British Astronomical Association

# VARIABLE STAR SECTION CIRCULAR

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## Contents



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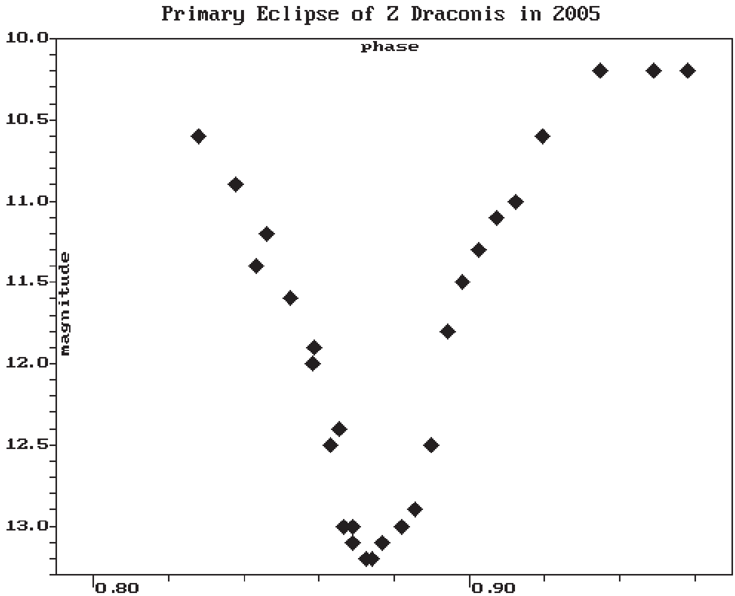
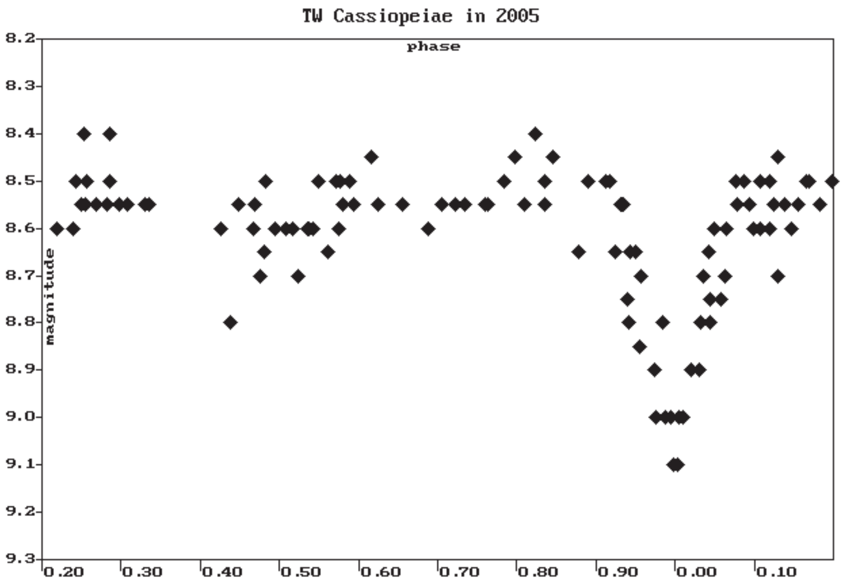
# ECLIPSING BINARY LIGHT CURVES

TONY MARKHAM AND MICHAEL CLARKE




The Z Dra light curve above is based on observations made by Michael Clarke.

The TW Cas light curve below, is based on observations made by Tony Markham. The variable was observed on a regular basis rather than only at the times of predicted primary eclipses and all observations were plotted in order to see how much scatter/tidy a light curve might result.



# FROM THE DIRECTOR

**Roger Pickard**

## Secretary's Email Address

It would seem that a full stop had crept into Clive Beech's email address on the back page of the Circulars (clive.beech) but it should be just clivebeech@blueyonder.co.uk. Please amend your address books, especially if you've been sending data to Clive and wonder why you've not had a reply or the email has bounced!

That said, it may be that some data has been lost, so could observers check that they've had an acknowledgement from Clive, and if not could they please re-send their data to him. Many apologies for this error.

## Old Data

I'm delighted to advise members that by the time you read this the project to enter all observations from old report forms and VSS Memoirs (from around 1890 to the present) into machine-readable form is just about complete. My many thanks to all those members (and others) who have contributed to this noble effort.

However, further to the BAA Office temporary removal to other premises whilst Burlington House is refurbished, a clear-out of the office brought forth a wonderful tome, compiled by a past Director, Col. E E Markwicke, and containing some 6750 observations from 1899 -1906. Many thanks to Alex Mennary for entering these observations so promptly. I've also received old observing logs containing some data not yet in the Section's database from other BAA members, and this should be entered soon.

Therefore, if any member is aware of the possibility that they may either have some old observations of their own (perhaps tucked away in the attic!) or know of someone who may have some, and they suspect that they are not already in the VSS database, I'd be delighted if they could get in touch with me. In addition, John Toone has suggested it may be worthwhile trawling through the old BAA Journals to ensure nothing has been missed from them. Anyway fancy taking on this task?

## Chart Catalogue

Again, by the time you read this, an updated version of the Chart Catalogue incorporating all new charts and sequences that John Toone has produced over the last several months will be on the web site. If anyone requires a hard copy please let me know.

### Sequences

I mentioned in the last Circular that Ian Miller had updated many of the Section's sequences, and these now need checking. John Toone can only check these if he takes time off from drawing charts, something I'd rather he did not do. Therefore, would anybody else care to consider helping with checking the sequence updates?

### Charges for Circulars

I had made a note at the beginning of the year that we might have to increase the charges for the Circulars from 1st January 2007. This was endorsed by the recent increase in postal charges. However, Karen Holland has advised that the kindly printer she uses for printing the Circulars has not increased his charges in 10 years. I therefore feel that, for the time being at least, subscription rates will remain unchanged.

### Excel Spreadsheets for AIP4WIN

Pleased be advised that spreadsheet B1.6 has been updated to B1.7 (very minor changes). This is intended for use with AIP4WIN version 1.

Also, just released is Spreadsheet B2.0 for use with AIP4WIN version 2.

These can be obtained from Andy Wilson or via the members only section of the BAA web site.

My thanks to Andy for the continued development of these spreadsheets (although that for AIP4WIN version 1 will be the last), and also to David Boyd who has done most of the error checking/proof reading.

Andy also adds his own thanks to David Boyd for all his help in debugging and checking, and also in providing the maths behind the ensemble and error calculations.

## ECLIPSING BINARY NEWS

**Des Loughney**

### RS Canum Venticorum

One of the eclipsing binaries that is featured in our ' Observing Guide to Variable Stars' is RS CVn. It has a period of 4.798 days. The "Guide" suggests that the system varies between 7.7 and 8.5. GCVS states the variation is from 7.9 to 9.1. The star is a binocular object although it may be difficult to follow fully in binoculars in a suburban situation.

The period of the star seems to be slowly decreasing as described by the Observed/Calculated diagram that is displayed on the Krakow web site at *http://www.as.wsp.krakow.pl/o-c/index.php3*.

In recent decades the period has been decreasing so that in 2006 the mid-point of minima were occurring about 0.25 days before the time predicted by the Krakow elements. These elements are: JD Hel 2438889.212 + 4.797827 E. The system would be worth studying to track the change in period which could possibly be due to mass exchange between the stars of the system.

One of the stars in these systems is a sub-giant, which by the very nature of the binary system is forced to rotate faster than it would if it was a single star. In the outer convective layers of the star the rapid rotation generates magnetic phenomena that are far more extreme than those observed on the surface of our sun. Whereas 1% of the sun's surface may be covered by sun spots, these binaries can have 25% or even 40% of one hemisphere covered by dark spots. Their coronas are denser and hotter than the sun's. Their temperature can be 10 million K rather than 1 million K and, consequently, they emit X-rays 10,000 more intense than the sun's. These binaries are said to account for 10% of all the known X-ray sources in the sky.

For observers, these systems have an additional interest because the star spot groups are big enough to cause variations in the light curve that can be observed visually. The brightness of the system changes as the sub-giant rotates. It is estimated that the changes in magnitude, superimposed on the variation caused by the eclipse, can be between 0.35 and 0.1 of a magnitude. Apparently the largest variation observed in this class of binaries is 0.65 magnitude.

It is suggested that the system be observed during the spring of 2007. Eclipses can be observed to establish if the change in period continues. The system can, however, be observed at any time to pick up the variations caused by the rotation of star spot groups.

It is claimed that systematic observation of RS CVn binaries has not only caught the effect of the rotation of the star spots, but also established that the stars have cycles similar to the 11 year sun spot cycle.

All observations of this system will be welcome and can be forwarded to Des Loughney at desloughney@blueyonder.co.uk for analysis.

## Further Reading


1 Hall and Genet ' Photoelectric Photometry of Variable Stars' RS Canum Venaticorum Binaries pp 230 -234

2 S V Berdyugina ' Stars Spots: A Key to Stellar Dynamo: < http://solarphysics.livingreviews.org/Articles/lrsp-2005-8/>

# RECURRENT OBJECTS PROGRAMME

GARY POYNER

### Programme Update

The Dwarf Nova star SDSSJ080434+510349 has now been added to the Recurrent Objects Programme. For further details of this star, see Jeremy Shears' short article in VSSC 128 (Jun 2006). At the moment, a good quality sequence doesn't exist. However a chart has been produced, with a preliminary sequence compiled from USNO A2.0, and is available as a gif or jpeg. This will suffice until a better sequence becomes available, providing observers record the comparison stars used when observing.

### VY Aqr

A rare outburst of this suspected UGWZ star was detected by Hiroyuki Maehara on Oct 7.563 UT at 12.46V [1]. This was the first outburst recorded since the normal outburst of April 1994. The outburst proved to be of normal type, peaking at mean magnitude 11.36 on Oct 7.92, and fading back to its quiescent level of 16.5-17.0 in just 4 days. The twelve year gap between outbursts, and the fact that this outburst was a normal one, suggests that a superoutburst could possibly have occured near or at Solar Conjunction 2005. AAVSO Alert Notice 341 comments that "For 4 of the 5 superoutbursts recorded in the AAVSO International Database, there is a 'regular' outburst approximately 1 year later. For the fifth superoutburst, there is a two-week gap in observations during the time when this "follow-up" regular outburst would have been expected"[2].

The light curve shown below is compiled from 362 observations reported to the BAAVSS, VSNET and CVnet. Contributing observers are L Bichon, D Boyd, K Geary, A Glez-Herrera, H Hautecler, W Kriebel, G Krisch, Y Maeda, H Maehara, I Miller, M Moriyama, E Muyllaert, H Narumi, G Poyner, P Schmeer, J Shears, R Stubbings, S Swierczynski, P Williams.

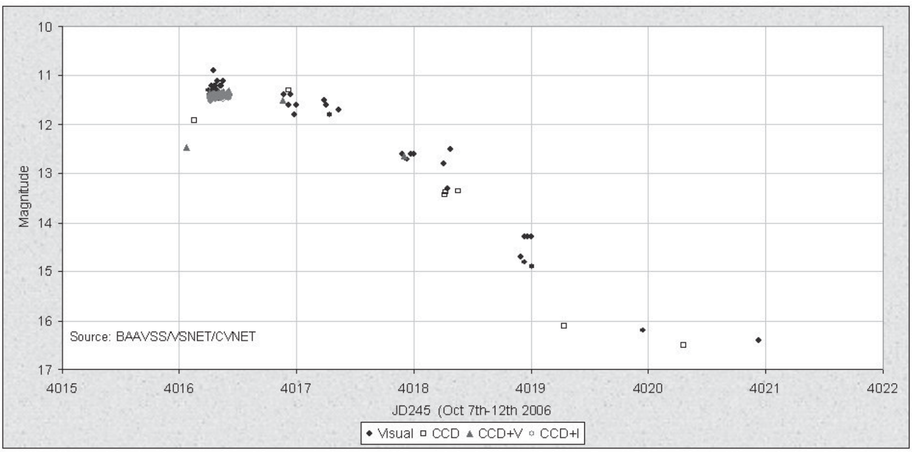



**Figure 1: Light curve of VY Aqr during the rare recent outburst**

References
1 VSNET Alert 9041
2 AAVSO Alert Notce 341 http://www.aavso.org/publications/alerts/

**SS LMi**

Jeremy Shears detected an outburst of the suspected Nova SS LMi (Nova LMi 1980) on Oct 24.168 at 16.2C. This constituted the first outburst ever recorded in this object following its discovery by Alksnis and Zacs on Riga Schmidt plates in April 1980. In his Atlas and Catalogue of Galactic Nova, Hilmar Deurbeck comments that “no spectroscopic information is available. SS LMi is an extragalactic nova or an unusual dwarf nova of large amplitude”. A short time series run by Shears on Oct 24 yielded a possible superhump period of 0.0585d (84.2 min). Tom Crajci reported on BAAVSS-alert of a time series he carried out on Oct 27 which revealed “0.2 magnitude superhumps with an approximate period of 0.054d”, thus confirming that SS LMi is a UGSU star. David Boyd obtained the following precise position 10 34 05.85 +/- 0.08 +31 08 00.10 +/- 0.09. David comments that “this is slightly different from the position of SS LMi on the AAVSO chart, but close.” The position in Downes and Shara is given as 10:34:05.43 +31:08:08.3. The astrometry finally pinpoints the position of SS LMi, which has been debated for some years.

Other outbursts of ROP stars during the period Jun 2006 to the present include V402 And (Aug 03.779 H Maehara CCD), DK Cas (Sep 7.87 Shears CCD), V452 Cas (Jly 11.98 Shears CCD, Aug 06.10 Shears CCD, Aug 28.89 Shears CCD, Nov 6.81 Shears CCD) V1316 Cyg (Aug 6.1 Shears CCD, Sep 24.81 D. Boyd CCD, Oct 17.78 Boyd and Shears CCD, Nov 4.8 Pickard and Miller CCD), V701 Tau (Oct 6.01 C. Gualdoni CCD), TY Vul (Aug 20.9 Shears CCD, Poyner Visual, Pickard CCD), SDSS J230351.64+010651 (Aug 29.9 Miller CCD & Poyner Visual)


As I write these words, Jeremy Shears and Gary Poyner independently detect a rare outburst of AW Sge, the first recorded since May 2004. The outburst is ongoing, and a more detailed report will appear in the March 2007 VSSC.

**Figure 2: CCD image of SS LMi in outburst, by Jeremy Shears**

# CHART NEWS

**John Toone**

The following new charts are now posted to the VSS web site and are available in paper form from the Chart Secretary:

### Telescopic Stars

**293.01 AM Her**
No BAA VSS chart previously existed for this object which was 'Variable Star of the Year' in the 2007 Handbook. A 15 minute field chart has been drawn complete with a Henden V sequence.

**300.01 U Leo**
This 20 minute field chart replaces TA chart GMH 960219. The sequence now adopts V measurements by Boyd and Downes and Szkody.

**305.01 EUVE J0854+390 Lyn**
No BAA VSS chart previously existed for this ROP star. A 30 minute field chart has been drawn with a preliminary sequence drawn from the GSC and Henden.

**019.03 SW UMa**
New 1 degree and 15 minute field charts replace chart 019.02. The sequence has been extended to cover the full range of the variable. Comparison stars C, D, F and L have been dropped and comparison stars X, Y, N, P, R and S have been added. The new sequence is a combination of V measurements taken from Tycho, Skiff, Stanton and Henden.

### Binocular Stars

**303.01 AQ And**
This 6 degree field chart replaces chart MDT 1982 Aug 16. Comparison stars A, B, D, E and G have been dropped, and comparison L has been added. Tycho 2 Vj is adopted for the sequence.

**301.01 AB Aur and TT Tau**
This 6 degree field chart replaces chart MDT 1983 Oct 01. Comparison stars A, C, J, Q, N, R and U have been dropped and comparison star X added. Tycho 2 Vj is adopted for the sequences of both stars.

**302.01 FZ Cep and RU Cyg**
This 6 degree field chart replaces chart MDT 1983 Oct 01. Comparison stars A, B, E, F, G, L, M, N, P, S, T, V, X, Y and Z have been dropped and comparison stars 1, 3, 4 and 5 added. Tycho 2 Vj is adopted for the sequences of both stars.

**225.02 RY Dra**
This 9 degree field chart replaces chart 225.01. Comparison stars A, D, G and H are dropped, and comparison stars N and P added. Tycho 2 Vj is adopted for the sequence and this has a big impact at the faint end of the sequence (comparison K amended from magnitude 7.8 to 8.7).

**106.02 TX and AH Dra**
This 9 degree field chart replaces chart 106.01 which previously included a sequence for AT Dra, which is now dropped from the binocular programme. Both sequences have been extended to cover the full range of the variables. Comparison stars B, D, E, F, G, H, K, L, M, 3 and 4 have been dropped, and comparison stars R, S, T, U, 7, 8 and 9 have been added. Tycho 2 Vj is adopted for the sequences of both stars.

**294.01 TU, TV, WY and BU Gem**
This 9 degree field chart replaces chart MDT 1972 Nov 11. Comparison stars B, C, E, G, L, M, N, P, R, U and W are dropped, and comparison stars H and T added. Tycho 2 Vj is adopted for the sequences for all these stars.

**108.02 SV and CE Lyn**
This 9 degree field chart replaces chart 108.01 which did not identify CE Lyn. Comparison stars C, D, F, G and J for SV Lyn have been dropped, and comparison stars N, P, R, S and T for CE Lyn have been added. Tycho2 Vj is adopted for the sequences of both stars.

**292.01 RV and SX Mon**
This 9 degree field chart replaces chart MDT 1987 Dec 30. Comparison stars J and K have been dropped, and comparison stars L and N have been added. Tycho 2 Vj is adopted for the sequence which was previously calibrated too bright.

**295.01 BQ Ori and Y Tau**
This 9 degree field chart replaces chart MDT 1984 Apr 12. Comparison stars A, B, C, E, H, J, K, N, P and T have been dropped, and comparison stars R, U, W, X and Z are added. Tycho 2 Vj is adopted for the sequences of both stars (the sequence for BQ Ori was previously calibrated too bright at the faint end).

**217.02 Z and RY UMa**
This 9 degree field chart replaces chart 217.01. Comparison stars F, G, K and 3 have been dropped, and comparison star 5 has been added. Tycho 2 Vj is adopted for the sequences of both stars.

**Active Galactic Nuclei**

**297.01 NGC4151**
This 1 degree field chart replaces chart JT 1984 Jul 15. There is no change to the Penston V sequence.

**251.02 OJ+287**
This 20 minute field chart replaces chart 251.01. The Penston, Wing and Fiorucci sequence has been replaced by V measurements by Kitt Peak, Miles and Kidger. The sequence is now fully-lettered and old comparison 9 has been dropped due to its suspected variability.

**296.01 NGC1275**
No BAA VSS chart previously existed for this type 1 Seyfert galaxy. A 30 minute field chart has been drawn which includes a V sequence by Penston.
*Please note that the chart for V358 Lyr (240.01) has now been withdrawn and observers should use the AAVSO chart in the future.*

# THE NEW VS SECTION CCD TARGET LIST

**Jeremy Shears**
**(CCD Target List Co-ordinator)**
**bunburyobservatory@hotmail.com**

The CCD target list was first developed in 2002 to provide people who were new to the field of CCD photometry with some interesting targets to which they could turn their CCDs, whilst developing their techniques. The existence of such a list was certainly one of the main factors that got me started in CCD photometry. The list has been ably maintained and developed by Karen Holland over the last few years, and I would like to thank her for her efforts and enthusiasm in starting this initiative and taking it forward. Recently I was asked to take over the coordination of the target list, and I aim to build on Karen's excellent work. I have listed below some projects and some stars, which comprise the new CCD target list, and I would be delighted to hear from anyone who decides to have a go!

There are two main aims of the CCD target list:

1 To encourage people who have CCDs, and who have developed the ability to take reasonable images with them, to point them at Variable Stars and develop their photometry techniques
2 To provide some interesting targets and projects to get people involved in doing some real science.

**Beginners Category**

The Beginners Category contains eclipsing-binaries which show significant brightness changes over a reasonable time scale. These stars are guaranteed to vary! Following one or more of these stars over a few nights allows the beginner to test their photometric system, and to see some results in a relatively short period. The VSS has a CCD advisor, Richard Miles, who is happy to provide advice. The CCD mentoring scheme also puts beginners in touch with more experienced observers for guidance. If you would like to be allocated a mentor, contact Roger Pickard.

**Basic CCD Data**

Dwarf novae (DNe) show outbursts during which they increase in brightness by two magnitudes and often much more; the shortest outburst duration is two to three days. However recent CCD monitoring of certain infrequently outbursting DNe in the VSS Recurrent Objects Programme has revealed that several stars appear to show intriguing "brief outbursts". These are much smaller in magnitude (often only 1 magnitude) and in duration (often only 24 h). The Basic CCD Data project involves the long term monitoring of DNe which are thought to exhibit these brief outbursts, with the aim of determining how frequently they occur, whether there is a periodicity and whether they are in any way associated with true outbursts. Who knows what new science this may reveal?

At its simplest, this project involves taking one image of the DN every clear night and measuring the brightness. Many of the targets are very faint at quiescence, so the target may actually be invisible on the image. If VS photometry is not your main interest, you could even consider following one or two of the targets, taking a few images during the course of your normal observing programme. Given the short duration of the outbursts, the key here is to image as often as possible.

Most of these targets are on the Recurrent Objects Programme (ROP), so that if an outburst is detected then the ROP co-ordinator, Gary Poyner, should be notified. Other ROP targets which CCD observers could consider monitoring are V402 And, V336 Per, V358 Lyr, CI Gem and 1502+09 Boo. These are all very faint at quiescence and are probably undetected by most amateur CCD systems. Monitoring for rare outbursts in these systems is particularly valuable. But be warned: spotting a rare outburst in one of these stars may mean you become hooked!

## Time-Resolved Photometry

Time-resolved photometry is a technique commonly used in the monitoring of variable stars, especially cataclysmic variables. Again the technique is relatively simple: a series of images of the target is taken over a period of minutes or hours to look for variations in brightness. Sometimes this technique is referred to as "time series photometry". CVs can show variations over many timescales, and sometimes these are associated with orbital features of the binary system which makes up the CV. The technique is often applied to newly discovered CVs during outburst, with the aim of detecting orbital humps or superhumps. The targets in this project are CVs which have already been shown to exhibit variations of minutes or hours. The aim is to measure the brightness of the stars for as long as possible on a given night to look for such variations. The resulting light curve can then be examined for periodic or stochastic variations, which may in turn reveal information about the underlying cause of the variations.

## Other Targets and Projects

Once the CCD photometry bug has bitten, there are of course thousands of other targets which could be monitored. Some examples are:

1. BAA VSS Recurrent Objects Programme: monitoring for outbursts of poorly characterised eruptive stars and follow-up with time-resolved photometry (programme co-ordinator Gary Poyner)
2. ICCE Programme (Identification, Characterisation, Correction of Erroneous GCVS entries): Here the aim is to collect data on certain poorly studied variables with the aim of building up a light curve which can be used to classify the star. These stars include some which are red; hence a photometric filter should be used for these studies. Possible CCD targets are V720 Cas, TAV0714+17, J0712+296, and TAV1933+53. Further details can be obtained from the co-ordinator, Chris Jones.
3. Long Term Polar Monitoring Programme. Monitoring of stars, mostly magnetic CVs, from the Hamburg Quasar Survey at the request of Dr Boris Gaensicke of Warwick University (programme co-ordinator Gary Poyner). Many of these stars are faint, so ideally suited to CCD observation.
4. Targets of opportunity: time-resolved photometry of unusual CVs in outburst. Outbursts are usually reported on various user groups such as CVnet and VSnet. Observers worldwide aim to obtain light curves which can be used to classify the CV and to understand the underlying astrophysics

**Notes on Specific Stars**

**V452 Cas** has shown several brief outbursts during 2005 and 2006 to around magnitude 16. What is the frequency of these and how are they related to true outbursts?

**GO Com** has shown two outbursts in 2006 and eleven since 1995. What is the true outburst frequency? Superoutbursts should also be reported; this star shows impressive superhumps at such times.

**KV Dra** shows an active quiescence in the low 16s to mid 17s and frequent brief outbursts. Are there patterns to this behaviour?

**V478 Her** was brighter than normal for several months in the summer of 2006. Is this typical behaviour? What is the long-term trend? What is its outburst behaviour?

**DV Dra** is normally very faint at quiescence, but has shown several short-lived brightenings to around magitude 17. Clearly these features are not picked up by visual observers. Is this simply an "active quiescence"? What else is going on? Future outbursts should be reported as a matter of urgency. Superhumps were detected during the 2005 superoutburst.

**HR Lyr** was Nova Lyr 1919 and is possibly a recurrent nova. This is well worth keeping an eye on for future activity. Periodic variations on a variety of timescales (hours, days, weeks and even years) have been reported in the literature. This is a target for long-term monitoring, as well as time resolved photometry.

**V1363 Cyg** is an enigma. Classified as a UGZ in the GCVS, observations have shown that this is extremely unlikely. The star shows variations on every possible time scale: seconds, minutes, hours, days and months, and possibly shows low and high states. There is something for everyone here!

**V1316 Cyg** was observed in superoutburst for the first time in 2006, confirming its UGSU classification. This system also shows brief outbursts to around magnitude 16, which last 24 to 48 hours. Do these occur with a particular periodicity and is there a relationship between these brief outbursts and normal or superoutbursts?

**TY Vul** appears to show low-amplitude outbursts from about 16.6C at quiescence to around 16.0C, as well as normal outbursts.

**V630 Cas** is an unusual DN which showed a 4.8 magnitude outburst in 1950 and a 2 magnitude outburst in 1992. However, variations on a variety of timescales have been reported, including frequent brightenings of about 0.5 magnitude from quiescence in the mid 16s.

**CG Dra** shows frequent outbursts. Time-resolved photometry has shown dips in the light curve which last a few minutes. Are these orbital features? Are they related to the orbital period? Further time-resolved photometry might reveal the answer. Long runs are required due to the long orbital period of this system (ca. 4.5 or 5.5 h)

**SV CMi** is an active UGZ star. Some modulations in the light curve have been detected during outburst. The period is 0.156 d, so long runs will be required to follow any orbital features.

**ES Dra**: time-resolved photometry during a future outburst is required to determine whether this is really a UGSU star. Superhumps have been reported, but these need to be confirmed during future outbursts. Reports indicate this is a DN just above the period gap.

### Beginners Category

| Star | RA (2000) | Dec (2000) | Type | Max | Min I | Min II | Orbital Period | Comp V mag | Comp GSC |
|---|---|---|---|---|---|---|---|---|---|
| AD And | 23 36.7 | +48 40 | EB | 10.9 | 11.6 | 11.6 | 0.99 d | 10.93 | 3641 0339 |
| OO Aql | 11.19.8 | +09 18 | EW | 9.2 | 9.9 | 9.8 | 0.51 d | 10.25 | 1058 409 |
| AC Boo | 14 56.5 | +46 22 | EW | 10 | 10.6 | 10.6 | 0.35 d | 9.39 | 3474 966 |
| EG Cep | 20 16.0 | +76 49 | EB | 9.3 | 10.2 | 9.6 | 0.54 d | 9.6 | 4585 413 |
| TZ Lyr | 18 15.8 | +41 07 | EB | 10.6 | 11.3 | 10.8 | 0.53 d | 10.06 | 3107 2554 |
| ER Ori | 05 11.2 | -08 33 | EW | 9.3 | 10.0 | 10.0 | 0.42 d | 9.25 | 5330 364 |

### Basic CCD Data

| Star | RA (2000) | Dec (2000) | Type | Range |
|---|---|---|---|---|
| V452 Cas | 00 52 19 | +53 52 | UGSU | 14-17.5 |
| GO Com | 12 56 37 | +26 37 | UGSU | 13.1-18.5V |
| KV Dra | 15 50 38 | +64 03 | UGSU | 13.4-17.7V |
| V478 Her | 17 21 05 | +23 39 | UGSU | 15.5-17.1p |
| DV Dra | 18 17 25 | +50 48 | UGSU/UGWZ | 15.0-<21p |
| HR Lyr | 18 53 25 | +29 14 | N (or NR) | 6.5-15.8v |
| V1363 Cyg | 20 06 12 | +33 43 | ? | 13.0-<17.6p |
| V1316 Cyg | 20 12 13 | +42 45 | UGSU | 14.5 – 17.8C |
| TY Vul | 20 41 44 | +25 35 | UG | 14.0-19.0p |
| V630 Cas | 23 48 53 | +51 28 | UG | 12.3-17.1p |

### Time-Resolved Photometry

| Star | RA (2000) | Dec (2000) | Type | Range |
|---|---|---|---|---|
| SV CMi | 07 31 08 | +05 59 | UGZ | 12.6 17.1V |
| ES Dra | 15 25 32 | +62 01 | UGSU? | 13.9-16.3p |
| HR Lyr | 18 53 25 | +29 14 | N (or NR) | 6.5-15.8v |
| CG Dra | 19 07 33 | +52 58 | UG | 15.0-17.5p |
| V1363 Cyg | 20 06 12 | +33 43 | ? | 13.0-<17.6p |

# THE MICRO-LENSING EVENT OF GSC 3656-1328

**Christopher Lloyd**
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During the first half of November a particularly unexpected event unfolded in the constellation of Cassiopeia. On October 31 Akihiko Tago [1] reported the discovery of a star, apparently in outburst, at magnitude 7.5, with a few earlier observations showing it brightening over the previous five days. The report also contained the seeds of suspicion that this was not the usual type of outburst, of a nova or any other flaring star, because the object was coincident with an apparently ordinary star of magnitude 11.4 called GSC 3656-1328, and this was quickly confirmed by accurate astrometry. Very little is known about this star; it has Tycho photometry giving V=11.37 and B-V=0.10, suggesting that it's an early A-type star, and 2MASS colours that are consistent with this, suggesting nothing unusual. The star does not appear in any emission line catalogues, and has not attracted attention in any way. It also appears in the NSVS catalogue, and is apparently constant, although all the data are flagged as being unreliable to some extent.

About an hour after the discovery report AAVSO Special Notice 22 was issued reporting a 'Bright New Variable in Cassiopeia' [2]. Keith Geary received this on his mobile phone and was able to take an image showing the star at magnitude 8.1 [3], and over the next few hours the first visual observations were reported showing that the star was fading quickly. A 3-hour run by Tom Krajci showed that the star was fading by about 0.07 magnitudes per hour [4], or 1.7 magnitudes per day; an incredible rate. Probably the most crucial observation at this time was provided by Robin Leadbeater who obtained a low-resolution spectrum, which (eventually) showed that the outbursting object had an early A-type spectrum and had no emission lines [5]. So the object was apparently a normal A-type star, just three magnitudes brighter than it had been previously. When a star goes into outburst there are dramatic physical changes which almost inevitably produce emission lines, but equally there is no reason to expect an ordinary A-type star to do this. The lack of any physical changes and the very rapid fade suggested that this was not a real outburst but a microlensing event [6].

Microlensing events require that the source, the lens and the observer are very closely aligned, typically milli-arc seconds. In the galactic plane, although there is apparently a continuum of background stars, there is actually so much space between them that the probability of the alignment being close enough to produce lensing is very, very low. There are several surveys that use microlensing to study the population of low-mass objects and discover planets in the galactic plane, but these use either the galactic bulge or the Magellanic Clouds to provide the background source. Also these surveys probe perhaps 10 kpc of the galactic plane to provide the lens, which is why they are successful. The probability of a star like GSC 3656-1328, which is only 1 kpc distant, being lensed is vanishingly small, but just how small is not clear. Over the coming months this question will receive serious attention and the density of low-mass objects in the galactic plane will be reviewed. The other interesting question is what type and mass of object is acting as the lens? Calculations based on the time-scale of the event suggest that it is something the mass of a brown dwarf or very low mass star.

The light curve of a microlensing event is actually surprisingly simple, and is determined by the closeness of the alignment and the speed at which this changes. The

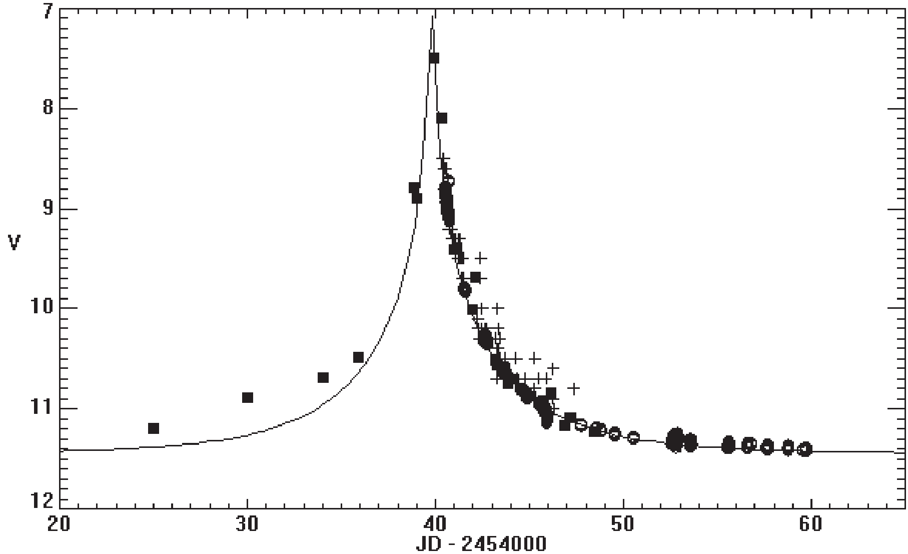


**Figure 1: The light curve obtained for this micro-lensing event**

alignment factor gives the magnification or amplification of the event, which in this case is about 60 times, and the relative speed provides the time scale. The overall shape of the event is constrained by these factors and once a part of the light curve has been seen, the rest can be predicted with ease. Microlensing light curves are symmetrical and characterised by a very sharp peak and asymptotic wings. Asymmetries can occur if some acceleration of one of the components is involved, rather than the relative motions being constant and linear, like for example the orbital motion of the earth about the sun. This particular effect is referred to as the microlens parallax but is usually seen in events lasting several tens of days. Short term blips on the light curve are usually a sign of planets [8].

Since discovery observations have been made on most days and several spectra have also been taken. The star is now very close to its original magnitude and there appeared to be no significant changes in the spectrum as the star has faded, and colour has also remained constant. The shape of the light curve of GSC 3656-1328 is exactly that of a simple microlensing event although most of the first half of the event is missing. The early points come from the amateur surveys and at the moment all look a little bright but it is not clear if this is due to an asymmetry or a calibration problem. For those lucky enough to have seen it this will be a memorable and possibly unique event.

**References**

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2 AAVSO SN 22 <http://www.aavso.org/publications/specialnotice/22.shtml>
3 <http://mira.aavso.org/pipermail/aavso-discussion/2006-October/010385.html>
4 <htt://mira.aavso.org/pipermail/aavso-discussion/2006-October/010392.html>
5 <http://mysite.wanadoo-members.co.uk/astro2/spectra_30.htm>
6 <http://tech.groups.yahoo.com/group/baavss-alert/message/912>
7 e.g., <http://adsabs.harvard.edu/abs/2004ApJ...606..319G>
8 e.g., <http://www.eso.org/outreach/press-rel/pr-2006/pr-03-06.html>

# MY FAVOURITE STAR

**Gary Poyner**

I currently monitor 393 variable stars, so you might think that choosing a favourite out of that lot might be a tricky thing to do. No chance. I don't even have to give it any thought. My favourite star just has to be DY Persei: an RCB star with a difference, lying in a star rich circumpolar field, it can be found less than 30 arc minutes from the lovely little star cluster Trumpler 2, and just two degrees from the more famous Sword Handle double cluster. Most of its cycle can be followed with nothing more elaborate than a 10 inch scope, for its range is 10.5-15.7. There is no waiting around for months or years for this one to fade either, for it's always active and it even has a period. You can't say that for any other RCB star known at this time.

For me it all started back in 1992, when the late Margareta Westlund wrote to Guy Hurst with an observation of the then catalogued NL star DY Per. Guy passed on the letter to me, I e-mailed Margareta, and we began to monitor it every night. At that time we were the only two amateurs observing it. At about the same time the Latvian astronomer Dr. A. Alksnis provided more information on this peculiar object, stating that it was a very cool RCB star (probably the coolest known), and had a mean period of 792d. He asked the TA group for more data, and Margareta and I were only too happy to oblige. From that time I have observed DY Per on every possible occasion.

The field is circumpolar from much of the UK, but is really tricky in the Summer months, as it is low down to the north. Such is the attraction of this star that very often I can be seen poking the 22cm dobsonian out of the bedroom window, or precariously balancing this instrument on breeze-blocks to get me higher than my neighbours hedge, just to make an observation of it at difficult times of the year!

As of November 1st 2006, I have made 1,065 observations of DY Per since 1992, resulting in the light curve shown opposite in Figure 1. Even if I say it myself, it's a lovely light curve. When you first start out VS observing, this is the type of plot you dream of compiling from your own data. It has both deep and shallow minima, and the decline rates are slower than 'classical' RCB stars. You also never see a prolonged minimum. Usually after just a few weeks, it will begin to recover. DY Per is either a unique object, or is the proto-type of a new sub-group of the RCB classification. Z UMi looks to be a similar object, but the decline rate is nearer to the classical RCB.

Analysis of my data using Peranso, results in a period of 797 days, as shown in Figure 2, which is pretty close to that published by Alksnis. I still have e-mail contact with Dr. Alksnis very occasionally, and as you would guess, the subject is DY Per. I have a feeling that it's his favourite star too. I know it's certainly mine!

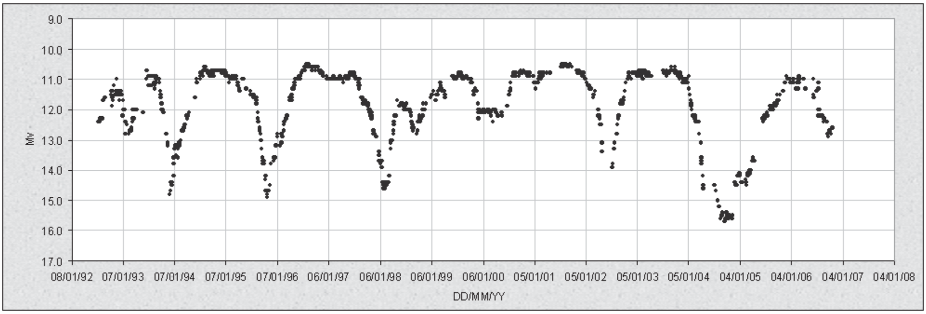


**Figure 1: DY Per: visual observations 1992-2006. G. Poyner**

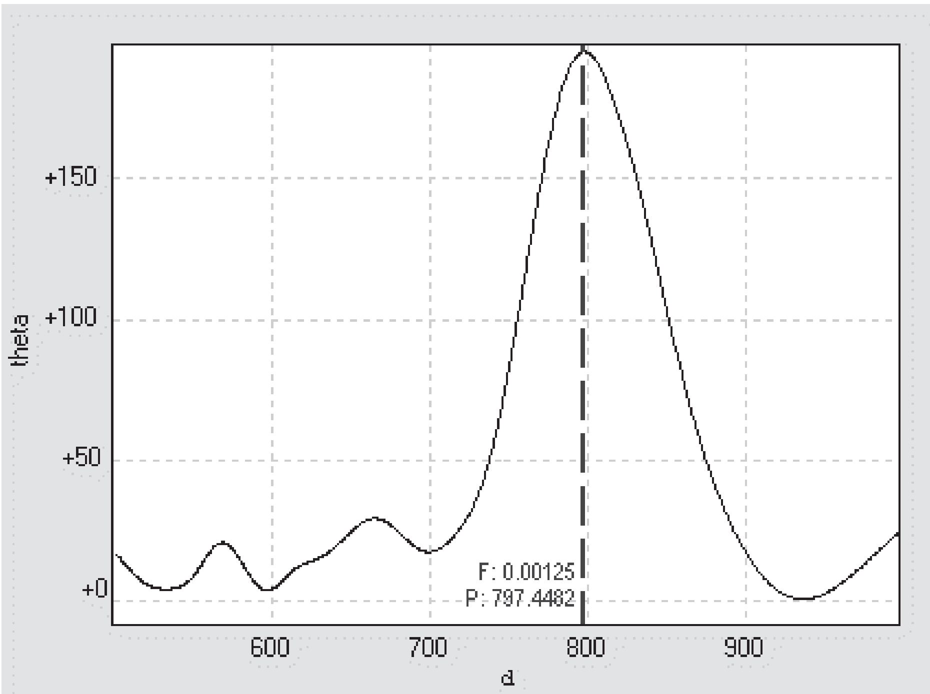


**Figure 2: Phase plot with period of 797 days shown.**

# MINIMA OF LONG PERIOD ECLIPSING VARIABLES

TONY MARKHAM

Although most known eclipsing variables have short periods which are measured in hours, days or weeks, there are some with much longer periods. The following table lists some eclipsing variables with catalogued periods in excess of 3 months.

| Star | RA | Dec | Mag Range | Period(days) |
|---|---|---|---|---|
| eps Aur | 05 01 58 | +43 49 24 | 2.92-3.83 V | 9892 |
| zeta Aur | 05 02 28 | +41 04 34 | 3.70-3.97 V | 972.16 |
| FP Car | 11 04 24 | -62 35 00 | 10.4-11.8 p | 176.027 |
| AZ Cas | 00 54 46 | +64 05 05 | 8.78-9.31 V | 197.27185 |
| V748 Cen | 14 59 37 | -33 25 07 | 11.5-13.6 V | 566.5 |
| VV Cep | 21 56 39 | +67 37 33 | 4.80-5.36 V | 7430 |
| EE Cep | 22 09 23 | +55 45 22 | 10.8-12.4 V | 2049.94 |
| KL Cep | 22 10 23 | +54 09 12 | 11.3-12.5 p | 256.1 |
| W Cru | 12 11 59 | -58 46 59 | 9.04-10.4 B | 198.537 |
| V1488 Cyg | 20 15 28 | +47 42 52 | 3.90-4.14 V | 1147.4 |
| V695 Cyg | 20 13 38 | +46 44 29 | 3.73-3.89 V | 3784.3 |
| NN Del | 20 46 49 | +07 33 10 | 8.38.8.92 V | 99.2684 |
| OW Gem | 06 31 42 | +17 04 56 | 9.00-10.9 B | 1258.59 |
| eta Gem | 06 14 53 | +22 30 25 | 3.15-3.90 V | 2983.49 |
| HP Lyr | 19 21 39 | +39 56 00 | 10.5-11.0 p | 140.75 |
| RZ Oph | 18 45 46 | +07 13 14 | 9.65-10.4 V | 261.9277 |
| ups Sgr | 19 21 42 | -15 57 00 | 4.34-4.44 p | 137.939 |
| mu Sgr | 18 13 46 | -21 03 31 | 3.79-3.92 V | 180.45 |
| V381 Sco | 17 47 03 | -35 47 07 | 12.3-16.0 p | 6545 |
| V383 Sco | 17 53 34 | -38 05 00 | 11.7-14.1 p | 4900 |
| BL Tel | 19 06 38 | -51 25 03 | 7.09-9.41 V | 778.6 |

Eclipses of NN Delphini last approx 21 hours.

Note that there is some confusion in the data reported for upsilon Sagittarii. Indeed, the SAC listings (Supplemento ad Annuario Cracoviense) name the star as eta Sagittarii, whilst giving the RA and Dec of upsilon Sagittarii (the GCVS lists eta Sagittarii as an irregular variable with range 3.05-3.12V). The elements quoted by the GCVS and SAC listings produce predictions (labelled G and S below) which differ by approximately half a cycle; it may be that one set predicts primary eclipses and the other predicts secondary eclipses.

The table which follows gives the calculated dates of eclipses from 2007 to 2009 :-

| Star | Eclipse Mid Date | Eclipse Duration |
|---|---|---|
| FP Car | 2007 Jan 13 12h | Jan 10 - Jan 15 |
| mu Sgr | Feb 02 | Jan 23 - Feb 11 |
| BL Tel | Feb 26 | Jan 20 - Apr 05 |
| ups Sgr G | Mar 12 | Feb 27 - Mar 24 |
| KL Cep | Mar 28 | Mar 25 - Apr 01 |
| NN Del I | Apr 07 20h | |
| NN Del II | Apr 26 13h | |
| W Cru | May 12 | Apr 22 - May 31 |
| ups Sgr S | May 18 | May 06 - May 30 |
| HP Lyr | May 23 | May 09 - Jun 06 |
| RZ Oph | Jun 01 | May 23 - Jun 09 |
| BM Cas II | Jun 25 | Jun 06 - Jly 15 |
| FP Car | Jly 08 13h | Jly 05 - Jly 11 |
| NN Del I | Jly 16 03h | |
| ups Sgr G | Jly 27 | Jly 14 - Aug 09 |
| mu Sgr | Aug 01 | Jly 22 - Aug 10 |
| NN Del II | Aug 03 19h | |
| BM Cas I | Oct 03 | Sep 14 - Oct 22 |
| ups Sgr S | Oct 03 | Sep 20 - Oct 15 |
| V748 Cen | Oct 06 | Aug 27 - Nov 14 |
| HP Lyr | Oct 11 | Sep 27 - Oct 25 |
| NN Del I | Oct 23 09h | |
| NN Del II | Nov 11 02h | |
| W Cru | Nov 26 | Nov 07 - Dec 16 |
| KL Cep | Dec 09 22h | Dec 06 - Dec 12 |
| ups Sgr G | Dec 12 | Nov 30 - Dec 24 |
| FP Car | Dec 31 14h | Dec 28 - Jan 03 |
| BM Cas II | 2008 Jan 09 | Dec 20 - Jan 28 |
| mu Sgr | Jan 28 | Jan 19 - Feb 07 |
| ups Sgr S | Feb 18 | Feb 05 - Mar 01 |
| RZ Oph | Feb 18 | Feb 10 - Feb 27 |
| HP Lyr | Feb 29 | Feb 16 - Mar 14 |
| ups Sgr G | Apr 28 | Apr 16 - May 08 |
| NN Del I | May 08 22h | |
| NN Del II | May 27 14h | |
| W Cru | Jun 12 | May 23 - Jly 01 |
| FP Car | Jun 24 14h | Jun 21 - Jun 27 |
| V383 Sco | Jly 02 | Jun 26 - Jly 07 |
| ups Sgr S | Jly 05 | Jun 21 - Jly 17 |
| HP Lyr | Jly 19 | Jly 05 - Aug 01 |
| BM Cas II | Jly 24 | Jly 05 - Aug 12 |
| mu Sgr | Jly 27 | Jly 17 - Aug 05 |
| NN Del I | Aug 16 04h | |
| KL Cep | Aug 22 00h | Aug 18 - Aug 26 |
| NN Del II | Sep 03 21h | |
| ups Sgr G | Sep 13 | Aug 31 - Sep 26 |
| BM Cas I | Nov 01 | Oct 12 - Nov 20 |

| Star | Eclipse Mid Date | Eclipse Duration |
|---|---|---|
| RZ Oph | Nov 06 | Oct 28 - Nov 14 |
| ups Sgr S | Nov 19 | Nov 07 - Dec 02 |
| NN Del I | Nov 23 11h | |
| OW Gem | Nov 24 | Nov 18 - Nov 30 |
| HP Lyr | Dec 06 | Nov 23 - Dec 19 |
| NN Del II | Dec 12 03h | |
| FP Car | Dec 17 15h | Dec 14 - Dec 20 |
| W Cru | Dec 27 | Dec 08 - Jan 15 |
| EE Cep | 2009 Jan 12 00h | Dec 29 - Jan 25 |
| mu Sgr | Jan 23 | Jan 14 - Feb 02 |
| ups Sgr G | Jan 29 | Jan 17 - Feb 11 |
| BM Cas II | Feb 06 | Jan 18 - Feb 25 |
| NN Del I | Mar 02 17h | |
| NN Del II | Mar 21 10h | |
| zeta Aur | Mar 22 | Mar 02 - Apr 11 |
| ups Sgr S | Apr 06 | Mar 25 - Apr 19 |
| BL Tel | Apr 14 | Mar 07 - May 22 |
| V748 Cen | Apr 24 | Mar 16 - Jun 03 |
| HP Lyr | Apr 26 | Apr 13 - May 09 |
| KL Cep | May 05 02h | May 02 - May 08 |
| BM Cas I | May 17 | Apr 28 - Jun 06 |
| FP Car | Jun 11 16h | Jun 08 - Jun 14 |
| NN Del I | Jun 12 00h | |
| ups Sgr G | Jun 16 | Jun 03 - Jun 28 |
| NN Del II | Jun 28 16h | |
| V1488 Cyg | Jly 13 | Jly 01 - Jly 23 |
| W Cru | Jly 14 | Jun 24 - Aug 02 |
| mu Sgr | Jly 23 | Jly 13 - Aug 01 |
| RZ Oph | Jly 26 | Jly 17 - Aug 03 |
| BM Cas II | Aug 22 | Aug 03 - Sep 10 |
| ups Sgr S | Aug 22 | Aug 09 - Sep 04 |
| HP Lyr | Sep 14 | Aug 31 - Sep 27 |
| NN Del I | Sep 17 06h | |
| NN Del II | Oct 05 23h | |
| ups Sgr G | Nov 01 | Oct 19 - Nov 13 |
| BM Cas I | Nov 30 | Nov 11 - Dec 19 |
| FP Car | Dec 04 16h | Dec 01 - Dec 08 |
| NN Del | Dec 25 13h | |

Since periods are often only given to the nearest day (and some may be even more uncertain), the dates given may also be slightly uncertain. Eclipse durations can be even less accurately known, especially in those cases where the constituent stars are themselves variable. For W Cru and BM Cas and other Beta Lyrae type variables, an eclipse duration of 20% of the period was used in the calculations.

Not all of the above eclipses are favourable, for example, the early year eclipses of Mu Sgr occur just after conjunction.

In some cases it is necessary to wait longer for favourable eclipses (or indeed for the next eclipse)

| Star | Eclipse Mid Date | Eclipse Duration |
|---|---|---|
| eps Aur | 2010 Aug 04 | 2009 Jly 05 - 2011 Sep 02 |
| eta Gem | 2012 Oct 02 | 2012 Sep 17 - 2012 Oct 17 |
| V381 Sco | 2015 Oct 03 | 2015 Aug 13 - 2015 Nov 22 |
| VV Cep | 2018 Apr 12 | 2017 Aug 10 - 2018 Dec 12 |

Claims have been made that several known variable stars might also be eclipsing variables. For example, it has been suggested that some of the sharp fades of CH Cygni have been due to eclipses. One model for CH Cyg involves a three star system, with orbital periods of 14.5 years (eclipses in 1971 and 1985) and 2.07 years (linked to other fades ?). It is not clear how the recent fade would fit in with this: relative to the suggested 14.5 year cycle it is half a cycle late !

Other examples include:

**XX Cam**, which showed a symmetrical fade of 2 magnitudes in 1939-40; this single fade is the basis of it being listed as a RCB variable

**V644 Cen**, with a suggested period of over 200 years

**Rho Cas**, which has shown some fades of over a magnitude; data keyed in to the VSS database for the last 30 years shows (probable) fades to magnitude 5.4 in 1986 and to 5.7 in 2001. It used to be listed as a RCB variable, but is now listed as type SRd

**BU Gem**, with a suggested period of around 32 years (although I haven't been able to track down the year of the previously reported eclipse; a 30 year light curve based on the data in the BAA VSS database shows no unusual fades, although there are some significant gaps where data is still to be keyed in)

**WY Gem**, was suggested, based on spectral changes to be in eclipse between 1960 and 1976; the suggested orbital period was around 50 years.

**V532 Oph**, with a suggested period in excess of 6000 days, but once again with no quoted date of a previous eclipse.

# WHY CHI CYG FADES...

**Maurice Gavin**
**www.astroman.fsnet.co.uk**

Chi Cyg was in the news last summer, being at the highest maximum for over a century and reaching mv3.7 about Aug 1st 2006 [ref:AAVSO]. Indeed my wide-field photo taken with an IR pass filter showed it was the brightest star in the constellation at this time!

My low-resolution spectra taken on Aug 1 [right] when near maximum light, and on Oct 16 [left], together with the combination of the two [centre] show a marked drop in intensity of the light in visible wavelengths [shaded area] between these dates. The near infrared [right of the H-alpha @ 656nm eg vertical line] is essentially unchanged but invisible to the human eye. CCDs typically retain sensitivity in near-IR.

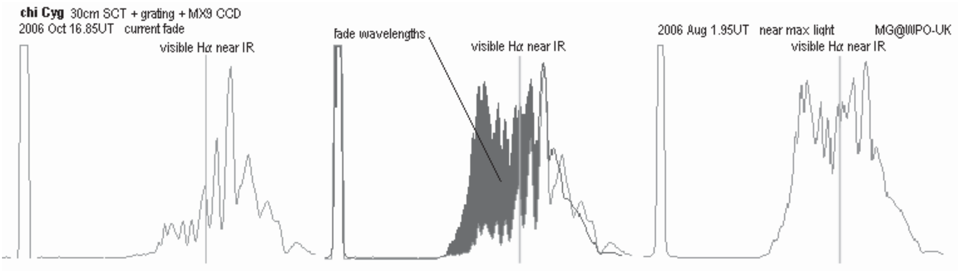


**Figure 1: Low resolution spectra of Chi Cyg from October 16th (left), August 1st (right) and combined at centre**

The standard view why Mira type variables change brightness is because the star expands [gets fainter] and contracts [gets brighter], but my spectra hopefully add an additional dimension to the discussion.

*****************************************************

A Danish amateur offered this additional explanation (opposite) on-line, and gave us permission to reproduce here. He is Poul Hansen, of Aalborg, in Denmark, who has written around 10 articles for Danish amateur astronomical publications, and has given presentations at about 25 local club meetings. His main interest in astronomy is observing Deep Sky and Variable Stars, though he does occasionally observe the sun.

He has access to the Urania Observatory in Aalborg, where he uses a 10" F/16 refractor from 1897 for some of his observations. The observatory also has a 90mm Coronado filter for viewing the sun in H-alpha light. He personally owns a 17.5" Dobsonian (at the moment mothballed), a 4" refractor, an 80 mm short-tube refractor, binoculars and lots of other stuff!

*****************************************************

*The peak visual brightness of a Mira star during its cycle occurs at the time of highest temperature and weakest TiO band strength (i.e. earliest spectral type).*

*After the (visual) maximum the star expands in size, and the temperature begins to drop. A reduced amount of energy is radiated per surface area, and the emitted light is shifted away from the visible part of the spectrum towards (invisible) infrared light.*

*But that is not the whole story. The strength of the TiO bands in the spectrum is also highly sensitive to changes in temperature. Colder temperatures result in stronger absorption by the TiO bands (i.e. later spectral type).*

*At spectral type M0, practically no light is removed by the TiO bands. But at spectral type M8 the TiO bands are so strong, that they absorb 2.75 magnitudes of the visible light, and 0.50 magnitudes of the infrared red light. The removal of light away from the visible region, when the temperature drops, is noticeably amplified because of this effect.*

*In your spectra of Chi Cyg, it is clearly visible, that the TiO bands are getting stronger (deeper) after the maximum in August. The spectrum is changing towards a later type. The answer to your question about why Chi Cyg is getting fainter, is a colder temperature (that shifts the energy away from the visible region) and stronger TiO bands (that absorb light in the visible region).*

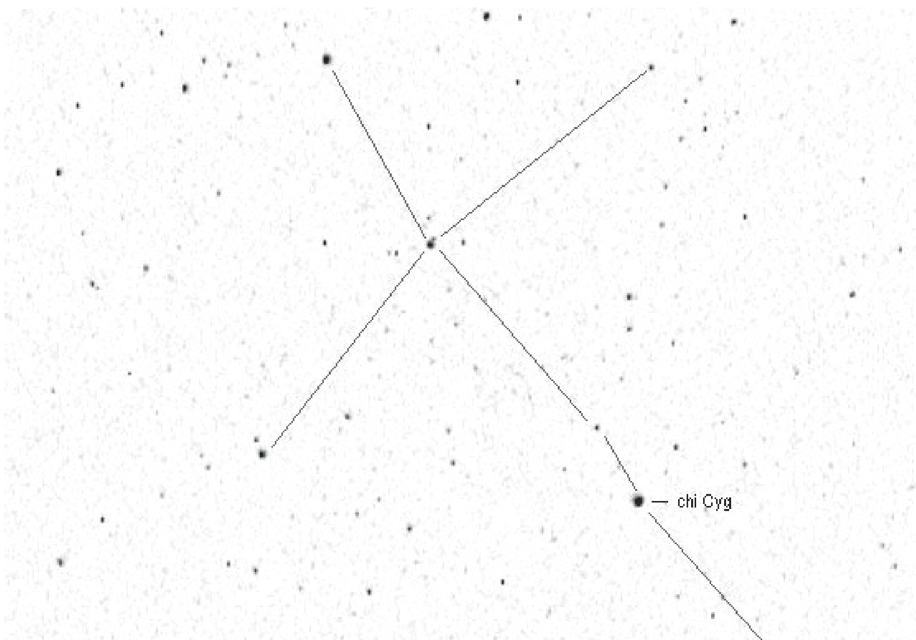


**Figure 2: The position of Chi Cyg in Cygnus**

# SX UMA – HELP!

**Graham Salmon**
**01872.501422, grahamobs@a30.net**

SX UMa is an RR Lyr type star, the third group of pulsating variables which have periods of hours compared to the Mira and Delta Cepheids, which have periods of months and days respectively. They have variabilities with an amplitude of around a magnitude.

I became interested in them because it is possible to obtain a complete, or nearly complete, light curve in the course of one night from dusk to dawn, to do so in more than one colour with my filter drive and, with the autoguider to keep it on track, to enable me to get a decent night's sleep.

I have to confess that they are, frankly, rather boring which is why they are rather neglected nowadays but it is also why they have a very important place in history. Like the Cepheids, their average absolute magnitude is related to their period, and they can therefore be used to measure stellar distances and thus, in the 1920s, established the distances to the galaxies. They are particularly useful as, although their amplitude is smaller than the Cepheids, there are many more of them. They are in a late stage of evolution and their periods do change very slowly.

They are divided in to two main sub-groups: RRAB with a steep rise in its light curve and RRC with a slower rise so that some of them approach a sinusoidal shape.

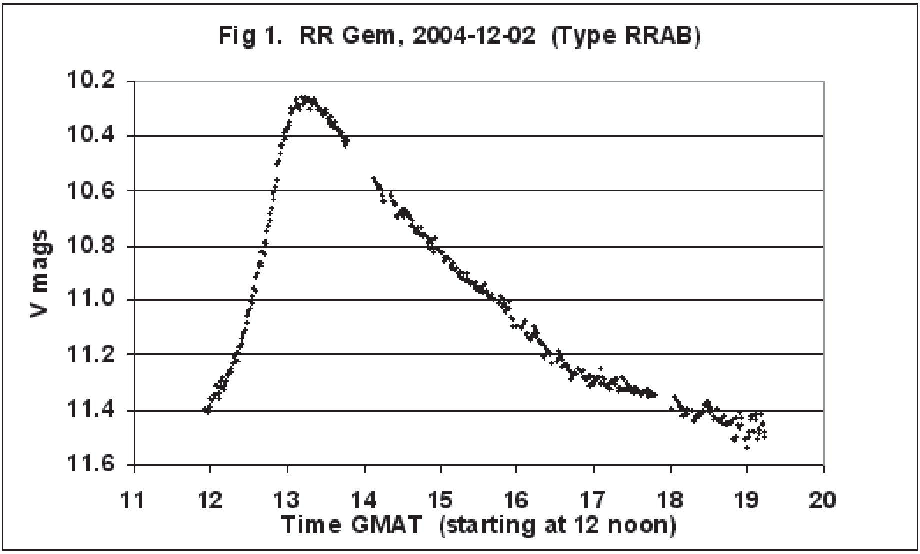


**Figure 1: Light Curve of RR Gem, an RRAB type RR Lyrae star, showing the steep characteristic rise**

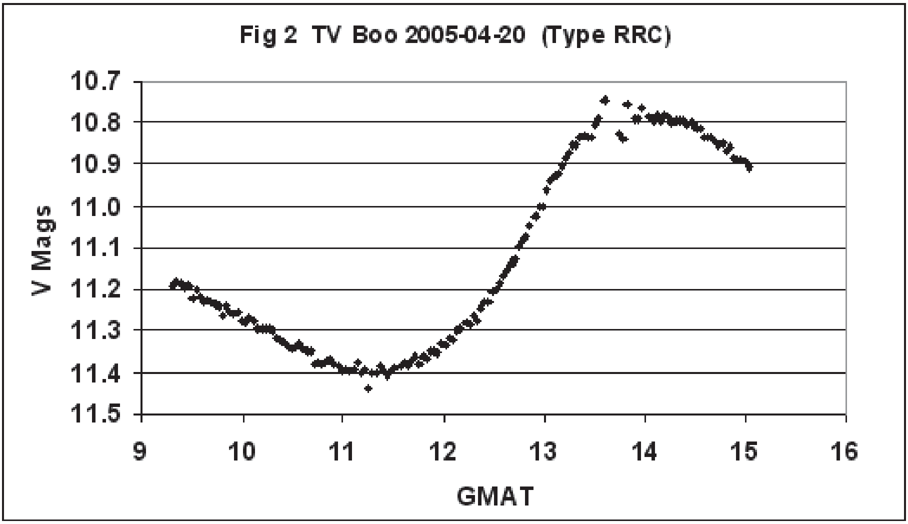


**Figure 2: Light Curve for TV Boo, an RRC type star, showing the gentler rise, and almost sinusoidal shape**

To determine if there is a change in period going on, the time of maximum is recorded, the Observed time and the difference between that and the Calculated time can then be plotted against the Cycle number in what is called an (O-C) diagram. The Calculated figure can be derived using the period given in the GCVS.

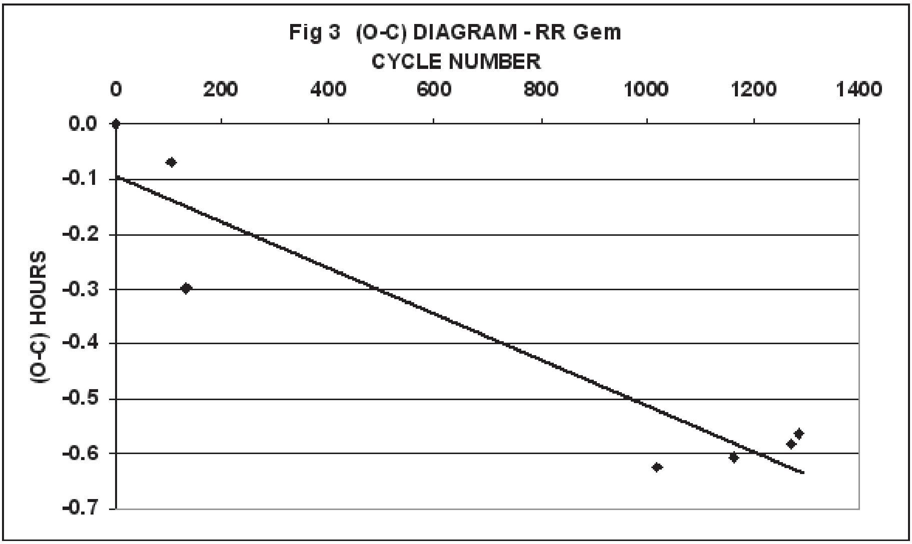


**Figure 3: The derived O-C diagram for RR Gem**

The two groups of data for RR Gem shown here were measured in January 2005 and 2006. Over this period the observed times were lagging by about 0.5 hours, making the period given by the GCVS of 9.5354 hours smaller by 0.0004 hours. The scatter in the measurements is probably due to the Blazhko effect in this star.

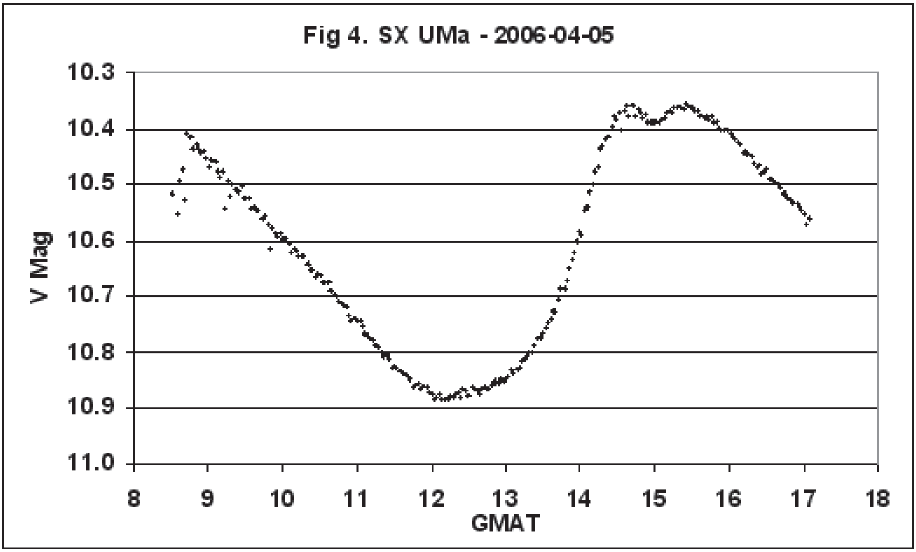


**Figure 4: Light Curve for SX UMa, an RRC star**

In April this year I obtained the light curve in Figure 4 for SX UMa. This is an RRC star even though the rise is quite steep, but why does it have a twin peak? It was possibly the Blazhko effect which is an additional frequency in its pulsation which causes a ripple to travel round the light curve in a matter of weeks. I continued observations through to the end of June, but the 'twin peaks' stayed obstinately together.

Venturing into the internet (not something I do lightly!) produced 'Guidelines for the development of graphical user interfaces suitable for the Nasa Colombian indigenous community' as somewhere in it was buried the phrase 'kwe'sx uma kiwe' !

However, venturing further into the internet I discovered the GEOS RR Lyr Datbase [1] which showed that Hipparcos had produced a light curve for it in 1997, also with the twin peaks.

This database also contained an (O-C) diagram for the last 107 years (1899-2006) which I have adapted here. It is first noticeable how well it was observed until about 1950 and how little it has been until the last few years. Then notice how it increases from -0.15 days to +0.15 days, at varying rates, but then plunges straight back to -0.15.

This puzzled me until I realized that this change of 0.3 was the period of SX UMa, and it was evidently slipping a notch from time to time. I added the trend lines to show up the

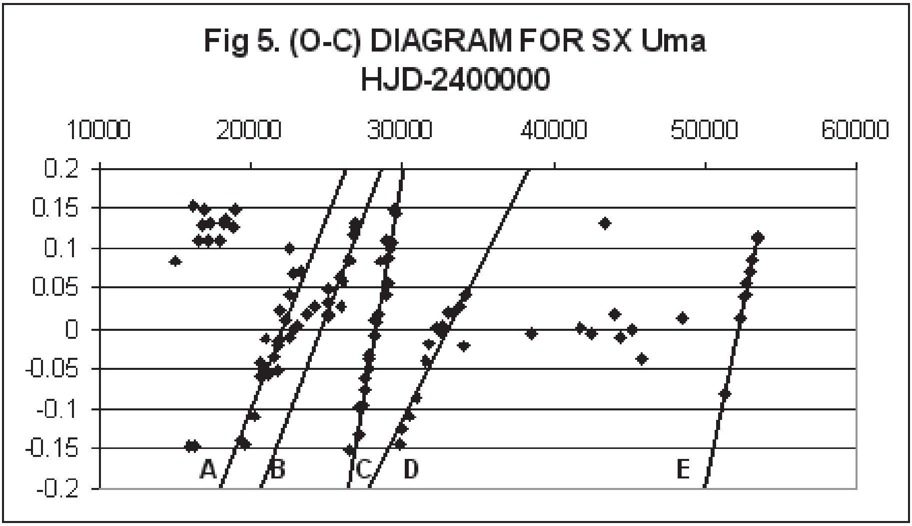


**Figure 5: The Adapted O-C diagram for SX UMa**

five principle groups (A to E) and determined the period for each group to make a better fit, as shown in Figure 6 which also shows the average for the five groups (which is significantly different from the GCVS figure) and the deviation from it of each in seconds.

| | Period(d) | Period (hrs) | Diff from av (secs) |
|---|---|---|---|
| GCVS | 0.3071178 | 7.3708272 | -1.798 |
| A | 0.3071339 | 7.3712138 | -0.406 |
| B | 0.3071345 | 7.3712281 | -0.354 |
| C | 0.3071486 | 7.3715659 | 0.862 |
| D | 0.3071308 | 7.3711391 | -0.675 |
| E | 0.3071452 | 7.3714858 | 0.573 |
| Av(A-E) | | 7.3713265 | |

**Figure 6: Table showing the Periods for each Group**

Perhaps RR Lyr stars are not quite as boring as it first seems, so if someone can shed some light on the twin peaks, I would be delighted to hear from them.

**References**


1 http://dbrr.ast.obs-mip.fr/htfiles/targ0032.html

# VS SECTION MEETING 2006 - PARTIAL REPORT

**Clive Beech**

*The editor apologises for the lack of the rest of the report, which she has been unable to write so far. Clive Beech offered to write up some of the later part of the day, and his report appears below.*

**David Boyd** spoke about ***Measuring Variable Stars Using a CCD Camera.*** He talked about the application of a Charge Coupled Device (CCD) together with a telescope or camera lens for the measurement of the brightness of variable stars. This was with particular reference to equipment that is readily available to the amateur. Firstly, some of the benefits of CCD photometry compared with visual brightness estimates were outlined. These benefits included: precision, consistency, no observer fatigue, fainter limiting magnitude, permanent record, no personal or physiological bias and some tolerance to light pollution. Secondly, David explained the operation of the combination of CCD and telescope/camera lens, and the associated image calibration required for good photometry.

Finally, David gave some personal examples of variable star photometry, including work on **V1363 Cyg**, which was a poorly understood system; **RXS J002258.3 +61411** which is an intermediate polar star with a clear X-ray periodicity of 9.4 mins; **HJ 0728 +6738** an eclipsing SW Sex star; and **V337 Cyg**, a UGSU dwarf nova which was a difficult target due to its proximity to a nearby field star.

David concluded his talk by stating that amateur CCD photometry is capable of producing both interesting and scientifically useful data and emphasised that the most important thing is to have fun. He also pointed out that he has produced a guide to CCD photometry that is available to buy in hard copy form or can be downloaded from the BAA website.

**Jeremy Shears** spoke next on the topic of ***V1316 Cyg - When is an Outburst not an Outburst?*** He described an observing project that he has undertaken jointly with Gary Poyner and David Boyd. Jeremy explained the reason for the study. Usually a dwarf nova outburst is characterised by an increase in brightness of ~2 magnitudes lasting for about two to three days. V1316 Cyg is not the same. Romano originally reported the variability of this star in 1967 but it was not confirmed until 1992. The GCVS reports the star to have a variability range from 17.5 to 14.1 magnitudes and classifies it as a UGSU star but the evidence for this designation is not clear. The star was added to the recurrent objects programme (ROP) list in 1996. However, in 2000 it was realised that the reported position of the star was incorrect so that the collected data was for a misidentified star separated from the target by ~10 to 15asecs. Jeremy, Gary and David started their observing program in the spring of 2005.

Jeremy described the equipment that he used; a Takahashi FS102 refractor with a dew heater and a CCD camera mounted on a Vixen GPDX GE mount+skysensor electronic control and located in Cheshire. The system has a 25’x19’ field of view and a limiting magnitude of 18 magnitude.

The quiescent magnitude of the star was found to be ~17.5 magnitude and during the observing period nine outbursts were detected with a typical increase in brightness of

~1.4 magnitudes. These outbursts were unusually short for a dwarf nova as they returned to quiescence after about 24 hrs. It is possible that a number of outbursts were missed due to their short duration and the interruptions to observing caused by adverse weather conditions. A periodicity analysis was performed but the results were not conclusive. David Boyd supported the study with time-resolved photometry and found that the rate of decay from outburst was ~0.9 magnitudes/day and that flickering was also evident. A literature search suggested that flickering is usually associated with intermediate polars such as TV Col, EX Her and V1225 Cyg but these have a much longer period between outbursts of 10 to 40 years. The cause of the variability of this unusual star was discussed and suggestions included an unstable accretion disc; only a part of the disc unstable; or a particularly active secondary star. One of the problems with the study of this star is the unpredictability of the outbursts.

The talk concluded with a suggestion that this star would be a good candidate for a BAAVSS programme this summer for both visual or CCD observers. The current data was incomplete, and so further data might reveal a clear periodicity or confirm a random nature to the outbursts. Questions that could also be resolved were whether the 2005 observations were unusual, and was the UGSU designation correct?

**Gary Poyner** spoke next giving ***An Update on the OJ +287 Observation Campaign of 2005/2006.*** He reported on the observing campaign of the Blazar OJ +287.

The object was recognised as a quasar in 1968 although the photographic history of the object dates back to 1891 and some 200 images are on record since that date to ~1970. Mauri Valtonen was the first to suggest a period of ~11.6 years for the outbursts which occur in pairs 13 months apart. In 1998 Finnish astronomers concluded that the light variability of this object might be caused by a binary black hole system. This theory was based on a 100 year light curve; however, the data before 1970 was quite sparse. There were ten times more photographic records between 1970 and 1998 than between 1890 and 1970. This light curve was the origin of the 11.6 year period. An outburst was predicted to occur in 1994 and the BAAVSS began observing from 1992. In November 1994 an outburst was observed and then thirteen months later a secondary outburst was also observed. This success suggested that the proposed period was correct. The next outburst was predicted to occur in 2005. The professional astronomical community showed little interest in follow up observations of the predicted outburst in the summer of 2006. However, Dr. Mark Kidger reviewed the past data and had some doubts about the prediction and believed a period of 11.85 years gave a better fit. To confirm the new proposed period a further study of this object is required and the BAAVSS asked its observers to support an observing campaign beginning in 2005 and running to 2007. In October 2005 a bright event lasting for about one week was observed but this was too early and it has been proposed that this might have been a flare. Over the last few years OJ +287 has been getting progressively brighter but then began to fade after the October brightening until February 2006 when it started to brighten again.

The campaign has been well supported by observers in 6 countries. It is now felt that an outburst will not happen this year, however, the object will continue to be monitored, once it comes out of conjunction, from September 2006 through to January 2007. Gary recommended this object for visual and CCD observation. Charts are available and there is a web page supporting the campaign. CCD observations can be filtered or unfiltered.

**John Toone** spoke next on **Long Term Visual Monitoring of AGNs.** He reported on a long-term visual photometry project that he started in 1981 and which he estimated would last for 50 years. The project was the study of three different types of active galaxy. It was believed that the luminosity of each was powered by a central black hole. The three objects were NGC4151 (Type 1 Seyfert Galaxy), 3C273 (Quasar) and Markarian 421 (Blazar). His report at this meeting marked the halfway point in this marathon observation programme.

The instrument used for the study was a 200mm Schmidt-Cassegrain telescope that he took delivery of on 11 April 1981. By this time he had already made ~5000 variable star observations and so was well-practised in the technique of visual brightness estimates and the application of BAAVSS procedures. The sequences used had V filter magnitudes determined to ±0.01 magnitude by PEP measurements. The defocus technique was often used.

**NGC4151**: 650 observations were reported for the period 1981 to 2006. This object showed

- Slow irregular variations.
- 0.6 mag range.
- B-mv, +0.2 to 1.1.
- Requires good seeing.
- Recommended observing frequency : 2 obs/month.

**3C273**: John reported 352 observations of this object for the period 1981 to 2006. A summary of the observations was as follows:

- Semi-regular variations observed with a range of 0.7 mag.
- R-mv of –0.3 to –0.1.
- Evidence for a 13.4yr period.
- Good seeing is required.
- Suggested observing frequency is 1 obs/10 days.

**Markarian 42**: John reported 1013 observations for the period 1981 to 2006, summarising as follows:

- Rapid variations of 1.8 magnitude range.
- Possibly two modes of variation.
- Possible link to TeV gamma flares.
- Suggested observing frequency is every clear night.

## COMMENT ON HD 221670 - A POSSIBLE ECLIPSING BINARY

**Christopher Lloyd**
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In the previous issue of the Circulars Alex Vincent [1] drew attention to an upcoming possible eclipse of the long-period, spectroscopic binary HD 221670, this December. The possibility of eclipses was pointed out by Griffin [2] who derived the spectroscopic orbit. However, a search for eclipses in this system has already proved negative. Miller and Osborn [3] observed the star on eight nights during the period [-4,+10 days] around the 1995 December 7 conjunction and found no variation above a level of 0.02 magnitudes. Based on the size of the system and stars involved Griffin put a limit of 90+/-3 degrees on the inclination for eclipses to be seen, so the negative result unfortunately places no real constraint on the system.

**References**


1 A. Vincent BAA VSS Circulars no. 129, 23, 2006

2 R.F. Griffin, The Observatory, 113, 294, 1993; http://cdsads.u-strasbg.fr/cgi-bin/nph-bib_query?1993Obs...113..294G

3 R. Miller, W. Osborn, Observatory, 116, 382, 1996; http://cdsads.u-strasbg.fr/cgi-bin/nph-bib_query?1996Obs...116..382M


# BINOCULAR PRIORITY LIST


## MELVYN TAYLOR


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

# ECLIPSING BINARY PREDICTIONS

**Des Loughney**

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 UT, with a value greater than 24 indicating a time after midnight. D indicates that the eclipse starts/ends in daylight; L indicates low altitude at the start/end of the visibility; and << indicates that mid-eclipse occurred on an earlier date. Please contact the EB secretary if you require any further explanation of the format. The variables covered by these predictions are:

| | | | | | |
|---|---|---|---|---|---|
| RS CVn | 7.9-9.1V | Z Dra | 10.8-14.1p | RW Tau | 7.98-11.59V |
| TV Cas | 7.2-8.2V | TW Dra | 8.0-10.5v | HU Tau | 5.92-6.70V |
| U CrB | 7.7-8.8V | S Equ | 8.0-10.08V | X Tri | 8.88-11.27V |
| SW Cyg | 9.24-11.83V | Z Per | 9.7-12.4p | TX UMa | 7.06-8.80V |
| V367 Cyg | 6.7-7.6V | U Sge | 6.45-9.28V | Z Vul | 7.25-8.90V |

Note that predictions for RZ Cas, U Cep, Beta Per and Lambda Tau can be found in the BAA Handbook. For information on other eclipsing binaries see the website < http://www.as.ap.krakow.pl/o-c/index.php3>. Again please contact the EB secretary if you have any queries about the information on this site and how it should be interpreted.

**2007 Jan 1 Mon**
TV Cas D17(18)22
TX UMa L17(19)23
HU Tau 21(25)29L

**2007 Jan 2 Tue**
Z Dra 01(04)06
RS CVn 04(10)07D
Z Vul L05(05)07D
SS Cet D17(21)25L
TW Dra 18(23)28
Z Per 23(27)29L

**2007 Jan 3 Wed**
TV Cas D17(14)18
U Sge D17(18)19L
S Equ D17(20)19L
Y Psc 18(23)22L
HU Tau 22(26)28L

**2007 Jan 4 Thu**
U CrB L00(<<)02
Z Vul D17(15)20L
SW Cyg D17(19)24L
TX UMa D17(20)25
Z Dra 18(21)23

**2007 Jan 5 Fri**
TV Cas 05(09)07D
TW Dra D17(18)23
SS Cet D17(20)25L
HU Tau 24(27)28L

**2007 Jan 6 Sat**
Z Per 00(05)05L
X Tri 02(04)02L
RW Tau 02(07)04L
Z Dra 03(05)07D
del Lib L04(<<)05
RS CVn 23(29)31D

**2007 Jan 7 Sun**
TV Cas 01(05)07D
U CrB 01(07)07D
X Tri 01(04)02L
Z Vul L05(02)07D
U Sge L05(03)07D
Y Psc D17(17)22
TX UMa D17(22)26

**2007 Jan 8 Mon**
X Tri 01(03)02L
HU Tau 01(05)04L
del Lib L04(07)07D
TW Dra D17(13)18
SS Cet D17(20)24
Z Dra 20(22)25
TV Cas 20(24)28
RW Tau 20(25)28L
X Tri 24(26)26L

**2007 Jan 9 Tue**
Z Per 01(06)05L
SW Cyg 02(08)07D
V367 Cyg L04(08)07D
V367 Cyg D17(08)22L
Z Vul D17(13)19
X Tri 23(26)26L

**2007 Jan 10 Wed**
HU Tau 02(06)04L
V367 Cyg L04(<<)07D
Z Dra 05(07)07D
V367 Cyg D17(<<)22L
S Equ D17(17)19L
TV Cas D17(20)24
TX UMa 19(23)28
X Tri 23(25)26L

**2007 Jan 11 Thu**
TW Dra 04(09)07D
V367 Cyg L04(<<)05
Z Dra D17(16)18
SS Cet D17(19)24
RW Tau D17(20)24
Z Vul 19(24)19L
RS CVn L21(25)31
X Tri 22(24)26L

**2007 Jan 12 Fri**
Z Per 03(08)05L
HU Tau 04(08)04L
Z Vul L05(00)05
TV Cas D17(15)19
X Tri 21(24)26L
Z Dra 22(24)27

**2007 Jan 13 Sat**
del Lib L03(<<)05
U Sge D17(21)18L
SW Cyg D17(22)24L
TX UMa 20(25)29
X Tri 20(23)25
TW Dra 23(28)31D
U CrB L24(28)31D

**2007 Jan 14 Sun**
SW Cyg L01(<<)04
RW Tau D17(14)19
SS Cet D17(18)23
X Tri 20(22)25

**2007 Jan 15 Mon**
del Lib L03(06)07D
Z Per 04(09)05L
Z Dra D17(17)20
X Tri 19(22)24

**2007 Jan 16 Tue**
TV Cas 02(06)07D
Z Vul D17(22)19L
TW Dra 18(23)28
X Tri 18(21)23
RS CVn L21(20)26
TX UMa 22(26)31D
Z Dra 23(26)28

**2007 Jan 17 Wed**

U Sge L05(06)07D
SS Cet D17(18)22
X Tri 18(20)23
TV Cas 22(26)30

**2007 Jan 18 Thu**

X Tri D17(20)22

**2007 Jan 19 Fri**

Z Vul L04(09)07D
TW Dra D17(19)24
X Tri D17(19)21
Z Dra D17(19)21
TV Cas D17(21)25
RW Tau 22(27)28L
TX UMa 23(28)31D

**2007 Jan 20 Sat**

del Lib L03(<<)04
SS Cet D17(17)22
X Tri D17(18)21
U CrB L23(26)31D

**2007 Jan 21 Sun**

Z Dra 01(04)06
TV Cas D17(17)21
X Tri D17(17)20
Z Vul D17(20)18L
RS CVn L21(15)21

**2007 Jan 22 Mon**

del Lib L03(06)07D
TW Dra D17(14)19
X Tri D17(17)19
Y Psc D17(19)21L
RW Tau D17(21)26
SW Cyg 19(26)23L

**2007 Jan 23 Tue**

TX UMa 01(05)07D
SW Cyg L01(02)07D
X Tri D17(16)19
SS Cet D17(16)21
Z Dra 18(21)23

**2007 Jan 24 Wed**

Z Vul L04(07)07D
U Sge L04(00)06
HU Tau D17(16)19

**2007 Jan 25 Thu**

Z Dra 03(05)07D
TV Cas 04(08)07D
TW Dra 04(10)07D
RW Tau D18(16)21

**2007 Jan 26 Fri**

TX UMa 02(07)07D
V367 Cyg L03(47)07D
RS CVn 04(10)07D
SS Cet D18(16)20
HU Tau D18(17)21
V367 Cyg D18(47)21L
TV Cas 23(27)31D

**2007 Jan 27 Sat**

del Lib L02(<<)04
V367 Cyg L03(23)07D
U Sge L04(10)07D
Z Per D18(14)19
SW Cyg D18(15)21
V367 Cyg D18(23)21L
Z Dra 20(23)25
U CrB L23(24)30
TW Dra 24(29)31D

**2007 Jan 28 Sun**

V367 Cyg L03(<<)07D
V367 Cyg D18(<<)21L
HU Tau D18(18)22
TV Cas 19(23)27

**2007 Jan 29 Mon**

del Lib L02(05)07D
V367 Cyg L03(<<)07D
Z Vul L04(05)07D
TX UMa 04(08)07D
Z Dra 05(07)07D
V367 Cyg D18(<<)19
SS Cet D18(15)20

**2007 Jan 30 Tue**

Z Per D18(16)20
TV Cas D18(18)22
HU Tau D18(20)24
TW Dra 19(24)29
RS CVn 23(29)31D

**2007 Jan 31 Wed**

RW Tau 00(05)03L
U CrB 05(11)07D
Z Dra 22(24)27

**2007 Feb 1 Thu**

SW Cyg L00(05)07D
TX UMa 05(10)07D
SS Cet D18(15)19
HU Tau D18(21)25

**2007 Feb 2 Fri**

Z Dra 06(09)07D
Z Per D18(17)22
TW Dra D18(20)25
RW Tau 19(23)27L

**2007 Feb 3 Sat**

del Lib L02(<<)03
Z Vul L03(02)07D
U Sge L04(04)07D
TV Cas 05(09)07D
Z Dra D18(17)20
HU Tau 19(22)26
U CrB L22(22)27

**2007 Feb 4 Sun**

SS Cet D18(14)19
RS CVn L20(24)30D
Z Dra 24(26)28

**2007 Feb 5 Mon**

TV Cas 01(05)06D
del Lib L02(05)06D
TW Dra D18(15)20
RW Tau D18(18)22
Z Per D18(18)23
SW Cyg D18(19)22L
HU Tau 20(24)26L

**2007 Feb 6 Tue**

Y Psc D18(20)20L
TV Cas 20(24)28

**2007 Feb 7 Wed**

U CrB 03(08)06D
SS Cet D18(13)18
Z Dra D18(19)22
HU Tau 21(25)26L

**2007 Feb 8 Thu**

Z Vul L03(00)06
TW Dra 05(10)06D
Z Per D18(20)24
TV Cas D18(20)24

**2007 Feb 9 Fri**

Z Dra 01(04)06
RS CVn L19(19)26
HU Tau 23(26)26L

**2007 Feb 10 Sat**

del Lib L02(<<)03
SW Cyg 02(09)06D
U Sge L03(<<)04
Z Vul 06(11)06D
U CrB L22(19)25

**2007 Feb 11 Sun**

TW Dra 01(06)06D
RW Tau 02(07)02L
Z Per D18(21)26
Z Dra 18(21)23
HU Tau 24(28)26L

**2007 Feb 12 Mon**

del Lib L01(04)06D
X Tri 23(26)24L

**2007 Feb 13 Tue**

Z Vul L03(<<)03
Z Dra 03(05)06D
U Sge L03(07)06D
TX UMa D18(16)21
V367 Cyg D18(61)20L
TW Dra 20(25)30
RW Tau 20(25)26L
X Tri 23(25)24L

**2007 Feb 14 Wed**

U CrB 00(06)06D
HU Tau 01(05)02L
V367 Cyg L02(37)06D
TV Cas 02(06)06D
SW Cyg D18(22)21L
Z Per D18(22)27L
V367 Cyg D18(37)20L
RS CVn L19(15)21
X Tri 22(24)24L
SW Cyg L23(22)28

**2007 Feb 15 Thu**

V367 Cyg L02(13)06D
Z Vul 04(09)06D
V367 Cyg D18(13)20L
Z Dra 20(23)25
X Tri 21(24)24L
TV Cas 22(26)30

**2007 Feb 16 Fri**

V367 Cyg L02(<<)06D
V367 Cyg D18(<<)20L
TX UMa D18(17)22
RW Tau D18(20)24
TW Dra D18(20)26
X Tri 21(23)24L

**2007 Feb 17 Sat**

del Lib L01(<<)03
V367 Cyg L02(<<)06D
Z Dra 05(07)06D
TV Cas D18(21)25
Z Per 19(24)26L
X Tri 20(22)24L
U CrB L21(17)23

**2007 Feb 18 Sun**

X Tri 19(22)23L

**2007 Feb 19 Mon**

del Lib L01(04)06D
RS CVn 03(10)06D
RW Tau D18(14)19
TW Dra D18(16)21
TV Cas D18(17)21
TX UMa D18(19)24
X Tri 19(21)23L
Z Dra 22(24)27

**2007 Feb 20 Tue**

Z Vul L02(07)06D
U Sge L03(01)06D
X Tri D18(20)23
Z Per 20(25)26L

U CrB 22(28)30D

**2007 Feb 21 Wed**

X Tri D18(20)22
Y Psc D18(22)19L

**2007 Feb 22 Thu**

Z Dra D18(17)20
X Tri D18(19)21
TX UMa D18(20)25

**2007 Feb 23 Fri**

TV Cas 04(08)06D
U Sge 05(11)06D
X Tri D18(18)21
SW Cyg 20(26)21L
Z Per 22(26)26L
RS CVn 22(29)30D
SW Cyg L23(26)30D
Z Dra 24(26)28

**2007 Feb 24 Sat**

del Lib L01(<<)02
S Equ L05(09)06D
X Tri D18(18)20
RW Tau 22(27)25L
TV Cas 23(27)30D

**2007 Feb 25 Sun**

TW Dra 01(07)06D
Z Vul L02(05)06D
Y Psc D18(16)19L
X Tri D18(17)19
TX UMa D18(22)27

**2007 Feb 26 Mon**

del Lib L01(04)06D
X Tri D18(16)19
Z Dra D18(19)22
TV Cas 19(23)27
Z Per 23(28)26L

**2007 Feb 27 Tue**

RW Tau D18(21)25L
U CrB L21(26)30D
TW Dra 21(26)30D

**2007 Feb 28 Wed**

Z Dra 01(04)06D
del Lib 05(11)06D
SW Cyg D19(16)21L
TV Cas D19(18)22
RS CVn D19(24)30D
TX UMa 19(24)28

**2007 Mar 2 Fri**

Z Per 00(05)02L
Z Vul L01(03)06D
U Sge L02(05)06D
RW Tau D19(16)20
HU Tau D19(16)20
Z Dra 19(21)23
TW Dra D19(21)26

**2007 Mar 3 Sat**

del Lib L00(<<)02
S Equ L05(06)06D
TX UMa 20(25)30D

**2007 Mar 4 Sun**

Z Dra 03(06)06D
TV Cas 05(09)06D
HU Tau D19(17)21
V367 Cyg D19(51)19L
SW Cyg 23(29)30D

**2007 Mar 5 Mon**

del Lib L00(03)06D
V367 Cyg L01(27)06D
TW Dra D19(17)22
RS CVn D19(19)25
V367 Cyg D19(27)19L

**2007 Mar 6 Tue**

TV Cas 01(05)06D
V367 Cyg L01(03)06D
V367 Cyg D19(03)19L
HU Tau D19(19)23
Z Dra 20(23)25
U CrB L20(23)29
TX UMa 22(27)29D

**2007 Mar 7 Wed**

V367 Cyg L01(<<)05D
Z Vul L01(00)05D
TV Cas 20(24)28
RW Tau 24(29)24L

**2007 Mar 8 Thu**

Z Dra 05(07)05D
HU Tau D19(20)24

**2007 Mar 9 Fri**

U Sge L01(<<)05
SW Cyg D19(19)20L
TV Cas D19(20)24
SW Cyg L22(19)25
TX UMa 23(28)29D
del Lib L24(19)25

**2007 Mar 10 Sat**

U CrB 04(10)05D
S Equ L04(03)05D
RS CVn D19(14)21
HU Tau D19(21)24L
RW Tau D19(23)24L
Z Dra 22(24)27

**2007 Mar 11 Sun**

TW Dra 02(07)05D
del Lib L24(27)29D

**2007 Mar 12 Mon**

Z Vul L01(<<)04
U Sge 03(08)05D
HU Tau 19(23)24L

**2007 Mar 13 Tue**

TX UMa 01(06)05D
RW Tau D19(18)22
Z Dra D19(18)20
U CrB L20(21)27
TW Dra 22(27)29D

**2007 Mar 14 Wed**

SW Cyg 03(09)05D
Z Vul 04(09)05D
del Lib 04(11)05D
HU Tau 20(24)24L
Z Dra 24(26)29

**2007 Mar 15 Thu**

TV Cas 02(06)05D
RS CVn 03(09)05D

**2007 Mar 16 Fri**

TX UMa 02(07)05D
TW Dra D19(22)27
HU Tau 22(25)24L
TV Cas 22(26)29D
del Lib L23(18)25

**2007 Mar 17 Sat**

Z Vul L00(<<)01
U CrB 02(08)05D
S Equ L04(00)05
Z Dra D19(19)22

**2007 Mar 18 Sun**

TV Cas D19(21)25
HU Tau 23(27)24L
del Lib L23(26)29D

**2007 Mar 19 Mon**

U Sge L01(03)05D
Z Dra 02(04)05D
Z Vul 02(07)05D
TX UMa 04(09)05D
TW Dra D19(17)23
RS CVn 22(29)29D

**2007 Mar 20 Tue**

TV Cas D19(17)21
U CrB L19(19)24

**2007 Mar 21 Wed**

del Lib 04(10)05D
Z Dra D19(21)23
RW Tau 20(25)24L
X Tri 21(24)21L

**2007 Mar 22 Thu**

X Tri 21(23)21L
V367 Cyg L24(66)29D

**2007 Mar 23 Fri**

Z Dra 03(06)05D
X Tri 20(22)21L
del Lib L23(18)24
V367 Cyg L24(42)29D
U CrB 24(30)29D
Z Vul L24(29)29D

**2007 Mar 24 Sat**

TV Cas 04(08)05D
RW Tau D19(19)23L
RS CVn D19(24)29D
X Tri 19(22)21L
V367 Cyg L24(18)29D

**2007 Mar 25 Sun**

TW Dra 03(08)05D
X Tri D19(21)21L
Z Dra 20(23)25
del Lib L23(26)29D
TV Cas 23(27)29D
V367 Cyg L23(<<)29D

**2007 Mar 26 Mon**

U Sge L00(<<)03
Z Per D19(16)21
X Tri D19(20)21L

**2007 Mar 27 Tue**

S Equ L03(07)05D
U CrB D19(16)22
X Tri D19(20)21L
TV Cas D19(23)27
SW Cyg L21(26)29D
TW Dra 23(28)29D

**2007 Mar 28 Wed**

del Lib 03(10)05D
X Tri D19(19)21L
Z Vul L24(27)29D

**2007 Mar 29 Thu**

U Sge 00(06)05D
Z Per D19(17)22
TV Cas D19(18)22
X Tri D19(18)21
RS CVn D19(19)25
Z Dra 22(25)27

**2007 Mar 30 Fri**

X Tri D19(18)20
TW Dra D19(23)28
U CrB 21(27)29D
del Lib L22(18)24

**2007 Mar 31 Sat**

X Tri D19(17)19

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

The **deadline for contributions** to the next issue of VSSC (number 131) will be 7th February, 2007. All articles should be sent to Janet Simpson at **batair@hotmail.co.uk**, and also copied to the editor (details are given on the back of this issue).



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**Nova and Supernova discoveries**
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**Variable Star Alerts** Telephone Gary Poyner (see above for number)