(06)09
TW Dra D05(07)12
RW Gem L07(08)13

1997 Nov 25 Tue

S Equ D05(04)09
RZ Cas D05(05)07
X Tri D05(06)08
Z Dra D05(07)10
SS Cet 06(11)15L
Z Per 07(12)17
TX UMa 10(14)18D
RW Tau 14(18)18D
ST Per 16(20)18D

1997 Nov 26 Wed

X Tri D05(05)07
Y Psc D05(05)10
U Cep D05(06)11
RZ Cas 07(09)12
Z Dra 13(16)18

1997 Nov 27 Thu

TW Dra D05(03)08
X Tri D05(04)07
RW Gem L06(05)10
SW Cyg 11(17)15L
RZ Cas 11(14)16
SW Cyg L16(17)19D

1997 Nov 28 Fri

U Sge D05(02)08
Z Vul D05(04)09
X Tri D05(04)06
SS Cet 06(10)15
ST Per 08(12)16
RW Tau 08(13)18
S Equ 09(14)10L
Z Per 09(14)18
TX UMa 11(16)19D
U Cep 13(18)19D
RZ Cas 16(19)19D

1997 Nov 29 Sat

X Tri D05(03)05
Z Dra 07(09)11
TW Dra 17(22)19D

1997 Nov 30 Sun

RW Gem L06(02)07
Z Vul 09(14)10L
Z Dra 15(18)19D

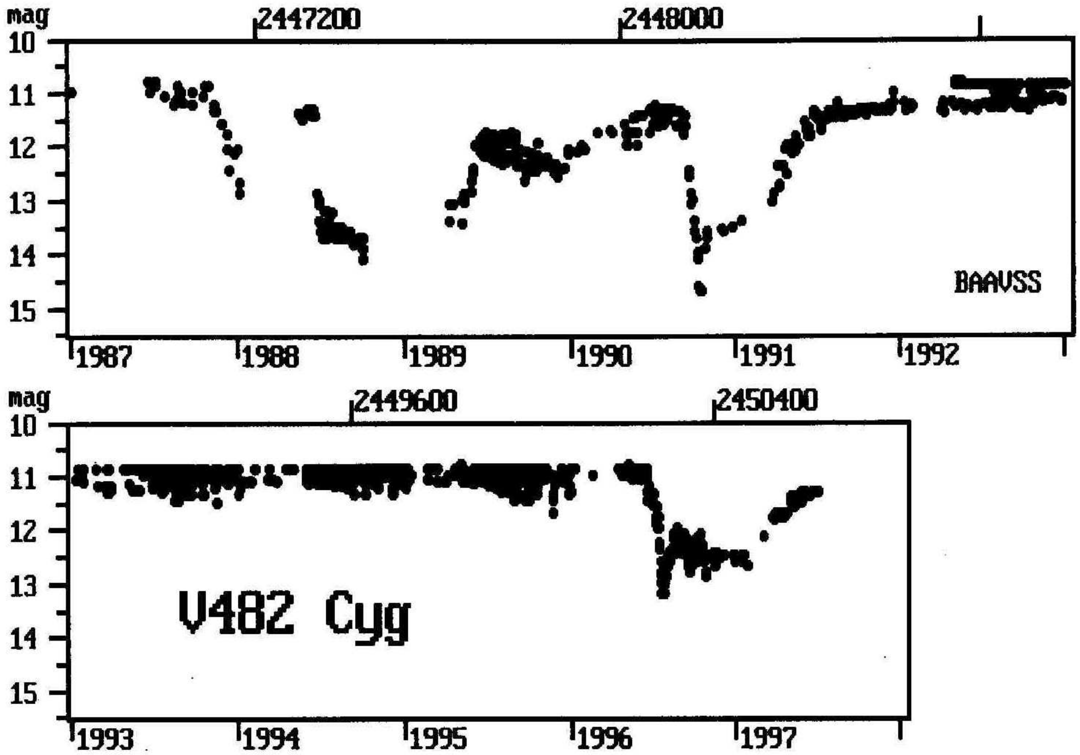
1997 Dec 1 Mon

ST Per D05(03)07
RZ Cas D05(04)06
U Cep D05(06)11
RW Tau D05(07)12
SS Cet 05(10)14
U Sge 05(11)09L
Z Per 10(15)19D
TX UMa 13(17)19D

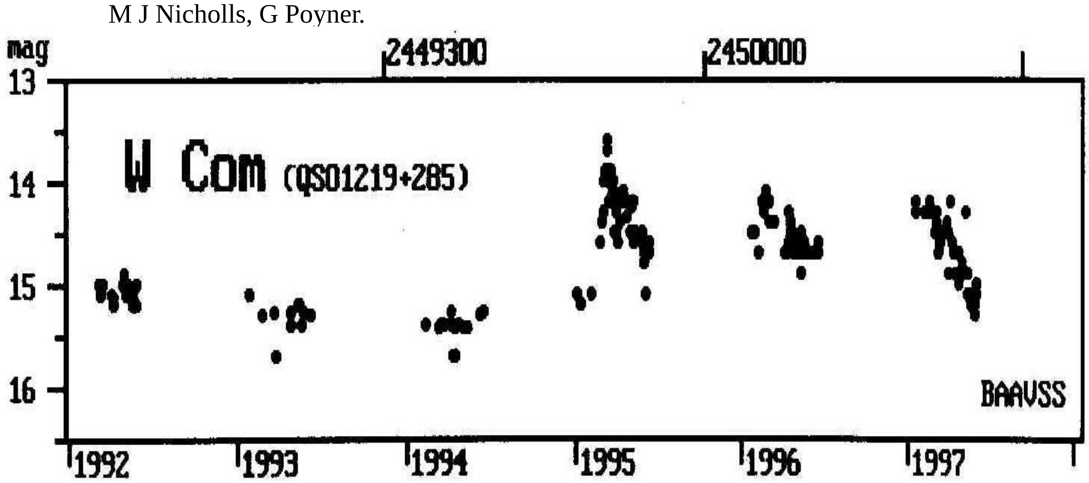
1997 Dec 2 Tue

S Equ D05(01)06
SW Cyg D05(06)12
RZ Cas 06(09)11
TW Dra 12(17)19D
RW Gem 17(22)19D

1997 Dec 3 Wed
Z Vul D05(01)07
Z Dra 08(11)13
RZ Cas 11(13)16
U Cep 13(18)19D
ST Per 15(19)19D
1997 Dec 4 Thu
RW Tau D05(02)06
SS Cet D05(09)14
Z Per 12(16)19D
TX UMa 14(19)19D
RZ Cas 16(18)19D
Z Dra 17(19)19D
1997 Dec 5 Fri
S Equ 06(11)09L
Z Vul 07(12)10L
TW Dra 08(13)18
RW Gem 14(19)19D
1997 Dec 6 Sat
Z Dra D05(04)06
U Cep D05(06)11
ST Per 06(10)14
RW Tau 16(20)18L
SW Cyg L16(20)19D
1997 Dec 7 Sun
RZ Cas D05(03)06
SS Cet D05(09)13
Y Psc 08(12)12L
Z Dra 10(13)15
Z Per 13(18)19D
TX UMa 16(20)19D
1997 Dec 8 Mon
U Sge D05(05)09L
TW Dra D05(08)13
RZ Cas 06(08)10
RW Gem 11(16)19D
U Cep 13(18)19D
Z Dra 19(21)19D
1997 Dec 9 Tue
ST Per D05(02)06
RW Tau 10(15)18L
RZ Cas 10(13)15
1997 Dec 10 Wed
Z Dra D05(06)08
SS Cet D05(08)13
Z Vul 05(10)09L
Z Per 14(19)19D
RZ Cas 15(17)19D
TX UMa 17(22)19D
1997 Dec 11 Thu
TW Dra D05(03)08
U Cep D05(05)10
Y Psc D05(07)11
SW Cyg D05(10)14L
RW Gem 08(13)18
Z Dra 12(14)17
ST Per 13(17)19L
SW Cyg L16(10)16
X Tri 16(18)16L
1997 Dec 12 Fri
S Equ D05(08)09L
RW Tau D05(09)14
X Tri 15(17)16L
Z Vul L19(21)19D
1997 Dec 13 Sat
RZ Cas D05(03)05
SS Cet D05(07)12
U Cep 12(17)19D
X Tri 14(17)16L
Z Per 16(20)19L
TW Dra 18(23)19D
1997 Dec 14 Sun
ST Per 05(09)13
Z Dra 05(07)10
RZ Cas 05(07)10
RW Gem L05(09)15
X Tri 14(16)16L
1997 Dec 15 Mon
U Sge D05(00)05
Y Psc D05(01)05
RW Tau D05(04)08
Z Vul D05(08)09L
RZ Cas 10(12)15
X Tri 13(15)16L
Z Dra 14(16)18
SW Cyg 18(24)19D
1997 Dec 16 Tue
SW Cyg D05(00)06
U Cep D05(05)10
SS Cet D05(07)11
X Tri 12(15)16L
TW Dra 13(18)19D
RZ Cas 14(17)19D
Z Per 17(22)18L
1997 Dec 17 Wed
RW Gem L05(06)11
X Tri 11(14)16L
RW Tau 17(22)18L
Z Vul L18(19)19D
1997 Dec 18 Thu
U Sge D05(09)08L
Z Dra 07(09)12
X Tri 11(13)16L
U Cep 12(17)19D
1997 Dec 19 Fri
S Equ D05(05)08L
SS Cet D05(06)11
TW Dra 08(14)19
X Tri 10(13)15
ST Per 12(16)18L
Z Dra 15(18)19D
1997 Dec 20 Sat
Z Vul D05(06)09L
RZ Cas D05(07)09
RW Gem L05(03)08
TX UMa L06(03)07
SW Cyg 07(13)13L
X Tri 09(12)14
RW Tau 12(16)17L
SW Cyg L15(13)19D
1997 Dec 21 Sun
U Cep D05(05)10
X Tri 09(11)14
RZ Cas 09(12)14
U Sge L19(18)19D
1997 Dec 22 Mon
SS Cet D05(05)10
ST Per D05(08)12
TW Dra D05(09)14
X Tri 08(11)13
Z Dra 08(11)13
Y Psc 09(14)11L
RZ Cas 14(16)19
Z Vul L18(17)19D
RW Gem 19(24)19L
1997 Dec 23 Tue
RW Gem D05(00)05
Z Per D05(00)05
TX UMa L06(04)09
RW Tau 06(11)16
X Tri 07(10)12
U Cep 12(17)19D
Z Dra 17(19)19D
RZ Cas 19(21)19D
1997 Dec 24 Wed
X Tri 07(09)12
1997 Dec 25 Thu
U Sge D05(03)08L
SW Cyg D05(03)09
Z Vul D05(04)08L
Z Dra D05(04)06
TW Dra D05(04)09
SS Cet D05(05)10
X Tri 06(08)11
RW Gem 15(21)19L
1997 Dec 26 Fri
S Equ D05(02)07
Z Per D05(02)07
U Cep D05(04)09
RW Tau D05(05)10
RZ Cas D05(06)09
Y Psc D05(08)11L
X Tri 05(08)10
TX UMa L06(06)10
Z Dra 10(13)15
1997 Dec 27 Sat
X Tri D05(07)10
V640 Ori L07(05)08
RZ Cas 09(11)13
ST Per 11(15)17L
Z Vul L18(15)19D
TW Dra 19(24)19D
Z Dra 19(21)19D
1997 Dec 28 Sun
SS Cet D05(04)09
X Tri D05(06)09
U Sge 06(12)07L
U Cep 11(16)19D
RW Gem 12(17)18L
RZ Cas 13(16)18
1997 Dec 29 Mon
Z Per D05(03)08
Z Dra D05(06)08
X Tri D05(06)08
TX UMa L05(07)12
S Equ 07(12)08L
V640 Ori L07(05)08
SW Cyg 11(17)13L
SW Cyg L14(17)19D
RZ Cas 18(20)19D
1997 Dec 30 Tue
Z Vul D05(02)07
Y Psc D05(02)07
X Tri D05(05)08
ST Per D05(06)10
Z Dra 12(14)17
TW Dra 14(19)19D
1997 Dec 31 Wed
SS Cet D05(04)08
U Cep D05(04)09
X Tri D05(04)07
V640 Ori L07(06)09
RW Gem 09(14)18L
RW Tau 14(18)17L
U Sge L18(21)19D



V482 Cyg 1987 to 1997. 1379 observations by;-
R J Bouma, L K Brundle, D Gill, M Gill, G M Hurst, J E Isles, C P Jones, M J Nicholls, G Poyner.



W Com 1992 to 1997. 231 observations by;-
J Greaves, L T Jensen, G Poyner, J Toone, W J Worraker.

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