British Astronomical Association

VARIABLE STAR SECTION CIRCULAR

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Contents

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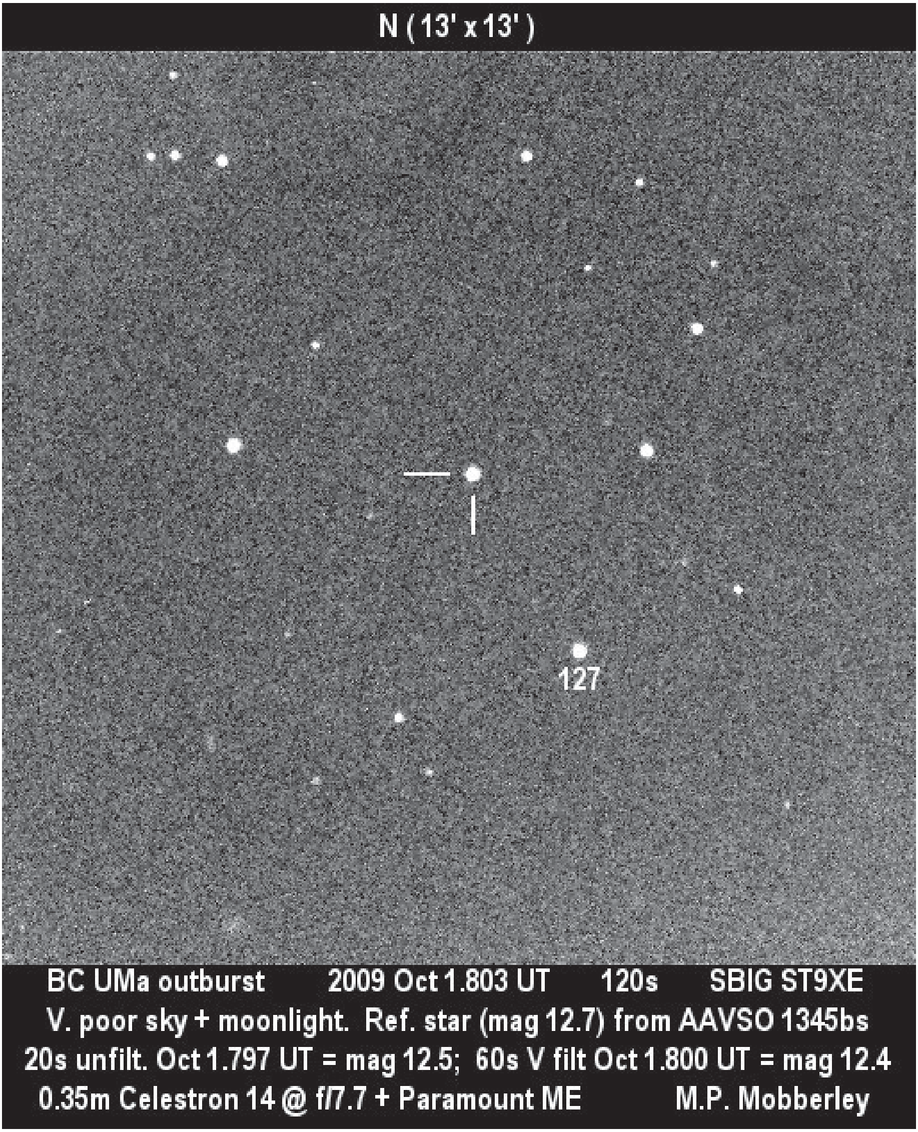
OUTBURST OF THE DWARF NOVA, BC URSAE MAJORIS.

MARTIN MOBBERLEY



FROM THE DIRECTOR

Roger Pickard

Of many things.

Well, I've now handed over the Presidency of the BAA to the very capable hands of David Boyd. I wish him as enjoyable a time as I had. Indeed, more so! The reason being that I found it very difficult to juggle both the Presidency, and the position of VSS Director! It was all very time consuming. Nonetheless, I'm very grateful to my fellow VSS Officers for holding the fort during this period.

However, I'm now free to concentrate on matters variable, and catch up with many of those tasks that I've let slip a little over the past two years. One of these has been data input. I know I mentioned in a much earlier Circular, that we'd now entered all the old data into machine readable form, but there is still some data that, although now in this form, does still require my attention.

More recently, I'm grateful to Bob Dryden, for collecting all the old eclipsing binary records from Tristram Brelstaff, at the end of the summer, and arranging to pass them to me. I still have to collate them, following which will be the job of asking for assistance in entering them into computer. So, if you feel like doing some of this work, let me know.

Another area I wish to investigate, is changes to the main observing programmes. I mentioned this, regarding the binocular programme, in the last Circular, and called for any suggestions. As I've had none, can I assume that everyone is happy with the programme as it is?

Alternatively (or in conjunction with) are there any other types of star that members would like to see officially brought into the existing programmes? Or do we have too many stars on our programmes already? Any thoughts will be welcome.

Variable Stars South.

I wonder how many of you, have made any observations on the equatorial eclipsing binaries project, that Tom Richards is coordinating, and that I sent out an electronic circular about? Well I'll tell you - three, at the last count! Come on you observers, let's support Tom a little more than this please.

Thanks to Karen Holland, and Steven Parkinson.

Although Karen has not edited the Circulars for a little while now, she has still been distributing the paper Circulars. This has entailed the following, every three months:-

* Receive circulars from printer

* Print and Stick labels on envelopes

* Put circulars in envelopes

*	Get stamps, and Post

*	Do BAA claim form for expenditure incurred

And more!

However Karen has now handed over these tasks to Steven Parkinson, so I wish to say a very big “Thank You” to Karen for doing this for almost 14 years; and also to Steve for taking on this somewhat onerous task.

Meetings

The Hampshire Astronomy Group have asked us to do a workshop for them at their Club House in Clanfield, on the 13th March 2010. Numbers will be limited to around 35, so if you wish to attend you’ll need to let me know. Subjects covered, will include visual observing with telescopes and binoculars; observing eclipsing binaries both visually and with a DSLR camera; CCD observing and N/SN searching.

Costs have not yet been calculated but will be fairly minimal.

Members General Meeting

The next full members meeting will probably be at Pendrell Hall near Wolverhampton, Staffordshire on Saturday 1st May 2010. Note, the Monday is a Bank Holiday in the UK so those of you travelling some distance may care to consider it as part of a short break? Further details, will be available, as soon as they are know, but it’s best to keep an eye on the web site.

Clive Beech, Visual observations

Please note the new email address for reporting Visual Variable star observations, on the back of the circular: *visual.variables@britastro.org*

CHART NEWS

JOHN TOONE

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

Telescopic Stars

041.04
R Coronae Borealis
Comparison star D has been dropped from the 18° field chart on account of its orange

colour. The values of the comparison stars on the 1° chart have been amended to ASAS3, TASS and SRO. On the 20′ field chart, comparison star DD has been dropped and comparison star NN has been added which extends the sequence at the faint end. SRO is adopted for the fainter end of the sequence on the 20′ field chart.

006.02
CI Cygni
This 40′ field chart replaces chart 006.01. Comparison stars D, F (very red) and H have been dropped and comparison stars K and N have been added. The new sequence is a combination of Tycho 2 Vj and Skiff.

080.03
AG Draconis
This 3° field chart replaces chart 080.02. Comparison stars A and J have been dropped and comparison stars N, K, L and M have been added. The sequence is extended at the faint end and now covers the known full range of the variable star. The new sequence is Tycho 2 Vj down to magnitude 10.5, and then switches to SRO.

Binocular Stars

072.02
EG Andromedae
This 3° field chart replaces chart 072.01. The sequence is unchanged with the exception that Hipparcos Vj is now adopted.

316.01
Epsilon Aurigae
No previous BAA VSS chart existed for this famous naked eye eclipsing binary which is Variable Star of the Year in the 2010 BAA Handbook. A 30° chart has been drawn which includes a sequence from Hipparcos Vj.

230.02
UU Aurigae
This 9° field chart replaces chart 230.01. Comparison stars D and H are dropped in order to reduce the B-V range within the sequence. The new sequence is Hipparcos Vj on account of the fact that comparison stars L and M are double stars.

111.02
ST Camelopardalis
This 6° field chart replaces chart 111.01. Comparison stars F, J and L are dropped and comparison star N is added. The new sequence is Tycho 2 Vj and has a very narrow B-V range.

089.03
CH Cygni
The 9° and 1° field charts have been redrawn and replace chart 089.01. Comparison stars M, B (V2080 Cygni), G, R, S and T have been dropped and comparison stars W, X and Y have been added. The sequence is drawn from Tycho 2 Vj, Skiff and SRO.
101.02

V Ursae Minoris
This 6° field chart replaces chart 101.01. Comparison stars A, C, F, H and L are dropped and comparison stars M, N and P are added. The new sequence is Tycho 2 Vj with the exception of comparison star M which is a double star and Hipparcos Vj is adopted. All comparison stars are now within 3 degrees of the variable star.

317.01
RW Virginis & RX Virginis
This 6° chart replaces chart MDT 1982 Feb 05. Comparison stars d, b and e have been dropped and the retained comparison stars are now capital letters. The new sequence is Tycho 2 Vj.

ECLIPSING BINARY NEWS

Des Loughney

Epsilon Aurigae

The eclipse started during the third week in August. The fade has continued to the time of writing (15th November 2009) when the magnitude is around 3.44V. As the eclipse started a couple of weeks late, 'totality' at around 3.75V is not now expected until the New Year.

The fade has not been without its surprises. The fade had been smooth until the middle of October, and then there was a change in slope, or a 'shoulder' developed in the light curve. This may be due to a change in density, or structure, of the obscuring cloud of dust and gas, or due to the intrinsic variations of epsilon Aurigae.

In the last news, there was a reference to a PowerPoint presentation on epsilon Aurigae. This is now available on the BAA VSS website, from which it may be downloaded. I used it at a successful public meeting in Dundee. The presentation will be updated with the latest light curves and information. There does not seem to have been many public talks on epsilon Aurigae. I hope that local societies will organise talks as the eclipse develops.

AO Cassiopeiae

This is a peculiar overcontact eclipsing binary system, comprising two stars of 30 and 32 solar masses. It varies by 0.2 magnitude between about 6.05 and 6.25. The variation is too small to be a target for visual observers, but is a good target for DSLR photometry. I started an observing campaign in June 2009, which is still ongoing. According to the Krakow database it has a displaced secondary minima. This is a phenomenon that I had never observed before, so I hoped that I might be able to pick it up.

The reason the eclipse variation is so small, with such massive stars, is because the system is not quite lined up with us on the Earth. The eclipses are partial, with only about 10% of the stars covered at minimum. The pair would be awe inspiring to see within their system, as each star is 35 times the radius of the Sun.

The settings of the Canon 450D camera for a system of that particular magnitude variation is, with a 85 mm lens, exposure 5 seconds, ISO 400, f 3.5.

The diagram below illustrates the data obtained in 2009, presented as a phase diagram which amalgamates the data from many of the continuous eclipses of this system. The phase diagram is constructed using the latest elements from the Krakow website. The data does seem to be symmetrical around the primary minimum (1.0 on the phase diagram) which suggests that eclipses are occurring on time. However, the secondary minima (around 0.5 on the phase diagram) does seem to be displaced to the left. I am hoping one of our astrophysicists can explain the significance of this.

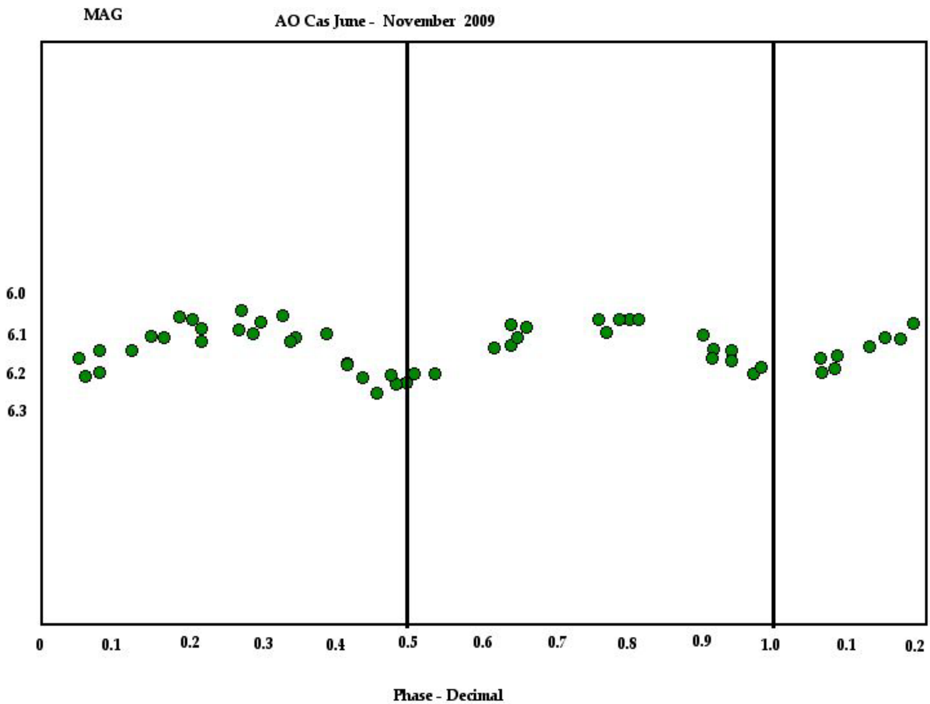


Figure 1: Phase diagram of AO Cassiopeiae

EG Cephei

My attention has been drawn to the eclipsing binary EG Cephei. It is on the BAA's observing list as its period is changing. Its current elements are 2452500.5214 + 0.54462228 days. It varies from 9.6 to 10.5, with the primary minimum showing a drop of 0.9, and the secondary minimum a drop of 0.3. It has a declination of 78°, and is therefore an object that can be observed all the year round. The AAVSO for some reason, classify it as an EA system, though that is plainly wrong. It is classified by other authorities as an EB system or, in other words, a semi-detached system. Its period is so short, at just over half a day, that it must be on the borderline of being an EW system. I have seen a figure of its light curve which is indistinguishable from an EW system, except for the fact that primary and secondary minima are usually more equal in the classic EW systems.

The system can be regarded as being in continuous eclipse, so all observations, at any time or date, are welcome in helping to construct its current light curve.

I intend to have a good look at the system over the winter. The magnitude level would normally make it a difficult target for undriven DSLR photometry. As it is quite near the North Pole, a longer exposure than usual is possible with undriven images, which will allow good estimates. With a 200 mm lens, the settings I would use, are exposures of 3.2 seconds, ISO 800 and f 2.8.

Delta Librae

In the last Newsletter I referred to the campaign to observe Delta Librae. I was able to observe it, using DSLR photometry, on La Palma, Canaries, from the middle of July to the middle of August. The accompanying phase diagram shows my estimates. I was not able to get a full light curve, as the system was only observable between 21.00 and 23.00 UT (when it became too low down). It is clear that, from the secondary eclipse, the period has shortened.

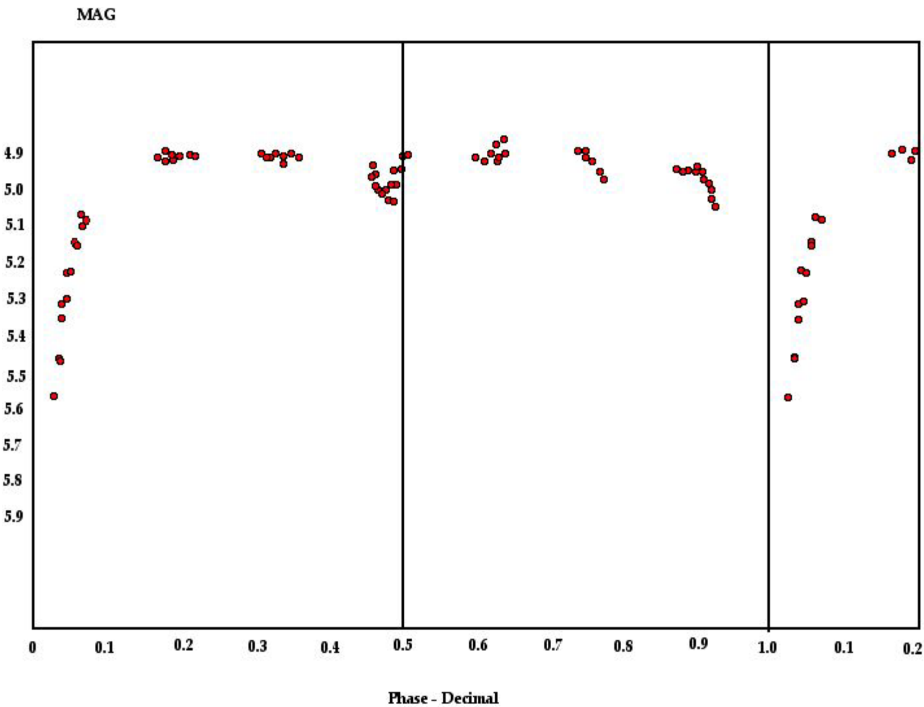


Figure 2: Phase diagram of delta Librae

DSLR photometry is precise enough to pick out the secondary minimum although it is only 0.1 magnitude deep.

VARIABLE STAR SECTION MEETING, CARDIFF UNIVERSITY, PART 2.

SATURDAY, 13TH JUNE 2009

RESULTS FROM THE INTERNATIONAL CCD PHOTOMETRY CAMPAIGN ON DW URSAE MAJORIS.

DAVID BOYD

Summary of a talk given at the VSS meeting at Cardiff University in June 2009.

Introduction

SW Sextantis stars are an unofficial class of cataclysmic variable (CV), not in the GCVS, which was first proposed by Thorstensen in 1991. There are now around 50 such stars listed in a comprehensive website maintained by Hoard at *http://web.ipac.caltech.edu/staff/hoard/cvtools/swsex/biglist.html* and their detailed properties are still not well understood. The aim of this observing campaign, was to try to understand a little more about SW Sex stars, by studying a particular example, DW UMa, in detail.

Like most CVs, SW Sex stars have an accretion disk around the white dwarf primary star, which is being continually supplied with material by the secondary star. In SW Sex stars, this disk is believed to have a particularly complex structure. Many SW Sex stars display permanent superhumps, periodic brightenings in the light output of the system which indicate they have elliptical accretion disks. These elliptical disks precess with a period of several days, while the secondary star orbits the primary every few hours. It is the regular passage of the secondary star past the slowly precessing outer edge of the elliptical disk, and the tidally-induced heating this causes, which gives rise to the superhump phenomenon, and is the reason why superhumps have a period a few percent longer than the orbital period. In SW Sex stars the accretion disk is in a permanently bright state, because of the high rate of accretion from the secondary. The disk is therefore the brightest source of light in these systems. Because many SW Sex stars are eclipsing, it has been suggested that eclipses would provide a good diagnostic tool for probing the structure of the accretion disk, by studying how the eclipse shape varies with the changing orientation, or phase, of the precessing disk. Previous researchers have noted that the depth of eclipses in both PX Andromedae (another SW Sex star) and DW UMa, appears to vary as the accretion disk precesses, but have not had sufficient data to confirm or analyse the variation.

DW Ursae Majoris campaign

DW UMa is an eclipsing SW Sex star with a mean V magnitude outside eclipse of 14.5, an orbital period of 3 hours 17 minutes, and an accretion disk precession period of about 2 days. To investigate if and how the eclipses vary over the precession period, would require as far as practically possible continuous observation of DW UMa for many days.

Professional astronomers would find this difficult to achieve, given the constraints on access to professional telescopes. On the other hand, the amateur community with ready access to many telescopes distributed around the world, could potentially achieve the necessary coverage. This led to the proposal, jointly formulated with Boris Gaensicke, and launched at the joint BAA/AAVSO meeting at Cambridge University in the UK in April 2008, for a coordinated observing campaign involving amateurs. The aim was to keep DW UMa under as near as possible continuous photometric observation, for one month.

During the next 4 weeks, 26 observers in 7 countries around the world, observed DW UMa whenever their skies were clear. They collected almost 55,000 images of DW UMa, each of which provided a magnitude measurement. 109 of the 219 eclipses during this period were observed, some by as many as 8 observers. DW UMa was being observed somewhere in the world for a total of 15.4 days during the 30-day period, more than 50% of the time.

Data analysis

The data was carefully analysed, to bring the light curves of individual observers into alignment in magnitude, so that we had as near as possible a single continuous light curve, see Figure 1. This step was important, because the amplitude of the precessional variation we were looking for was only about 0.1 mag, and DW UMa (like many other CVs) exhibits continuous random flickering with an amplitude of around 0.2 magnitudes. See Figure [1], page 9.

Periodic signals in the light curve were investigated by period analysis. The resulting power spectrum is shown in Figure [2], page 9.

Signal A is the accretion disk precession period, P_{prec} = 2.22 days, E is the superhump period, P_{sh} = 0.1455 days, and F is the orbital period, Porb = 0.1366 days. These periods confirm the normally assumed relationship that the superhump period is the beat between the orbital and precession periods.

$$1/P_{sh} = 1/P_{orb} - 1/P_{prec}$$

This superhump period is consistent with previously published values. Times of minimum were found for all well-recorded eclipses, from a 2nd order polynomial fit to the lower half of each eclipse. This gave 209 eclipse timings for 109 distinct eclipses. Mean timings were calculated for eclipses observed by more than one observer. Orbit numbers were assigned to each eclipse, and a linear eclipse ephemeris computed. This gave an the orbital period consistent with the value found by period analysis. Research of published eclipse timing measurements over the past 25 years, confirmed that this period was also consistent with historical data. An O-C plot of eclipse times, with respect to this linear ephemeris, is shown in Figure [3], page 10.

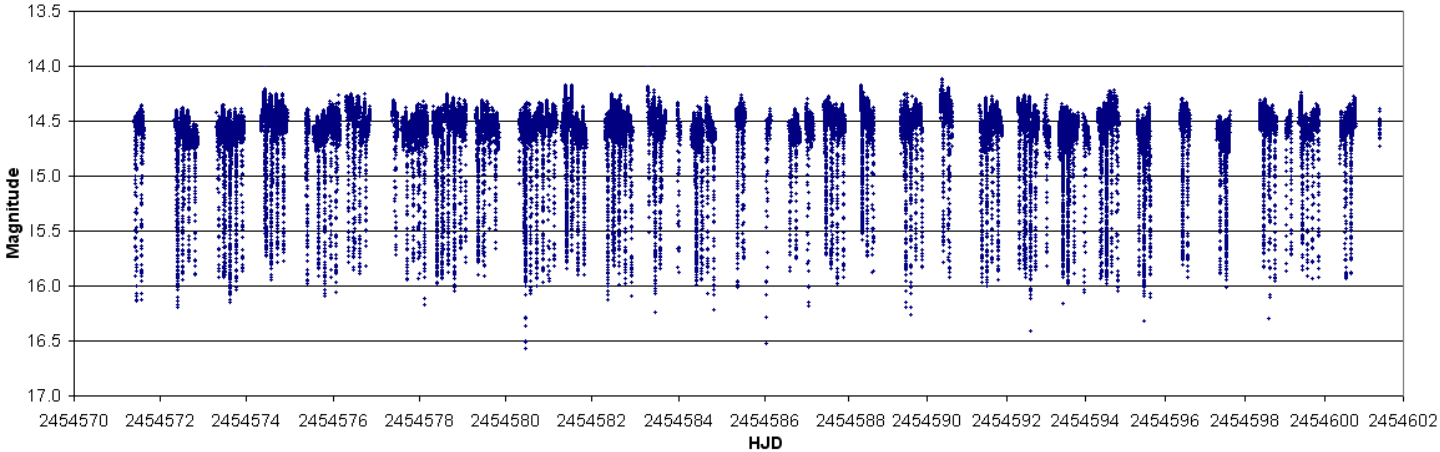


Figure 1. Combined 30 day light curve for DW Ursae Majoris.

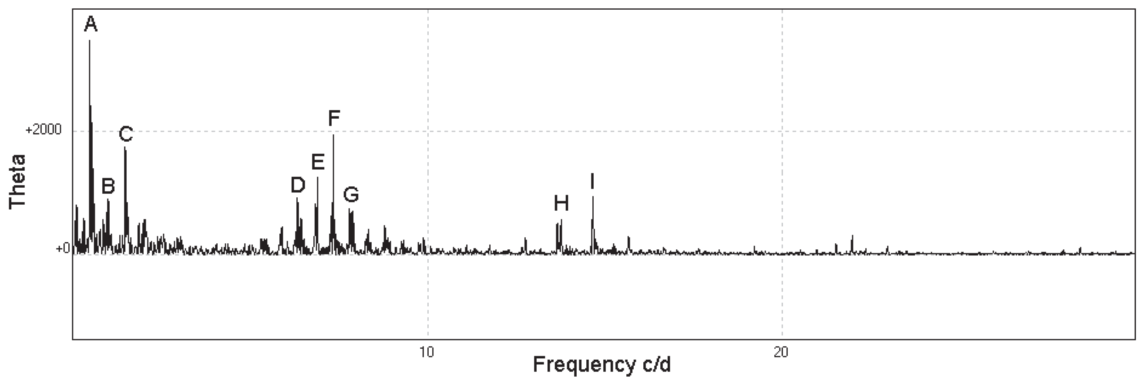


Figure 2. Power spectrum from period analysis of the combined light curve.

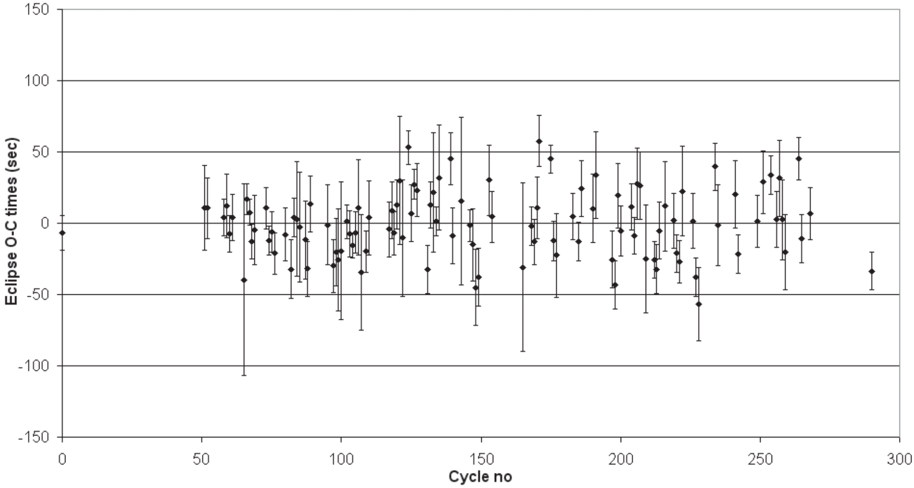


Figure 3. O-C times for 109 eclipses relative to a linear eclipse ephemeris.

Knowing the precession period of the accretion disk, we could study how the shape of eclipses, and in particular their depth, varied with the precession phase. To do this we had to develop a method of measuring the depth of each eclipse. We did this by measuring the magnitude of the light curve on either side of an eclipse, and taking the average of these. We also measured the mean magnitude at the bottom of the eclipse, and then took the difference between these magnitudes as the eclipse depth. When we plotted the eclipse depth against the precession phase as shown in Figure [4], we found a clear sinusoidal variation, confirming that there is a correlation between eclipse depth and the phase of the precessing accretion disk, as had previously been suspected.

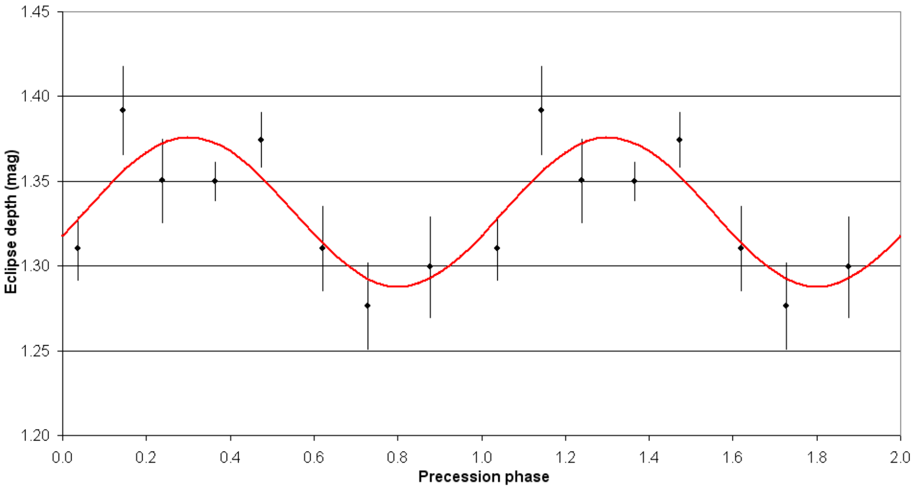


Figure 4. Variation of eclipse depth with accretion disk precession phase.

With further analysis we also found, that both the time of minimum, and the width of eclipses also vary with the precession phase. These are new and unexpected results.

This campaign has confirmed that eclipses do indeed provide a good diagnostic tool for probing the accretion disk in SW Sex stars. They enable us to study how the changing aspect of the disk as it precesses, modulates the time and shape of eclipses. It now remains, for those who model the structure of accretion disks in SW Sex stars, to come up with a model which fits these observations. The campaign has also demonstrated the potential for coordinated observation by amateurs, to provide new scientific information.

A full account of these results, along with details of the observers contributing to the campaign, will be published in MNRAS in due course.

STUDYING SOUTHERN VARIABLES COLLOQUIUM - PART 2.

CARL KNIGHT

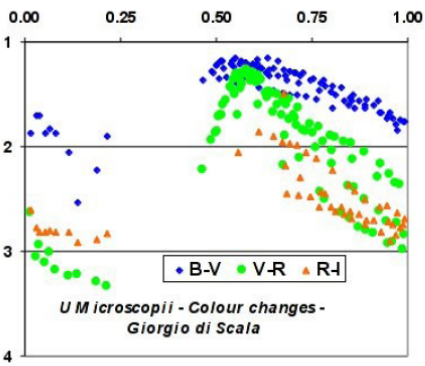
sleepless.knight@paradise.net.nz

Stan Walker – Near Infra-Red J and H Band Photometry at Wharemaru.

Stan resumed the after lunch session with a discussion about investigating stars at IR wavelengths of 1.3μ to 1.7μ.

The topic was quite fluid, this reflecting Stan's enthusiasm, and the fact he rightly points out, that there is still so much to be done.

Previously, Stan and other members of the Auckland Astronomical Society had made several thousand measurements of Mira stars, using the Mark I UBV Photometer at Auckland University over a period of 20 years, commencing in 1968. He points out that whilst there is criticism of using a largely blue sensitive system with Miras, these criticisms are groundless. Stan further states that "UBV provides temperatures, measures of the gas shell, and a very accurate measure of light variations."



On his current project, Stan has made use of an AAVSO loan SSP4 NIR photometer. The basic idea is to track the colour changes in Miras, and to fit these changes to the UBV light curve initially, and then J and H IR bands (JH) a few days after the peak in UBV, as the peak in JH lags that in V. This is illustrated in Figure [1], where the B-V peaks before V-R, and similarly V-R before R-I. I.e. Longer wavelengths peak after shorter wavelengths.

Figure 1: Longer wavelength lag in peak.

One significant limitation of the loan IR photometer, is that it is rather insensitive and is largely incapable of measurements below magnitude 4 or so. However this is compensated for somewhat, according to Stan, by the fact that Miras are very bright at these wavelengths, indeed brighter than Sirius in many cases. For example, α Herculis is magnitude -2.45 in J!

A further more general restriction, is the equipment that different bands require. UBV, BVRI, and JH, are all within the reach of the amateur and small observatory. Longer wavelengths like KLM, require yet more specialised equipment, and so fall into the domain of the professional Astronomer.

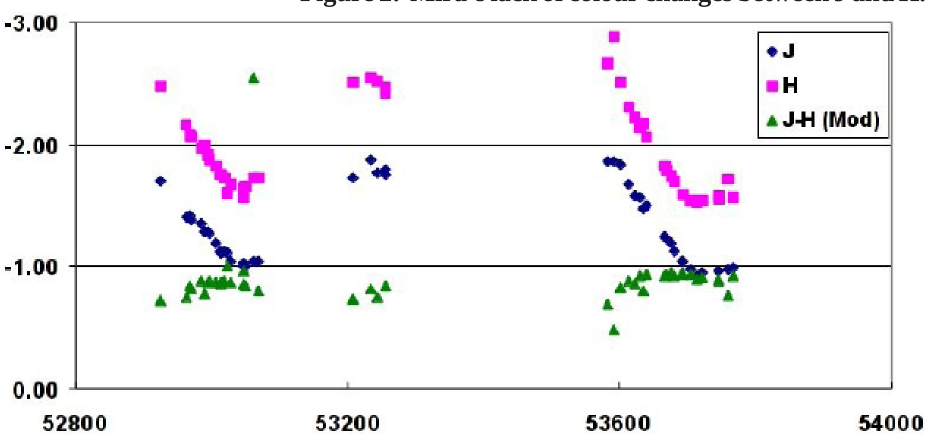
There are many stars bright at JH, indeed many are naked eye stars, and the sky makes no contribution in these bands. Colour can be quite deceptive. There are red variables that are not at all bright in these Near Infra-Red (NIR) bands, whilst others are very bright. For example, the LPV, V Pavonis is bright at JH whilst it's cousin, S Scuti is not. Very red carbon stars like, T Indi and V Pavonis, are also not bright at JH.

Owing to the brightness of these variables, getting suitable comparison stars is difficult. Stan states "there are only 49 stars with V magnitudes of 2.0 or brighter in the whole sky." Colour matters when it comes to finding suitable comparison stars. With respect to the stars that Stan is measuring, he has found only 37 suitable comparison stars in the southern sky, of which more than half are suspected of being variable, and ..."in an area of 25,000 square degrees (to about 10N) there are about 50 usable comparisons. Thus on average the nearest comparison is about 22 degrees away."

K and M stars for comparison are more stable but not as bright in IR JH bands.

In answering why he is doing this, Stan says he is interested in moving beyond the periods of these variables, and looking at the physics of these stars. The area of interest is the same as that covered in Stan's prior Colloquium presentation[1], that is, well evolved low mass stars "assorted red variables. Miras, SRs, LPVs, SARVs, Irregulars." He is seeking to identify which is which, what order these types appear in, in the overall evolution of the stars they originated from, and what do the inbetween stages look like. In Stan's own words "Maybe we can bring a little order out of the seeming chaos in the red variable area of the H-R Diagram?"

Figure 2: Mira's lack of colour changes between J and H.



Almost as an aside, Stan pointed out that whilst Mira itself peaks in JH, the relationship between the emissions at these bands remains relatively constant. What does that tell us?

Stan also answered one of the author's questions, illustrating the physics that can be revealed by the colour measurements he is making. Referring to Figure[1] the lag between short and long wavelength peak emission, he explained that this lag suggests that there is absorption and re-emission at longer wavelengths in the region surrounding stars like U Microscopii.

A typical Mira has an immense gas shell which is responsible for it's characteristic spectra, and an even more expansive dust shell. This dust shell is very likely seen in the IR and NIR.

Referring to his morning presentation (footnote[1], below), Stan touched again on the topic of LPV period changes, but moved on to explain other areas of interest in LPVs. For example, the relationship of light and colour curves of R Centauri whilst it was still displaying a pronounced double maxima.

It is suggested that this reveals a hotter blue companion.

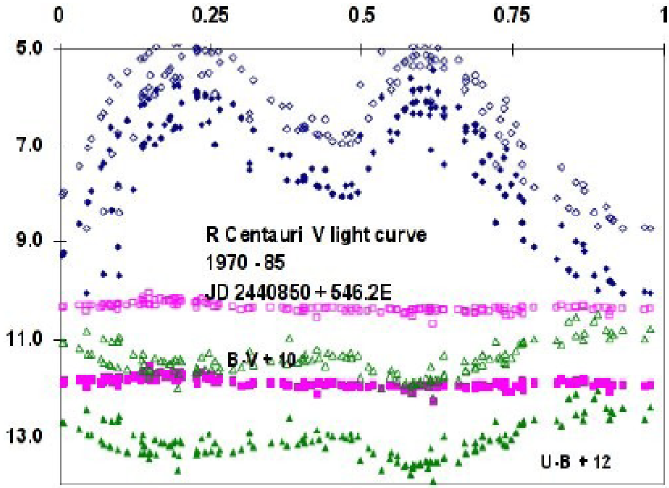


Figure 3: R Centauri Light and Colour Curves.

Explaining the dual maxima, it is further suggested that the true period might be half the currently accepted 546 days, or that the first overtone and fundamental have an exact 2;1 ratio – "...which is correct?", asks Stan.

Collaboration and project outline.

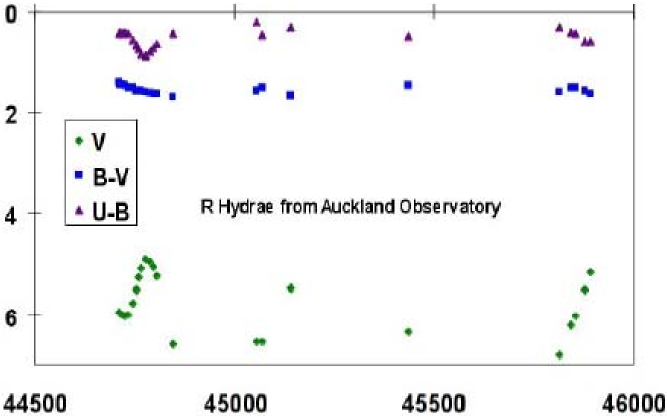
Another star showing unusual colour changes that Stan used to "tease" his audience (his "sales pitch" to generate further interest) was R Hydrae. It exhibits "...tantalising indications of unusual colour changes."

Stan is keen to locate further measurements to fill in the gaps for R Hydrae.

Collaboration is key for work like this. More measurements are needed. At the time of the Colloquium, Stan was hoping to further search the international database, and was hoping to find further measurements made by the likes of Giorgio di-Scala (e.g. Figure [1]) and others.

1. *See Studying Southern Variables Colloquium - Part 1, VSSC No 141.*

Figure 4: R Hydrae variations in colour.



Posing the question, "What will we find?", Stan answers, in effect, nothing at all if we don't try!

Whilst Stan believes that the measurements for any project will most likely finish up in the AAVSO database, he points out that the AAVSO does Time Series Photometry and not the sort of colour measurements that Stan's work requires. To that end, the collaborative work must maintain it's own database.

Stan proposes that the project will work on 20 – 40 stars at a time, and that as each star is adequately (adequate defined by the period of the star, i.e. capture sufficient cycles for the data to be meaningful) measured, the project will move on to another star.

Professional input is also sought, to provide the necessary theoretical grounding. Publication is also vital. Stan points, out that a group he was part of in Auckland using one UBV photometer, managed to publish two or three papers a year for 25 years.

See also, "**Stan Walker – Colour measures of unusual stars.**" later in this report.

Marc Bol – Teaching an old dog new tricks.

Marc's presentation documented his journey into fine engineering, as he sought to produce a telescope mount to meet the exacting requirements of doing photometry of faint objects in crowded fields. To achieve this goal, he needed to improve pointing, tracking, guiding, and to use digital setting circles.

Previously Marc had a German equatorial mount, built with inadequate tools in 1989. It had no setting circles. In 1997 he fitted setting circles, rebuilt the drive, and did more precise engineering.

In 2006 Marc overhauled and rebuilt the mount. He added encoders into the mount. Added an Argo Navis unit, and anti-backlash mounting. All this was done using off the shelf components.

Marc was at pains to explain how flat, is flat, when it comes to engineering surfaces that must rotate against other surfaces, and not introduce tracking error in the mount.

Single star alignment with Argo Navis is possible, if the mount is in proper alignment.

Marc uses a Maxim-DL image link, to get the exact pointing right. The fields he is doing photometry in are too crowded for star charts.

Marc has build his own CCD camera, and uses a 12" Meade Classic SCT.

Bill Allen – Eta Carinae.

Bill Allen has 38 years worth of photoelectric observations of Eta Carinae. Currently he works from his Blenheim, NZ based Vintage Lane Observatory, which also houses the Boötes-3 Telescope (Figure [6]).

η Carinae is located in the centre of the nebula of the same name, in the New General Catalogue, it is NGC 3372 (Figure [5]).

In 1843, η Car outshone Canopus at magnitude -0.86, before fading in the 1900s to magnitude 7.5. It has been steadily brightening again since the 1940s, and is now around magnitude 4.95. This is shown more clearly in Figure [8], page 17.

Bill treated us to a quick summary of η Car facts:

Figure 5: Eta Carinae Nebula

- Eta Carinae is one of the most massive and luminous stars in our galaxy.
- 100 solar masses.
- 5,000,000 times brighter than our sun.
- 7500 light years away.
- Close to "Eddington Limit".
- Supernovae candidate?
- Suspected binary.

Figure6: Bootes-3 with the Vintage Lane Observatory Dome in the background

Old and new.

Bill would appear to not be one to ever waste anything. His equipment includes an Apple IIe[2] computer. He is using:

- Photomultiplier EMI 9789QB.
- Johnson U B V filter set.
- Automated filter wheel.
- Output "Rowe" current to frequency converter.
- Control computer is an Apple IIE.
- High tech insulation tape to hold things together. (Figure [7])!

2. *Something the author remembers fondly from his High School days over 20 years ago now.*

Figure 7: Bill's equipment

For anyone interested in a project to monitor η Car, see "**Alan Plummer – Eta Carina Project**" later in this report.

Grant Christie – Microlensing.

Grant's observing program uses a Meade 16″ on a paramount. It's focus is on:

- Gravitational Microlenses (GM) – Part of the MicroFun Project, Ohio State University, USA.
- Gamma Ray Burst (GRB) afterglows. Böotes-3 (See Figure [6], page 15).
- Comet and Near Earth Object (NEO) Astrometry.
- Cataclysmic Binary Stars (CBS).

Gravitational Microlenses.

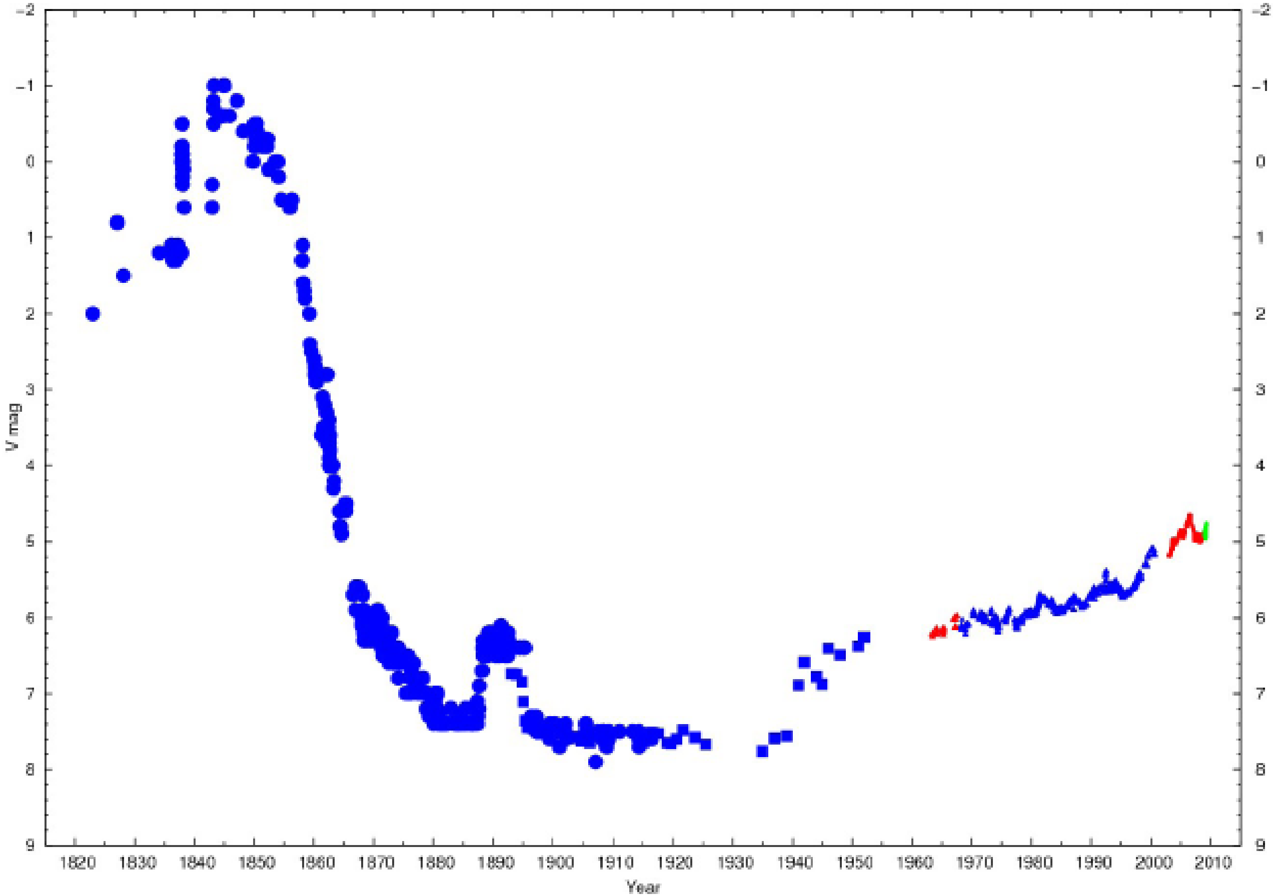
According to Grant, GMs achieve magnifications of 1000 to 1500 times. A typical lens lasts 10 to 100 days. The magnification is greatest if the alignment is exact.

The region of the Milky Way where Grant spends his time hunting for GMs, is the galactic bulge. The greater star density increases the odds of finding a GM.

Surveys monitor something in the order of 100 million stars. This leads to the detection of around 700 events per year and for these events alerts are issued.

Grant has been using Maxim DL and reports it is quite robust. The telescope used is a 16″ Meade LX200R.

Figure 8:
Eta Carinae
light curve
1820 - 2009.



Using Gravitational Lenses to detect Exoplanets.

When a GM concurs with a star with no planets present, the light curve simply shows an increase in amplitude and then a corresponding decay. This is illustrated in Figure[9].

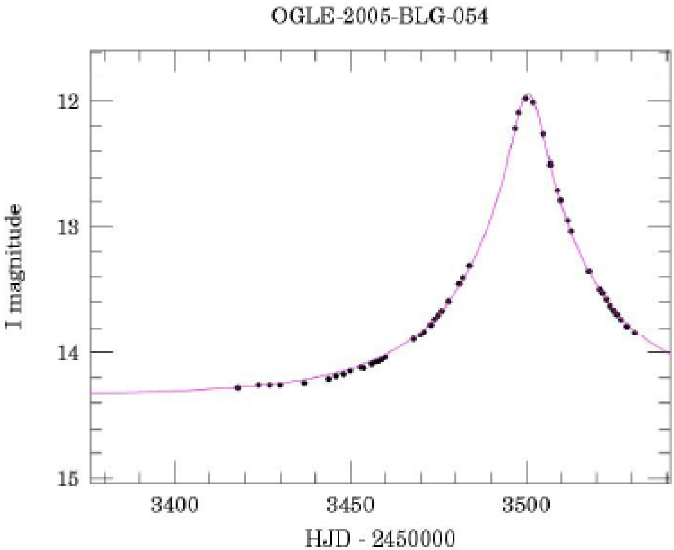


Figure 9: Simple lens with no planets.

If there are planets present however, the planets cause an aberration in the behaviour of the lens. An example of this is found in Figure [10].

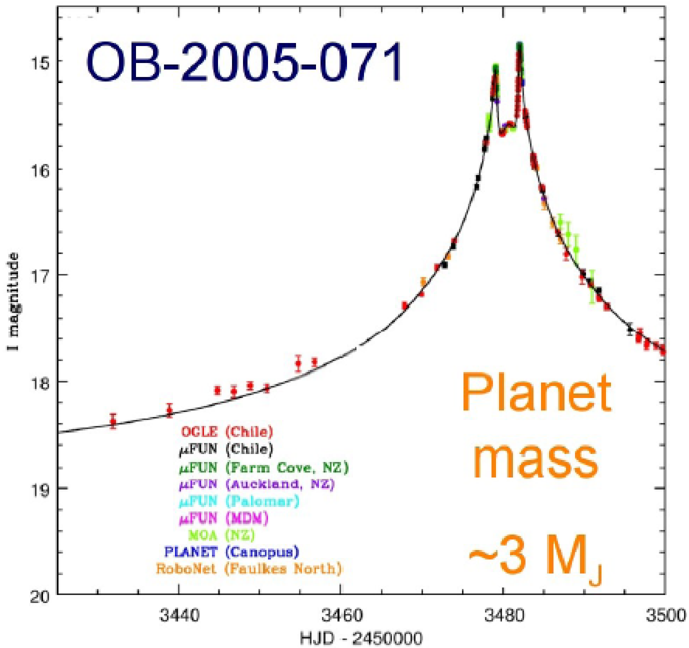


Figure 10: Lens with planets.

To better illustrate the contribution of the Exoplanet, to the light curve of the lens, we can well imagine (Figure 11) that the position of the Exoplanet in it's orbit, over time will result in it having a varying contribution to the overall magnification achieved. When it is better aligned (from the observers perspective) in it's orbit to the source being lensed, it will cause an enhanced peak, similarly when it is not so well placed such a peak will be absent.

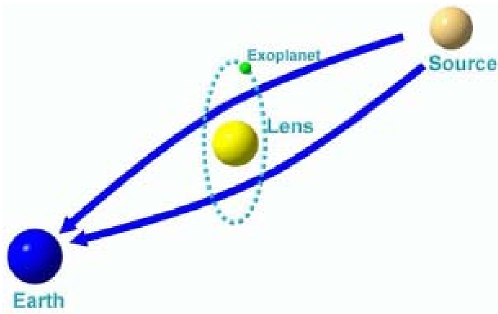


Figure 11: Exoplanet and the lens.

Discoveries:

- 3.8 Mj 2005
- 13 Me 2005
- 1Mj and 1Ms 2006
- At the time of Grant's presentation, the project had discovered 9 Exoplanets.

Grant said that possibly 5-155 of GMs might indicate the presence of planets and that incredibly accurate parallax measurements out to 20kly are possible.

Discussion Session.

Alan Plummer – Eta Carina Project.

Alan kicked off the discussions outlining his proposal for an Eta Carina project. Participants will be beginners, and the project will aim to publish results. It will be a one year project for now, and focus on η Car and R Car. There is plenty of historical data according to Alan. Light curves generated from the observations, will hopefully provide some insight into the stars in question, and at the very least the group will publish a popular piece – if not scientific.

There was lively discussion on the topic of how to handle data, and whether or not personal equations would be of use.

Starter Kit. Fields prepared, comparison stars, calculations with non-variables to help people get it right. Charts for the project are RASNZ chart number 1 for R Car, and the AAVSO Variable Star Plotter for η Car.

Tom Richards – ECB Project.

This project is to be a collaboration between the BAA VSS and the RASNZ VSS. Des Loughney of the BAA, and Dr Bob Nelson from Canada, are liaison for their respective organisations.

The motivation for the project is that ECBs are understudied. Many lack periods. There is data from the first half of the 20th century, but that's it.

Tom suggests that the first step is to find minima. Targets will be:

- Bright at minima, brighter than magnitude 13.
- Near the celestial equator.

The projects members, will probably be organised into three zones: Europe; Australia/New Zealand; and the Americas.

Targets will be allocated to given telescope/detector combinations based on suitability.

Analysts are required to:

- Analyse data.
- Produce an accurate ephemeris.
- Research on line data.
- Publication preparation.

Participants will get their own personal list of stars to cover. Many lack good comparison stars.

Time series of observations during predicted eclipse, are particularly important.

Stan Walker – Colour measures of unusual stars.

The project is to make sustained colour measurements over long periods of ten years or more. The intention is to look for changes in the evolution of the star.

Stan also referred participants to the ECB project that he proposed in the February VSS Newsletter. This project involves four stars in QZ Car. In this system the secondary pair causes elliptical distortions in the primary pair. There are huge differences in eclipse times, due to the size of the system. These differences are typically ±7hrs.

VSS IYA Project.

Tom floated the idea of getting involved with the AAVSO project to study ε Aur. The AAVSO have approximately $800,000 (USD) in funding from the US National Science Foundation. They are wanting to share this funding with a southern hemisphere project, through the VSS.

For this to succeed the VSS needs to:

- Find an interesting southern project.
- Aim at amateurs, possibly the public, and schools.
- Produce materials to explain/get people on board.
- Publication of results.
- Involve Astronomy Societies.

At the colloquium the project was in need of someone to lead it. For now the contact is Tom Richards. Support will be forthcoming from the AAVSO.

The AAVSO IYA website for anyone interested is:
http://www.aavso.org/aavso/iya.html
Download the AAVSO ε Aur campaign document from:
http://www.aavso.org/vstar/price-iya08.pdf

Closing the colloquium.

Finally Tom Richards brought the colloquium to a close and in particular thanked:

- Pauline and Brian Loader.
- The RASNZ Conference Committee, and the local organising committee.
- Frank, Mike, and Bill.
- Stan, and Bill, his fellow organisers.
- All of the colloquium presenters.

IBVS 5891-5910

Janet Simpson

5891 A Period Analysis of the delta Scuti Variable GSC 03973-01698. (Hintz, et al, 2009)
5892 Short-Period Oscillations in the Algol-Type Systems IV: Newly Discovered Vari able GSC 4293-0432. (Dimitrov, et al, 2009)
5893 New Times of Minima of Some Eclipsing Binary Stars. (Dogru, Erdem, et al, 2009)
5894 Timings of Minima of Eclipsing Binaries. (Diethelm, 2009)
5895 The GEOS RR Lyr Survey. (Le Borgne, et al, 2009)
5896 IRAS 19015+1625: A Multi-periodic, Highly Reddened M6III SR Variable. (Munari, Siviero, et al, 2009)
5897 148 CCD times of minima of 47 eclipsing binaries. (Liakos and Niarchos, 2009)
5898 Minima Times of Selected Eclipsing Binaries. (Parimucha, Dubovsky, et al, 2009)
5899 Observations of variables. (2009)
5900 Reports on New Discoveries. (2009)
5901 Photometric and Spectroscopic Study of the W-type, W UMa Binary, TYC 2853-18-1. (Samec, Figg, et al, 2009)
5902 Discovery of delta Scuti type oscillations in two Algol-type binaries: DY Aqr and BG Peg. (Soydugan, E.; Soydugan, F.; et al, 2009)
5903 Elements for 6 Pulsating Stars. (Haussler, et al, 2009)
5904 Photoelectric Minima of Some Eclipsing Binary Stars. (Sipahi, et al, 2009)
5905 New Extreme Outburst of Z CMa. (Grankin and Artemenko, 2009)
5906 Brightness Variations of SAO 53210. (Guerrero, 2009)
5907 Drastic Changes in Photometric Variability of V410 Tau. (Grankin and Artemenko, 2009)
5908 Photometric Analysis of USNO-B1.0 1323-0548678. (Capezzali, et al, 2009)
5909 The New Eccentric Eclipsing Binary GSC 3152 1202. (Kozyreva, et al, 2009)
5910 New Times of Minima of Some Eclipsing Variables. (Lacy, 2009)

The Information Bulletin on Variable Stars (IBVS) can be accessed through the WWW in HTML format at the following URL…. *http://www.konkoly.hu/IBVS/IBVS.html*

UV AURIGAE 1990 TO 2004

MELVYN TAYLOR

This long period variable, within 1.25° of Fl14 Aurigae, is quoted with an extreme range of 7.4 to 10.6 in the General Catalogue of Variable Stars. Its 2000.0 position is RA 05h 22m, Dec. + 32° 31', and the latest chart sequence number, 074.02.

The BAA VSS cd data for the interval in the light curve shows it ranging from 8.2 to 10.7 (mean variation 8.7 to 10.2) and changing with the (quoted) period of 394 days. The next maximum is likely due 2010 February-March in contrast to the date of January 19th in the BAA Handbook.

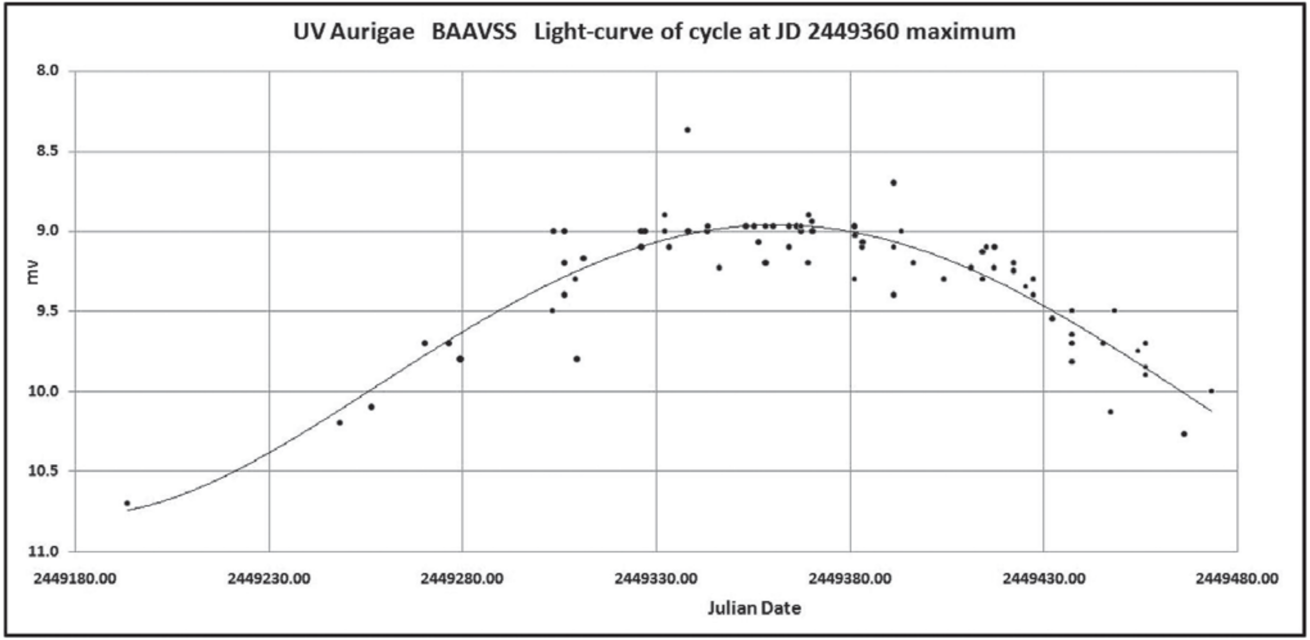


Figure 1.

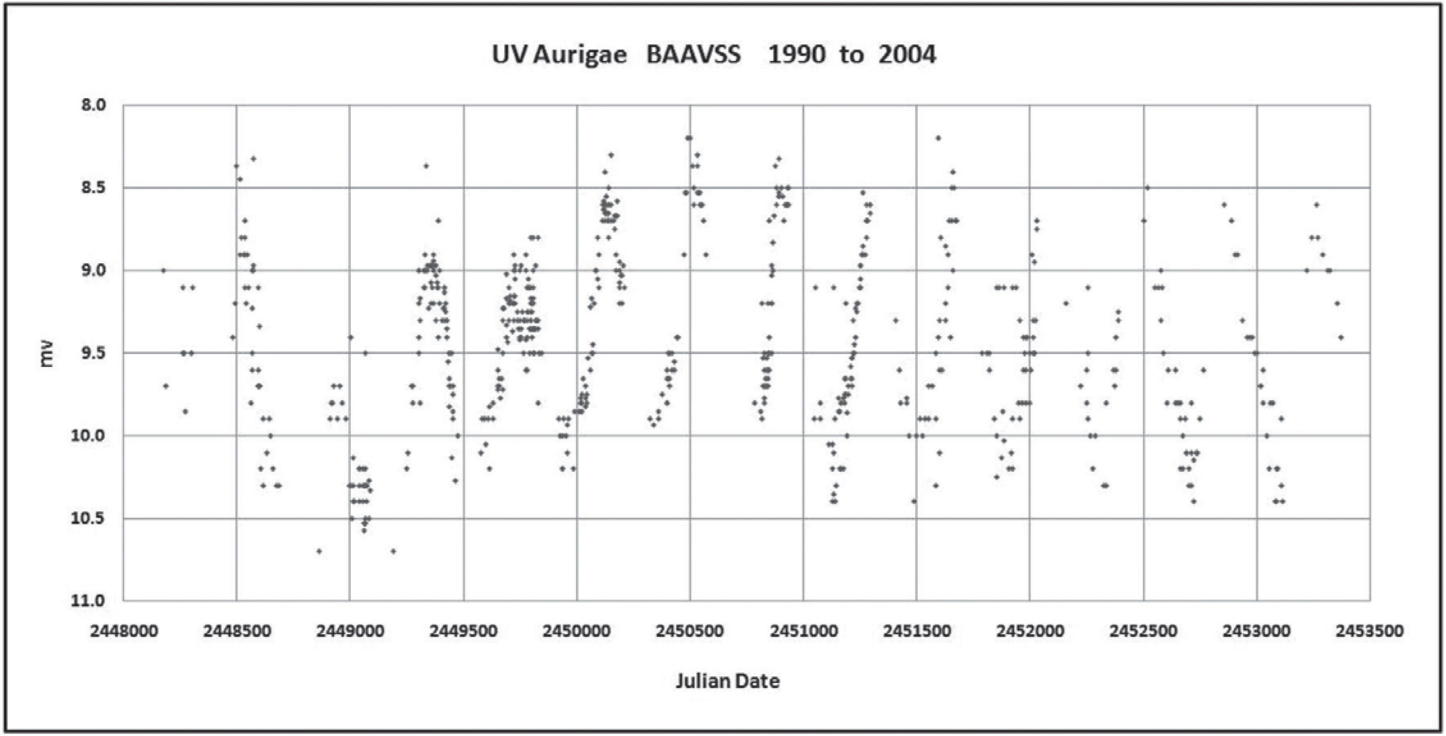
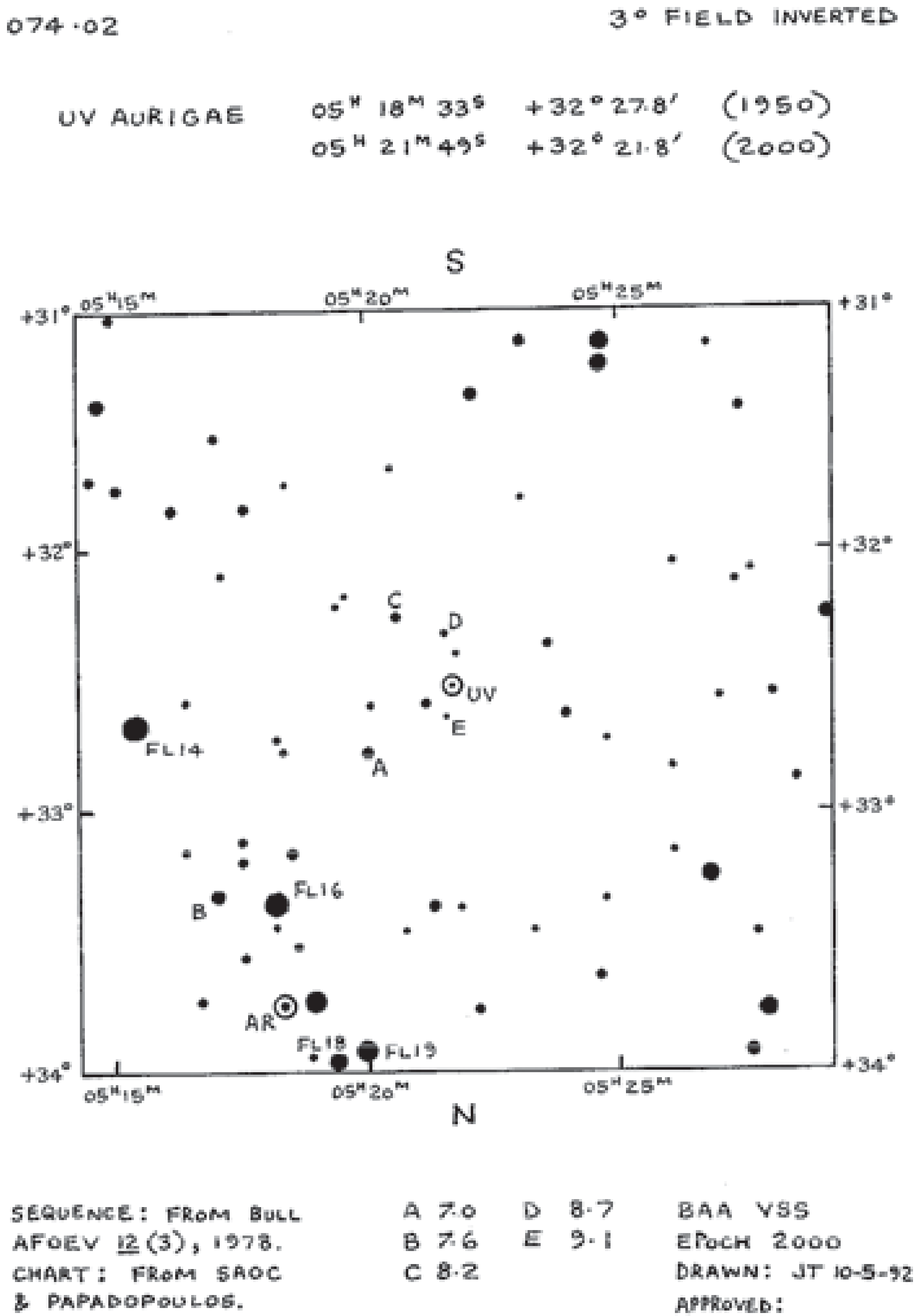


Figure 2.

Light estimates were made by the following observers; Albrighton, Baransky, Bouma, Brundle, Charleton, Conner, Davies, Day, Dryden, Farrer, Gill, Hoare, Horsley, Hunt, Kelly, Koushiappas, Middleton, Mitchell, Paterson, Pickard, Poyner, Ramsey, Stefanopoulos, Taylor, Washington, Worraker. Apertures used by the observers varied from 60mm to 413mm; a mid range of say 200mm would seem more appropriate depending on local sky conditions.

Figure 3.

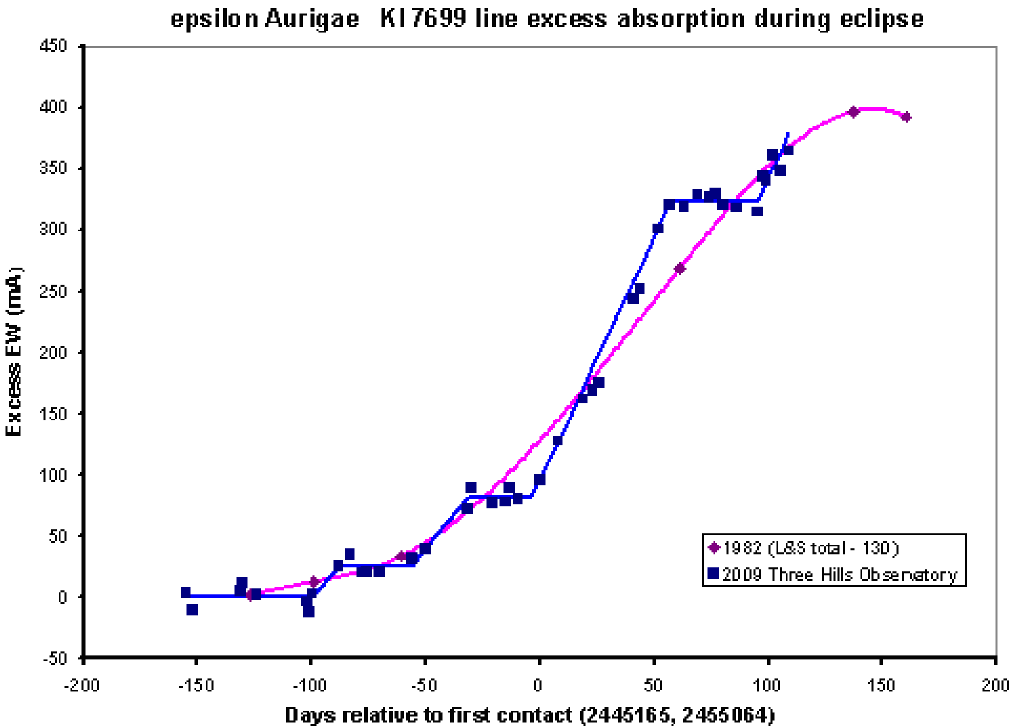


A 1° Field Inverted chart, with comparisons from 7.0-11.4 magnitude is available from the BAA VSS website.

EPSILON AURIGAE ECLIPSE PROGRESS.

ROBIN LEADBEATER

7th December 2009 update. The second contact point of the epsilon Aurigae eclipse is only a few weeks away now, but the approach to it (as seen in the Equivalent Width of the KI 7699 line) has not been a smooth one. The two pauses in the increasing intensity of the absorption line, seen May-August (before any change was seen in the brightness) were followed by a third in October/November. This latest pause has now ended and the EW curve is back on track. The KI 7699 line started increasing in intensity again from 26th November after a pause of ~ 40 days. Is this evidence of a gap in an eclipsing disc as postulated by Ferluga*?



*Epsilon Aurigae I - Multi-ring structure of the eclipsing body. S. Ferluga, Astronomy and Astrophysics. vol. 238, no. 1-2, Nov. 1990, p. 270-278.

Graphs and further details can be seen on my website: *http:www.threehillsobservatory.co.uk/astro/spectra_40.htm*

IGR J00234+6141 – AN INTERMEDIATE POLAR CV

David Boyd

Intermediate Polars (IPs) are a type of cataclysmic variable (CV) in which the white dwarf (WD) primary has an intermediate strength magnetic field. This field disrupts the inner portion of the accretion disk around the WD, and creates accretion streams which channel material from the inner edge of the disk down onto one or both magnetic poles of the WD. In the process these accretion streams are accelerated to high velocities and emit radiation at optical and higher energy wavelengths. The varying aspect of these accretion streams as the WD spins on its rotation axis (which may not be aligned with its magnetic axis) causes periodic modulation of the light output.

IGR J00234+6141 was first identified as a hard X-ray source in a survey by the INTEGRAL satellite. Its position was consistent with the ROSAT X-ray source 1RXS J002258.3+614111, and with an optical source at the same position which showed strong Balmer emission lines indicating it was probably a CV. Bonnet-Bidaud et al.[(1)] obtained 5.3 hrs of photometry in 2006 August with a 1.5-m telescope. A period analysis of their data showed a strong signal at 563.53+/-0.62 s which they interpreted as the spin period of the magnetic WD primary. They also obtained spectroscopic data from which an analysis of radial velocities gave an orbital period of 4.033+/-0.005 hr. More recently Anzolin et al.[(2)] analysed X-ray data from XMM-Newton taken in 2007 July and found a WD spin period of 563.64+/-0.56 s.

As part of a recent Centre for Backyard Astrophysics (CBA)[(3)] call for observations of IGR J00234+6141, I recorded 6 time series during 2009 September totalling about 24 hours, and containing 1172 magnitude measurements. A typical light curve is shown in **Figure 1, page 21**. The regular fluctuation due to the WD spin can just about be detected visually although there is a lot of random variation in the light output which masks this regular pattern. I used a 0.25-m Newtonian and HX516 CCD camera for these observations.

The observations were sent to the CBA for incorporation into a long-term analysis of this object. However, out of curiosity, I analysed my own data using Tonny Vanmunster's period analysis software Peranso[(4)]. After subtracting a nightly mean from each night's data and applying heliocentric corrections to all times, a Discrete Fourier Transform gives the power spectrum in **Figure 2, page 21**.

This shows a prominent peak representing the WD spin period at 563.16+/-0.26 s plus alias signals as expected because of the multi-day separation of the datasets. The phase diagram obtained by folding the light curve on this period is shown in **Figure 3, page 22**. The amplitude of variation is about 0.18 mag. The strongest peak at the low frequency end of the spectrum is at 2.018+/-0.010 d, almost exactly half the orbital period seen by Bonnet-Bidaud et al. I saw no sign of their proposed 4 hr orbital period in my data.

It is interesting to see that a modest amount of observation with a relatively small telescope can produce results comparable to those published in the professional literature.

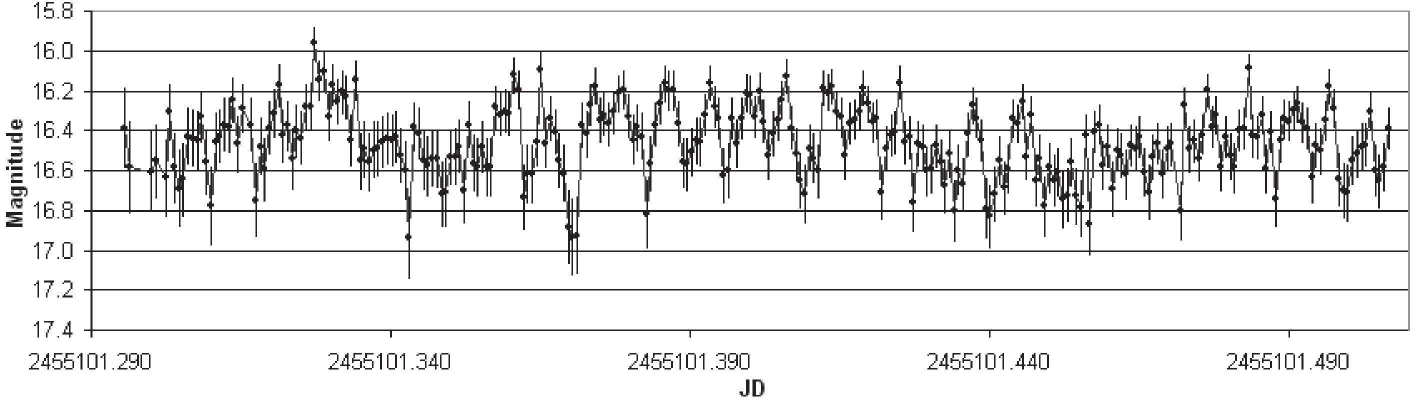


Figure 1: Light curve of IGR J00234+6141 from 2009 September 26.

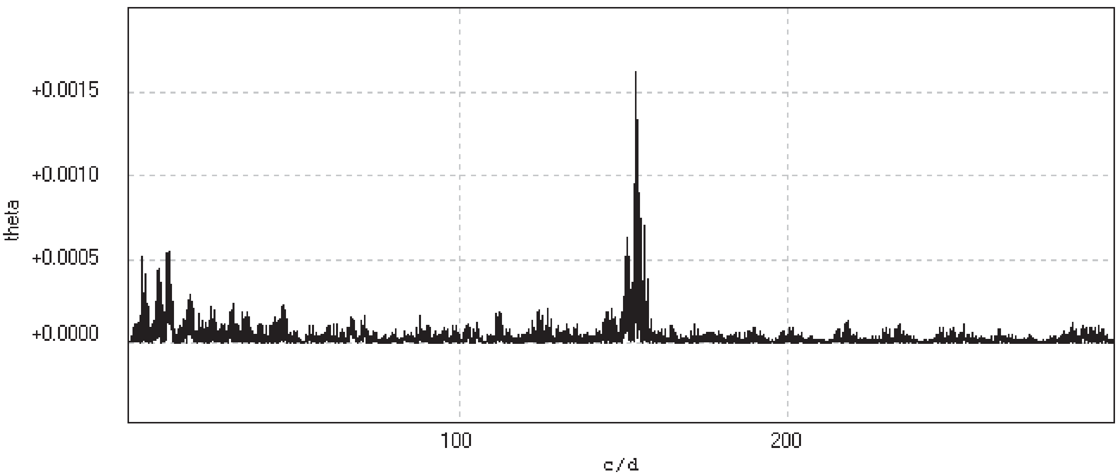
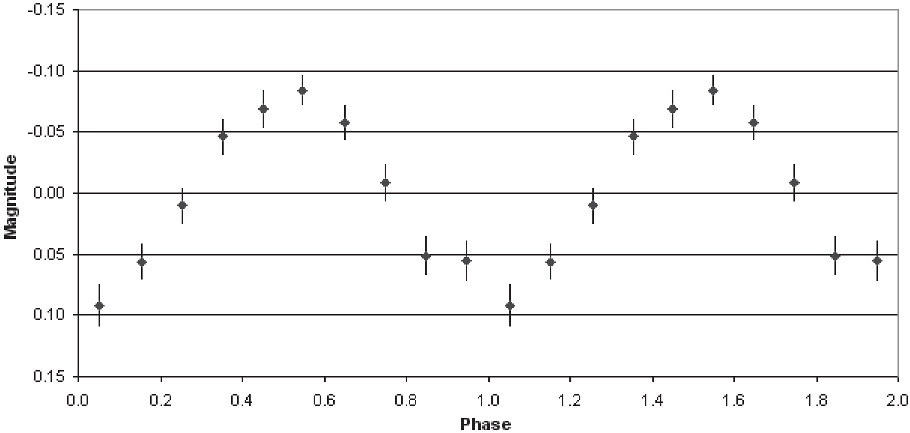


Figure 2: Discrete Fourier Transform of all data.

Figure 3: Phase diagram folded on a period of 563.16 s.



References

(1) Bonnet-Bidaud J-M. et al., Astronomy and Astrophysics, 473, 185 (2007)
(2) Anzolin G. et al., Astronomy and Astrophysics, 501, 1047 (2009)
(3) Centre for Backyard Astrophysics: http://cbastro.org/
(4) Peranso: http://www.peranso.com/

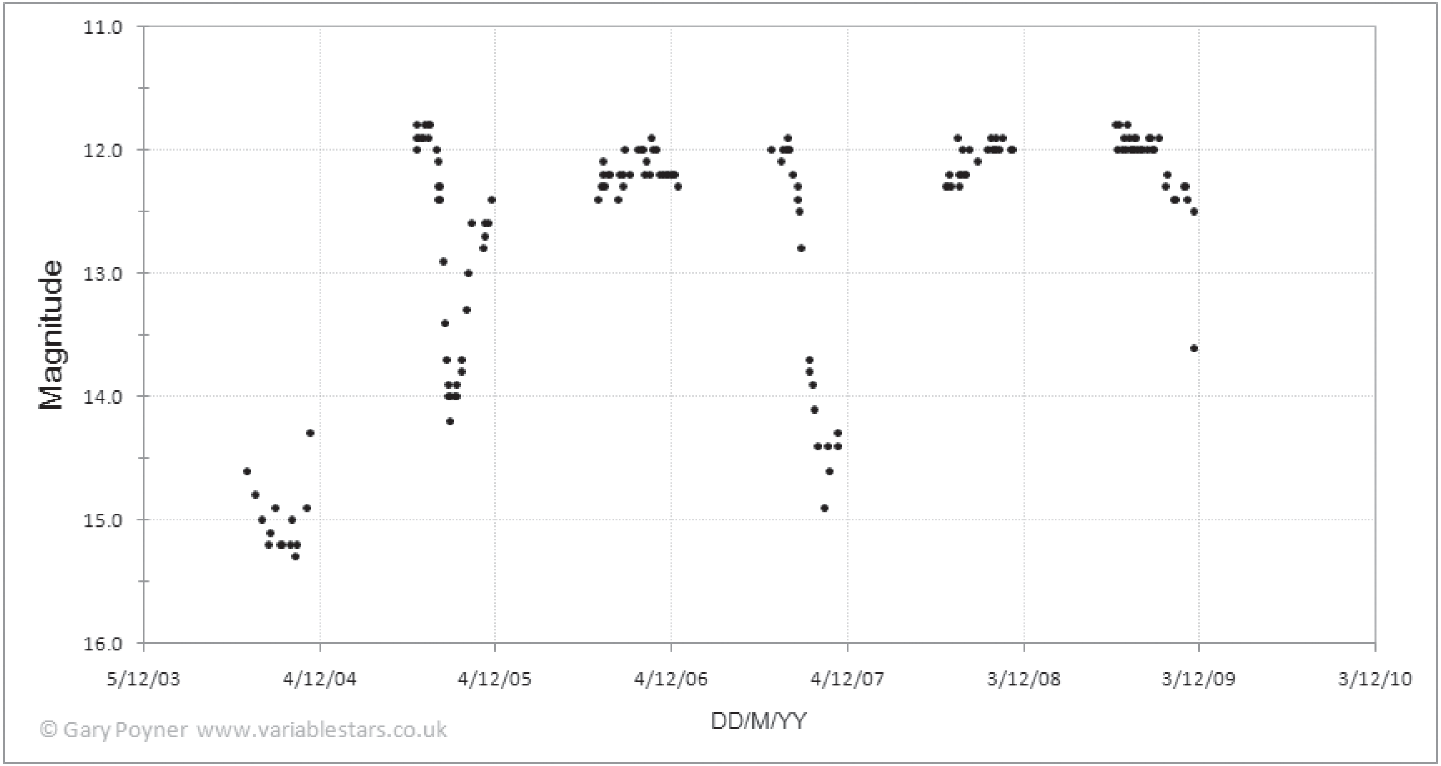
TT ARIETIS AND ES AQUILAE LIGHT CURVES.

GARY POYNER

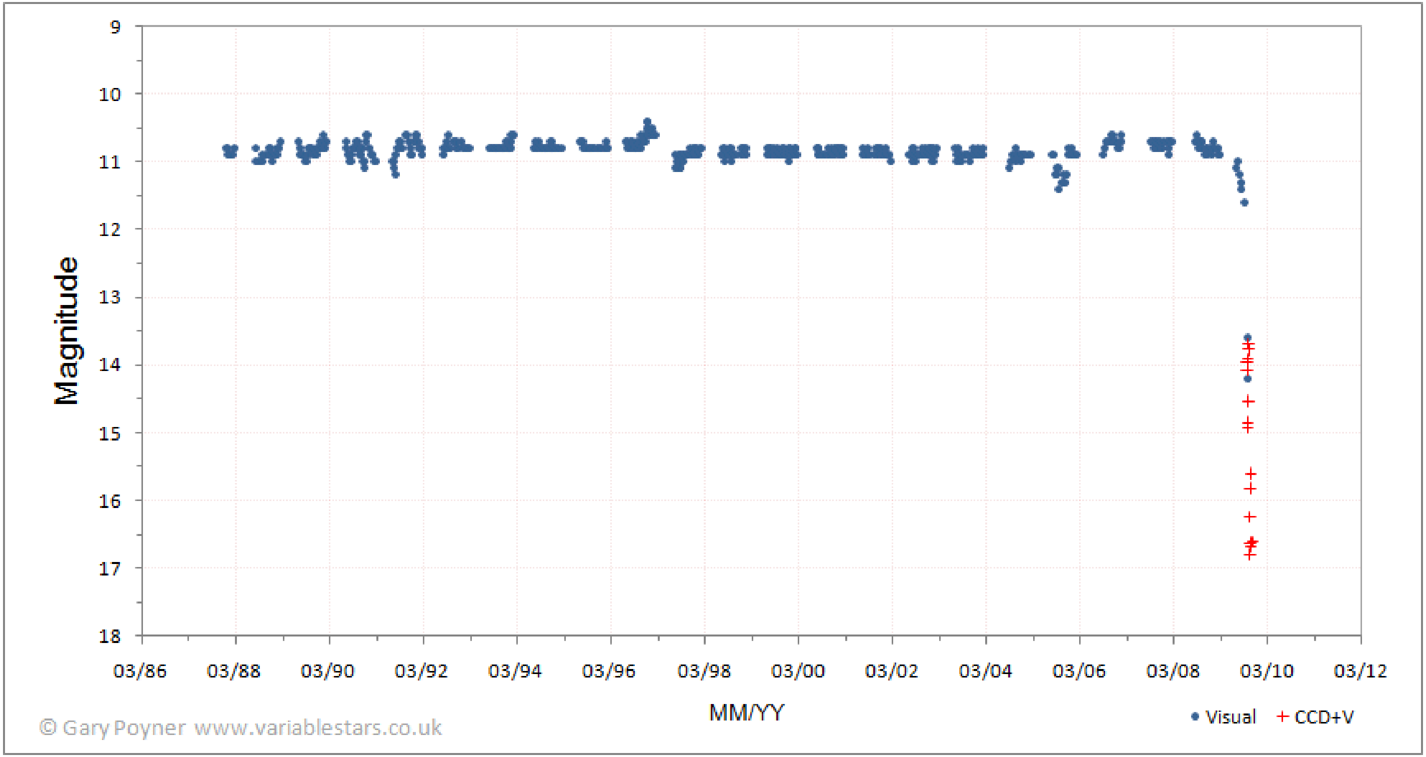
TT Arietis:
TT Ari is a VY Sculptoris type star, which undergoes deep low states at unpredictable times. The current low state shown here in the light curve, is the first to be observed since the extended low state of 1982-1985, just before I began to monitor it. The fade began with a small drop in brightness during August and September, before reaching magnitude 16.8V in early November. Also present are high amplitude (+1 mag) periodic oscillations. AAVSO SN 172, notes that the measured period is longer than the known P_orb, and is of unknown origin.

ES Aquilae:
ES Aql is an underobserved RCB star which shows a great deal of activity. The GCVS record this star as type SR, with a range of 13.2-<15.1p, but it's suspected RCB classification was first mentioned on VSnet around 2002! Subsequent study has indeed revealed it be an RCB star.

[1]Ref: 1: *http://www.journals.uchicago.edu/doi/abs/10.1086/341716*



ES Aquilae: Under-observed and very active RCB star. Observations in November 2009 show new fade in progress.



TT Arietis: Rare low state of TT Ari. V-band data from Bradford Robotic Telescope.

BINOCULAR PRIORITY LIST

MELVYN TAYLOR

(Includes *XX Cam*, *Mira*, *R CrB*, and *R Hya* which are also on the telescopic programme)

Variable		RA (2000) Dec	Range	Type	Period	Chart	Prog
AQ	***And***	00 28 +35 35	8.0-8.9	SR	346d	303.01	
EG	***And***	00 45 +40 41	7.1-7.8	ZAnd		072.01	
V	***Aql***	19 04 -05 41	6.6-8.4	SRb	353d	026.04	
UU	***Aur***	06 37 +38 27	5.1-6.8	SRb	234d	230.01	
AB	***Aur***	04 56 +30 33	6.7-8.4	Ina		301.01	
V	***Boo***	14 30 +38 52	7-12	Sra	258d	037.01	
RW	***Boo***	14 41 +31 34	7.4-8.9	SRb	209d	104.01	
RX	***Boo***	14 24 +25 42	6.9-9.1	SRb	160d	219.01	
ST	***Cam***	04 51 +68 10	6.0-8.0	SRb	300d?	111.01	
XX	***Cam***	04 09 +53 22	7.3-9.7	RCB		068.01	T/B
X	***Cnc***	08 55 +17 04	5.6-7.5	SRb	195d	231.01	
RS	***Cnc***	09 11 +30 58	5.1-7.0	SRc	120d?	269.01	
V	***CVn***	13 20 +45 32	6.5-8.6	SRa	192d	214.02	
WZ	***Cas***	00 01 +60 21	6.9-8.5	SRb	186d	1982Aug16	
V465	***Cas***	01 18 +57 48	6.2-7.8	SRb	60d	233.01	
γ	***Cas***	00 57 +60 43	1.6-3.0	GCAS		064.01	
Rho	***Cas***	23 54 +57 29	4.1-6.2	SRd	320d	064.01	
W	***Cep***	22 37 +58 26	7.0-9.2	SRc		312.01	
AR	***Cep***	22 52 +85 03	7.0-7.9	SRb		1985May06	
Mu	***Cep***	21 44 +58 47	3.4-5.1	SRc	730d	112.01	
O	***Cet***	02 19 -02 59	2.0-10.1	M	332d	039.02	T/B
R	***CrB***	15 48 +28 09	5.7-14.8	RCB		041.03	T/B
W	***Cyg***	21 36 +45 22	5.0-7.6	SRb	131d	062.03	
AF	***Cyg***	19 30 +46 09	6.4-8.4	SRb	92d	232.01	
CH	***Cyg***	19 25 +50 15	5.6-10.5	ZAnd+SR	97	089.02	
U	***Del***	20 46 +18 06	5.6-7.9	SRb	110d?	228.01	
EU	***Del***	20 38 +18 16	5.8-6.9	SRb	60d	228.01	
TX	***Dra***	16 35 +60 28	6.6-8.4	SRb	78d?	106.02	
AH	***Dra***	16 48 +57 49	7.0-8.7	SRb	158d	106.02	
NQ	***Gem***	07 32 +24 30	7.4-8.0	SR+ZAnd	70d?	077.01	
X	***Her***	16 03 +47 14	6.1-7.5	SRb	95d	223.01	
SX	***Her***	16 08 +24 55	8.0-9.2	SRd	103d	113.01	
UW	***Her***	17 14 +36 22	7.0-8.8	SRb	104d	107.01	
AC	***Her***	18 30 +21 52	6.8-9.0	RVA	75d	048.03	
IQ	***Her***	18 18 +17 59	7.0-7.5	SRb	75d	048.03	
OP	***Her***	17 57 +45 21	5.9-7.2	SRb	120d	1984Apr12	
R	***Hya***	13 30 -23 17	3.5-10.9	M	389d	049.02	T/B
RX	***Lep***	05 11 -11 51	5.0-7.4	SRb	60d?	110.01	
Y	***Lyn***	07 28 +45 59	6.5-8.4	SRc	110d	229.01	
SV	***Lyn***	08 84 +36 21	6.6-7.9	SRb	70d?	108.03	
U	***Mon***	07 31 -09 47	5.9-7.9	RVB	91d	029.03	
X	***Oph***	18 38 +08 50	5.9-9.2	M	328d	099.01	
BQ	***Ori***	05 57 +22 50	6.9-8.9	SR	110d	295.01	

Variable		RA (2000) Dec	Range	Type	Period	Chart	Prog
AG	***Peg***	21 51 +12 38	6.0-9.4	Nc		094.02	
X	***Per***	03 55 +31 03	6.0-7.0	GCas+Xp		277.01	
R	***Sct***	18 48 -05 42	4.2-8.6	RVA	146d	026.04	
Y	***Tau***	05 46 +20 42	6.5-9.2	SRb	242d	295.01	
W	***Tri***	02 42 +34 31	7.5-8.8	SRc	108d	114.01	
Z	***UMa***	11 57 +57 52	6.2-9.4	SRb	196d	217.02	
ST	***UMa***	11 28 +45 11	6.0-7.6	SRb	110d?	102.02	
VY	***UMa***	10 45 +67 25	5.9-7.0	Lb		226.01	
V	***UMi***	13 39 +74 19	7.2-9.1	SRb	72d	101.01	
SS	***Vir***	12 25 +00 48	6.9-9.6	SRa	364d	097.01	
SW	***Vir***	13 14 -02 48	6.4-8.5	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/time.

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	AI Dra	7.2 - 8.2	U Sge	6.45 - 9.28V
TV Cas	7.2 - 8.2V	Z Vul	7.25 - 8.90V	RW Tau	7.98 - 11.59V
U Cep	6.8 - 9.4	Z Dra	10.8 - 14.1p	HU Tau	5.92 - 6.70V
U CrB	7.7 - 8.8V	TW Dra	8.0 - 10.5v	X Tri	8.88 - 11.27V
SW Cyg	9.24 - 11.83V	S Equ	8.0 - 10.08V	TX Uma	7.06 - 8.80V
V367 Cyg	6.7 - 7.6V	Z Per	9.7 - 12.4p	Del Lib	4.9 - 5.9
Y Psc	10.1 - 13.1	SS Cet	9.4 - 13.0	RZ Cas	6.3 - 7.9

Note that predictions for 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.

January

2010 Jan 1 Fri
Z Per.........02(07)05L
X Tri.........03(05)03L
del Lib....L04(01)07D
Z Vul......L05(02)07D
TW Dra....D17(15)20
SW Cyg....D17(17)23
RZ Cas.....D17(18)20
AI Dra.........17(19)20
HU Tau.....21(25)28L

2010 Jan 2 Sat
U CrB....L01(04)07D
X Tri........02(04)03L
TV Cas.....05(09)07D
TX UMa..06(10)07D
RZ Cas........20(23)25
Z Dra..........20(23)25
U Cep..........21(26)31
AI Dra.........22(24)25

2010 Jan 3 Sun
X Tri.........01(04)03L
del Lib....L04(09)07D
U Sge.....L06(01)07D
Z Vul........D17(13)18
Y Psc.....D17(19)22L
S Equ........17(23)19L
RW Tau.......18(23)27
HU Tau....23(26)28L

2010 Jan 4 Mon
TV Cas.....01(05)07D
X Tri.........01(03)02L
RZ Cas........01(03)06
AI Dra.........03(04)06
Z Per.........03(08)05L
Z Dra.......05(07)07D
TW Dra..05(10)07D
RS CVn..L22(27)31D
X Tri.........24(26)26L

2010 Jan 5 Tue
RZ Cas.....06(08)07D
U Cep......D17(14)18
Z Dra.......D17(16)18
Z Vul........19(24)19L
TV Cas........20(24)28
X Tri........23(26)26L
HU Tau....24(28)28L

2010 Jan 6 Wed
SW Cyg....L02(07)07D
Z Vul...........L05(00)05
U Sge........L06(10)07D
RW Tau.......D17(17)22
Z Dra.............22(25)27
X Tri............22(25)26L

2010 Jan 7 Thu
TW Dra.......00(06)07D
Z Per............05(09)05L
Y Psc..........D17(13)18
RZ Cas.......D17(18)20
TV Cas.......D17(20)24
AI Dra...........17(19)20
U Cep............21(25)30
X Tri...........22(24)26L

2010 Jan 8 Fri
HU Tau.......01(05)04L
del Lib.......L04(01)07D
Z Vul...........06(11)07D
Z Dra..........07(09)07D
TX UMa....D17(13)18
V367 Cyg....17(62)23L
RZ Cas..........20(22)25
X Tri..............21(24)26
AI Dra...........22(23)25

2010 Jan 9 Sat
U CrB.......L00(02)07D
V367Cyg..L04(38)07D
TV Cas........D17(15)19
Z Dra..........D17(18)20
U Sge........D17(20)19L
V367Cyg..D17(38)22L
TW Dra..........20(25)30
X Tri..............20(23)25
RS CVn........L21(22)28

2010 Jan 10 Sun
SS Cet..........00(05)00L
RZ Cas...........00(03)05
HU Tau.......03(06)04L
AI Dra...........03(04)05
del Lib.......L04(08)07D
V367Cyg..L04(14)07D
U Cep.........D17(13)18
V367Cyg..D17(14)22L
S Equ........D17(20)19L
SW Cyg....D17(21)24L
Z Vul.........D17(22)19L
X Tri..............20(22)25
Z Dra.............24(26)29

2010 Jan 11 Mon
SW Cyg.......L02(<<)03
V367Cyg..L04(<<)07D
RZ Cas........05(08)07D
TV Cas........07(11)07D
V367 Cyg D17(<<)22L
TX UMa.....D17(15)20
X Tri..............19(22)24

2010 Jan 12 Tue
RW Tau........01(06)04L
V367Cyg..L04(<<)07D
TW Dra.......D17(20)25
X Tri..............18(21)23
U Cep............20(25)30
SS Cet.........24(28)24L

2010 Jan 13 Wed
TV Cas........02(06)07D
Z Vul.........L05(09)07D
U Sge.........L05(05)07D
RZ Cas........D17(17)19
AI Dra.........D17(18)20
Z Dra..........D17(19)22
X Tri.............18(20)23

2010 Jan 14 Thu
TX UMa......D17(17)21
X Tri...........D17(20)22
RZ Cas...........19(22)24
RW Tau........20(24)28L
RS CVn........L21(17)23
TV Cas...........22(26)30
AI Dra...........22(23)25

2010 Jan 15 Fri
Z Dra.............02(04)06
del Lib.........L03(00)07
SW Cyg.......05(11)07D
U Cep..........D17(13)18
TW Dra........D17(16)21
X Tri...........D17(19)21
Z Vul.........D17(20)19L
SS Cet.........23(28)24L
U CrB...........L24(24)30
RZ Cas...........24(26)29

2010 Jan 16 Sat
AI Dra............03(04)05
Z Per...........D17(14)18
U Sge.........D17(14)18L
X Tri...........D17(18)21
TV Cas........D17(21)25

2010 Jan 17 Sun
del Lib.....L03(08)07D
RZ Cas......05(07)07D
S Equ......D17(17)18L
X Tri.........D17(17)20
TX UMa...D17(18)23
RW Tau.....D17(19)23
Z Dra...........19(21)24
U Cep..........20(25)30

2010 Jan 18 Mon
Z Vul.......L04(07)07D
TW Dra.....06(11)07D
TV Cas......D17(17)21
X Tri.........D17(17)19
Y Psc......D17(20)21L
SS Cet........23(27)24L

2010 Jan 19 Tue
Z Dra........03(06)07D
U CrB.......05(11)07D
RS CVn.....06(12)07D
Z Per.........D17(15)20
X Tri.........D17(16)19
RZ Cas......D17(16)19
AI Dra.......D17(18)20
U Sge......D17(23)18L
SW Cyg.....18(24)23L

2010 Jan 20 Wed
SW Cyg.....L01(00)06
U Sge.........L05(<<)05
U Cep.......D17(13)17
RW Tau.....D17(13)18
X Tri.........D17(15)18
Z Vul.......D17(17)18L
TX UMa...D17(20)24
RZ Cas.........19(21)23
AI Dra..........22(23)24

2010 Jan 21 Thu
TW Dra.....01(06)07D
Z Dra...........20(23)25
SS Cet.......22(27)24L
RZ Cas.........23(26)28

2010 Jan 22 Fri
AI Dra..........03(04)05
del Lib........L03(00)06
TV Cas......04(08)07D
HU Tau.....D17(15)18
Y Psc.........D17(15)19
Z Per..........D17(16)21
U Cep..........20(25)29
U CrB.......L23(22)27

2010 Jan 23 Sat
RW Tau.......03(08)03L
Z Vul........L04(04)07D
RZ Cas.......04(06)07D
U Sge........L04(08)07D
Z Dra..........05(07)07D
TX UMa....D17(21)26
TW Dra......21(26)31D
TV Cas.......23(27)31D

2010 Jan 24 Sun
RS CVn.......01(07)07D
del Lib......L03(08)07D
S Equ........D18(14)18L
SW Cyg......D18(14)20
HU Tau.......D18(16)20
Z Dra..........D18(16)18
SS Cet..........21(26)23L

2010 Jan 25 Mon
Z Vul........D18(15)18L
RZ Cas.......D18(16)18
Z Per...........D18(18)22
AI Dra........D18(18)19
TV Cas..........19(23)27
RW Tau.......21(26)27L
Z Dra............22(25)27

2010 Jan 26 Tue
U CrB.........03(08)07D
HU Tau.......D18(17)21
TW Dra......D18(21)26
TX UMa.......18(23)27
RZ Cas..........18(20)23
AI Dra...........22(23)24

2010 Jan 27 Wed
TV Cas.......D18(18)22
V367Cyg..D18(52)21L
U Cep............19(24)29
SS Cet.........21(25)23L
RZ Cas..........23(25)28

2010 Jan 28 Thu
AI Dra...........02(04)05
V367Cyg..L03(28)07D
Z Vul........L04(02)07D
Z Dra..........D18(18)20
HU Tau.......D18(19)22
Z Per...........D18(19)24
RW Tau.......D18(21)25
V367Cyg..D18(28)21L
RS CVn.......20(26)31D
SW Cyg.......22(28)23L

2010 Jan 29 Fri
SW Cyg....L00(04)07D
del Lib........L02(<<)06
V367Cyg..L03(04)07D
RZ Cas.......03(06)07D
V367Cyg..D18(04)21L
TV Cas.......D18(14)18
TW Dra......D18(16)21
TX UMa.......19(24)29
U CrB.........L23(19)25
Z Dra.............24(26)29

2010 Jan 30 Sat
V367Cyg..L03(<<)07D
U Sge........L04(02)07D
V367Cyg..D18(<<)21L
Z Vul........D18(13)18L
HU Tau......D18(20)24
SS Cet.........20(25)23L

2010 Jan 31 Sun
del Lib......L02(07)07D
TV Cas.......05(09)07D
RW Tau......D18(15)20
AI Dra........D18(18)19
Z Per..........D18(20)25

February

2010 Feb 1 Mon
Z Dra..........D18(20)22
RZ Cas.......D18(20)22
HU Tau......D18(21)25
U Cep............19(24)29
TX UMa.......21(26)30
AI Dra...........22(23)24

2010 Feb 2 Tue
U CrB.........00(06)07D
TV Cas.......01(05)07D
Z Vul...........L03(00)05
U Sge..........06(11)07D
SW Cyg....D18(18)22L
Y Psc........D18(22)20L
SS Cet.........19(24)23L
RS CVn.......L20(22)28
RZ Cas..........22(25)27

2010 Feb 3 Wed
Z Dra.............02(04)06
AI Dra...........02(04)05
Z Per..........D18(22)26
HU Tau.......19(23)26L
TV Cas..........20(24)28

2010 Feb 4 Thu
TW Dra....02(07)06D
RZ Cas.....03(05)06D
Z Vul........06(11)06D
TX UMa..22(27)30D

2010 Feb 5 Fri
del Lib......L02(<<)05
TV Cas.....D18(20)24
SS Cet.......19(23)23L
Z Dra..........19(21)24
HU Tau.....20(24)26L
U CrB.......L22(17)23
RW Tau.....23(28)26L

2010 Feb 6 Sat
Y Psc......D18(16)20L
AI Dra......D18(18)19
Z Per.........18(23)27L
U Cep..........19(24)28
TW Dra....21(27)30D

2010 Feb 7 Sun
SW Cyg....01(07)06D
del Lib....L02(07)06D
Z Vul........L03(<<)03
Z Dra........03(06)06D
S Equ......L06(07)06D
TV Cas.....D18(15)19
RZ Cas.....D18(19)22
RS CVn.....L19(17)23
AI Dra.........21(23)24
HU Tau.....21(25)26L
X Tri.........24(26)24L
TX UMa..24(29)30D

2010 Feb 8 Mon
RW Tau..D18(22)26L
SS Cet.......18(23)22L
RZ Cas........22(24)26
U CrB....L22(28)30D
X Tri.........23(26)24L

2010 Feb 9 Tue
AI Dra.........02(03)05
U Sge......L03(06)06D
Z Vul........03(09)06D
TW Dra....D18(22)27
Z Per.........20(24)27L
Z Dra...........21(23)25
X Tri.........23(25)24L
HU Tau.....23(27)26L

2010 Feb 10 Wed
RZ Cas......02(05)06D
X Tri..........22(24)24L

2010 Feb 11 Thu
TX UMa....02(06)06D
TV Cas.......02(06)06D
Z Dra..........05(08)06D
RW Tau.......D18(17)22
SW Cyg....D18(21)22L
SS Cet......D18(22)22L
U Cep............18(23)28
X Tri...........21(24)24L
SW Cyg.......L23(21)27

2010 Feb 12 Fri
HU Tau.......00(04)02L
del Lib.........L01(<<)05
RS CVn.......06(12)06D
Z Dra..........D18(16)19
TW Dra......D18(17)22
AI Dra........D18(18)19
X Tri...........21(23)24L
Z Per...........21(26)27L
TV Cas..........22(26)30

2010 Feb 13 Sat
RZ Cas........D18(19)21
X Tri...........20(22)24L
AI Dra...........21(23)24
Z Dra.............22(25)27

2010 Feb 14 Sun
del Lib......L01(06)06D
HU Tau.......02(05)02L
Z Vul........L02(07)06D
TX UMa....03(08)06D
S Equ........L06(04)06D
TV Cas.......D18(21)25
SS Cet......D18(22)22L
X Tri...........19(22)24L
RZ Cas..........21(23)26

2010 Feb 15 Mon
AI Dra...........02(03)05
V367Cyg..L02(43)06D
V367Cyg..D18(43)20L
X Tri.............18(21)23
U CrB.......L22(26)30D
Z Per...........22(27)26L

2010 Feb 16 Tue
RZ Cas.......02(04)06D
V367Cyg..L02(19)06D
U Sge...........L03(00)06
SW Cyg......05(11)06D
TV Cas........D18(17)21
Z Dra..........D18(18)20
V367Cyg..D18(19)20L
X Tri D18(20)23
U Cep D18(23)28

2010 Feb 17 Wed
RS CVn......01(07)06D
RW Tau.......01(06)02L
V367Cyg.L02(<<)06D
TX UMa....05(09)06D
V367Cyg.D18(<<)20L
X Tri..........D18(20)22
SS Cet......D18(21)22L
Y Psc..........19(23)19L

2010 Feb 18 Thu
Z Dra............00(02)05
V367Cyg.L02(<<)06D
TW Dra......03(08)06D
AI Dra........D18(18)19
X Tri..........D18(19)21
Z Per...........24(28)26L

2010 Feb 19 Fri
del Lib........L01(<<)04
Z Vul........L02(04)06D
U Sge..........03(09)06D
U Cep.........06(11)06D
RZ Cas.......D18(18)21
X Tri..........D18(18)21
RW Tau.......19(24)25L
AI Dra...........21(22)24

2010 Feb 20 Sat
TV Cas.......04(08)06D
X Tri..........D18(18)20
Z Dra..........D18(20)22
SS Cet......D18(20)22L
SW Cyg......19(25)21L
RZ Cas..........20(23)25
TW Dra......22(27)30D
SW Cyg....L23(25)30D

2010 Feb 21 Sun
del Lib......L01(06)06D
AI Dra...........02(03)04
S Equ........L05(01)06D
X Tri..........D18(17)19
Y Psc.......D18(18)19L
U Cep.........D18(23)27
RS CVn......20(26)30D
TV Cas.......23(27)30D

2010 Feb 22 Mon
Z Per...........01(06)02L
RZ Cas.......01(04)06D
Z Dra..........02(04)06D
X Tri..........D18(16)19
RW Tau......D18(19)23
U CrB.........L21(23)29

2010 Feb 23 Tue
RZ Cas.....06(08)06D
SS Cet....D18(20)22L
TW Dra....D18(23)28
TV Cas........19(23)27

2010 Feb 24 Wed
Z Vul......L02(02)06D
U Cep......06(10)06D
AI Dra......D18(17)19
Z Dra..........19(21)24

2010 Feb 25 Thu
SW Cyg....D18(14)20
RZ Cas.....D18(18)20
TV Cas.....D18(18)22
AI Dra.........21(22)24

2010 Feb 26 Fri
del Lib......L00(<<)04
U Sge.....L02(03)06D
Z Dra.......04(06)06D
U CrB......04(10)06D
TX UMa..D18(14)19
TW Dra....D18(18)23
SS Cet....D18(19)21L
RS CVn....D18(21)28
U Cep......D18(22)27
RZ Cas........20(22)25

2010 Feb 27 Sat
AI Dra........02(03)04

2010 Feb 28 Sun
del Lib....L00(05)06D
RZ Cas........01(03)05
HU Tau....D19(15)19
Z Dra..........21(23)25

March

2010 Mar 1 Mon
Z Vul.........L01(00)05
TV Cas.....05(09)06D
U Cep......05(10)06D
RZ Cas.....05(08)06D
TX UMa..D19(15)20
SS Cet....D19(18)21L
U CrB.......L21(21)27
SW Cyg.L22(28)30D

2010 Mar 2 Tue
Z Dra.......05(08)06D
HU Tau....D19(16)20
AI Dra......D19(17)19
RW Tau....21(26)25L

2010 Mar 3 Wed
TV Cas.......01(05)06D
S Equ.......L05(09)06D
Z Dra.........D19(16)19
RS CVn......D19(16)23
RZ Cas.......D19(17)19
U Cep........D19(22)27
AI Dra...........21(22)23

2010 Mar 4 Thu
TW Dra......04(09)06D
TX UMa....D19(17)22
HU Tau......D19(18)21
SS Cet......D19(18)21L
RZ Cas..........19(22)24
TV Cas..........20(24)28
Z Dra...........22(25)27

2010 Mar 5 Fri
del Lib........L00(<<)04
AI Dra...........02(03)04
U Sge..........L02(<<)03
U CrB........02(08)06D
RW Tau....D19(20)25L
V367Cyg..D19(57)19L

2010 Mar 6 Sat
RZ Cas..........00(02)05
V367Cyg..L01(33)06D
Z Vul..........L01(<<)03
U Cep........05(10)06D
SW Cyg...D19(18)20L
HU Tau......D19(19)23
TV Cas......D19(20)24
V367Cyg..D19(33)19L
SW Cyg......L22(18)24
TW Dra......23(28)29D
del Lib......L24(29)29D

2010 Mar 7 Sun
V367Cyg..L01(09)05D
RZ Cas.......05(07)05D
SS Cet......D19(17)21L
Z Dra.........D19(18)20
TX UMa....D19(18)23

2010 Mar 8 Mon
V367Cyg..L01(<<)05D
U Sge........L02(07)05D
Z Vul..........04(09)05D
RS CVn......05(12)05D
RW Tau......D19(15)20
TV Cas.......D19(15)19
HU Tau......D19(20)24
U Cep........D19(22)26
U CrB.........L20(19)24

2010 Mar 9 Tue
Z Dra............00(03)05
V367Cyg.L01(<<)05D
RZ Cas.......D19(17)19
TW Dra......D19(24)29
AI Dra...........21(22)23

2010 Mar 10 Wed
S Equ........L04(06)05D
SS Cet......D19(17)21L
TX UMa....D19(20)25
RZ Cas.......D19(21)24
HU Tau....D19(22)24L

2010 Mar 11 Thu
Z Vul...........L01(<<)01
AI Dra...........01(03)04
SW Cyg......02(08)05D
U Cep.........05(09)05D
Z Dra..........D19(20)22
RZ Cas..........23(26)28
del Lib.........L24(21)27
U CrB.........24(29)29D

2010 Mar 12 Fri
TV Cas.......02(06)05D
TW Dra......D19(19)24
HU Tau.......19(23)24L

2010 Mar 13 Sat
RS CVn......00(07)05D
Z Vul..........01(07)05D
Z Dra..........02(04)05D
RZ Cas.......04(07)05D
SS Cet......D19(16)20L
U Cep.........D19(21)26
TX UMa....D19(21)26
TV Cas.......22(26)29D
RW Tau.......23(28)24L
del Lib......L23(29)29D

2010 Mar 14 Sun
HU Tau.......20(24)24L

2010 Mar 15 Mon
U Sge........L01(01)05D
TW Dra......D19(14)19
Z Per...........D19(15)20
TV Cas.......D19(21)25
SW Cyg...D19(21)20L
Z Dra............19(21)24
U CrB.........L20(16)22
AI Dra...........21(22)23
SW Cyg.......L21(21)27

2010 Mar 16 Tue
U Cep.......04(09)05D
SS Cet.......D19(15)20
RZ Cas......D19(21)23
RW Tau...D19(22)24L
TX UMa...D19(23)28
HU Tau......22(26)24L

2010 Mar 17 Wed
AI Dra.........01(03)04
Z Dra........04(06)05D
S Equ......L04(03)05D
TV Cas......D19(17)21
RS CVn.....20(26)29D
X Tri..........21(24)22L
RZ Cas.........23(25)28

2010 Mar 18 Thu
Z Vul.......L00(05)05D
U Sge.........05(10)05D
TW Dra.....05(10)05D
Z Per..........D19(17)21
U Cep.......D19(21)26
X Tri.........21(23)22L
U CrB.......21(27)29D
del Lib........L23(20)27
HU Tau......23(27)24L

2010 Mar 19 Fri
RZ Cas.....04(06)05D
SS Cet......D19(15)19
RW Tau....D19(17)21
TX UMa..20(24)29D
X Tri........20(22)22L
Z Dra..........21(23)26

2010 Mar 20 Sat
X Tri........19(22)21L
del Lib....L23(28)29D
TW Dra....24(29)29D

2010 Mar 21 Sun
TV Cas.....04(08)05D
U Cep......04(09)05D
Z Per........D19(18)23
X Tri.....D19(21)21L
AI Dra.........20(22)23

2010 Mar 22 Mon
U Sge........L01(<<)01
RZ Cas.....D19(20)22
X Tri.....D19(20)21L
RS CVn....D19(21)27
U CrB.......L19(14)20
TX UMa..21(26)29D
TV Cas.....23(27)29D

2010 Mar 23 Tue
Z Vul...........L00(02)05D
AI Dra............01(02)04
X Tri..........D19(20)21L
U Cep...........D19(21)25
TW Dra.........19(24)29D
RZ Cas............22(25)27
Z Dra..............23(25)27

2010 Mar 24 Wed
V367 Cyg......03(47)05D
S Equ..........L03(<<)05D
X Tri..........D19(19)21L
Z Per...........D19(19)24L
TV Cas..........D19(23)27
SW Cyg......L21(25)29D
V367 Cyg...L24(47)29D

2010 Mar 25 Thu
U Sge..........L00(05)05D
RZ Cas..........03(05)05D
X Tri............D19(18)21
U CrB........D19(25)29D
del Lib...........L23(20)26
TX UMa.......23(27)29D
V367 Cyg...L23(23)29D

2010 Mar 26 Fri
U Cep...........04(08)05D
X Tri............D19(18)20
Z Dra...........D19(18)20
TV Cas..........D19(18)22
TW Dra.........D19(20)25
V367 Cyg...L23(<<)29D

2010 Mar 27 Sat
S Equ.........05(10)05D
RS CVn......D19(16)23
X Tri..........D19(17)19
Z Per........D19(21)24L
RW Tau......19(24)23L
AI Dra..........20(22)23
del Lib.....L23(28)29D
Z Vul.......L24(24)29D

2010 Mar 28 Sun
Z Dra.........00(03)05D
RZ Cas......D19(19)22
U Cep........D19(20)25

2010 Mar 29 Mon
TX UMa...00(05)05D
AI Dra..........01(02)04
TW Dra.....D19(15)20
SW Cyg......L20(15)21
RZ Cas.........22(24)27

2010 Mar 30 Tue
RW Tau...D19(19)23L
Z Dra.........D19(20)22
Z Per........D19(22)24L

2010 Mar 31 Wed
RZ Cas......02(05)04D
U Cep........03(08)04D
U Sge.......L24(23)28D

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The **deadline for contributions** to the next issue of VSSC (number 143) will be 7th February, 2010. All articles should be sent to the editor (details are given on the back of this issue).

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Nova and Supernova discoveries

First telephone the Nova/Supernova Secretary. If only answering machine response, leave a message and then try the following: Denis Buczynski 01524 68530, Glyn Marsh 01624 880933, or Martin Mobberley 01284 828431.

Variable Star Alerts Telephone Gary Poyner (see above for number)