British Astronomical Association

VARIABLE STAR SECTION CIRCULAR

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Contents

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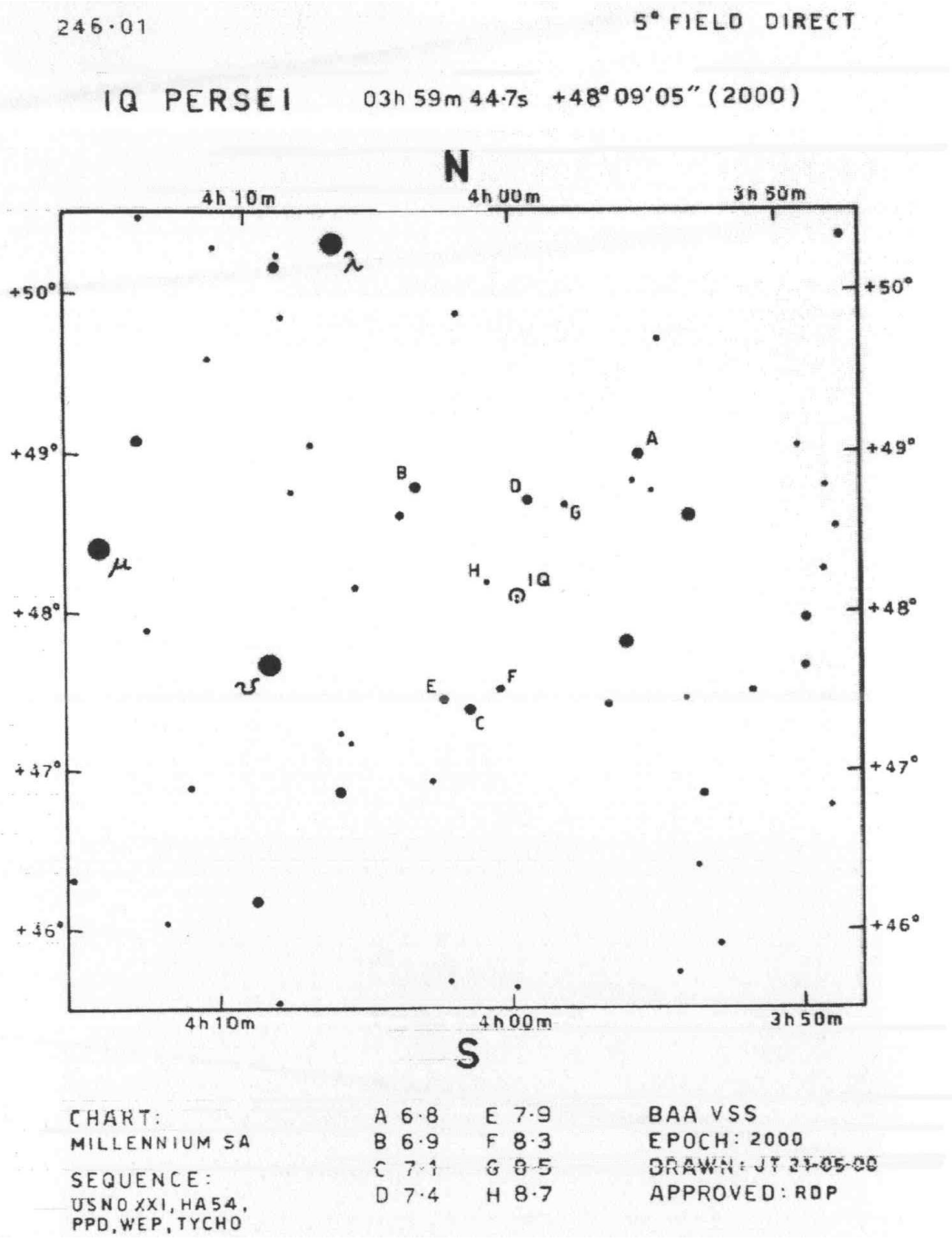
NEW CHARTS

JOHN TOONE

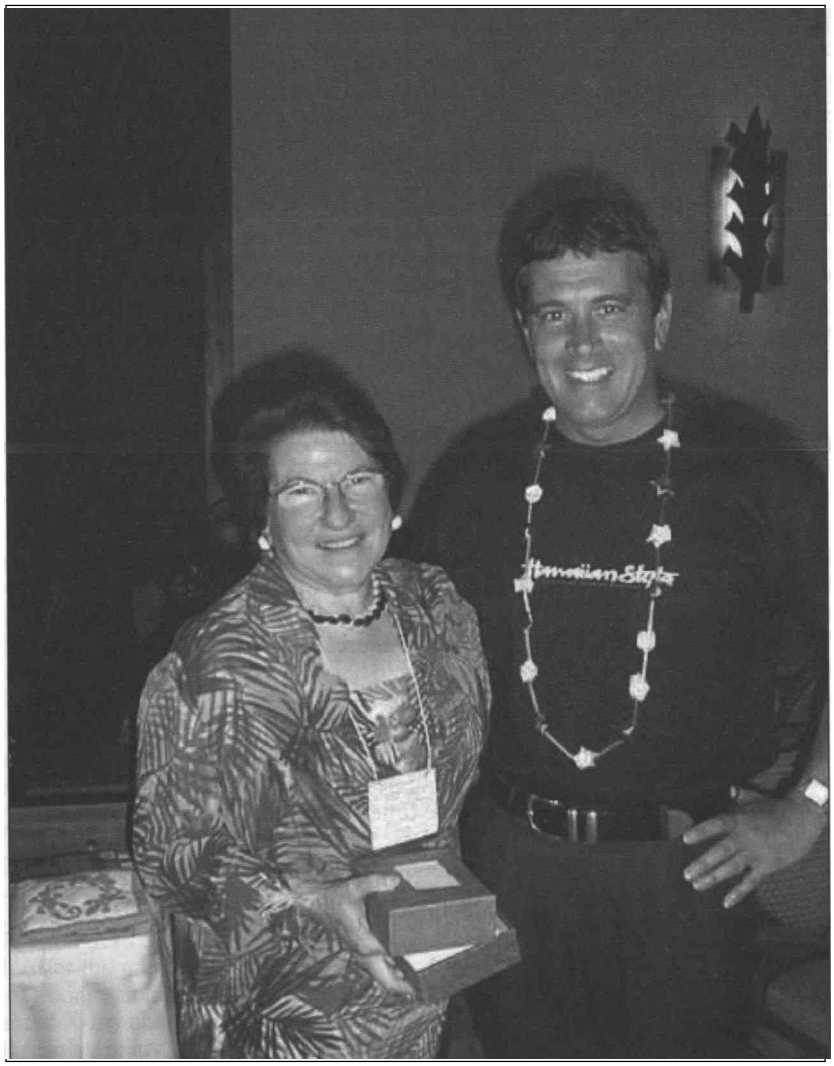


FROM THE DIRECTOR

ROGER PICKARD

John Toone Reaches 100,000 Visual Observations

I had the good fortune to attend the 91st Spring Meeting of the AAVSO in Hawaii recently, along with John Toone, Hazel McGee and some other Brits (more about that in a later Circular). Whilst there, John managed to complete his 100,000th visual variable star observation; what a location in which to reach this remarkable total! It was most fitting therefore, that I was able to announce this achievement at the AAVSO Awards Ceremony at the Banquet, which closed the whole meeting; the announcement was greeted with loud applause and a warm handshake from the AAVSO Director, Janet Mattei (see picture below).



John made his first observation back in 1975 from the light polluted skies of Manchester - hardly the place to inspire observing of any sort? He used a pair of 12x50 binoculars then, that he has used ever since, including that landmark observation in Hawaii. However, John does not restrict his observing to binoculars, he also uses a C8 and, occasionally, a 14" especially for those faint AGNs. He also observes from a much darker site now!

BAA Exhibition Meeting

This Meeting will be held on 2002 September 21st at the spacious Exhibition venue at The Cavendish Laboratory, off Madingley Road, Cambridge - far away from the heat and dust that has plagued us at more recent exhibition meetings in London. I've booked a large amount of space and hope that many of you will be able to attend and also exhibit some of your work. The VSS has always supported this meeting by displaying a wide selection of light curves of many types of variable star but it would be nice to see some other material as well. In addition, Gary Poyner has also displayed a number of his own amazing light curves and there have been good displays of both PEP and CCD work in the past. I hope this year will be no exception but I would also like to extend the range of material presented. Karen Holland is hoping to produce something on the new CCD target list that we are working on, and also the Mentor Scheme. We should have power available so that a PC could be used to display things that would be lost on a more static display. It should also be possible to provide a light box if this would assist any displays.

If you think you would like to contribute to the Exhibition this year please contact me as soon as possible so that I can reserve the necessary space.

OBSERVER PROFILES - REQUEST FOR SHORT ARTICLES

KAREN HOLLAND

At the recent officers meeting (see page 4 of this circular for a summary), it was suggested that it would be good to include articles in the circulars about VS members - *observer profiles*; it was suggested that these articles could take the form of a short article (they could be as short as half a page) about the observer, his/her interests and life. It would also be nice to include a small picture of the observer, which would help newcomers to identify VS members at meetings.

Additionally, another suggestion was that there could be an occasional '*Confessions of a Variable Star Observer'* series, in which willing observers might confess to those observing mistakes that we have all fallen foul of at some time or another!

If there are any VS members willing to contribute small articles to this series, I would be very grateful if they could be sent to the editor (details on the back cover); raw text is preferred for text submissions, and images in TIF, PCX or BMP are preferred, but other formats can be handled.

WW CETI - A PROFESSIONAL REQUEST FOR OBSERVATIONS

DARREN BASKILL

Beginning in mid-August (hopefully!), the Rossi X-ray Timing Explorer (RXTE) Earth-orbiting telescope will begin observing the dwarf nova **WW Ceti**. The aim of this brief article is to encourage as many people as possible to join in with the simultaneous optical monitoring of WW Ceti. For news on the project, please see: **http://www.star.le.ac.uk/~dbl/xtewwcet.html** Many of you may have already heard of the campaign, which was advertised to start in May. However, a few minor interruptions to the RXTE observing schedule had a knock-on effect, which forced the WW Ceti campaign to be delayed until mid-July; further discussions between me and the RXTE planners led to the campaign being delayed again until mid-August.

Many problems can occur with Earth orbiting telescopes. Last December, RXTE suffered problems when the telescope went into "safe" mode (where the satellite does nothing, in order to prevent a detected minor problem becoming a major problem). On that occasion, the star trackers failed to update properly. Within a week, the problem had been corrected. RXTE had tried to guide itself on a "bad star"; perhaps a variable or transient star had managed to sneak into the star tracking catalogue by mistake, and the star RXTE was supposed to guide on had disappeared, causing RXTE to worry about its own mental health and enter safe mode.

The later delay was arranged to ease the RXTE timetable problems, and to improve our ground based optical visibility of WW Ceti. The (approximate) transit times of WW Ceti for the majority of northern hemisphere observers are (in local time for the 15th of each month): July, 5am; August, 3am; September, 1am; October, 11pm; November, 9pm. So the optimum time for back-yard observing of WW Ceti for 3 months is to begin the campaign in autumn. As one of the RXTE planners put it: "I was planning to delay the start to roughly mid-August, based on our earlier correspondence. That's slightly better for us, and it sounded like it won't interfere nearly as much with the sleep plans of the optical observers".

But why are we doing such a long monitoring campaign on WW Ceti? The main problem I am trying to resolve is the apparently contradictory data that comes from once only observations of dwarf novae. Take SS Cygni, for instance. We expect the X-ray luminosity of dwarf novae to be faint during an optical outburst, and bright during optical quiescence. But the opposite happened during the outburst and quiescent observations of SS Cyg, with the Japanese X-ray observatory, ASCA. We think that SS Cyg was unusually faint during the quiescence observation. The fundamental problem is that the majority of X-ray observatories take snapshots at an instant in time, but we need a full movie to understand what is going on. RXTE has observed SS Cyg for almost 3 months previously, during which the X-ray flux varied by a factor of 4 during the optically quiescent periods. We are only now beginning to realise just how much the X-ray flux varies during optical quiescence.

Looking to the future, we have the Lobster-ISS telescope, an project led by the University of Leicester Space Research Centre, and now a core part of the ESA future missions programme (**http://www.src.le.ac.uk/lobster/home.htm**). It is hoped that the Lobster telescope will be mounted on the European Columbus module of the International Space Station (ISS). With a field of view of 162x22 degrees, it will scan (almost) the entire X-ray sky every 90 minutes (the orbital period of the ISS). RXTE also has an all-sky monitor, which unfortunately is not sensitive enough to detect even the X-ray brightest dwarf novae. That is where the Lobster-ISS will offer the greatest improvement over anything that has gone before: sensitivity. So, instead of asking satellites like RXTE to be repeatedly pointed at an object, we will automatically get repeated X-ray observations of the brightest cataclysmic variables. No doubt that Lobster-ISS will resolve many of the apparent contradictions which currently trouble us.

SUMMARY OF THE VSS OFFICERS MEETING

KAREN HOLLAND

A meeting of the Variable Star Section Officers was held on 5th May, 2002, at 16 Westminster Close, Basingstoke; officers present were Roger Pickard, Guy Hurst, Gary Poyner, John Toone, John Saxton and Karen Holland; apologies for absence were received from Melvyn Taylor, Richard Miles and Tony Markham. Thanks were given to Guy and Anne Hurst for providing the venue for this meeting, and particularly to Anne for the excellent lunch that she provided, as well as tea.

The Database (visual only)

John Saxton reported that the database was now working well, and he circulated a copy of the new VSS database to all the officers present. John said that he was still receiving some observations without accompanying estimates, and it was agreed that John should contact those people to inform them that whilst the data would be logged (as for estimates that were sent in for stars not on the BAAVSS programme), it would not be included with our high quality data unless it was accompanied by the estimate.

Paper Records

Melvyn reported that he was about to send the 2001 paper summary to Roger. Roger reported that most people were moving over to electronic reporting, but a few paper reports were still received. There were still a vast number of paper observations that needed to be entered into the database, and more assistance was required with this.

The Telescopic Programme

John Saxton agreed to send some statistics on the number of observations for each star to Roger, in order that a decision could be made if any stars needed to be dropped from the programme; Gary had many ideas for new stars that could be added to the programme, which he would send to Roger for consideration.

CCD Programme

The question of whether we needed a CCD programme or not, had not originally been on the agenda, but discussion naturally drifted in this direction, as Gary had pointed out that some of the fainter stars on the programme were only really suitable for CCD observers. It was agreed that Karen would produce a short target list for CCD observers, that would allow members to concentrate their effort on a few stars initially, in order to gain experience and exchange knowledge.

Binocular Programme

Roger agreed to speak to Melvyn about the forthcoming Binocular Chart booklet, and John Toone thought that the binocular programme should be re-examined. It was agreed that the binocular priority list, that was still produced, should be included in more circulars.

Recurrent Objects Programme

Gary reported that the ROP programme was on the web page, and he presented observing statistics for the last few years; the last review of the programme had been in June, 2002. Obtaining charts for new objects was difficult, and Gary frequently made use of Henden charts where BAA/TA charts were not available; he preferred not to add objects to the programme for which there were no good charts.

The Eclipsing Binary programme

In response to a query that Tony Markham had sent by e-mail, Roger asked if anyone had a frame capture device to assist with Alex Vincent's video. No one had such a device; if anyone knows of a frame capture device that might assist Tony, please contact him directly. Roger had received all outstanding EB observations from Tristram, and had distributed them for keying in, but most of them were still waiting to be keyed in.

The New Variable Star Programme

Roger reported that Chris Jones had taken this over (Mike Collins stars), and would be working on this.

International Variable Star Charts and Sequences

John Toone reported that this had been discussed internationally, and that the meeting on 30th June should include representatives from the BAA VSS, AAVSO, RASNZ, VSNET and VVS WVS (Belgium) observers. It was hoped that consensus might be reached on a number of significant issues. The issue of most discord, currently, was that of comparison star colour, and John spent some time describing Sebastian's Theory on coloured Comparison Stars, and showing charts that he had plotted, which showed the number of stars of a given colour that were available for different galactic latitudes.

Circulars

Karen said that she was happy producing the circular, and invited comments and suggestions for improvement. More images would be welcomed, together with more articles from observers about their observing and specific interests (see page 2 of this circular for more details of the request).

PALC

Roger reported that there hadn't been a PALC meeting for the last two years. The meetings had been regular, until a pause, whilst John Saxton was getting to grips with the database, but with the recent increase in Variable Star and Pro-Am meetings, most PALC content was being adequately covered. There was some uncertainty as to whether the Pro-am meetings should continue, at least in their current format, and it was agreed that Roger would draft a message to send to the current PALC members, to see if it was felt to be worth continuing with the meetings.

Other Programmes

Karen reported that she was hoping to obtain some data that could be used by professionals at Leicester University, and was hoping to persuade other amateurs to join her in acquiring data. At the current time high precision data was required for comparison with predictions that were being made by theoretical modelling scientists for SS Cyg. Accurate long-term eclipse-timing measurements might prove interesting on some CV systems. Karen hoped that, if time permitted, she might produce something for the exhibition meeting in September. She noted that if several observers monitored the same objects simultaneously, then this might help to confirm the suitability of CCD cameras that have anti-blooming gates, if they were properly used.

Submitting Observations to the AAVSO

Darren Baskill (Leicester University) had asked Roger, if BAA data could be added to the AAVSO database, and flagged as BAA data, so that a professional could obtain all data available from the same place. This was not thought to be practical. Darren had also asked if the AAVSO would accept data from anyone, whether or not they were a member of the AAVSO, and it was agreed that it was thought that this was the case.

CCD Photometry and the CCD Database

Karen briefly discussed ideas and reasons for forming a CCD database, and John Saxton passed around a document outlining some of his thoughts, viewed from the perspective of the mechanics of archiving the data. It was agreed that, as a first step, John Toone and Roger should investigate how the AAVSO accept and archive CCD data , as if the AAVSO system was considered satisfactory, then it would be sensible for us to follow their example. John Toone said that the AAVSO CCD charts were very similar in format to our standard charts.

CCD Photometry Workshop

Karen explained that she hoped that the BAA might be willing to consider running a jointly organized Leicester University/BAA photometry workshop at some point in the future. It was hoped that this would help to provide relevant information to amateurs regarding photometry, and suggest suitable projects. If the CCD database were ready in time, then this could perhaps be launched, and explained at the workshop. The idea of inviting teachers who might be participating in the Telescopes in Education programme would be considered nearer to the time.

New Observing Guide

Roger showed some of the charts that were being reproduced in the observing guide; some of them had been reformatted, but it was agreed that the reformat was not considered necessary given the additional great extra cost that would be incurred. It was thought that the observing guide should be produced as a hard copy with an accompanying CD ROM.

The VSS Web site

Roger felt that our web pages could perhaps be updated; Guy said that the main BAA pages were being redesigned, and he wondered whether the individual sections' format should

reflect the central one, or whether there should just be a link to each section, and they should be left to do what they wanted.

Other data collection systems

The development of WASP and TASS-like systems was considered and it was agreed that we should keep abreast of developments, at the very least. Roger agreed to contact Arne Henden to ask about developments with TASS.

AOB

Dick Chambers, who was on the RAS membership Committee had informed Roger that the RAS were looking to see if closer co-operation between the RAS and BAA was possible to ease discussion of relevant issues. Guy thought that this was a good idea and asked Roger if a short note could be submitted to the BAA Council for discussion.

Guy mentioned that there was a vast amount of data available on film; Guy now had a digital film scanner, and he could scan photographs and analyse the resulting digital data. Karen suggested, and John Saxton agreed, that we could form a digital index of images that were available, and then the relevant films could be scanned and the data reduced if it were required. The case of photoelectric photometry was also considered, as this data should also be archived. This would mean that our archive would be a unique and valuable resource. It was noted, however, that colour film produced unreliable results with a large degree of scatter, and in a subseqent discussion it was agreed that whilst indexing the images was a good idea, only those produced on black and white film should be indexed.

Tony Markham had e-mailed a comment: he had asked if the VSS came over as being too interested in new technology? Whilst this was generally thought not to be the case, Guy commented that BAA membership was declining, and this seemed to be partially because members made observations, but never sent them to anyone because they were afraid they would not be good enough. Karen thought that the buddy system should be instigated in an effort to give new members more assistance; new members should be asked if they would like to be notified of potential buddies in their area, and, if interested, could be offered a list of a few buddies with matched interests. The buddies could also be notified, and could directly contact those who had indicated that they would like to make contact with a buddy. It might also be possible to have an e-mail buddy system, for those who preferred e-mail contact. (This was later renamed the *VSS Mentoring Scheme*.

John Toone asked Guy if there was any chance of there being some Variable Star activity in the BAA circulars. Guy said that he would have to send relevant material to Don Miles for him to send out, but Don preferred not to send out circulars on one item only; he preferred to include a few subjects of interest in each circular. It was agreed that if John Toone could keep on feeding Don with information, with a copy to Roger,that he would probably be able to slot it into a circular at an appropriate time.

John Saxton had a question regarding CCD linearity. He wondered if he should loan out his equipment for linearity-testing CCD cameras. Roger thought that linearity tests could be done on a star field (we could also archive the first CCD image an observer sends, to allow us to monitor linearity data). There was a brief discussion on unfiltered photometry with SX cameras and lenses.

THE EARLY BIRD GETS THE VARIABLE

JOHN TOONE

In his classic book "Starlight Nights", Leslie Peltier describes a lost opportunity on a cold February morning back in 1946. He had been observing the old nova **T CrB** for over 25 years, and had planned to observe it again on this particular morning. His alarm clock roused him at 0230, but he did not feel well and returned to bed inspite of the sky being very clear. Unluckily for him, this happened to be the very night that T CrB confirmed its recurrent nature, and rose to its second spectacular outburst. He went on to say that after missing this event, he no longer held a warm feeling towards this particular variable star.

This story reminded me of my own experience with another famous recurrent nova, **RS Oph**. Its last outburst occurred whilst it was hidden behind the sun, and the first observer to pick it up in the morning sky in 1985 was guaranteed to discover the outburst. In 1983 and 1984, I had secured observations as early as 18th January, but in 1985 bad weather prevailed throughout most of January. On the 22nd I braved heavy snowfall to visit my girlfriend, and did not return home until 0215. The snow had stopped falling at that time, and the sky was beginning to clear. I then faced a dilemma; should I stay up to observe in freezing conditions, or retire to bed, as I had to get up for work at 0650. Unfortunately I chose the latter, and it was crystal clear at 0650. This was fully 4 nights before Warren Morrison of Canada was credited with discovering the 1985 outburst of RS Oph. Unlike Peltier, I did not fall out with the variable star, but I did dump the girlfriend! Since then I have redoubled my efforts to observe both T CrB and RS Oph in the morning sky, particularly in the months of January and February.

When the light curves of variable stars with seasonal gaps are closely examined, the period immediately following the gap is often sparsely populated with observations. This is because the majority of our observers are only active in the evening, no doubt due to lifestyle and work commitments. However, those who do make a special effort to observe in the morning are up against less competition to find the interesting activity occurring in variable stars that are emerging from solar conjunction. There are other significant advantages to observing in the morning as well:

Dark Adaption
If you get up to observe after several hours of sleep your dark adaption is optimized.

Fatigue
Sleep replenishes oxygen to the eyes and you are less fatigued after sleep than if you have been awake for 12 - 18 hours.

Light Pollution
There are less people about, than in the evening, resulting in less lighting. Some local councils (sadly only a few so far) switch off some streetlights during the early hours of the morning.

Sky Transparency
Emissions from factories and building heating systems are reduced, often resulting in improved transparency.

Aurorae
Magnetic midnight is around 2200, so the risk of auroral activity interfering is reduced compared with the evening.

To outline the potential scope for observing some of the well known and visually rewarding variable stars from the British Isles in the morning, here is a month-by-month journey throughout the calendar year:

January
The year starts with the best possible conditions for observing in the morning. For a week either side of the 10th, it is possible to observe variable stars right up to 0700. The first week of the new year also often has good sky clarity, due to factories being shut down over the Christmas and New Year holiday period.
Aquila, **Cygnus**, **Ophiuchus**, **Sagitta**, **Scorpius**, **Scutum** and **Serpens Cauda** all come into view this month.
RS Oph emerges at the start of the month; I have seen it at minimum as early as the 3rd. The last outburst in 1985 occurred during solar conjunction, and it was more than 3 weeks into its morning apparition before it was picked up.
R Aql appears around the 10th only a few days after it is lost in the evening.
R Sct can be seen from about the 11th onwards having been lost in the evening close to the Winter solstice date 3 weeks earlier.
V818 Sco the visible component of Sco X1, that varies significantly on a nightly basis, is visible from mid month onwards having been lost the previous August.
A challenge for large telescope owners is **WZ Sge**. **SV Sge** on the other hand is usually brighter and can be seen at the start of the month just as it disappears from the evening sky.

February
The northerly movement of the sun starts to make an impact this month. The limit for observing variable stars is around 0620 at the start of the month, but this recedes to 0540 by the end.
Delphinus, **Lacerta** and **Vulpecula** appear in the northeastern sky this month.
U Del and **EU Del** can be seen with binoculars right at the start of the month.
V Aql and **S Sct** rise sufficiently high for useful binocular observations around mid month.
BL Lac is visible in the second half of the month to those equipped with large telescopes.

March
As winter turns to spring, the cut off for morning observing is 0530 at the start, and 0420 at the end of the month.
Pegasus and **Sagittarius** become visible this month.
RU Peg and **AG Peg**, hidden from view for a month, reappear during the first week. **AG Peg** usually requires a small telescope to render it visible, until it gains altitude above the advancing twilight a month or so later.
SX Lac on the southeastern limit of **Lacerta** is an easy binocular object right from the start of the month.
The spring months of March and April are ideal times for the nova hunter to observe in the late morning, with the Milky Way arcing across the eastern sky. George Alcock discovered **Nova Vul 1968** and **Nova Her 1991** on the 15th April and 25th March respectively, both after 0300 in the morning.

April
The time available for morning observing rapidly shortens this month from 0410 at the start, to 0300 by the end.
Andromeda slowly creeps up from the northeastern horizon this month.
R And and **RX And** lost in the evening right at the end of March, become morning objects during the first week of April to telescopic observers.

EG And on the edge of M31 is an easy binocular object throughout the month.
GO Peg rises sufficiently high enough for binocular observers to recover it (having lost it in mid February).

May
Although it is possible to observe up to 0245 at the start of the month, twilight is ever present by the end of the month, and it is difficult to continue beyond 0110 by that time. Therefore, the advantages of observing in the morning are largely eroded by the rapid onset of summer.
W And can be seen from about the 10th onwards, having been lost in the evening in mid April.
AQ And and **BZ And** might rise sufficiently ahead of twilight for the keen binocular observer.
Circumpolar objects like **S Cas** and **T Cas** and **TZ Per** and **UV Per** are now actually higher in the morning sky than in the evening.

June
All night twilight prevails this month, and it is really only possible (except on the south coast) to observe between 2300 and 0100, thus with the application of BST the evening observers are forced to become morning observers.
The autumn zodiac constellations of **Aquarius**, **Capricornus** and **Pisces** creep up above the eastern horizon in strong twilight. **Triangulum** also reappears.
Z Psc and **TX Psc**, lost to binocular observers in February, now reappear in the first week.
VY Aqr and **Markarian 509** can be recovered by telescopic observers mid month.
GK Per, which is usually lost at the end of April, can be picked up by determined telescopic observers towards the end of the month.
W Tri can be seen with binoculars at the end of the month.

July
Dark skies reappear during the third week and by the end of the month observations can continue until 0210.
Aries, **Cetus** and **Taurus** become fully visible this month.
X Per above the Pleiades, emerges during the first week, having been lost at the start of May.
Y Lyn becomes a morning object, having finished its evening apparition at the end of June.
UU Aur, dipping into the northern twilight at the start of June, reappears around the 22nd.
AB Aur was lost during the first week in May, but can be recovered from about the 25th.
Mira, hidden from view since mid March, re-emerges during the third week.
RV Tau can be picked up during the final week of the month.

August
As summer concludes, the scope for morning observations dramatically increases. At the start of the month observations can continue until 0220, but by the month's end this is extended to 0340. Dark skies, warm conditions and meteors should encourage the observer to explore the morning skies this month.
Gemini, **Eridanus**, **Lepus**, **Lynx** and **Orion** appear in the east this month.
U Ori and **SU Tau** (lost at the start of May) and **W Ori** (lost in mid April), reappear during the first week.
TV Gem and **BU Gem**, lost in mid May, are visible from around the 4th onwards.
RX Lep can be seen once the observer has a clear view of Rigel.
U Gem, which is usually lost at the end of May, can be recovered from mid month onwards.
RS Cnc hidden from view since early June, reappears during the final week.

September
This month the morning observer can enjoy the winter constellations in all their glory without having to deal with winter temperatures. Observations of variable stars may continue until

0345 at the start and until 0450 at the end of the month.
Cancer, **Canis Major**, **Canis Minor**, **Leo**, **Leo Minor** and **Monoceros** are visible this month.
I have observed **X Cnc**, **RV Mon**, **SX Mon** and **CN Ori** on the 1st day of the month. Under favourable conditions the observer may pick them up at the end of August.
U LMi can be seen from the first week onwards.
U Mon and **W CMa** are visible from mid month onwards.
Markarian 421, lost in July, can be seen during the last week as can **TV UMa** nearby.
X Leo, lost at the start of June, can be picked up at the very end of the month.

October
The morning observer usually encounters the first ground frost this month, when observations are possible until 0500 at the start and until 0540 at the end of the month.
Coma Berenices, **Hydra**, **northern Puppis** and **Sextans** emerge in the east this month.
R Com and **W Com** are visible to telescopic observers from the second week onwards.
U Hya, lost at the end of May, can be seen from the middle of the month.
RW Vir and **SS Vir** lost in mid June can be seen during the final week of the month.

November
Fog can hamper morning observers this month, but at least the smoke from bonfires, fireworks, car fumes and heating systems are largely confined to the evening. The cut off for morning observations this month is 0550 at the start, and 0620 at the end.
Bootes, **Corona Borealis**, **Corvus**, **Crater** and **Virgo** are the spring constellations visible in the east this month.
Although still visible in the evening, **R**, **S**, **T**, **V**, **W**, **RR** and **SW CrB** can now be seen during the first week of November in the morning. This is worthwhile noting if you are keen to catch the next outburst of **T CrB**.
SW Vir is lost at the start of July reappears around the 9th.
3C-273 can be seen from about the 10th having been lost in mid June.
V, **RV**, **RW and RX Boo** emerge in the morning sky during the second week just as they disappear in the evening sky.
TT Crt , which was lost at the end of May, can be observed from the middle of this month.
R Ser can be picked up in the third week just as it is lost in the evening sky.

December
This is the worst month for light pollution, as Christmas lights are erected. Fortunately not all these lights are illuminated during the morning hours. Observations can be made up to 0630 at the start and until 0645 at the end of the month.
Hercules, **Libra** and **Serpens Caput** put in an appearance this month.
AH Her can be picked up right at the start of the month having been lost just a couple of weeks earlier in the evening sky.
R Hya sneaks up above the southern horizon during the first week.
30, **X**, **RU**, **ST**, **SX**, UW, **OP** and **AC Her** are now both evening and morning objects.

Hopefully the above calendar highlights might encourage a few more observers to brave the morning skies where the rewards can be potentially much greater than in the evening. Anyone who does will certainly help achieve a more even spread to our light curves and in some cases reduce the gaps that currently appear. Also, the morning skies represent the future and it is a nice feeling to see spring constellations with the promise of more warmth during the depths of a cold British winter. If you do make the extra effort to get up early from bed (and you are luckier than Leslie Peltier) you might even be rewarded with a recurrent nova performing.

PHOTOMETRIC EXPERIMENTS WITH A CANON EOS D30 DIGITAL CAMERA

RICHARD MILES

Historical background

About a year ago, I came across a Canon D30 digital camera, that had been recently acquired by the photographic section at my then place of work. The professional photographer who was toting this intriguing camera, was at the time, very complimentary about its capabilities and so it led me to wonder whether the device could possibly be of use in Astronomy, and in particular for Photometry.

Unfortunately I could not convince the chap that it would have been safe in my hands for even one night, but he did let me borrow the equipment manual, which I took away and studied. I was impressed that the camera was capable of taking long exposures (using the 'B' or 'Bulb' setting), and furthermore that it had one particular function termed 'Noise Reduction', which, when switched on, following each normal exposure, causes the camera to take a second exposure of the same duration, but with the shutter closed. It then automatically subtracts this dark frame from the original image, to produce a lower-noise image.

Clearly, given that Canon have built in this dark frame subtraction routine, the camera might very well be of use to amateurs, who want a dual-function camera, i.e. for normal photography during the daytime, or at night as an alternative to an astronomical CCD camera.

I did manage to try out the D30 camera in the photographic studio at work. Connected to a computer for image capture, it was very simple to operate, and could be programmed to take several exposures. It could store images in various formats, including a true 'lossless' compression mode. The dark frame subtract appeared to function, since it reduced the filesize of 'jpegged' long-exposure images by a factor of 3 or 4. Unfortunately without a single exposure on a clear, starry night sky, it was impossible to relate the noise in the image to a limiting detectable magnitude. I thought about hiring this particular model of camera, but in the end I just filed the idea away for a future time.

The Canon D30 in the hands of an amateur astronomer

Then in late April of this year, Ian Megson (from Scholes, Cleckheaton, West Yorkshire) sent me an e-mail, saying that he was looking to get into CCD work on EB's. Tony Markham had given Ian my name because of my role as the VSS CCD Advisor. As well as being interested in eclipsing binaries, Ian had recently acquired a Canon EOS D30 digital camera, and he wondered whether he could utilise it on his telescope, a Vixen 90mm, FL 810mm, f 9 refractor.

I replied to his e-mail directly, suggesting that he try out the camera using an interchangeable photographic lens for preliminary testing. Fortunately, Ian had a 500 mm f.l. f/8 mirror lens and it was with this that he ultimately carried out some imaging of the star field around Arcturus, and also around Mizar/Alcor, by piggybacking the camera on his driven telescope. Ian sent me a CD-ROM with some of his images, and I then photometrically analysed the star images recorded to establish how accurate such a camera might be for magnitude determinations.

Preliminary results - a disappointment ?

Ian's first experiments were with the camera unguided, just pointing at a clear night sky. His comments were as follows:

"The camera has different sensitivity settings, from ISO 100, 200, 400, 800, 1600. I took exposures of 10 seconds at all the ISO settings, all with the noise reduction facility ON. I was ignoring star trails for this purpose.

To say the least the results were rather disappointing!

When I viewed the results, the ISO 100 was slightly speckled with noise, the ISO 200 slightly more so, the ISO 400 even more, so much so that the whole screen was littered with speckles. The ISO 800 even more, such that it looked like a vast star field!! The ISO 1600, well I can't find words, the entire screen was a sheer mass of tiny speckles.

I repeated the 'experiment' this time with the camera capped up, so as just to record the inherent noise in the camera. The results were obviously just the same of course, except without the star trails. I repeat, these were done with the noise reduction ON.

Just to prove the point, and to prove that the noise reduction was working, I did an exposure with the noise reduction OFF, and even at ISO 100 at 10 seconds the screen was very much more speckled than the equivalent exposure with the noise reduction ON."

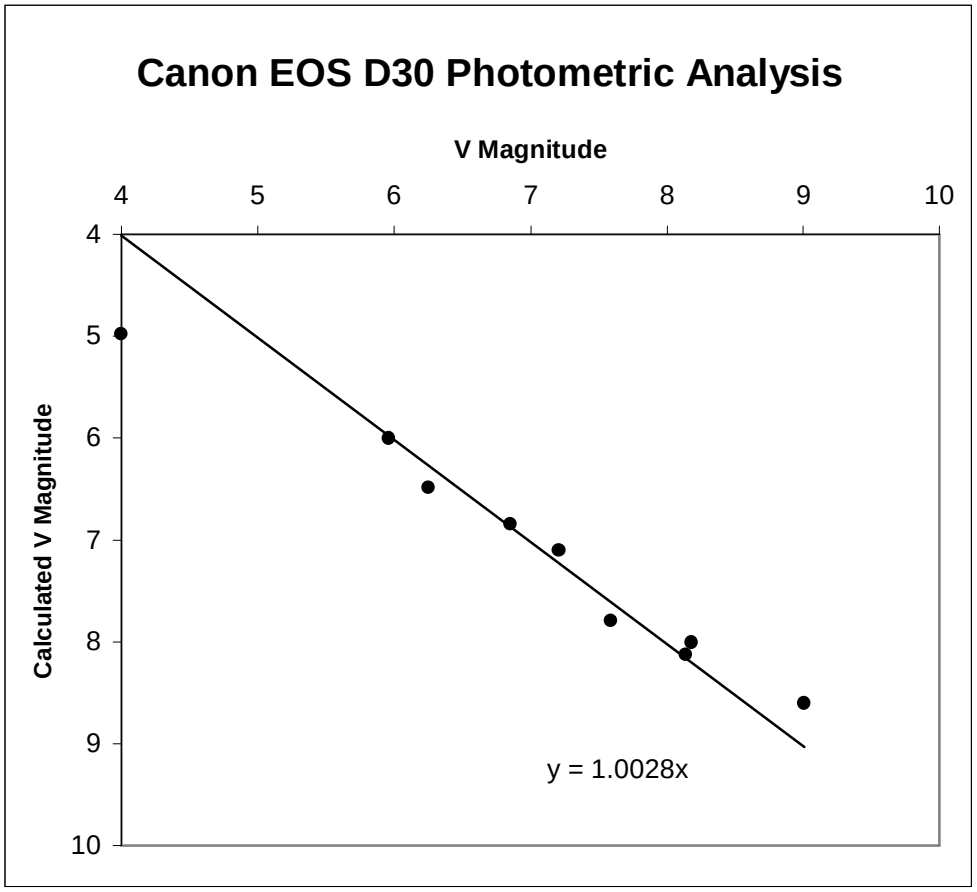
A more detailed investigation

Subsequently, Ian was able to secure some guided 10-sec and 30-sec exposures using his small catadioptric mirror lens, which has an effective aperture of about 55 mm. The vertical coverage of the camera plus mirror lens was about 1.7 degrees, and, in the case of Arcturus, included 6 other field stars, the faintest was clearly recorded (using a 30-sec exposure and ISO 200), being of V=8.18.

My initial impression was not good. I commented that the general appearance of the image was very similar to ones I have produced using a Canon XL-1 video camera, which at its maximum telephoto setting reaches stars as faint as V=7.0 with a 1/6 sec exposure (effective aperture = 35 mm). With the mirror lens (effective aperture of about 55 mm), and a 30-sec exposure, I would have expected the digital camera to reach about 300 times fainter than my video camera, i.e. to about V=13.0. In practice the cut-off in Ian's images appeared to be around V=9.0 (just detecting stars GSC 1475 0065 at V=8.99, and GSC 1472 0794 at V=9.01). So the Canon D30 seems to be stopping a full 4 magnitudes short of where even my Canon video camera does. I concluded that that the camera may not be suitable for astronomical photometry except possibly for stars brighter than about V=8.0.

Ian took some further 10-sec exposure images and sent them to me for objective analysis. For the study, I first converted the bitmapped images (size = 1440 x 960 pixels) from colour (RGB) to grayscale mode, and then loaded the images into a software package, ASTPHOT32, supplied to me by the author, Stefano Mottola. With this software I was able to integrate the pixel values within a circular aperture of nominal radius 5 pixels centered on each of the stellar images (total area within aperture = 97 pixels), and to subtract the equivalent sky brightness

so as to yield a value for the total flux recorded for each star. I loaded these flux values into an Excel spreadsheet along with stellar magnitude data for the analysis. A plot comparing the calculated V magnitude versus the catalogued V magnitude from Guide 8.0 is shown below. In this correlation, the linear fit passes through the origin (0,0) of the plot.



The image of the star Alcor (V=4.00) in the Mizar field, was found to be saturated as can be seen from the result in the plot, which is in error by almost one magnitude. For stars in the relatively narrow magnitude range, 5.9<V<8.2, it was possible to fit a calibration line, the standard deviation of which amounted to 0.14 mag, i.e. rather poor and in fact comparable in performance to that of a visual observer but with a much more restricted 'dynamic range'.

Ian also took two dark frames, one using a 1/100 sec exposure and a second using a 10-sec exposure so as to check on the relative amount of noise in the bias (readout) frame compared to thermally-induced noise.

My overall conclusions were as follows:

- There is far too much thermally-produced noise in the 10-sec images taken at ambient temperatures. CCD cameras used for astronomy are usually cooled at least 30°C BELOW ambient temperatures to reduce this 'thermal' noise to an acceptable level.

- There appears to be a strong 'anti-blooming' effect which means that the calibration is non-linear, and the brighter stars are underexposed (e.g. image of Alcor at V=4.00) - the effective dynamic range is only therefore about 3 or 4 mags.

- The Canon D30 camera lacks overall sensitivity; stars fainter than V=8.5 are not reliably registered using 10-sec exposure, and an effective clear aperture of 55 mm. In this respect, it seems to be about 4 magnitudes less sensitive than the Canon XL-1 video camera.

- Even if photometry is limited to stars in the mag range, V = +5.5 to +8.5, it will not be possible to attain a precision much better than 0.1 mag.

Where to go from here? An offer.

Although these results appear to be quite disheartening, it may very well be the case that one or other digital cameras currently on the market is indeed capable of yielding useful photometric measures on some of the brighter variables. I encourage anyone who would like to test their digital camera to follow in Ian's footsteps, taking GUIDED exposures through a lens of intermediate focal length (say in the range,135 - 500 mm), or at the maximum telephoto setting so as to capture a sufficient number of catalogued stars on the image for subsequent analysis. I suggest that for any field, two images are taken: one being well-focussed, the other being slightly out of focus. The reason for this, is that a slight defocussing of the image will help to reduce the tendency for the central pixels of the stellar images to reach saturation. In this way, it will be possible to extend the useful dynamic range for photometry.

Please DO NOT try to e-mail any such images to me, but instead, if you can store them on CD as bitmapped images (preferably in 16-bit format although 8-bit will suffice), mail them to me at the address given below and I shall carry out a similar study on each. Try to image stars in any region near a bright star for ease of identification and well above the horizon (altitude greater than 50 degrees). By doing this for a range of digital cameras, we may very well be able to rank them in performance and maybe eventually identify one suitable for astronomical photometry.

Good luck and thank you.

Richard Miles
BAA VSS CCD Advisor

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BINOCULAR PRIORITY LIST

MELVYN TAYLOR

Variable	Range	Type	Period	Chart	Variable	Range	Type	Period	Chart
AQ And	8.0-8.9	SRC	346d	82/08/16	***AH Dra***	7.1-7.9	SRB	158d?	106.01
EG And	7.1-7.8	ZA		072.01	***NQ Gem***	7.4-8.0	SR+ZA	70d?	077.01
V Aql	6.6-8.4	SRB	353d	026.03	***X Her***	6.3-7.4	SRB	95d?	223.01
UU Aur	5.1-6.8	SRB	234d	230.01.	***SX Her***	8.0-9.2	SRD	103d	113.01
AB Aur	7.2-8.4	INA		83/10/01	***UW Her***	7.8-8.7	SRB	104d	107.01
V Boo	7-12	SRA	258d	037.01	***AC Her***	6.8-9.0	RVA	75d	048.03
RW Boo	6.4-7.9	SRB	209d	104.01	***IQ Her***	7.0-7.5	SRB	75d	048.03
RX Boo	6.9-9.1	SRB	160d	219.01	***OP Her***	5.9-6.7	SRB	120d	84/04/12
ST Cam	6.0-8.0	SRB	300d?	111.01	***R Hya***	3.5-10.9	M	389d	049.01
XX Cam	7.3-9.7?	RCB?		068.01	***RX Lep***	5.0-7.4	SRB	60d?	110.01
X Cnc	5.6-7.5	SRB	195d	231.01	***SS Lep***	4.8-5.1	ZA		075.01
RS Cnc	5.1-7.0	SRC	120d?	84/04/12	***Y Lyn***	6.9-8.0	SRC	110d	229.01
V CVn	6.5-8.6	SRA	192d	214.01	***SV Lyn***	6.6-7.5	SRB	70d?	108.01
WZ Cas	6.9-8.5	SRB	186d	82/08/16	***U Mon***	5.9-7.8	RVB	91d	029.03
V465 Cas	6.2-7.2	SRB	60d	233.01	***X Oph***	5.9-9.2	M	328d	099.01
γ Cas	1.6-3.0	GC		064.01	***BQ Ori***	6.9-8.9	SR	110d	84/04/12
rho Cas	4.1-6.2	SRD	320d	064.01	***AG Peg***	6.0-9.4	NC		094.01.
W Cep	7.0-9.2	SRC		83/10/01	***X Per***	6.0-7.0	GC+XP		84/04/08
AR Cep	7.0-7.9	SRB		85/05/06	***R Sct***	4.2-8.6	RVA	146d	026.03
mu Cep	3.4-5.1	SRC	730d	112.01	***Y Tau***	6.5-9.2	SRB	242d	84/04/12
O Cet	2.0-10.1	M	332d	039.02	***W Tri***	7.5-8.8	SRC	108d	114.01
R CrB	5.7-14.8	RCB		041.02	***Z UMa***	6.2-9.4	SRB	196d	217.01
W Cyg	5.0-7.6	SRB	131d	062.1	***ST UMa***	6.0-7.6	SRB	110d?	102.01
AF Cyg	6.4-8.4	SRB	92d	232.01	***VY UMa***	5.9-7.0	LB		226.01
CH Cyg	5.6-10.0	ZA+SR		089.02	***V UMi***	7.2-9.1	SRB	72d	101.01
U Del	5.6-7.5	SRB	110d?	228.01	***SS Vir***	6.9-9.6	SRA	364d	097.01
EU Del	5.8-6.9	SRB	60d?	228.01	***SW Vir***	6.4-7.9	SRB	150d?	098.01
TX Dra	6.8-8.3	SRB	78d?	106.01					

RECENT PAPERS ON VARIABLE STARS

DICK CHAMBERS

High-Precision, Time-Resolved Linear Polarimetry of Two Bright Dwarf Novae, Moffat, A.F.J., Manset, N., Villar-Spaffi, A., Vincent, L. and Shara, M.M., PASP Vol. 113 No. 790 (2001 December), page 1541.
Monitoring of broadband linear polarimetry of **RX And** and **SS Cyg** has failed to detect any polarisation due to the scattering of free electrons in the accretion disc. This is the likely consequence of the fact that there are simply not enough polarising free electrons available to allow detection.

The 1993-1994 Activity of ***EX Lupi***, Herbig, C.H., Aspin, C., Gilmore,A.C., Imhoff, C.L, and Jones, A.E, PASP Vol No.790 (2001 December), page 1547 .
Observations, both visual and instrumental, of this Southern TTauri object (dec -40°) are discussed. During 1993-1994 the star remained slightly above normal minimum at about V = 12.8, but showed three maxima up to V = 11.4. Spectral examination shows that at minimum light an M0V absorption spectrum is present, but at outburst the spectrum is veiled by a hot continuum. The outbursts are believed to be due to episodic infall onto the M0 star.

Superhumps in Cataclysmic Variables XXL, ***HP Librae***, Patterson, J., Fried, R.E., Rea, L., Kemp, J., Espeillat, C., Skillman, D.R., Harvey, D.A., O'Donoghue, D., McCormick,J., Velthius, F., Walker, S., Retter, A., Lipkin, Y., Buttersworthy, N., McGee, P. and Cook, L.M, PASP Vol 114 No. 791 (2002 January), page 65
Observations of this helium-dominated cataclysmic variable during 1995-2001 are reported. The main photometric signal varies between 1118.89 and 1119.14 sec over a few years, and displays superhumps. A weak residual signal at 1102.70 +/- 0.05 sec is interpreted as the orbital period. The superhump shows no change in amplitude or waveform on any timescale and no change in period over 3000 cycles,

ECLIPSING BINARY PREDICTIONS

TONY MARKHAM

The following predictions, based on the latest Krakow elements, 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 (UT-12h). D indicates that the eclipse starts/ends in daylight, and L indicates low altitude at the start/end of the visibility. Thus, for example, on Oct 1, U Cep D06(09)14 indicates that an eclipse of U Cep starts in daylight, but can be observed between 06h and 14h GMAT (Oct 1 18h UT and Oct 2 02h UT), with mid eclipse at about 09h GMAT (Oct 1 21h UT). Please contact the EB secretary if you require any further explanation of the format. Note that predictions for **RZ Cas**, **Beta Per**, **Lambda Tau** and **HU Tau** can be found in the BAA Handbook.

2002 Oct 1 Tue
U Sge D06(03)09
Y Psc D06(04)08
TX UMa D06(05)09L
X Tri D06(08)10
U Cep D06(09)14
Z Dra 16(18)17D

2002 Oct 2 Wed
X Tri D06(07)10
SW Cyg D06(11)17
ST Per 12(16)17D
TV Cas 12(16)17D
RW Tau 13(18)17D
SS Cet 16(20)17D

2002 Oct 3 Thu
Z Per D06(02)07
Z Vul D06(04)09
S Equ D06(05)10
TW Dra D06(06)11
X Tri D06(06)09
U Cep 17(21)17D

2002 Oct 4 Fri
X Tri D06(06)08
TX UMa D06(07)08L

U Sge 07(12)13L
TV Cas 08(12)16
Z Dra 09(11)14
TX UMa L11(07)12

2002 Oct 5 Sat

X Tri D06(05)08
ST Per D06(08)12
RW Tau 08(12)17D
Z Vul 10(15)13L
SS Cet 15(20)17D

2002 Oct 6 Sun

TW Dra D06(01)06
Z Per D06(03)08
X Tri D06(04)07
TV Cas D06(07)12
U Cep D06(09)14
S Equ 10(15)13L

2002 Oct 7 Mon

SW Cyg D06(01)07
Z Dra D06(04)07
TX UMa D06(08)08L
TX UMa L11(08)13

2002 Oct 8 Tue

Z Vul D06(02)07
TV Cas D06(03)07
RW Tau L07(07)12
Z Dra 11(13)15
Y Psc 12(17)16L
RW Gem 14(19)17D
SS Cet 14(19)17D
TW Dra 16(21)17D
U Cep 16(21)17D

2002 Oct 9 Wed

Z Per D06(04)09

2002 Oct 10 Thu

S Equ D06(02)07
TX UMa D06(10)08L
Z Vul 08(13)13L
ST Per 11(15)17D
TX UMa L11(10)15

2002 Oct 11 Fri

Z Dra D06(06)09
U Sge D06(07)12
U Cep D06(09)14
SW Cyg 08(14)17D
RW Gem 11(16)17D
TW Dra 11(16)17D
SS Cet 14(18)17D
TV Cas 14(18)17D

2002 Oct 12 Sat

Z Per D06(06)11
Y Psc 07(11)16
Z Dra 12(15)17

2002 Oct 13 Sun

ST Per D06(06)10
S Equ 07(12)13L
TX UMa 07(11)08L
TV Cas 09(13)17D
TX UMa L10(11)16
RW Tau 15(20)17D
U Cep 16(21)17D

2002 Oct 14 Mon

TW Dra 06(11)17
RW Gem L09(13)17D
U Sge 10(16)12L
SS Cet 13(18)17D

2002 Oct 15 Tue

Z Per D06(07)12
Z Dra D06(08)10
TV Cas D06(09)13
Z Vul D06(11)13L

2002 Oct 16 Wed

SW Cyg D06(04)10
Y Psc D06(05)10
U Cep D06(08)13
RW Tau 10(14)17D
TX UMa L10(13)17D
Z Dra 14(16)17D

2002 Oct 17 Thu

TV Cas D06(04)09
TW Dra D06(07)12
RW Gem L09(10)15
SS Cet 12(17)17D

2002 Oct 18 Fri

U Sge D06(01)07
Z Per D06(08)13
ST Per 09(13)17D
U Cep 16(20)17D
X Tri 17(19)17D

2002 Oct 19 Sat

RW Tau L07(09)13
Z Dra 07(10)12
TX UMa L10(15)17D
X Tri 16(19)17D

2002 Oct 20 Sun

TW Dra D06(02)07
Z Vul D06(09)12L
S Equ D06(09)12L
RW Gem L09(07)12
SW Cyg 12(18)17L
SS Cet 12(16)17D
TV Cas 15(19)17D
X Tri 16(18)17D
Z Dra 16(18)17D

2002 Oct 21 Mon

ST Per D06(05)09
U Cep D06(08)13
Z Per D06(10)15
U Sge D06(10)12L
X Tri 15(17)17D

2002 Oct 22 Tue

RW Tau L06(03)08
TV Cas 11(15)18D
TX UMa 11(16)18D
X Tri 14(17)18D
TW Dra 17(22)18D

2002 Oct 23 Wed

Z Dra 09(11)14
SS Cet 11(16)18D
X Tri 14(16)18D
Y Psc 14(18)15L
U Cep 15(20)18D
ST Per 16(20)18D

2002 Oct 24 Thu

Z Per 06(11)16
TV Cas 06(10)15
X Tri 13(15)18D
RW Tau 17(22)18D
Z Dra 18(20)18D

2002 Oct 25 Fri

Z Vul D06(06)12
SW Cyg D06(08)14
TW Dra 12(17)18D
X Tri 12(15)17
TX UMa 13(18)18D

2002 Oct 26 Sat

Z Dra D06(05)07
TV Cas D06(06)10
U Cep D06(08)13
ST Per 08(12)16
SS Cet 11(15)17L
X Tri 11(14)16

2002 Oct 27 Sun

S Equ D06(06)11
Z Per 08(13)17
Y Psc 08(13)15L
Z Dra 11(13)16
X Tri 11(13)16
RW Tau 11(16)18D
Z Vul 12(17)12L

2002 Oct 28 Mon

TV Cas D06(01)06
U Sge D06(04)10
TW Dra 07(12)17
X Tri 10(13)15
TX UMa 14(19)18D
U Cep 15(20)18D
RW Gem 16(21)18D

2002 Oct 29 Tue

ST Per D05(04)08
X Tri 09(12)14
SS Cet 10(15)17L
SW Cyg 15(21)16L
TV Cas 17(21)18D

2002 Oct 30 Wed

Z Vul D05(04)10
Z Dra D05(06)09
RW Tau L06(10)15
X Tri 09(11)14
Z Per 09(14)18D
S Equ 11(16)12L

2002 Oct 31 Thu

Y Psc D05(07)11
U Cep D05(07)12
TW Dra D05(08)13
U Sge 08(14)11L
X Tri 08(11)13
TV Cas 12(16)18D
Z Dra 12(15)17
RW Gem 12(18)18D
ST Per 15(19)18D
TX UMa 16(21)18D

2002 Nov 1 Fri

X Tri 07(10)12
SS Cet 09(14)17L
Z Vul 10(15)12L

2002 Nov 2 Sat

RW Tau L06(05)10
X Tri 07(09)12
TV Cas 08(12)16
Z Per 10(15)18D
U Cep 15(19)18D

2002 Nov 3 Sun

S Equ D05(03)08
TW Dra D05(03)08
SW Cyg D05(11)16L
Z Dra 06(08)10
X Tri 06(09)11
ST Per 07(11)15
RW Gem 09(14)18D
TX UMa 17(22)18D

2002 Nov 4 Mon

Y Psc D05(01)06
Z Vul D05(02)07

TV Cas D05(07)12
X Tri 05(08)10
SS Cet 09(13)17L
Z Dra 14(17)18D

2002 Nov 5 Tue

X Tri D05(07)10
U Cep D05(07)12
V640 Ori L11(09)11
Z Per 12(17)18D
TW Dra 17(22)18D

2002 Nov 6 Wed

ST Per D05(02)06
TV Cas D05(03)07
X Tri D05(06)09
Z Vul 08(13)11L
RW Gem L08(11)16
S Equ 08(13)11L

2002 Nov 7 Thu

X Tri D05(06)08
U Sge D05(08)11L
Z Dra 07(10)12
SS Cet 08(13)17L
V640 Ori L11(09)12
RW Tau 13(18)18D
U Cep 14(19)18D

2002 Nov 8 Fri

SW Cyg D05(01)07
X Tri D05(05)08
TW Dra 13(18)18D
Z Per 13(18)18D
ST Per 14(18)18D
Z Dra 16(18)18D

2002 Nov 9 Sat

X Tri D05(04)07
RW Gem L08(08)13
V640 Ori L11(10)12
TV Cas 14(18)18D

2002 Nov 10 Sun

TX UMa D05(01)06
Z Dra D05(03)05
X Tri D05(04)06
U Cep D05(07)12
SS Cet 07(12)16L
RW Tau 08(12)17

2002 Nov 11 Mon

X Tri D05(03)06
ST Per 05(09)13
Z Vul 05(11)11L
TW Dra 08(13)18D
Z Dra 09(11)14
TV Cas 09(13)18
Y Psc 10(14)14L
V640 Ori L10(10)13
Z Per 14(19)18D

2002 Nov 12 Tue

RW Gem L07(05)10
SW Cyg 08(15)16L
U Cep 14(19)18D
SW Cyg L17(15)18D
Z Dra 18(20)18D

2002 Nov 13 Wed

TX UMa D05(03)06L
RW Tau D05(07)11
TV Cas D05(09)13
S Equ D05(10)11L
SS Cet 07(11)16
V640 Ori L10(11)13

2002 Nov 14 Thu

U Sge D05(02)08
Z Dra D05(05)07
TW Dra D05(08)14
Z Per 16(21)18D

2002 Nov 15 Fri

TV Cas D05(04)09
U Cep D05(06)11
Y Psc D05(08)13
V640 Ori L10(11)14
Z Dra 11(13)16

2002 Nov 16 Sat

RW Tau D05(01)06
TX UMa D05(04)06L
Z Vul D05(09)11L
SS Cet 06(11)15
TX UMa L08(04)09
ST Per 12(16)18D

2002 Nov 17 Sun

TW Dra D05(04)09
SW Cyg D05(04)10
U Sge 05(11)10L
V640 Ori L10(12)14
U Cep 14(18)18D
RW Gem 17(22)18D
Z Per 17(22)18D

2002 Nov 18 Mon

Z Dra D05(06)09
RW Tau 15(20)18D
TV Cas 15(20)18D

2002 Nov 19 Tue

Y Psc D05(03)07
TX UMa D05(06)05L
ST Per D05(08)12
SS Cet L06(10)15
TX UMa L08(06)10
V640 Ori L10(12)15
Z Dra 13(15)17
TW Dra 18(23)18D

2002 Nov 20 Wed

U Cep D05(06)11
S Equ D05(07)10L
TV Cas 11(15)18D
RW Gem 14(19)18D

2002 Nov 21 Thu

Z Vul D05(06)10L
RW Tau 09(14)18D
V640 Ori 10(13)15
SW Cyg 12(18)15L
SW Cyg L17(18)18D
X Tri 17(20)17L

2002 Nov 22 Fri

TX UMa D05(07)05L
SS Cet L06(10)14
Z Dra 06(08)10
TV Cas 06(11)15
TX UMa L08(07)12
U Cep 13(18)18D
TW Dra 14(19)18D
X Tri 16(19)17L

2002 Nov 23 Sat

V640 Ori 11(13)16
RW Gem 11(16)18D
Z Dra 14(17)18D
X Tri 16(18)17L

2002 Nov 24 Sun

Z Per D05(01)05
U Sge D05(05)10L
TV Cas D05(06)10
RW Tau D05(08)13
ST Per 11(15)18D
X Tri 15(17)17L

2002 Nov 25 Mon

U Cep D05(06)11
TX UMa D05(09)05L
SS Cet L05(09)14
TX UMa L08(09)13
TW Dra 09(14)18D
V640 Ori 11(14)16
X Tri 14(17)17L

2002 Nov 26 Tue

TV Cas D05(02)06
Z Vul D05(04)10
SW Cyg D05(08)14
RW Gem 07(13)18
Z Dra 07(10)12
Y Psc 11(16)13L
X Tri 14(16)17L

2002 Nov 27 Wed

Z Per D05(02)07
RW Tau D05(03)08
S Equ D05(04)09
ST Per D05(07)11
U Sge 09(15)09L
V640 Ori 12(14)17
U Cep 13(18)18D
X Tri 13(15)17L
Z Dra 16(18)18D
TV Cas 17(21)18D

2002 Nov 28 Thu

TW Dra D05(09)14
SS Cet L05(08)13
TX UMa L07(10)15
Z Vul 10(15)10L
X Tri 12(15)17L

2002 Nov 29 Fri

Z Dra D05(03)05
RW Gem L06(09)14
X Tri 12(14)17
V640 Ori 12(15)17L
TV Cas 12(17)19D
RW Tau 17(21)19D
ST Per 18(22)19D

2002 Nov 30 Sat

Z Per D05(03)08
U Cep D05(05)10
Y Psc 05(10)12L
Z Dra 09(12)14
S Equ 09(15)10L
X Tri 11(13)16
SW Cyg L16(22)19D

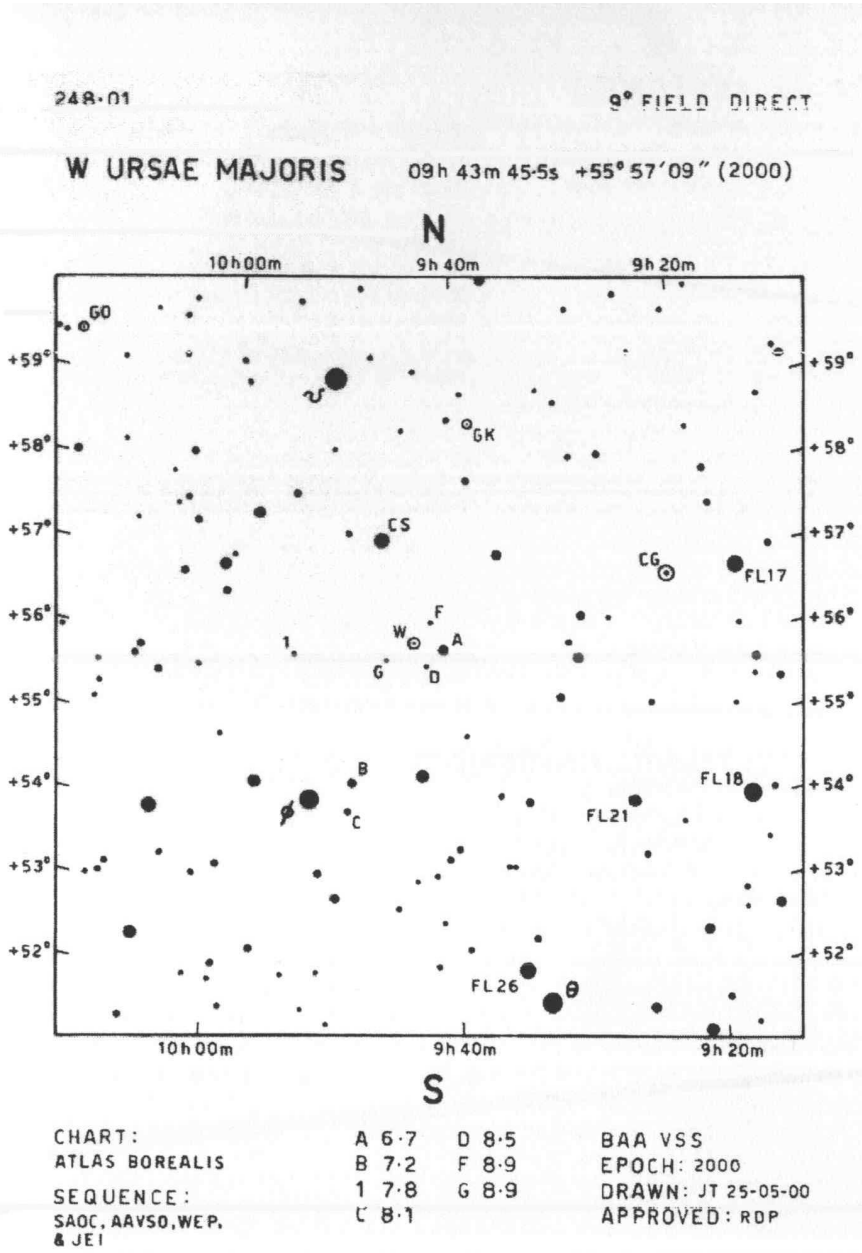
2002 Dec 1 Sun

U Sge D05(00)05
Z Vul D05(02)07
TW Dra D05(05)10
SS Cet L05(08)12
TX UMa L07(12)17
TV Cas 08(12)16
X Tri 10(13)15
V640 Ori 13(15)17L
Z Dra 18(20)19D

2002 Dec 2 Mon

RW Gem L06(06)11
X Tri 10(12)15
ST Per 10(14)18
RW Tau 11(16)19D
U Cep 13(17)19D

2002 Dec 3 Tue
Z Dra D05(05)07
Z Per D05(05)10
TV Cas D05(08)12
Z Vul 08(13)10L
X Tri 09(11)14
V640 Ori 13(16)17L
2002 Dec 4 Wed
TW Dra D05(00)05
S Equ D05(01)06
Y Psc D05(04)09
SS Cet D05(07)12
U Sge D05(09)09L
X Tri 08(11)13
TX UMa 09(13)18
Z Dra 11(13)16
2002 Dec 5 Thu
TV Cas D05(03)07
U Cep D05(05)10
ST Per D05(05)10
SW Cyg 05(11)14L
RW Tau 06(10)15
RW Gem L06(03)08
X Tri 07(10)12
V640 Ori 14(16)17L
SW Cyg L16(11)17
2002 Dec 6 Fri
Z Vul D05(00)05
Z Per D05(06)11
X Tri 07(09)12
TW Dra 14(19)19D
TV Cas 18(23)19D
2002 Dec 7 Sat
Z Dra D05(06)09
SS Cet D05(06)11
X Tri 06(09)11
S Equ 06(11)09L
TX UMa 10(15)19D
U Cep 12(17)19D
V640 Ori 14(17)17L
ST Per 17(21)19D
RW Gem 18(24)19D
2002 Dec 8 Sun
RW Tau D05(05)09
X Tri 05(08)10
Z Vul 06(11)09L
Z Dra 13(15)17
TV Cas 14(18)19D
2002 Dec 9 Mon
X Tri D05(07)10
Z Per D05(07)12
TW Dra 10(15)19D
V640 Ori 15(17)16L
2002 Dec 10 Tue
SW Cyg D05(01)07
U Cep D05(05)10
SS Cet D05(06)10
X Tri D05(07)09
ST Per 08(13)17
TV Cas 09(14)18
TX UMa 12(16)19D
RW Gem 15(20)19D
Z Vul L19(22)19D
2002 Dec 11 Wed
U Sge D05(03)08L
X Tri D05(06)08
Z Dra 06(08)11
V640 Ori 15(18)16L
2002 Dec 12 Thu
X Tri D05(05)08
Z Per D05(09)14
TV Cas 05(09)13
TW Dra 05(10)15
U Cep 12(17)19D
Z Dra 14(17)19D
2002 Dec 13 Fri
ST Per D05(04)08
X Tri D05(05)07
SS Cet D05(05)10
Z Vul D05(09)09L
RW Gem 12(17)19D
RW Tau 13(18)18L
TX UMa 13(18)19D
V640 Ori 16(18)16L
2002 Dec 14 Sat
X Tri D05(04)06
TV Cas D05(05)09
S Equ D05(08)09L
U Sge 07(12)08L
SW Cyg 09(15)13L
SW Cyg L15(15)19D
2002 Dec 15 Sun
X Tri D05(03)06
U Cep D05(05)09
TW Dra D05(05)11
Z Per 05(10)15
Y Psc 07(11)11L
Z Dra 08(10)12
ST Per 16(20)18L
V640 Ori 16(19)16L
Z Vul L18(20)19D
2002 Dec 16 Mon
X Tri D05(02)05
SS Cet D05(05)09
RW Tau 07(12)17
RW Gem 09(14)19D
TX UMa 15(19)19D
Z Dra 16(18)19D
2002 Dec 17 Tue
U Cep 12(16)19D
TV Cas 15(20)19D
U Sge L19(21)19D
2002 Dec 18 Wed
TW Dra D05(01)06
Z Dra D05(03)05
Z Vul D05(07)09L
Z Per 07(11)16
ST Per 07(11)15
2002 Dec 19 Thu
SS Cet D05(04)09
SW Cyg D05(05)11
Y Psc D05(06)10
RW Tau D05(07)11
RW Gem 06(11)16
Z Dra 09(12)14
TV Cas 11(15)19D
TX UMa 16(21)19D
2002 Dec 20 Fri
U Cep D05(04)09
TW Dra 15(20)19D
Z Dra 18(20)19D
Z Vul L18(17)19D
2002 Dec 21 Sat
ST Per D05(03)07
S Equ D05(05)08L
U Sge D05(07)08L
TV Cas 06(11)15
Z Per 08(13)18
2002 Dec 22 Sun
RW Tau D05(01)06
SS Cet D05(03)08
Z Dra D05(05)07
RW Gem D05(07)13
U Cep 11(16)19D
TX UMa 18(22)19D
2002 Dec 23 Mon
Z Vul D05(04)08L
TV Cas D05(06)10
TW Dra 11(16)19D
Z Dra 11(13)16
SW Cyg 12(18)13L
ST Per 14(18)18L
SW Cyg L15(18)19D
2002 Dec 24 Tue
Z Per 09(14)18L
RW Tau 15(19)17L
U Sge L18(16)19D
2002 Dec 25 Wed
TV Cas D05(02)06
SS Cet D05(03)07
U Cep D05(04)09
RW Gem D05(04)09
Z Vul L18(15)19D
2002 Dec 26 Thu
Z Dra D05(07)09
ST Per 06(10)14
TW Dra 06(11)16
TV Cas 17(21)19D
2002 Dec 27 Fri
RW Tau 09(14)17L
Z Per 11(15)18L
U Cep 11(16)19D
Z Dra 13(15)18
2002 Dec 28 Sat
U Sge D05(01)07
RW Gem D05(01)06
SS Cet D05(02)07
Z Vul D05(02)08
S Equ D05(02)08
SW Cyg D05(08)13L
TV Cas 12(17)19D
2002 Dec 29 Sun
ST Per D05(01)06
TW Dra D05(06)11
TX UMa L05(01)06
X Tri 14(17)15L
2002 Dec 30 Mon
U Cep D05(04)08
RW Tau D05(08)13
Z Dra 06(08)11
TV Cas 08(12)16
Y Psc 08(13)10L
Z Per 12(17)18L
X Tri 14(16)15L
RW Gem 17(22)18L
Z Vul L17(13)18
2002 Dec 31 Tue
SS Cet D05(01)06
U Sge D05(10)07L
S Equ 07(13)07L
ST Per 13(17)17L
X Tri 13(16)15L
Z Dra 14(17)19D



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