



From the director — <i>Tom Richards</i>	2
Editorial	3
<i>O-B5 Stars in Centaurus: re-evaluation of published data - Mati Morel</i>	5
<i>Simplest CCD photometry - Tom Richards</i>	7
<i>CCD targets in the EB/EW Project - Tom Richards</i>	9
<i>Southern semi-regulars – a progress report – Aline Homes</i>	10
<i>SY Fornacis - a high galactic latitude binary star – Stan Walker</i>	14
<i>The long period variable - dual maxima Mira scene – Stan Walke</i>	16
<i>Bright Cepheids in the 2015 season – Stan Walker</i>	17
<i>Transforming magnitudes in the I passband – David Moriarty</i>	18
<i>The EB & EW binaries project update – Mark Blackford</i>	20
<i>The Orion Project - for serious amateur astronomy – Carl Knight</i>	22
<i>Publication Watch</i>	30
<i>About</i>	31

From the Director – *Tom Richards*

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Alan Baldwin to lead Beginners Visual Project

Worldwide experience indicates that to attract amateur astronomers to variable star work, and to keep them there, nothing is as valuable as visual photometry – simply done with basic equipment. From the beginning of VSS six years ago, Alan Plummer, one of Australasia's best known visual observers and researchers, volunteered to set up and run a beginners visual observing project for VSS.

Of late, Alan has indicated to me he'd like to pass on this role to another, and concentrate on his important R/Eta Car project, as well as family and his musical career. VSS has been very lucky in finding an excellent replacement, New Zealand's Alan Baldwin.



I first knew Alan B when we were both schoolkids, enthusiastically using Wellington College Observatory. Since that time, Alan has maintained his contacts with RASNZ and his variable star work, and will be well remembered from his presence and work at VSSS3 in Whakatane earlier this year. Alan has prepared some material to send to enquirers and will act as a first point of contact and coordinator of the Beginners Project. Thank you very much for taking on this role, Alan. I'm sure that established visual variable star observers will give you every support; and I'd like to invite leaders of astronomy club variable star groups and others to contact Alan to see how you can help each other and inspire newcomers. You can email him at alanb.varstar@iinspire.net.nz.

Finally I'd like to thank our other Alan very warmly for the work you have done in this project over the years. I know that you'll be continuing your education and outreach passion locally, as well as continuing your excellent column in *Australian Sky and Telescope*. And there's always the big R/Eta Car project.

Time to replace this director

I have tendered my resignation as Director to the Council of RASNZ, effective December 31st. Over the nearly six years since I became director of the moribund variable star section of RASNZ and renamed it, it has grown into a thriving and successful research organisation. It now has thirteen projects led by various very able astronomers. Its membership, though that is now an informal concept, hovers around 50-60 and its finances are strong. It has run three symposia with 30 or more attendees, presented papers at every RASNZ and NACAA conference, and has an accelerating stream of refereed publications in recognised astronomical journals. This is thanks to the dedicated work of many VSS members, who have taken leadership roles as well as observing and research.

With VSS in such a strong and healthy state, I have decided this is an opportune time for me to hand over to another leader (or leadership team) with another vision. Because of the diversified non-centralized nature of VSS it is to a large extent functioning autonomously and it will not be hard for a new leader to take up the position. I am very ably assisted by three office-bearers: Bob Evans for financial matters, Phil Evans editing the newsletter, and David O'Driscoll as webmaster. I am sure these three will provide continuing support to a new director. In addition Stan Walker has been a close and invaluable adviser with far more knowledge than I have, and I'm confident he will be willing to assist whoever replaces me.

We are not an incorporated body and do not have a formal structure, so the task of deciding on a replacement, or replacement team, is also informal. I have asked the office-bearers and project leaders to discuss the succession and formulate a decision on it – before my resignation date. It would be very good if anyone associated with VSS work expressed their views on the succession on our email forum. We are certainly not bound by the present structure of a single "director" responsible to RASNZ; we can take VSS where we want and organise it as we think best.

Although I think VSS is functioning very successfully in its present form, I do think there are important new directions we can and should develop. Here are three: you may think of more (and should discuss them on our forum).

- Internationalise beyond Australasia, in particular to South America and southern Africa.
- Establish strong and enduring working relationships with appropriate professional astronomers and institutions.
- Develop new types of research activities beyond the “project”.

So please give the situation some thought and make your views known, so they can be considered in a succession plan.

Finally I’d like to thank everyone who has contributed to VSS over the last six years, particularly the office-bearers and project leaders. You have grown VSS from essentially nothing to what it is today, and have made my job exciting and joyful. Now let’s move on to better things.

Editorial

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In this issue of the newsletter Tom Richards formally notifies all members of his resignation as director of Variable Stars South. Behind the scenes there has been some discussion among team leaders and office bearers about a possible successor but with no conclusions.

It is time to bring all members up to date with that discussion and to encourage further contributions. The following comments have all come from members and the director and much of it is lifted verbatim from the emails.

One thing all are agreed on is that we owe a tremendous debt to Tom for setting up and running the group for six years and that we wish him well in his retirement (from the position but not from astronomy).



Tom has laid out the jobs that he now does routinely and they are:

- Encouraging new projects, helping leaders set them up, getting the right material onto the website and elsewhere, monitoring progress and advising
- Welcoming new “members”, encouraging members to get involved in appropriate research, answering email questions, and the like.
- January report to RASNZ (Bob provides the balance sheet)
- Checking Newsletter content before publication, writing From Director and other VSS-level material
- Close liaison over the website - content, organisation, presentation, updating, writing for it
- Coordinating between different areas as the need arises
- Maintenance of the eclipsing binary database
- Less specifically, a lot of miscellaneous work, arising because everybody else has very specific roles so anything outside those roles must fall to the director.

And he sets out possible new directions for us above.

There seems to be a consensus forming among the contributors to the discussion that some kind of team is needed now to run VSS. It has been suggested that we can manage without a specific leader as all our projects are running smoothly, but many feel that we should have a nominal leader, not least for political reasons.

It is true that we have strong project leaders and finance, web and newsletter are all taken care of and we could simply carry on leaderless, but from where would the drive and impetus come for improvement and expansion?

In the past the Photometric Section of the RASNZ had two, and for a time, three directors, good working relationships with the three main NZ groups and many overseas professionals. In contrast, VSS finds itself in a changed environment where liaisons seem based around such groups as CBA with CVs, MicroFun and others with planetary detection and where the AAVSO is trying to establish a monopoly with variable star observing.

At present we are not an incorporated body and have no formal means of choosing a successor so it may be that the first job of an incoming leader should be to setup some formal structures for our group, including a structure for succession. A fixed term, renewable once or twice would seem a good way to go. It has been pointed out that in the discussion that when a leader carries on for far longer than he should divisions arise and the director is largely ignored.

Given that the majority of our members come from Australia, should the director be Australia based? East or west? Administratively, there is no good reason why the director's role should not be replaced by a group localised in one city so they can meet and plan on a regular basis. Brisbane, Sydney or Canberra have been suggested as possible bases. All are reasonably easily reached from New Zealand.

If we are unable to agree among ourselves on a replacement by 31 December will RASNZ impose a director on us? Do we want that?

Is RASNZ a suitable parent body? Astronomy in NZ is now strongly divided between the professionals who have been collected into the 'Professional Astronomers' Group' and the RASNZ which is mostly amateur with only about a dozen professional members. Its membership of ~150 is very poor. So maybe we should become independent or perhaps reach for a different (Australian) umbrella.

Whoever we elect should be a person of some standing in our community, be a good administrator, have good astronomical and astrophysical knowledge, be forward thinking and hard working and very possibly be Australian.

There's plenty here to chew on but our first priority is to settle the question of leadership. Let us now have lots of robust discussion on the VSS Google group from all our members and hope that by December we have several nominations (or at least one volunteer) so that we can head into 2015 with a head.

Summary

About forty years ago McGruder (1975) published a catalogue of 417 stars of spectral types O-B5 in Centaurus. Coordinates for B1950, photographic UBV data and spectral types were given. It is now possible to identify all objects with certainty, and to resolve anomalies in the photographic photometry by comparison with high-quality recent data, and to assess its general accuracy. The dataset in updated form now provides accurate BV data for more than 300 stars.

Introduction

The field studied by McGruder lies in southern Centaurus, covering 5 square degrees, centred at about (J2000) 13^h27^m.5 -62°30'. Thirty-one of his stars were already known OB stars, and are identified by their LS (Luminous Southern Star) numbers. The remainder lack confirmation (Skiff 2014). At least one dozen of the McG stars have very large B-V colours, + 3.00 to +4.75, which appear abnormal. With the recent release of the *AAVSO Photometric All-Sky Survey (APASS)*, sufficient data is available to permit direct comparisons of the photometry for about 75% of the McG stars.

Photometry

McGruder's UBV data is based on scans of photographic plates, but no details as to the numbers of plates are given, nor many other pertinent details. By comparison with APASS data it became clear that blending was an issue. Numerous cases of pairs, or close groups of several stars, often were blended to yield McGruder's V magnitude. This is not unexpected in a rich Milky Way field. The APASS data has far fewer problems in this regard. I determined the differences between the APASS V_{APASS} and McGruder V_{PTG} , in the sense $V_{APASS} - V_{PTG}$, and from these standard deviations were derived for each magnitude interval, as shown in the following table.

Mag Interval	No of Stars	Std Dev
9.00 -10.00	7	0.5645 mag
10.00-10.99	38	0.3846
11.00-11.99	74	0.2465
12.00-12.99	103	0.2950
13.00-13.99	66	0.2548
14.00-14.99	45	0.2571
15.00-15.99	27	0.4510
<16.00	15	0.3213
All stars	375	0.3269

Table 1. Standard deviations of differences $V_{APASS} - V_{PTG}$

Notes:

- (1) Duplicates not included.
- (2) Reliable VSP/APASS photometry only reaches V = 15.12. Differences below 15.12 are based on comparison with USNO-A2.0 or GSC2.2 V-mags, and therefore are approximate.
- (3) The above results were generated on a spreadsheet which uses a formula for standard deviation (attached), for a population standard deviation. Physical scientists often use the term *Root Mean Square* as a synonym for standard deviation. However they evidently use a somewhat different formula. I tried their formula, but it may generate values which differ significantly from my table.

Photographic photometry is, in general, regarded as “noisy” compared to the best PEP or CCD data. In this instance it is possible to quantify it over the whole dataset. So, over all, McGruder’s V is only accurate to $\pm 0.3\text{mag}$. The source paper already flags data with an uncertainty of this order with a single colon (:). Very uncertain data is flagged with a double colon (::).

Ambiguous positions

I found that twenty-six McG stars, with B-V in the range +2.0 to +3.73, all have a faint 16 mag companion $\sim 8\text{--}9''$ to the south. McGruder’s position, as published for each star, consistently matches the faint companion while V clearly refers to the brighter main star. As his V is fairly reliable (within limits) generally, I explain the abnormally large B-V in each case as the result of measuring B for a different nearby star, apparently the faint companion referred to. In my electronic file of McG stars I record only the brighter star.

Most of the very large B-V values are debunked when compared with APASS data. However, a few stars cannot be explained this way. There may be a different cause (instrumental?) for these anomalous B-Vs. I ran a special test of ~ 110 stars with B-V ranging from +1.00 to +2.00, and only a small number (perhaps 3 or 4) showed any ambiguity in position, in the same sense as the very red stars.

The reader is invited to peruse the dataset, in its entirety, on the VSS website.

Concluding remarks

Having contacted Brian Skiff (2014), Lowell Observatory, I am advised that there is no evidence of follow-up to confirm McGruder’s OB stars, and his UBV data proves to be so noisy it is of little value in the professional realm. Consequently the 1975 paper and list have been largely ignored.

As the work done here now provides a reliable sequence of BV photometry for more than 300 stars in southern Centaurus it can be made available for other purposes. Note that Nova Cen 2005 = V1047 Cen appeared in the midst of this same field. The complete, updated file will be placed on the VSS website.

Acknowledgements

APASS DR7

This research was made possible through the use of the *AAVSO Photometric All-Sky Survey (APASS)*, funded by the Robert Martin Ayers Sciences Fund.

References

- McGruder, C.H. 1975 *Astron. Astrophys. Suppl.* 22,161-170
 Skiff, B. 2014 Private communication.

Appendix

The formula used for population standard deviation is:

Formula	$\sqrt{\frac{\sum (v_i - avg)^2}{n}}$	n = number of items in the list v_i = the i th item in list avg = average of values in list
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Simplest CCD Photometry - *Tom Richards*

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I've been thinking a bit about the difficulty many people find in getting going, even if they are sophisticated users of CCDs astronomically. So I've tried to pare it all back to a bare minimum (effort, learning, and cost). Here's my approach. I'm assuming you know the basic ropes of imaging and calibration, perhaps from astro-imaging experience. (The DSLR story is essentially the same, but I'll stick to CCDs.)

To do CCD photometry you usually have to track for many hours while taking a time series of images. The simplest and arguably most useful photometry you can do is to obtain the times of eclipsing binary minima (*ToMs* or *epochs*), though RR Lyrae or Delta Scuti short-period pulsator maxima can also provide you with an exciting night's light-curve.

Your equipment is a telescope with a reliable tracking mount, and a way of keeping that tracking spot on: a second tracking CCD or automatic astrometric re-centering capability in your imaging software. You don't need filters with your CCD camera. Armed with that, here's what you do.

- 1) Find the target for tonight. Use David Motl's freeware Ephemerides software for eclipsing binary minima (<http://www.motl.cz/dmotl/predpovedi/>). Look for a target that's culminating, and eclipsing, around your midnight to give you the longest eclipse run. Or use AAVSO's VSX (www.aavso.org) to locate any very short-period EB or EW eclipser or RR Lyrae pulsator suitably placed in your sky. Stay bright – I work at mag 10-13 with a 0.41 m scope.
- 2) At the telescope, focus isn't critical, in fact you should ensure the FWHM (full width at half maximum – your imaging software can measure that) of your star images occupies 2-3 pixels. Centre the target variable *V*.
- 3) You also need a comparison and check star (*C* and *K*) in the field, preferably about as bright as *V* and not near the edges. *C* provides a "standard candle" against which you measure the brightness of *V*. It must not be a variable (the purpose of *K* is to check for that) and should be of a similar colour to *V* (your planetarium software should tell you the B-V colour index. See Figure 1).

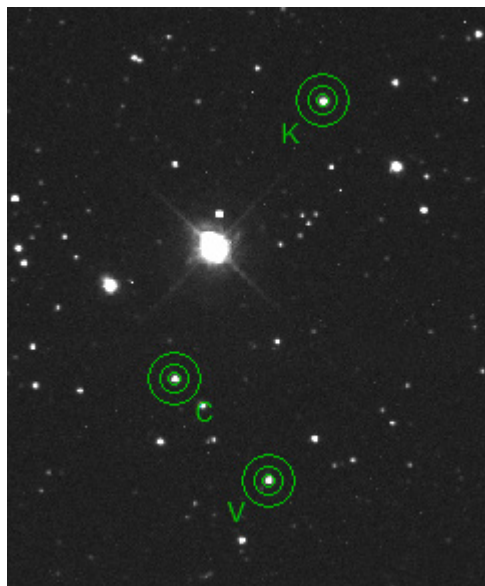


Figure 1. Central portion of a CCD image showing selection of *V*, *C* and *K*. (MaxIm).

- 4) Test to find a suitable exposure time that gives you a signal/noise ratio on *V* and *C* well in excess of 100. I aim for 500 or more. Run your time series imaging, then calibrate the images in the usual way using bias, dark and flat masters.
- 5) Photometry comes next. If your imaging software doesn't support photometry (or calibration), try the highly recommended freeware Muniwin (<http://c-munipack.sourceforge.net>) – commonly used professionally and easy to use. The steps are:
 - a) In the photometry tool, open all the image files in your night's time series (after removing bad ones).
 - b) Adjust the sizes of the *photometry circles* (three are shown in Figure 1). Innermost is the *star aperture* circle which measures the star's intensity. Set its radius *r* to about twice the FWHM of your poorer images. The

outer two circles define the *sky annulus* which measures the background sky intensity for subtracting from the measure in the star aperture. It should be kept separated from the star aperture by about *r*. The sky annulus should have a width of at least *r*, but adjust it and its separation from the star aperture to avoid it containing bright stars, especially for *V* and *C*.

- c) The photometry tool requires you to identify *V*, *C* and *K* in one of your images in the time series

set (see Figure 1). If you have to supply a value for C's magnitude, use 0.0 – don't bother with its actual mag. The software will then locate and measure those stars in all images in the set; then output a table containing the Julian Date (maybe heliocentric, maybe geocentric) of the midpoint of each exposure, and the measured magnitude of V and K. Open that in a spreadsheet.

- 6) Heliocentric JD is needed. If your photometry tool won't provide, you'll have to convert from JD. Lew Cook's software is recommended (www.lewcook.com/SUNTime.htm). You input the RA and Dec of your target and a time around the middle of your run. The resulting correction is good for all your images on that target for the night. Make the correction in your spreadsheet.
- 7) Want to see your light curve? Use the spreadsheet's graphing facility (Scatterplot, Vmag and Kmag against HJD) and don't forget to reverse the direction of the Y axis. If K's line is straight and level, neither it nor C are varying and its standard deviation is a good check on the quality of V's data. See Figure 2.

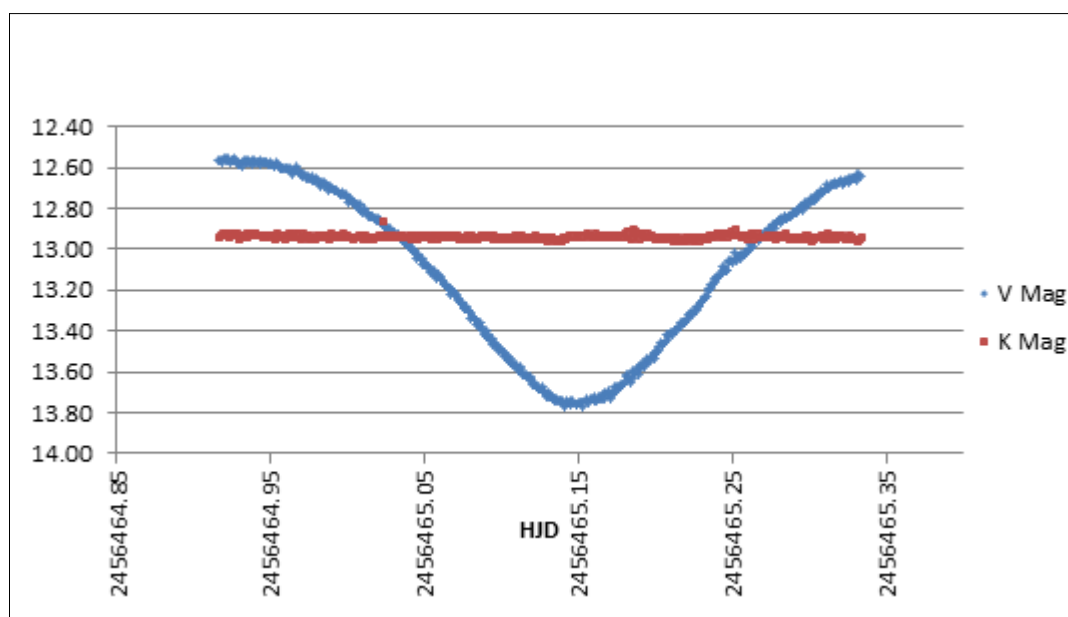


Figure 2. A good night's work on an EA eclipsing binary (Richards)

- 8) Now for the ToM, or maxima times for pulsators. Bob Nelson's freeware Minima program is recommended, even if it can be a bit flaky (<http://members.shaw.ca/bob.nelson/software1.htm>). It has many ways of finding minima and maxima times. Experiment. You input your HJD and Vmag. Output is the HJD of ToM and its uncertainty. You should definitely do better than 0.001 days.
- 9) What do you do with that result? For minima of eclipsers, email it to me. Include your name, name of target star, HJD of ToM, error. A plot of your light curve would be nice. Don't forget to keep your spreadsheet – you may be asked for it! The data goes into the VSS public Eclipsing Binary Database (except for the EA project whose data are embargoed), crediting you. For pulsators, I'm not aware of a similar database collecting maxima timings, more's the pity. Talk to me about setting one up for VSS like the eclipser database. Also it's very desirable to send your data to the AAVSO variable star database (www.aavso.org) – most photometry software will output a file in the format they require.
- 10) Want to go further? Have a look at the VSS Southern Eclipsing Binaries EA and EB/EW Projects, both taking work on eclipsers a lot further than what I've just described (www.variablestarsouth.org). Also the AAVSO has an excellent online manual about CCD photometry.

This note covers some recent CCD work in the EB/EW project. Project members can access fuller data on these targets in the project's Dropbox. If you're not a member, consider signing up – full details of the project are on the VSS website.

AO Aquarii

AO Aqr is listed in the AAVSO VSX as an EW binary of spectral type F, with a V magnitude range of 11.04-11.67 and period of 0.4893432 d. ASAS3 data suggests this period either is not quite correct or that there is a slow period change.

Jonathan Powles obtained a full light curve in B, V, Rc and Ic of AO Aqr over twelve nights last winter. His combined light curves are in Figure 1. A follow-up next winter would help pin down the period issue. The light curves obtained suffice for immediate astrophysical modelling.

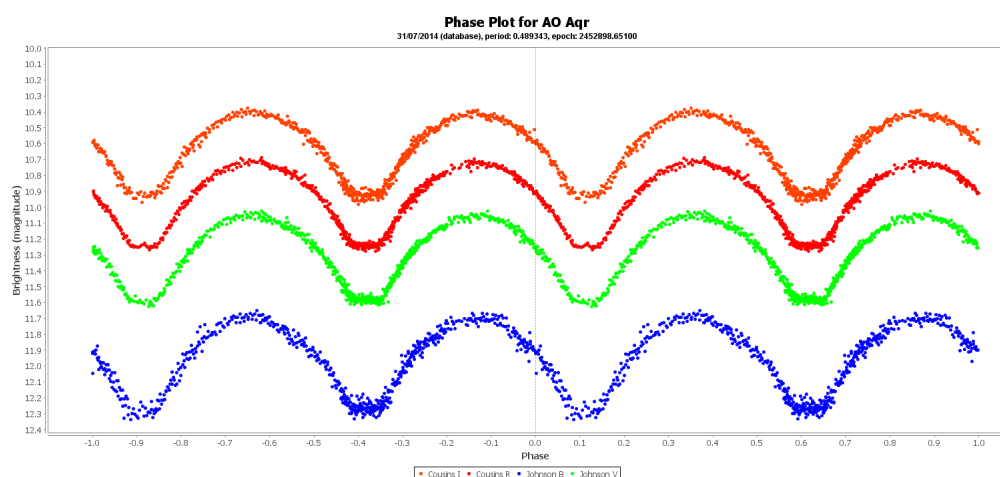


Figure 1. AO Aqr light curve by Jonathan Powles

BU Velorum

BU Vel (CD-42 4492, Tyc 7683 0671) is described as an A-type EW (over-contact) binary system, ie the primary eclipse is a transit not an occultation. Hence, the larger star is hotter. B-V for this system is +0.29, from which an envelope temperature of 7500 K and spectral type of A8 may be derived.

Unlike their cooler W-type cousins, an EW of this temperature would lack the complications of spot activity and hence light curve variations, so a study of period change, to which EWs are prone, would be relatively straightforward.

I obtained a light curve of the primary minimum in B, V and Ic on 2014-02-23. The flat floor shows the transit of the cooler smaller star across the other. The centre of the eclipse is at HJD 2456712.15693(2), measured in V (figure 2). I intend to obtain complete 3-colour light curves next season, to compare against the earlier data and to complete a light curve.

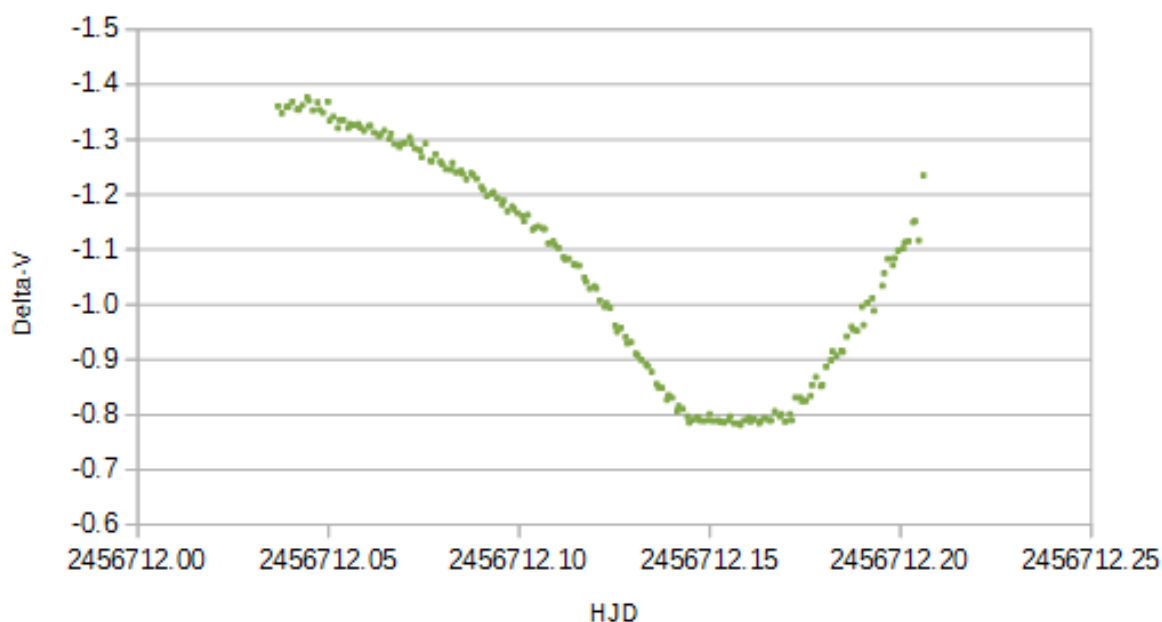


Figure 2. *V* differential light curve of the primary minimum of BU Vel. Comparison star is GSC 7670 0119.

Southern semi-regulars – a progress report – *Aline Homes*

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Progress to date

As the general said, no plan survives first contact with the enemy and this project has had to change a little from what was announced in the last newsletter – but that is good - the focus on short-period semi-regulars and the lists were only meant as guidelines to get observers started. What we have so far received is large files of data, some going back many years, from a few experienced observers who have had one or two semi-regulars in their observing programmes for some time, and that is great, as it gives the analysts something to get their teeth into right away.

Thanks to Peter Williams, Stan Walker, Neil Butterworth and anyone else who has sent in data so far. A preliminary analysis of Peter's data on T Muscae is presented below. This was perhaps not the easiest target to start off with, but the data set represents twelve years of consistent observations running from 2002 to the present. A lot more work is needed, but the results so far are intriguing. Thanks to Pauline Loader for carrying out most of the analysis, and to Peter for clarifying a number of points about the data.

We have now started work on T Centauri and also have data on L2 Puppis to move on to, but we could do with more, so if you have a favourite SR you have been observing for some time, even if it is not a short period one, do feel free to send it in.

Preliminary analysis – T Muscae

Aline Homes, Pauline Loader and Peter Williams

T Muscae ((J2000) 13:21:13.85, -74.26:31.0) is listed by the AAVSO as an SRb semi-regular variable with a C-type spectrum, a primary period of 111.8 days, a secondary period of 1021 days and an amplitude of about 1 magnitude (7.5-8.5). Periods of 93 days and 1082 days are also mentioned in the literature (Gaposchkin 1950; Lloyd Evans 2010). The data set available from AAVSO covers the period JD 2447819 to 2456823 (Mid October 1989 to early August 2014). This data set includes measures contributed Peter Williams.

This analysis covers the period JD 2452339 to 2456869 (March 2002 to July 2014 and comprises approximately 850 visual observations by Peter, using 80x20 binoculars and a refined set of comparison stars. Analysis was carried out using a spreadsheet (LibreOffice Calc), V-Star from AAVSO and the self correlation program available from John Percy's website (Percy *et al.* 2006).

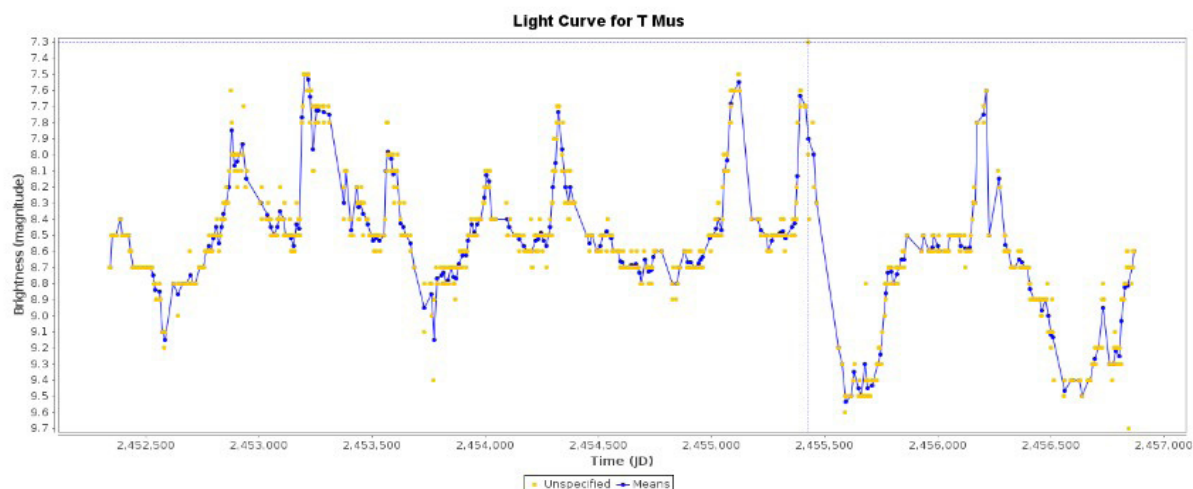


Figure 1. Light Curve, T Mus. The yellow points are actual observations and the blue line an average obtained by binning data.

The light curve shows a greater amplitude than the published range of 7.5 to 8.5 and is currently somewhat over two magnitudes. There has been little overall change in the intensity of maxima and the change in amplitude seems to be almost entirely due to an increase in the depth of the minima. The change may have taken place before JD 2452339, possibly in two steps, with an additional deepening around JD 2455500.

Initial phase plots were made using V-Star and trial periods of 112 (close to the published period of 111.8 days) and 1021 days. Both were centred on the given epoch of JD 2453443. The secondary period of 1021 days fitted the observational data rather better than the primary period of 112 days. In order to obtain a better estimate of the periods, a number of experimental plots were made using the Percy self-correlation program and a variety of bin number and period range combinations. All were consistent when the selected ranges overlapped. Fig. 2 shows a self correlation plot of Peter's data using 200 bins and a period range of 0-4000.

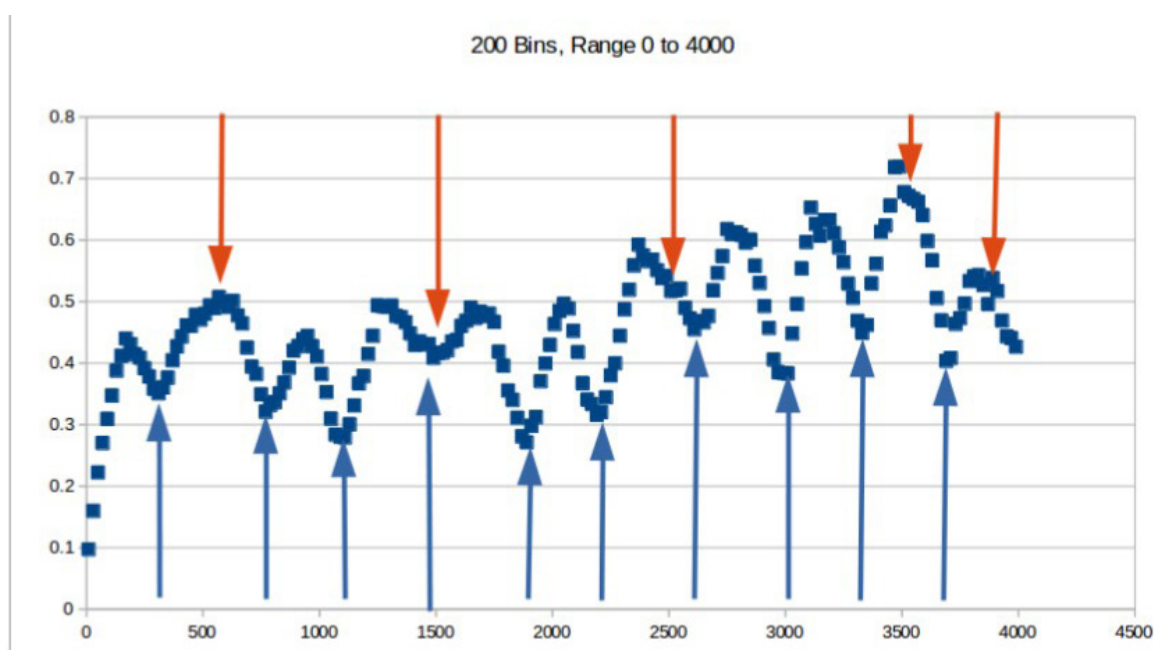


Figure 2. Self-correlation plot for 200 bins and period range 0-4000

The minima (blue arrows) on a self-correlation plot indicate periods or multiples of periods and the mean period can be derived from the average of the difference between successive pairs of minima. Points of inflection (orange arrows) can indicate non-coherent events, semi-regular or secondary periods (Percy *et al* 2006). In the plot above the differences between successive pairs of minima are 460, 340, 380, 400, 300, 420, 400, 320, 360. Omitting the first, which seems out of range, this gives a mean of 375.5 days.

Similarly the differences between successive pairs of points of inflection are 1000, 1000, 900, 390. Again the last is out of range and omitted for the present. A secondary period in the region of 1000 days is indicated. These periods were used to create phase plots using V-Star.

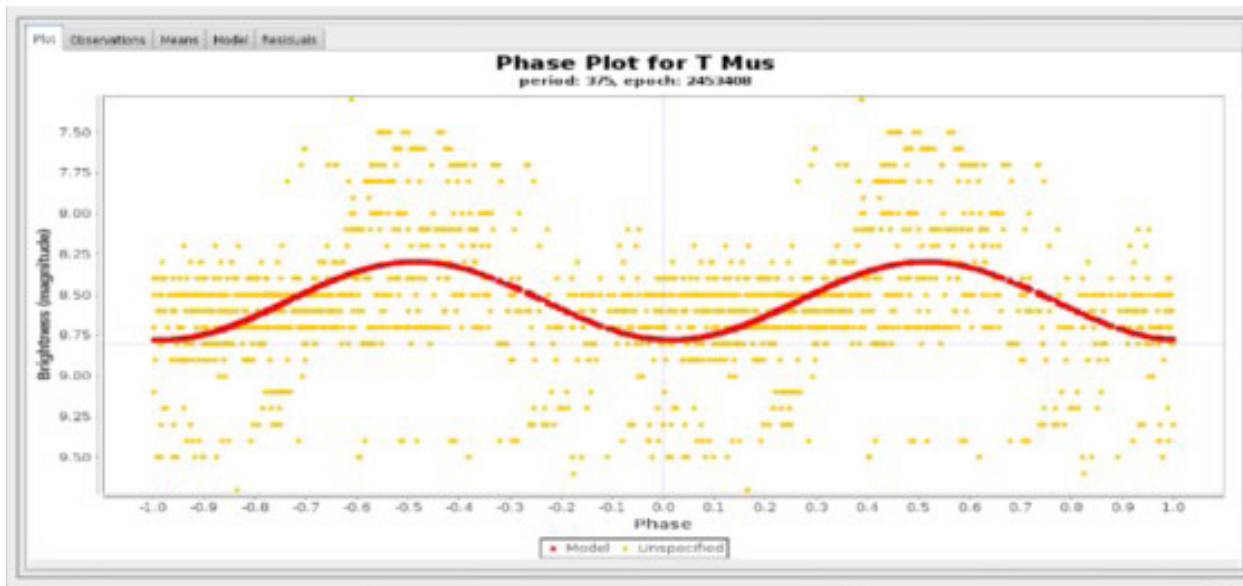


Figure 3. Phase plot and model for a period of 375 days.

Fig. 3 shows the resultant phase plot for the 375-day period from the self-correlation analysis with an epoch of JD 2453408. The red line is from a model using V-Star DC-DFT analysis and modelling. This is a reasonable fit to the data. The DFT period analysis also confirmed the presence of a longer period, although 1001 days was a better fit than 1000 (Fig. 4).

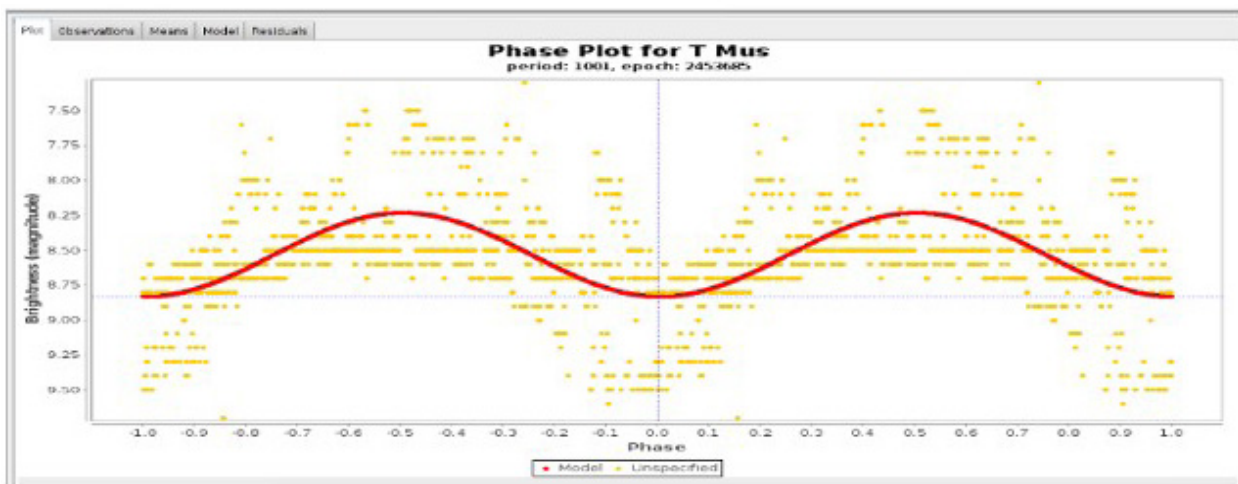


Figure 4. Phase plot and model for a period of 1001 days.

To see how well a combination of the two models fitted the data, a spreadsheet program was used to add the two models and the mean of the to base magnitudes was subtracted. The resulting combined model (green points) superimposed on the original data (red points) is shown in Fig. 5.

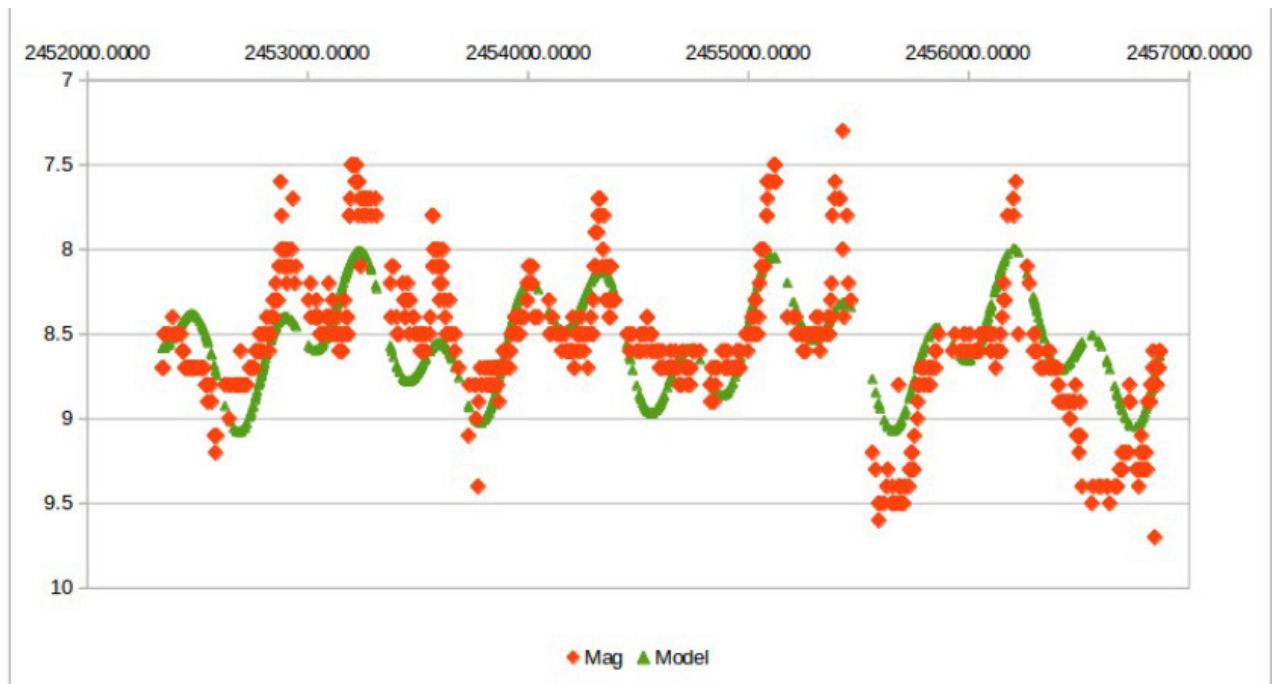


Figure 5. Combined model and original data.

The general shape of the combined model fits the actual data fairly well, however the model data does not extend brighter than magnitude 8 or lower than about 9.1 whereas the actual range of the observations varies between 7.5 to about 9.6. The method of combining the two models was also crude. The current model needs refining to better match the actual amplitude of the data set, and a better method of combining the period models employed. The model data should also be fed into the self-correlation program to check that it does in fact produce a very similar SC plot.

Further work needed is to examine and account for the anomalous first minimum and last point of inflection and to assess whether the modelling needs to account for these. The larger data set available from the AAVSO database should also be analysed and modelled in a similar manner.

The results of the analysis to date raise a number of interesting points. Why is there no sign of the reported 111.8 day primary period? If this period has changed, and changed substantially, when did this happen and what caused it? Is it connected in any way with the increase in amplitude? What colour changes take place during the cycle? This is likely in a carbon star, so is dust emission (Lloyd Evans 2010). Is the star undergoing a transition, and if so, into what?

This is a target that warrants continued monitoring, including instrumental observation. Members with spectroscopic and colour photometry capabilities could assist by making several measures over the next few years, and we hope that some will do so.

Watch this space.

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SY Fornacis – a high galactic latitude binary star – *Stan Walker*

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The 1969 edition of the GCVS described SY Fornacis as a bright dwarf nova and Brian Marino and I began UBV measures of it in February, 1973. At almost the same time Wenzel, (Wenzel1973) published an article in IBVS 763 which indicated that it was a semi-regular variable with a period of 50-60 days. Our measures, however, showed that it was quite bright in the U filter and may well have been an unusual type of CV so we continued to measure it at intervals until 1982. These measures are shown in Figure 1. These can only be explained by a composite object.

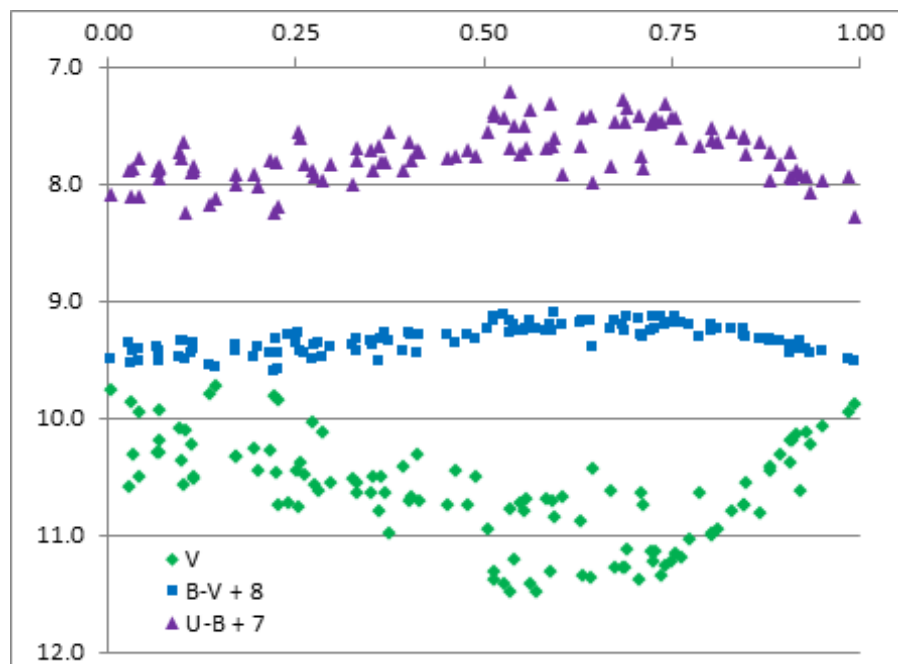


Figure 1. UBVM measures of SY Fornacis folded with the period of 142.7 days and epoch of JD 2441767.

There is a strong antiphase shown in the B-V and U-B measures which are offset by the magnitudes indicated.

This normally indicates a system of at least two stars

In Figure 2 are shown the individual filter measures which type of presentation may be more familiar to some of our observers. Back in the 1970s we endeavoured to determine the brightness and colours of the bluer star but those were pre-spreadsheet days and the task proved impossible.

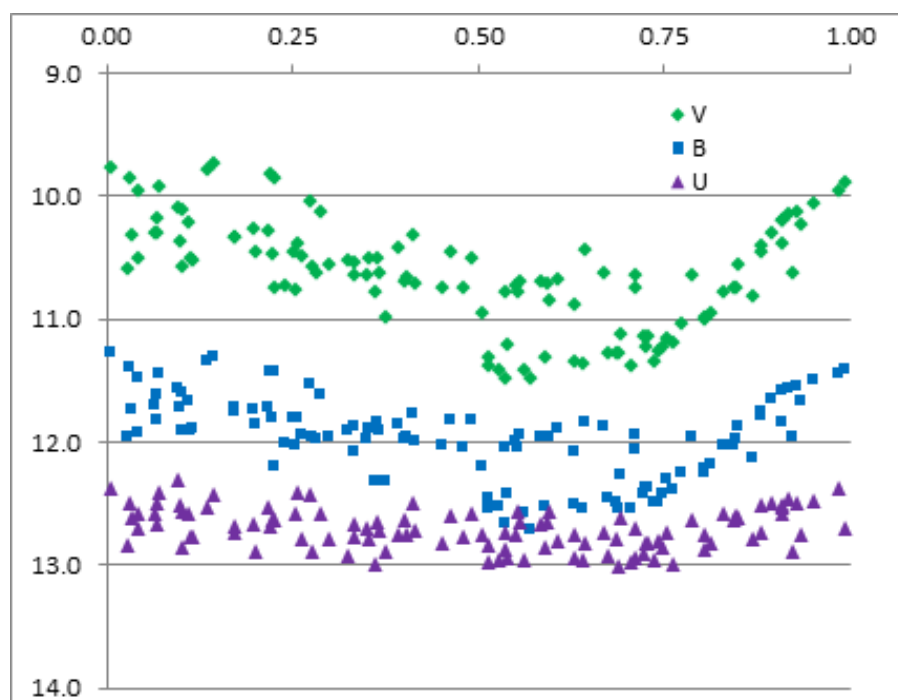


Figure 2. This shows the measures through each of the U, B and V filters. In other SR stars of about this period which we have measured in UBVM the B curve follows the V curve with slightly less amplitude in U. This may be attributable to the presence of some gas affecting these two filters but the spectra are not noted as strongly emissive as are Mira stars.

It is noticeable that the U curve is almost flat, indicating that here we are measuring mainly the bluer star but the variable star is strongly visible at the V wavelength.

Using this graph it appears that the U magnitude of the blue star is about 13 with some contribution from the SR star when it's near maximum. This suggested that V, B and U each be set at 13 to give an A0 type star with V, B-V and U-B of 13.0, 0.0, 0.0. These have been converted into intensities and subtracted from the combined intensities to produce Figure 3.

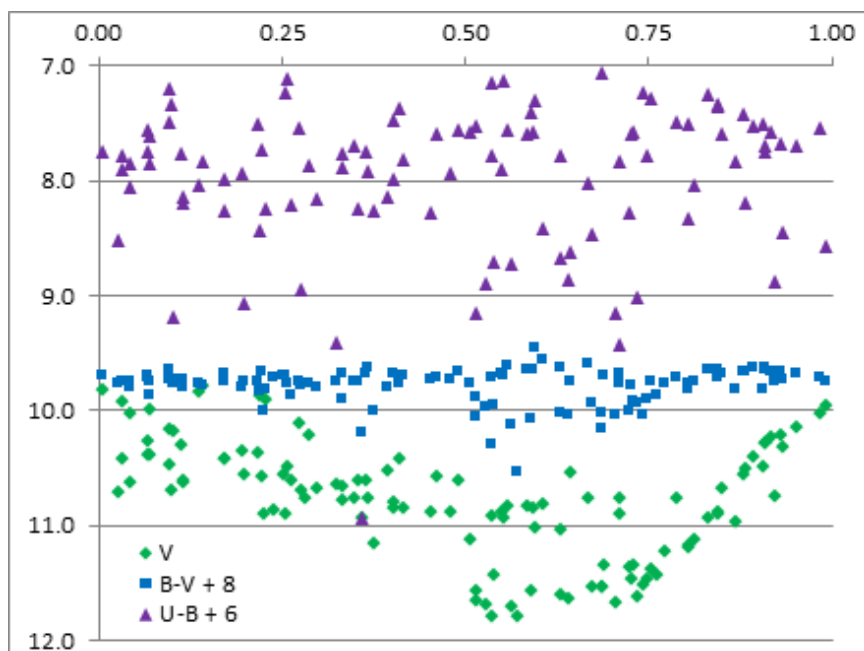


Figure 3. This shows an amplitude of ~ 2.0 magnitudes in V, typical of many SR stars with this period.

B-V is offset but is around 1.8 and fairly flat indicating little temperature change.

U-B is similar but very noisy. But it should be appreciated that these values depict a range from $U = 11.7$ at maximum to $U = 13.7$ at minimum - both very approximate. More on this noisiness below.

These values are fairly normal for an SR star - $V = 9.8$ to 11.8 , $B-V \sim 1.8$, $U-B \sim 2.0$, but may not be appropriate for the hotter star. Changing the blue star to 12.5, 0.3, 0.2 provides the values of Figure 4 which may be more realistic for reasons discussed below.

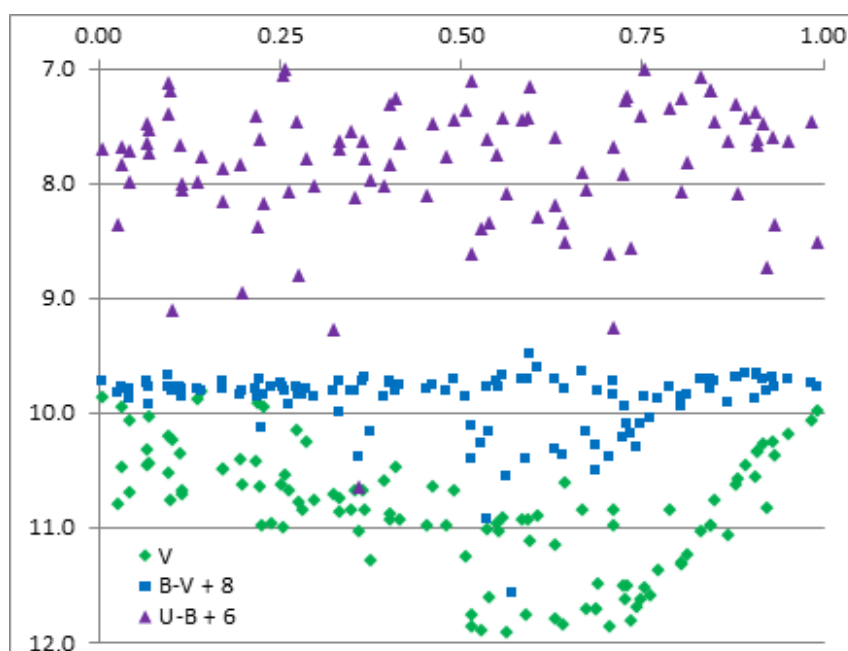


Figure 4. The change in blue star values increases the amplitude of variation and makes the U-B colour a little less red. Some SRs are like this

A word about EMI 9502 photomultiplier tubes with glass filters. Using similar integration times (which was normal in pre- and small computer days) the B filter intensity was about 3 times better than V, which in turn was twice that of U. Thus response before correction was: $U \sim 17\%$, $B \sim 100\%$, $V \sim 33\%$. Hence the noisy U!

So what is the blue star? SR stars as a group are either giants or bright giants and are highly evolved. Thus it was the more massive star in this system but its companion is bright enough to affect the measures substantially. The easiest solution is a chance line of sight bluish companion but the galactic latitude is -62.5 and the star density is low. (We used to look at the Fornax galaxy cluster nearby once the measure was made) and most stars of this colour in this region are very faint objects and are also very infrequent. The absolute magnitudes must also be considered - SR stars of this period at about -2 , but the blue star is brighter than a main sequence object.

So we must assume that the system is binary in nature, but there is no evidence of eclipses. They'd be hard to recognise but in our 117 measures we saw no indications of these - the colour would be quite different. It might be worth someone with access to a large telescope taking a spectrum which should give a better idea of what the blue star is.

One final area of interest. In his paper Wenzel mentions a period of about 50-60 days which applied in 1936, 1937 and 1952/53. The GCVS still quotes 55 days and this period is used on the AAVSO VSX. Our measures from 1973 to 1982 are best fitted by a period of 142.7 days. Yet the ASAS3 measures in the first decade of this century show clearly 150 days. Both these latter two periods have been confirmed by cycle counting. A period search will undoubtedly show multiple periods at any time - which is why SR stars have erratic light curves - but the change from 142.7 days to 150 days is hard to understand. Maybe some CCD measures for a cycle or two could be compared with the earlier measures?

The Auckland Observatory measures were made by Brian Marino, Gary Freeth and the author using the 50cm Edith Winstone Blackwell telescope and a very good photoelectric photometer. They appear in the AID if anyone wishes to use them. There are also many visual measures. CCD photometry is very effective and simpler in many ways than the old PEP - but unless you're using a back-illuminated detector and can work in U much of valuable information is just not available.

Reference

Wenzel, W. (1973). "SY Fornacis - no U Geminorum Star." Information Bulletin on Variable Stars 763: 1

The long period variable - dual maxima Mira scene – *Stan Walker*

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Miras and others

R Hydrae is the prototype period changing Mira star. Back about the time of the Great Fire of London a cycle took 550 odd days but since about 1940 it's been static at 388 days with the normal alternations of a few percent. But its light curve frequently shows humps, usually on the rising branch. The last maximum at JD 2456000 was interrupted by the Sun's proximity but was exceptionally wide - almost 100 days. Or was it much brighter than the current normal of $V = 5.5$? It's at or near maximum at present and, of course, badly placed again with that period but someone may be able to manage a few early morning measures.

BH Crucis has attracted several DSLR and CCD observers so we are getting BVRI data some of which goes back to JD 2454100. The present maximum showed a very pronounced hump on the rise, clearly the remaining vestige of the now largely vanished first maximum. This is reminiscent of R Hydrae above and it raises the question - was R Hydrae once a dual maxima object. We'll never know! Hopefully the BVRI measures will continue through the rest of the maximum. Using times of minima some more epochs have been added to the list but the period of ~520 days seems to be stable at present.

Another star combining both the characteristics of BH Crucis and R Hydrae is **R Centauri** (Figure 1). Actually the prototype star of the dual maxima Miras, its period is shortening in a manner similar to R Hydrae which took 200 to 250 years to evolve through what is usually described as a helium flash event. That star's period change of about 160 days was at a rate similar to R Centauri's 70 days in just over a century. There are some good BVRI measures but the B-V shows little change since the 1970s when it was about 540 days. We'd expect an increase in temperature to go along with what is theoretically a slightly smaller star. But the dramatic changes in the shape of the light curve may disguise the fact that the star may be a little fainter now.

A comment by Matthew Templeton of the AAVSO about R Centauri is interesting:

"Has anyone done spectroscopy? I would be interested to know if the temperature is changing or if there's evidence of increased mass loss or dust formation."

This may be of interest to some of the spectroscopic people. I'm not sure how faint they can usefully

observe but some of these stars reach close to naked eye visibility and even if they cannot be measured through a full cycle sets of measures once a decade might build up an interesting picture over time. This could well apply also to some of the bright normal Miras such as R and S Carinae and omicron Ceti.

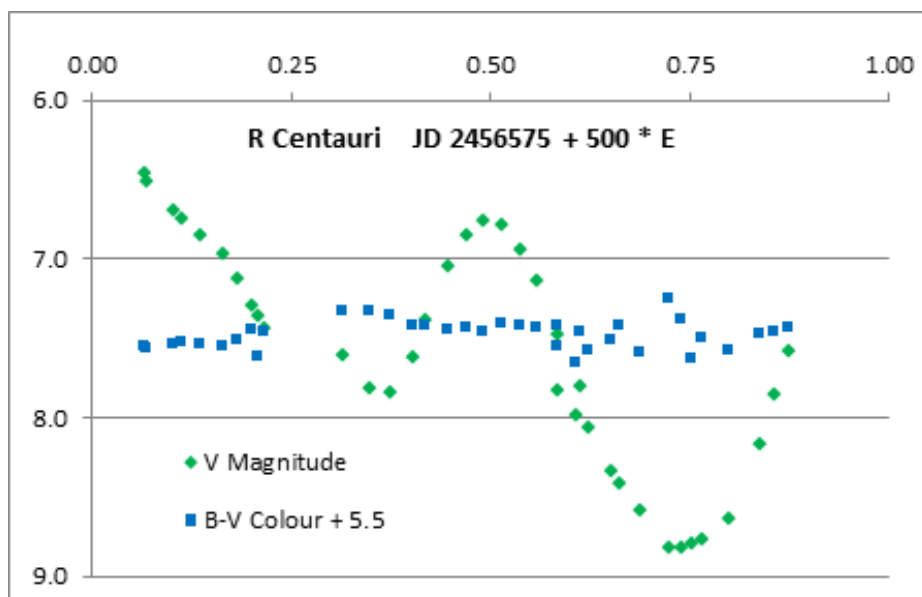


Figure 1. DSLR Measures by Neil Butterworth in V and B-V. The latter is displaced by 5.5 from ~2.0 to improve the scale of the chart. The noisiness at phase 0.75 is because the actual B measures are around $B = 10.8$, extremely faint for DSLR work without being used through a telescope.

There is a suggestion that the B-V colour is anti-phase, probably caused by a rather blue but faint companion. The old UBV measures from Auckland Observatory in the 1970s show this quite clearly.

Another DMM star, **V415 Velorum**, is near the second maximum at present according to the visual observers. This star could well use some CCD measures in BVRI or BVI - there are few measures of this object recently apart from those by ASAS3.

As with the spectral measures these filtered measures are best done for a complete cycle then repeated a decade or so later. Visual measures of these large amplitude stars are usually adequate to keep track of their behaviour the rest of the time.

I'm not trying to encroach on Aline's project but an old favourite, **L2 Puppis**, continues to plod along at a faint level. The last thousand days of the International Database show maxima at 6.1 and minima of 8.5.

This star is well covered visually but maybe we could get a cycle or two of DSLR measures to compare with earlier ones. At Auckland Observatory we obtained 43 UBV measures from JD 2446051 to 46396 when it was reaching around $V = 4$ at maximum. From 48997 to 51309 Harry Williams made 162 UBV measures during which the star was slightly above $V = 4$ at the beginning but then declined to $V = 5.8$. The period was around 140 days and it shows a second one of ~103 days, hence the messy light curve. All of these measures are in the International Database.

Bright Cepheids in the 2015 season – Stan Walker

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Due to a business work overload and the temporary failure of my observatory's run-off roof I have been unable to complete a target list for the coming season. My apologies. This will be completed in November with appropriate charts and comparisons and loaded onto the website with a notice on the email system. Any specific questions can be emailed to me as above.

Transforming magnitudes in the I passband – David Moriarty

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I have observed several cycles of contact eclipsing binary RV Gruis in the B, V and I passbands with a Moravian G3 camera with the KAF6303E CCD chip. In order to transform the data to the standard Johnson-Cousins system using the Excel spreadsheet template from Tom Richards, I needed to select a comparison star and find its standard magnitudes in B, V and I. RV Gru has a K2 spectral type and Johnson V magnitude of 10.975; its B-V colour index is 1.18. The only potential comparison star with a similar colour index within the field of view of my CCD (24 x 16 arc minutes) is GSC 8446 0442. However, it is 1.5 magnitudes brighter in V than RV Gru. An alternative comparison star is GSC 8446 0575, which has a G0 spectral type, but has an advantage in that it is closer in magnitude to the target variable (Table 1).

Magnitudes	RV Gru	GSC 8446 0442	GSC 8446 0575	Table 1. Johnson and 2MASS magnitudes (Source: Tycho2 and 2MASS catalogues via SIMBAD).
B	12.156	10.59	10.948	
V	10.975	9.479	10.495	
B-V	1.181	1.111	0.453	
J	9.378	7.681	9.431	
H	8.861	7.125	9.176	
K	8.729	6.958	9.118	

Conversions are required to calculate a standard magnitude for the I band from 2MASS JHK bands or the Sloan g, r and i passbands. Several different formulae have been published for converting 2MASS or Sloan to the Johnson-Cousins VBRI system. The only data for the two reference stars in the Sloan passbands is from the AAVSO All Sky Survey (APASS), but the values are not accurate for stars brighter than about V magnitude 10 – 10.5, due to saturation of images. Thus, APASS magnitudes for GSC 8446 0442 may not be accurate, whereas those for GSC 8446 0575 may be correct. The 2MASS catalogue has a wide coverage of southern hemisphere stars, whereas the SDSS does not.

Formulae for transformation of Sloan g, r and I bands are given in the SDSS web page: <https://www.sdss3.org/dr8/algorithms/sdssUBVRITransform.php>. Formulae for converting 2MASS data to the UBVRI system were published by Caldwell et al, 1993. As shown in Table 2, the I magnitudes vary by about 0.5, depending upon which of the various conversion formulae is used. The result is a wide variation in the V-I values that are required to transform data to the standard system.

It is not always clear, or stated directly, by the authors of papers to which I have referred whether they mean the Johnson or Cousins version of the I pass band. As astronomical photometry has progressed from visual and photographic detectors to photometers with photomultiplier tubes that record fluxes or intensity of light to CCDs that count the number of photons detected per unit of time, and the sensitivity of the various detectors to different wavelengths of light has changed, astronomers have varied filter band passes to try and achieve uniformity and correspondence in photometric measurements. Bessell (2005) in his review of photometric systems points out that the passbands for the UBVRI system now refer normally to the Johnson-Cousins UBV system and the Cousins RI system, not the wavelengths used in earlier filters. Therefore, we would expect that I magnitudes derived with the conversion formulae taken from the references in this document are indeed Ic values.

Formula	GSC 8446 0442	GSC 8446 0575	Reference
$V-I = (0.675 \pm 0.002) * (g-i) + (0.364 \pm 0.002)$	8.367	9.472	Jordi et al. (2006)
$V-I = (0.671 \pm 0.002) * (g-i) + (0.359 \pm 0.002)$	8.379	9.48	Jordi et al. (2006)
$V-I = (V-1.09 * (r-i) + 0.22) - (r-i) + 0.21$	8.894	9.945	Jester et al. (2005)
$I = r - 1.2444 * (r - i) - 0.3820$	8.392	9.716	Lupton (2005)
Formula No. 38 using J-K values	8.418	9.873	Caldwell et al. (1993)

Table 2. Derivation of I magnitudes for the comparison stars.

An alternative consistent source of standard magnitudes for comparison stars brighter than V magnitude

10 to 11 is the All-sky spectrally matched Tycho2 catalogue of Pickles and Depagne (2010). The advantage of using the synthetic fitted UBVRi magnitudes in this catalogue is that they are based on the Tycho2 data together with NOMAD Rn and 2MASS J H K magnitudes, which have been calibrated against Landolt and Sloan primary standards and the HST CALSPEC spectrophotometric standards.

	BT	VT	BT fitted	VT fitted	B fitted	V fitted	I fitted
GSC 8446 0442	10.995	9.639	10.93	9.7	10.64	9.589	8.53
GSC 8446 0575	10.948	10.495	11.02	10.45	10.91	10.394	9.78

Table 3. Tycho2 magnitudes and spectrally fitted magnitudes.

As a check on using these data for determining magnitudes in the Ic band, I compared values calculated from APASS magnitudes with the formula of Lupton (2005) and from Tycho2 and 2MASS magnitudes with the formula of Caldwell et al (1993). Magnitudes for the two brightest members of the MCT 0401-4017 field were available in the Tycho2 and 2MASS catalogues. There is good agreement between the magnitudes given by Landolt (2007) and those calculated with conversion formulae as shown in Table 4.

Landolt Star	Ic	Formula reference	Source
MCT 0401-4017 A	10.003	Lupton (2005)	APASS
MCT 0401-4017 A	10.103	Caldwell et al. (1993)	Tycho2 and 2MASS
MCT 0401-4017 E	9.968	Lupton (2005)	APASS
MCT 0401-4017 E	9.995	Caldwell et al. (1993)	Tycho2 and 2MASS
MCT 0401-4017 C	11.285	Lupton (2005)	APASS
MCT 0401-4017 D	11.271	Lupton (2005)	APASS

Table 4. Calculated Ic magnitudes from catalogue values with formulae listed in Table 2.

On 16th October, I observed the MCT 0401-4017 field and derived magnitudes for stars A, B, C, E and F by assigning the standard magnitudes of star D as the reference. The spectrally fitted magnitudes for stars A and E are from Table 15 in Pickles and Depagne (2010); they are similar to those I determined.

Star	Derived	Landolt	Derived	Landolt	Derived	Landolt	Spectrally Fitted		
	B	B	V	V	I	I	B	V	I
A	11.274	11.271	10.709	10.709	10.052	10.060	11.270	10.699	10.000
B	13.152	13.160	12.657	12.654	11.998	12.021			
C	13.281	13.301	12.380	12.395	11.275	11.320			
E	11.128	11.163	10.593	10.636	9.990	10.030	11.140	10.623	10.020
F	13.788	13.780	12.994	12.990	12.139	12.149			
D		12.496		11.947		11.324			

Table 5. Magnitudes of stars in the Landolt South MCT 0401-4017 field. Magnitudes were derived from 5 replicates using the comparison star MCT 0401-4017 D with magnitude values given by Landolt (2007). The standard deviations for the 5 replicates were less than 1% of the means.

In conclusion, I will use the spectrally fitted magnitudes for stars brighter than about V mag. 10 -10.5 (i.e. where APASS magnitudes could be saturated). For fainter targets, I will use APASS with the Lupton (2005) formula, or if no data are available, then 2MASS with the Caldwell et al. (1993) formula.

References

- Landolt A. U. 2007.UBVRi Photometric standards stars around the sky at -50° declination. AJ 133: 2502-2523
- Caldwell, J. A. R., et al. (1993). "Statistical Relations between the Photometric Colours of Common Types of Stars in the UBVRi, JHK, and uvby Systems." South African Astronomical Observatory Circular 15: 1.
- Bessell, M.S 2005 Standard Photometric Systems. Annual Review of Astronomy & Astrophysics 43, 293-336
- Pickles A. and Depagne E. 2010. All-Sky Spectrally Matched UBVRi-ZY and u'g'r'i'z' Magnitudes for Stars in the Tycho2 Catalog. PASP 122, pp.1437-1464. <http://cdsads.u-strasbg.fr/abs/2010PASP.122.1437P>
- http://vizier.u-strasbg.fr/viz-bin/VizieR-3?-source=VI/135/table15&-out.max=50&-out.form=HTML%20Table&-out.add=_r&-out.add=_RAJ,_DEJ&-sort=_r&-oc.form=sexa

An update on DSLR observations

This new project was introduced in the April 2014 VSS Newsletter and officially launched during the Third Variable Stars South Symposium in Whakatane in June. The target variables are southern hemisphere eclipsing binaries of Beta Lyrae and W Ursae Majoris types. Briefly the aims are:

- Updating light elements;
- Obtaining transformed light curves in two or more bandpasses;
- Investigating historical period changes (O-C analysis);
- Carrying out astrophysical modelling.

Currently I have complete (or near complete) BVR light curves for V0535 Arae, RR Centauri, CN Hydri, GG Lupi, AE Phoenicis and μ 1 Scorpii. These were recorded with several Canon DSLR camera models and 180mm or 200mm telephoto lenses. The phased light curves are shown on the following page; each is shown with a vertical scale of 1.5 magnitudes to allow direct comparison. Each dot represents the average of three individual measurements and error bars are ± 1 standard deviation of the three measurements.

Check star V light curves are shown at the bottom of each plot, vertically displaced by arbitrary amounts. As expected, none show evidence of variability except the GG Lupi Check star (HD 136334). This star is not listed as a variable in SIMBAD but it appears to vary by ~ 0.03 magnitude in V. Further observations are required to confirm variability and determine type.

V0535 Arae and RR Centauri have flat bottomed secondary eclipses indicating total eclipses whereas the other targets are only partially eclipsing.

GG Lupi's light curve is clearly different from the others due to its components being relatively further apart. The secondary eclipse is displaced from phase 0.5 indicating an elliptical orbit.

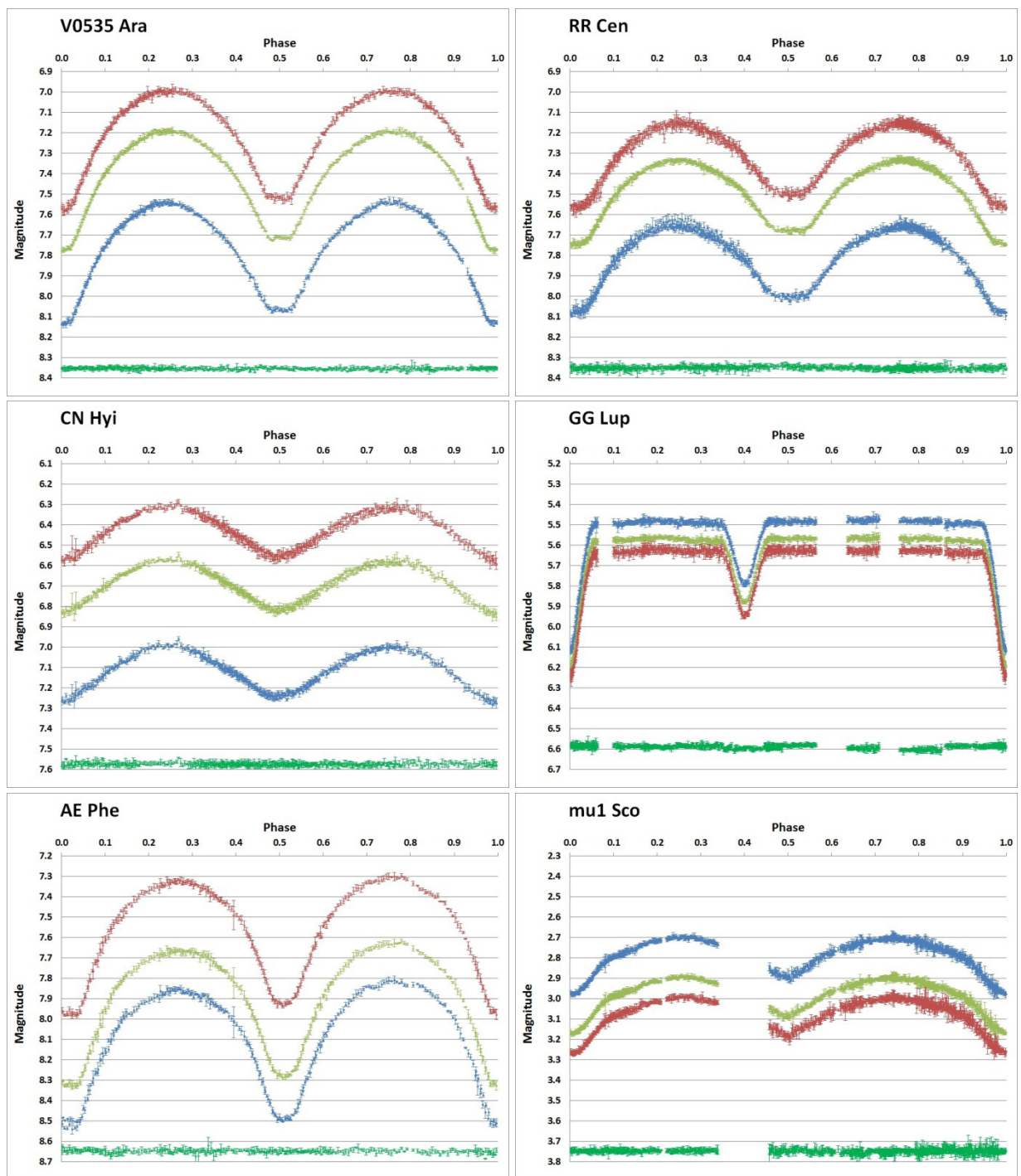
For AE Phoenicis the B curve has been displaced by 0.5 magnitudes brighter so that it could be shown at the same vertical scale. The secondary eclipse is distinctly non-symmetric, primary eclipse depth varied from eclipse to eclipse and the maxima following secondary eclipses were significantly brighter than the maxima following primary eclipses (O'Connell Effect). All of these features can be explained by the presence of large, rapidly evolving star spots.

Roger Butland, Ed Budding and I are preparing a paper on GG Lupi and μ 1 Scorpii based on the DSLR photometry and high resolution spectroscopy using the 1m McLellan telescope and HERCULES spectrometer at Mt John Observatory.

Further observations next season will allow accurate determination of light elements. In the meantime published Times of Minimum will be collated from the literature and, together with our own, will be used to construct O-C diagrams for period change analysis.

Light curve modelling has not yet been attempted. I purchased Binary Maker 3 but haven't found time to start learning the process. Other modelling software will be tried as well to check consistency of results. We would love to hear from anyone willing to help with light curve analysis. Past experience would be a great benefit but not absolutely necessary.

Apart from Neil Butterworth (AE Phoenicis) I am not aware of anyone else observing any of the targets listed on the project webpages (<http://www.variablestarssouth.org/projects/projects/eb-and-ew-binaries-project#dslr-targets-list>) but would like to hear from you if you are.



The Orion Project - for serious amateur astronomy – *Carl Knight*

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Introduction

Orion straddles the Celestial Equator making it an excellent target from both Northern and Southern Hemispheres. The Orion Project had its genesis at the May 2012 Society for Astronomical Sciences (SAS) meeting that Jeff Hopkins (Hopkins Phoenix Observatory, Phoenix, Arizona USA) attended:

“I [Jeff Hopkins] had discussions with Dr Edward Guinan (Villanova University) and Dr John Martin (University of Illinois) about spectroscopy of Betelgeuse. Later when talking with Dr Matthew Templeton (AAVSO) he too indicated an interest in observations of Betelgeuse. Because of this interest I set about to devise a plan for an observing project for Betelgeuse. Shortly thereafter I found that several other bright stars in Orion were also lacking observations. At that time the project was expanded and called the Orion Project.” (Hopkins 2014)

The project is attempting to provide scientifically useful photometry and spectroscopy of the target stars. The targets are all bright, and ironically, because of their brightness, do not receive much attention from professional astronomers.

The project observers span the United States, Asia, United Kingdom, Europe and New Zealand. Project membership is open. Details are provided at the end of this article.

Observer equipment is varied. Spectroscopic equipment ranges from low resolution Star Analyzer gratings (SA100 - 100 line/mm (l/mm)) to higher resolution Lhires III equipment with 2400, 1200, 600 and 300 line/mm gratings and the Alpy 600 (600l/mm grating) for spectroscopy. Photometry equipment covers UBVRI and J&H near IR bands as well. The brightness of the targets suits the Optec PIN diode photometers rather well as the PIN diode instruments need either large aperture or bright targets. Members are using the Optec SSP-3 (BVRI - primarily BV); the SSP-4 (JH near IR); and CCDs (BVRI). The telescopes of the project members are a variety of types and apertures from 8” to 18”.

For my part, I use an Optec PIN diode SSP-4 J&H near IR photometer on my Meade 12” SCT and my focus is Betelgeuse. In the coming 2014-2015 Orion observing season I hope to add spectroscopy using a borrowed SA100 diffraction grating.

The target stars... and why they might be interesting

All of the bright stars in the project pose saturation issues for CCD photometry. This brightness is less of an issue for PIN diode photometers such as the Optec SSP-3 (UBVRI) or the Optec SSP-4 (J&H near IR) as long as integration time and gain are set to ensure saturation of the sensor does not result. The brightness of the stars also means that good spectra with higher resolution gratings can be obtained.

Betelgeuse

Betelgeuse is a good candidate for a supernova. It is a highly evolved red supergiant nearing the end of its life. Betelgeuse pulsates and tips the scales at around 15 solar masses. Estimates of its diameter are poorly constrained as it depends upon what wavelength you look at as to how large an angle it subtends on the sky (cf Kaler 2014a). Recent estimates using near IR K and L bands which seem least affected by Betelgeuse’s extended atmosphere, when combined with the distance obtained from the parallax measured by the Hipparcos Satellite, yield a stellar diameter of approximately 3.4AU or 730 solar diameters (Kervella et al 2011).

Hopkins (2014) notes “Betelgeuse has shrunk around 15% in size over the past 15 years [cf Townes et al 2009] yet has not significantly changed its brightness.” And rightly concludes that “It warrants continual observations. Something is happening fairly quickly.”

In V Betelgeuse varies from magnitude 0.3 to 1.2 with a period of between 150 to 300 days, however it is much much brighter in near IR bands being around magnitude -4.0 in H for example (Hopkins 2014).

Rigel

Photometrically, Rigel is the opposite of Betelgeuse being brightest in short wavelengths. Its U magnitude is -0.81 whilst its H is 0.22 or about one full magnitude dimmer. In V, Rigel varies from 0.05 to 0.18 with a period of 1.2 to 74 days as the star pulsates (Hopkins 2014).

Mintaka

Mintaka is a multiple star system. The primary is actually two stars: a class B and a smaller and hotter class O. These two stars orbit one another every 5.73 days. The secondary is a magnitude 7 star separated from the primary by almost an arc minute (Kaler 2014b). The components of the primary present problems for photometry but not for spectroscopy (Hopkins 2014).

Photometrically, the primary is magnitude 2.23 in V, 2.09 in U and H at 0.98 (Hopkins 2014).

Alnilam

Alnilam is a large blue supergiant of spectral class B (Kaler 2014c). Kaler (2014c) notes, that whilst Alnilam does not appear to be the brightest of the Orion belt stars (the other two being Mintaka and Alnitak) it is more distant at around 1340ly compared to the others at around 870ly a piece. Alnilam radiates at 375,000 L_{solar} from its 25,000K surface.

Correspondingly its U magnitude is 0.47 and its H is 2.41 - significantly less (Hopkins 2014).

Enigmatically, high resolution spectroscopy shows that Alnilam appears to exhibit a distinct changes in its hydrogen alpha (H α) line morphology every few days. This is covered in more detail in the spectroscopy section.

Alnitak

Alnitak is associated with nearby Horsehead and Flame nebulae. It is a large blue, spectral class O Hsupergiant star. Like Alnilam it exhibits changes in its H α line morphology in its spectrum and is much brighter in U (0.77) than longer wavelengths such as H (2.28) (Hopkins 2014). It has a spectral class B companion with an orbital period of thousands of years (Kaler 2014d). Kaler (2014d) speculates that in all likelihood it has ceased hydrogen fusion in its core after only some 6 million years compared to the Sun's 4.5 billion years as a main sequence star to date.

2013 - 2014 season results.

Betelgeuse

Observers used the Optec SSP-4 J&H PIN diode photometer. This instrument allows the PIN diode to be cooled to 40° below ambient. The SSP-4 has a flip mirror and circular reticle to allow precise centering of the star on the diode. The scope mount must be able to track well enough to keep the target star centered (Hopkins 2014).

Bellatrix was used as the comparison star in the majority of cases (Hopkins 2014).

With the exception of Gerald Persha (PGD, see Figure 1), results reflect observers (Al Stiewing - ASO & myself - KCD) getting used to their equipment, making good observations, and/or not yet having sufficient calibration data. My last measurements were made of a setting Betelgeuse in May (KCD far right of Figure 1). There appears to be a slightly too great J-H (1.221) and this probably requires better extinction calibration data than I presently have to correct or confirm the reduction.

J&H band near IR

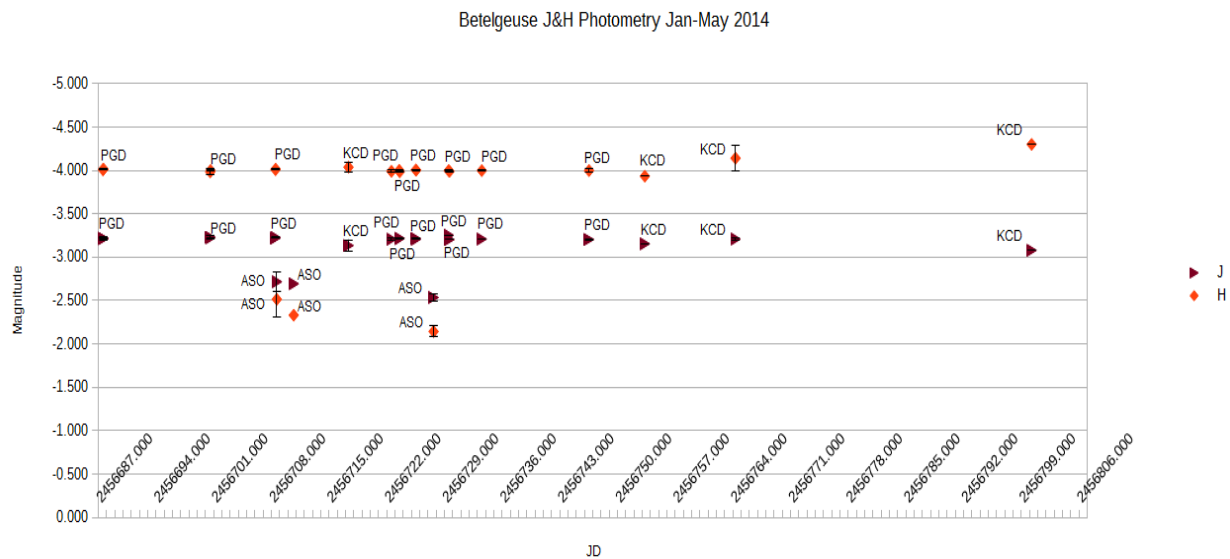


Figure 1. Orion Project Betelgeuse JH band photometry¹.

BVRI

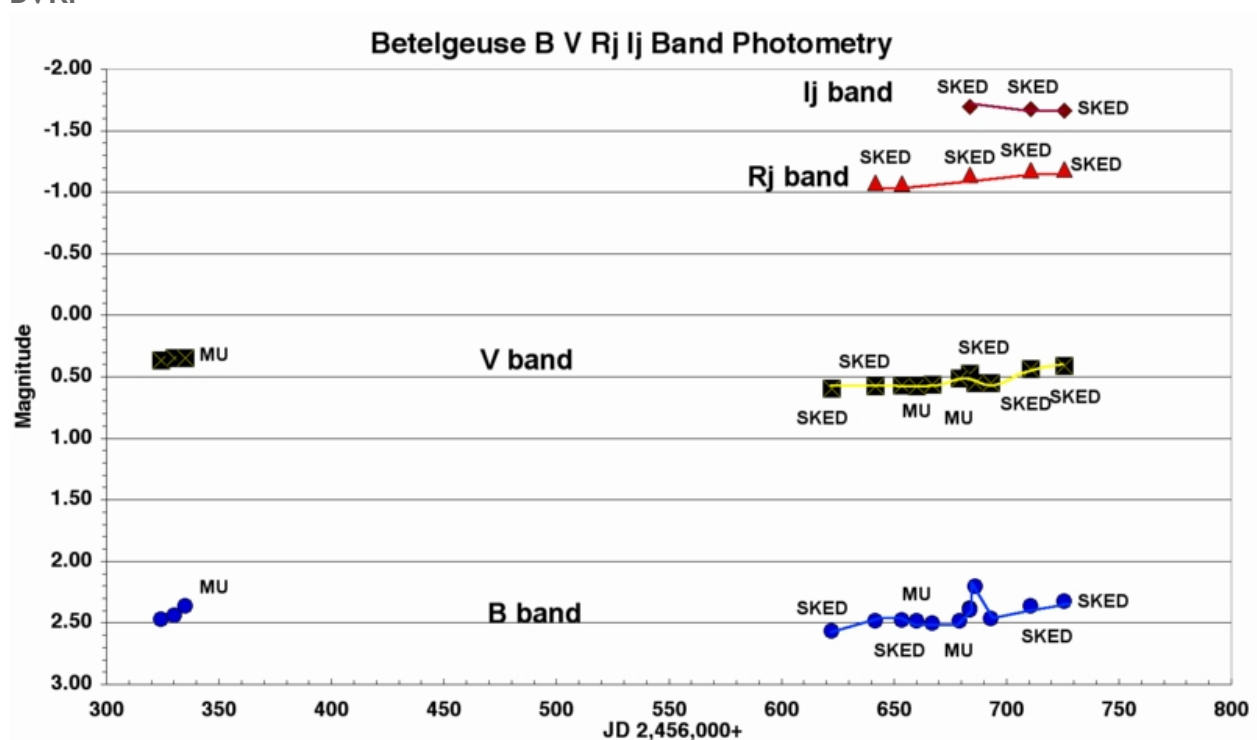


Figure 2. Orion Project Betelgeuse BVRI Band Photometry retrieved from <http://www.hposoft.com/Orion/Betelgeuse/Photometry%20Data/SSP3.html> 11 October 2014

The observations of Betelgeuse at these wavelengths were done using the Optec SSP-3 photometer. Most observations are just B and V. Bellatrix and Meissa were used as comparison stars. (Hopkins 2014)

¹ Figure 1 includes data not yet available on the Orion Project website. Following advice from Stan Walker I obtained more transformation calibration data using brighter IR sources than those I had and the result is a significant improvement in accuracy in the reduced magnitudes which I've include here for the first time.

From experience Betelgeuse poses real problems for CCD and DSLR photometry (the latter is not suitable for the Orion Project). Experimenting with DSLR photometry, it took me quite some effort to find a wide enough field, with enough bright stars, and the right amount of defocus to avoid saturation on Betelgeuse. Difficult enough for me to use DSLR photometry on dimmer, easier targets!

Rigel

J&H band near IR

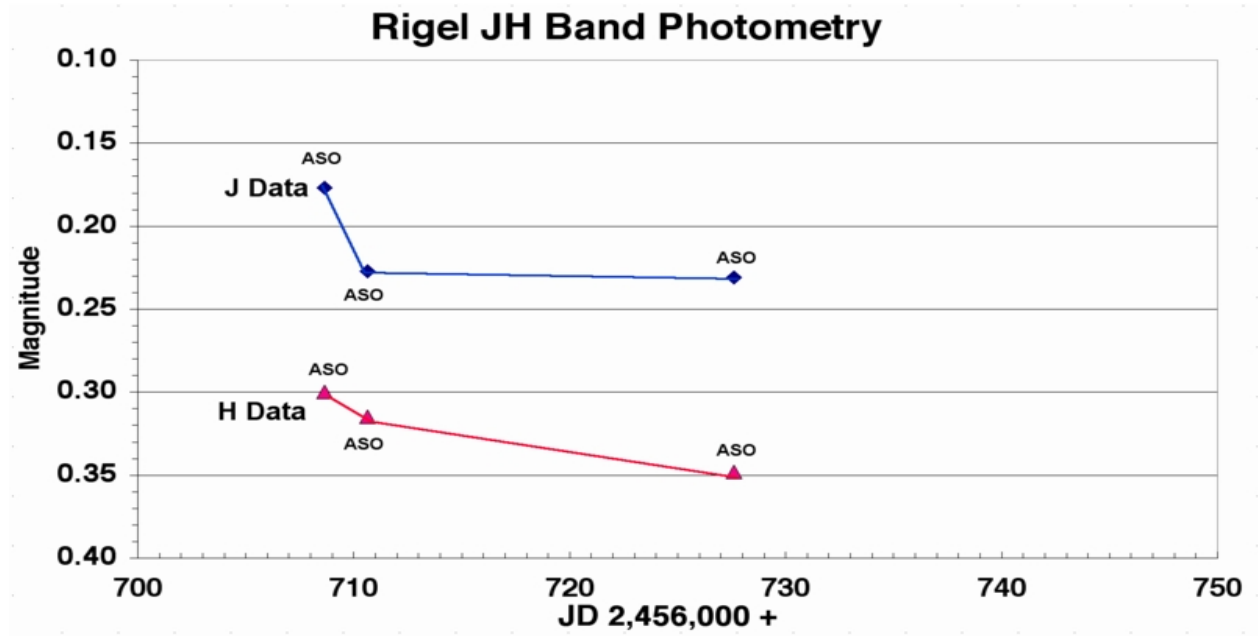


Figure 3: Orion Project Rigel JH Photometry retrieved from <http://www.hposoft.com/Orion/Rigel/Photometry%20Data/SSP-4.html> 11 October 2014

The Optec SSP-4 was used for J&H. Bellatrix was used as the comparison star. (Hopkins 2014)

BVRI

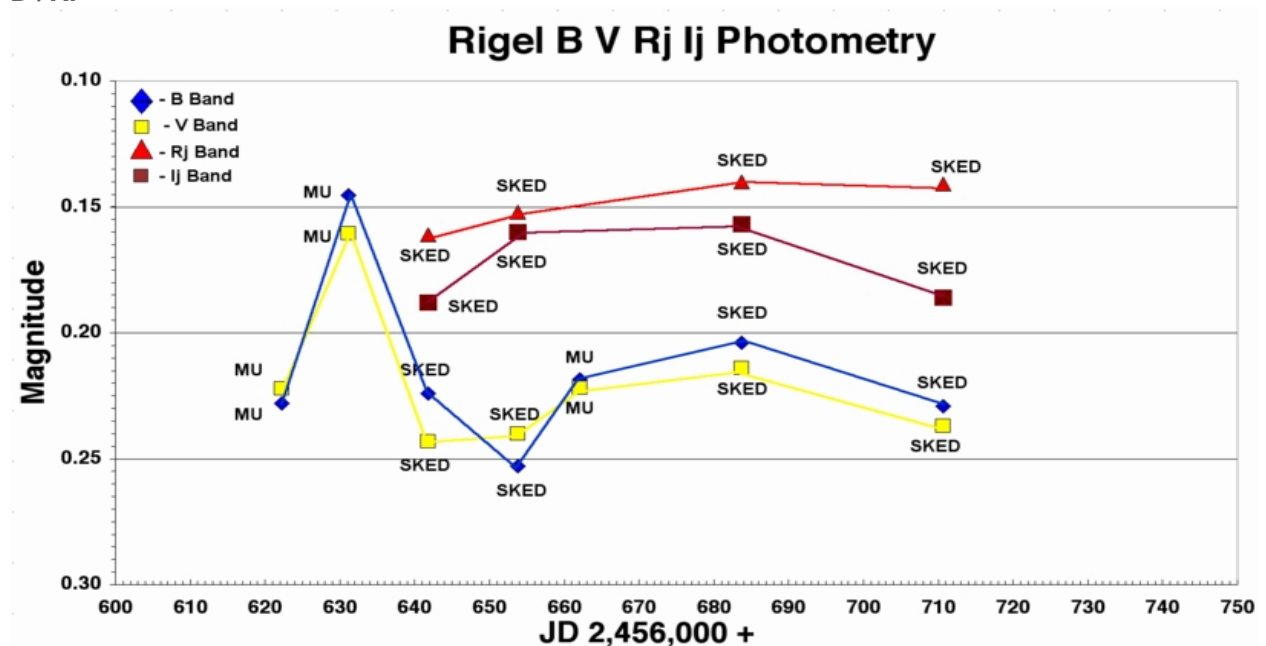


Figure 4. Orion Project Rigel BVRI Photometry retrieved from <http://www.hposoft.com/Orion/Rigel/Photometry%20Data/SSP-3.html> 11 October 2014

BVRI was again done using the Optec SSP-3 photometer. As with Betelgeuse BVRI, Bellatrix and Meissa were used as the comparison stars. (Hopkins 2014)

Mintaka

J&H band near IR

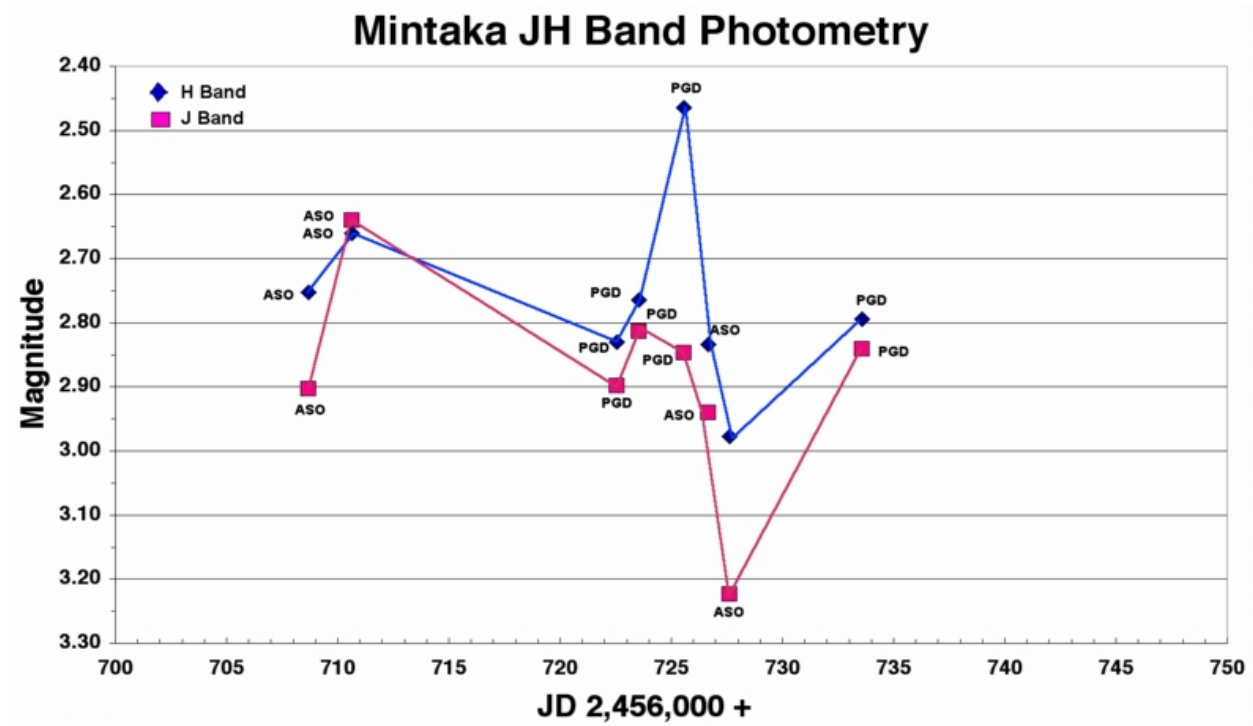


Figure 5. Orion Project Mintak JH Band Photometry retrieved from <http://www.hposoft.com/Orion/Mintaka/Photometry%20Data/SSP-4.html> 11 October 2014.

Gerald Persha and Al Steiwing provided J&H band photometry of Mintaka using Bellatrix as the comparison star.

BVRI

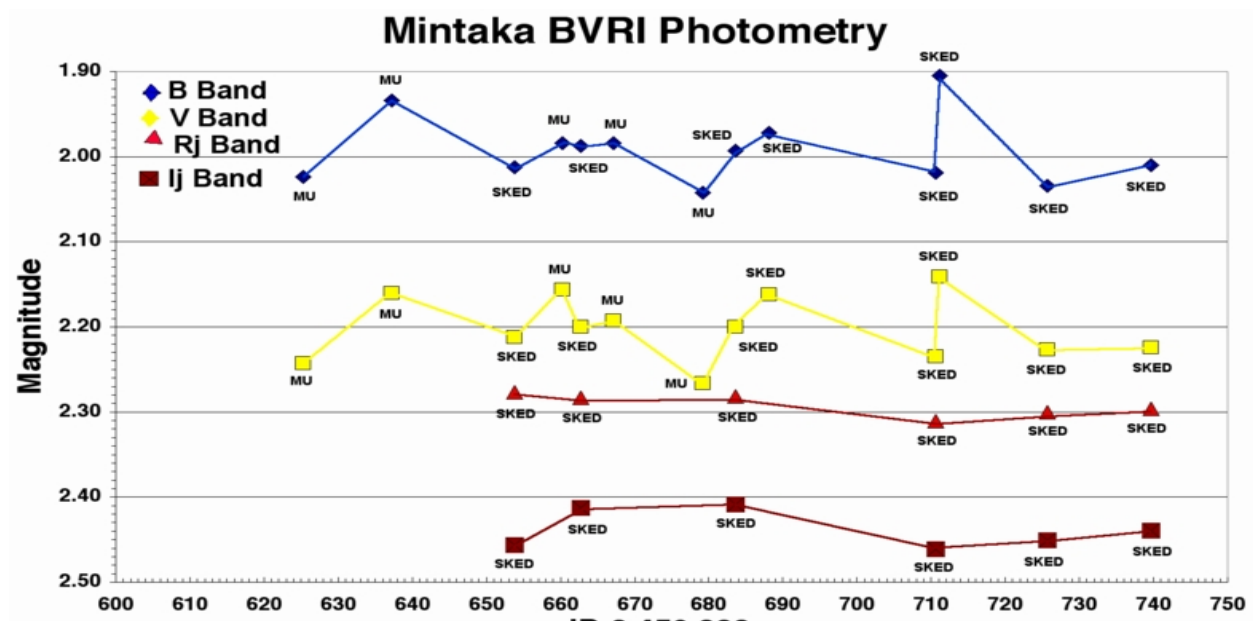


Figure 6. BVRI photometry from <http://www.hposoft.com/Orion/Mintaka/Photometry%20Data/SSP-3.html> 11 October 2014

SSP-3 photometers were used by the observers. K. Yugindro Singh (MU) used Meissa as the comparison, Ken Sikes (SKED) used Bellatrix. Note the R and I band curves. These do not show as much variation as the B and V bands, but lacking R and I for every B and V it is premature to draw any conclusions about any lack of variability in R and I.

Alnilam

J&H band near IR

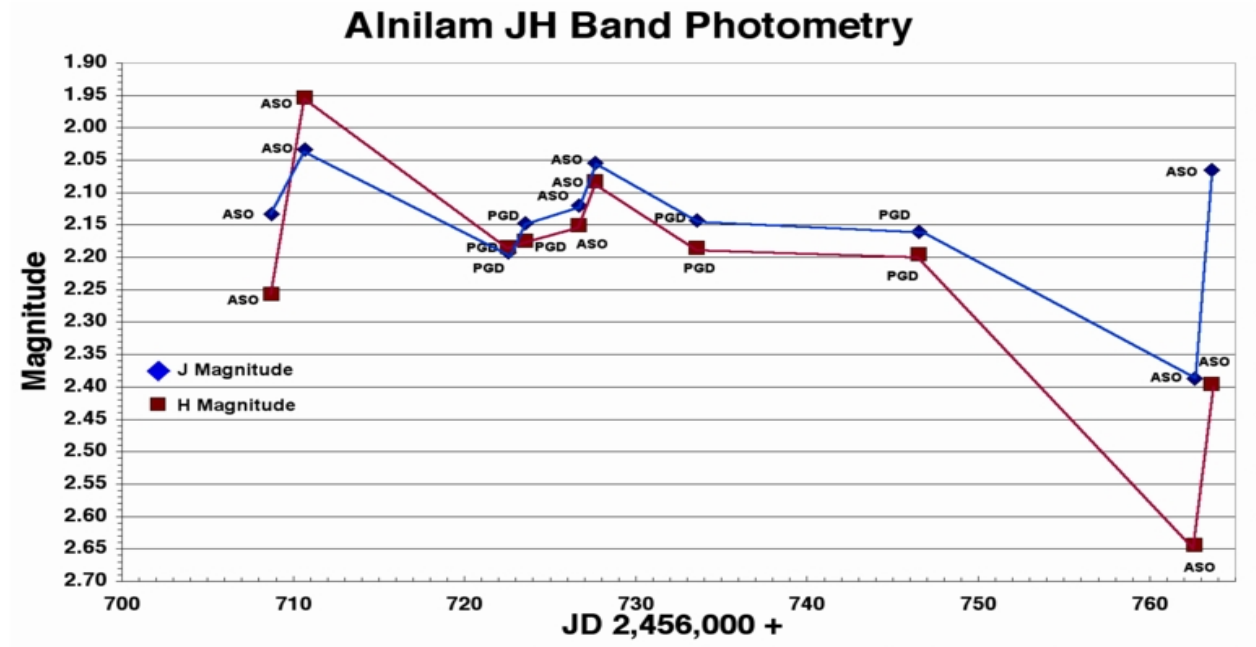


Figure 7. JH Band photometry from <http://www.hposoft.com/Orion/Alnilam/Photometry%20Data/SSP-4.html> 13 October 2014

Bellatrix was again used as the comparison star for Alnilam. BVRI

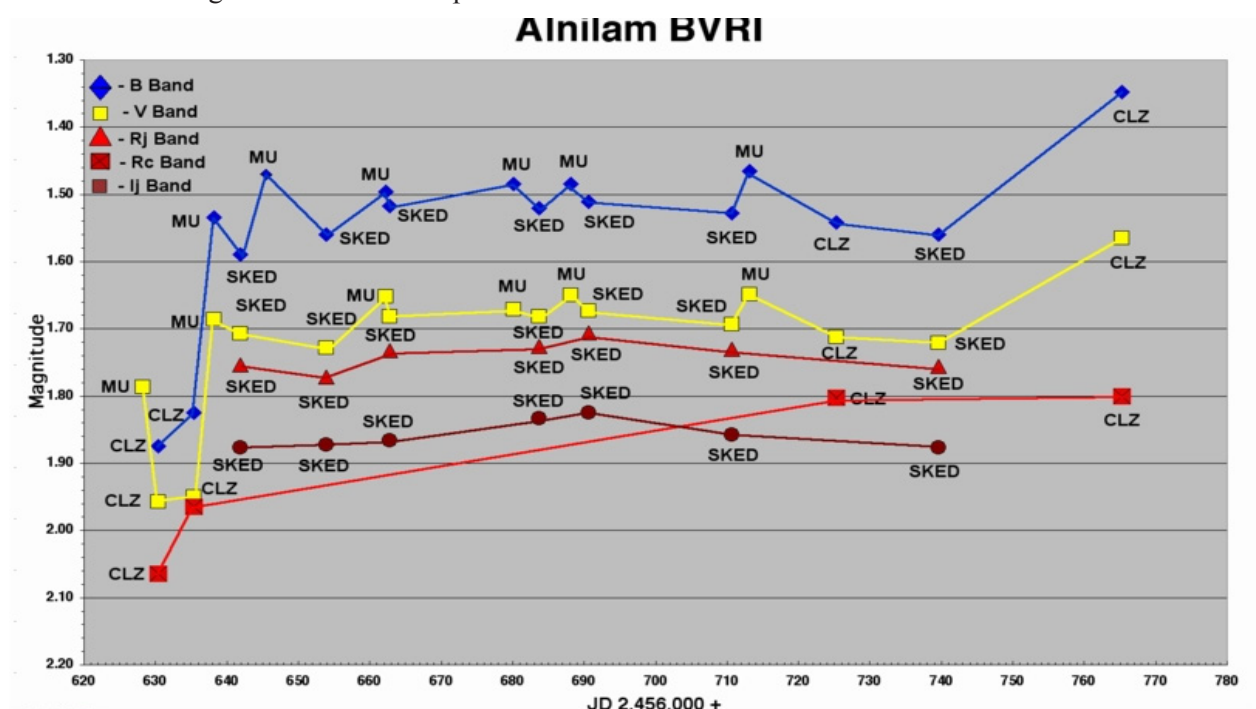


Figure 8. BVRI Photometry from <http://www.hposoft.com/Orion/Alnilam/Photometry%20Data/SSP-3.html> 13 October 2014

K Yugindro Singh (MU) used Meissa as the comparison, Ken Sikes (SKED) used Bellatrix, and both used the Optec SSP-3 whilst Laurent Corp (CLZ) used Alnitak as the comparison star and a CCD camera on a 50mm lens.

Alnitak.

J&H band near IR and BVRI have not been obtained for Alnitak as it appears to be unvarying.

Spectroscopy

The project leader, Jeff Hopkins processed the spectra for the project using RSpec (see <http://www.rspec-astro.com>). Steve Spears (Westlake, Ohio USA) Jim Tubbs (Twin Falls, Idaho USA), John Menke (Barnsville, Maryland USA) and Steve Guthbert (York, UK) have also provided spectra for the project. (Hopkins 2014)

Spectra were taken of all the project stars, however, the *pièce de résistance* spectroscopically from the author's perspective was finding the H α line morphology changes identified by Thompson and Morrison (Thompson, G B, & Morrison, N D 2013) and others in the spectra of Alnilam by Orion Project leader Jeff Hopkins. He obtained high resolution spectra using a Lhires III spectrograph with 2400l/mm grating on his observatory 12" SCT (Hopkins 2014). This temporal H α line evolution phenomena is examined in more detail in Thompson, G B, & Morrison, N D (2013). It is clearly visible in Figure 9 (H α absorption) and Figure 10 (H α emission).

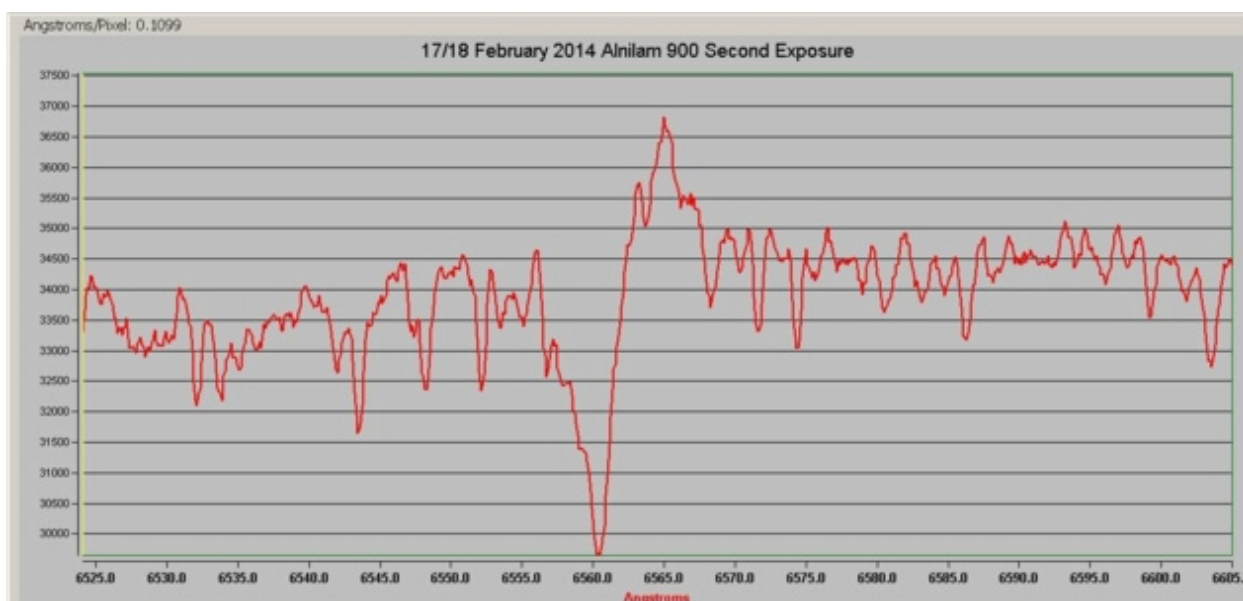


Figure 9. Orion Project Alnilam H α absorption (prominent dip) line 17/18 February retrieved from <http://www.hposoft.com/Orion/Alnilam/Showcases/HPO%20Lhires%20Showcase.html> 14 October 2014

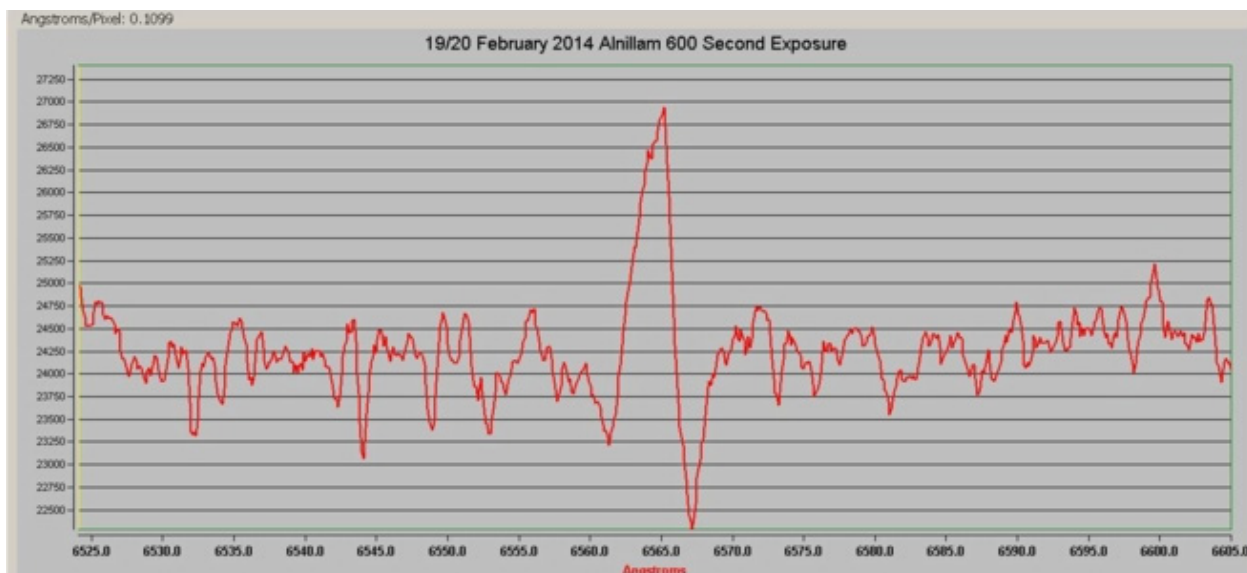


Figure 10. Orion Project Alnilam H α emission (prominent peak) line 19/20 February retrieved from <http://www.hposoft.com/Orion/Alnilam/Showcases/HPO%20Lhires%20Showcase.html> 14 October 2014

I hope to pique the interest of the spectroscopists in Variable Stars South - examining this phenomena is a worthy summer project - whether under the umbrella of the Orion Project or as a separate effort - and arguably should receive longer term attention to determine any (or not) evolution or change in periodicity of the phenomena.

Thompson, G B, & Morrison, N D (2013) postulate that beginning at the photosphere there may be a region producing an enhanced or denser wind and as the star rotates this creates a spiral density gradient in the wind itself as the wind propagates outwards. They conclude that this “strong and highly variable stellar wind” causes the H α line to display several morphologies “including P Cygni, inverse-P Cygni, double absorption, and pure emission”.

Joining the project

Project membership is open to any suitably equipped observer. The only caveat is stated thus on the project website:

“This is not a Citizen Science type project. Observers must be willing to use the proper equipment and develop the necessary skills to produce quality data. This project presents an opportunity to both learn photometry and/or spectroscopy or sharpen your skills while contributing valuable data. This is discovery science and an on-going project.”

Don’t be put off! From my correspondence with other VSS members there is clearly a good fit as we all strive to provide good quality data and improve our technique. I have had to come to grips with the SSP-4, some quirks of the particular instrument I have, and to put it quite simply - practice. Having obtained more calibration data for the SSP-4 I can see my later results are better than my early results. I have benefitted from the advice of other project members tremendously.

To join the project and for more information, please send an email to Jeff Hopkins at phxjeff@hposoft.com

The project website is found at <http://www.hposoft.com/Orion/Orion.html>

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Publication watch – CT Lacertae

Alan Baldwin has noted the following recently published paper of interest to those studying long-period variables.

Templeton, M. R., et al. (2014). “*CT Lacertae: Another Long-period Carbon Star with Long-Timescale Variations?*” Journal of the American Association of Variable Star Observers (JAAVSO): 282.

CT Lacertae is a very Long Period, 500 days plus, Carbon star with a double maximum feature. Attention has been drawn to this star because, in the last 1000 days or so, it has been under-going a long time-scale dimming. Although this is a northern variable (Dec 48° 21' north), the analysis of 45 years of data of this star is interesting.

The paper, by Matthew Templeton and others, presents a Fourier spectrum analysis of 40 years data produced an estimate of the period (558.2 days), first harmonic (279.1 days) and a frequency a little away from this (286.3 days).

The paper also discusses the recent dimming in brightness. The dimming appears to be associated with a reduction in variability. The most likely explanation of the dimming is thought to be due to the carbon dust. Only time will tell whether the star will return to its historical mean magnitude or undergo some more dramatic change and hence on-going visual observation is recommended.

Thanks to Stan Walker for drawing this paper to our attention. The paper is available on the AAVSO web-site: <http://www.aavso.org/sites/default/files/jaavso/ej282.pdf>

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About

Variable Stars South is an international association of astronomers, mainly amateur, interested in researching the rich and under-explored myriad of southern variable stars.

Renamed from the Variable Star Section of the Royal Astronomical Society of New Zealand, it was founded in 1927 by the late Dr Frank Bateson, OBE, and became the recognised centre for Southern Hemisphere variable star research.

VSS covers many areas and techniques of variable star research, organised into “Projects” such as Beginners’ Visual Observations and Dual-Maxima Miras. The goal of each project is to obtain scientifically useful data and results. These may be published in recognised journals, or supplied to international specialist data collection organisations.

VSS is entirely an internet based organisation, working through our website <http://www.VariableStars-South.org> and its e-group <http://groups.google.com/group/vss-members>. It also encourages members to work in with major international organisations such as the British Astronomical Association, the Center for Backyard Astrophysics and the American Association for Variable Star Observers.

To find out more, please visit our website, where, incidentally, you will find PDF copies of all our newsletters. Our website has a great deal of information for VSS members, and for anyone interested in southern hemisphere variable star research. All VSS project information and data is kept there too.

Who’s who

Director Dr Tom Richards, FRAS.

Treasurer/Membership Bob Evans

Newsletter Editor Phil Evans

Webmaster David O’Driscoll

Visit our website to see a list of our area advisers, and to find out about our projects and how to contact their leaders

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New members are welcome. There is no annual subscription but donations would be gratefully received. Find out how to join by visiting the VSS website. There you will find out how to join by post, email, or directly online. If you join by email or online and wish to make a donation you will get a link to pay by PayPal’s secure online payment system, from your credit card or bank account.

After you’ve joined and received your membership certificate, you will be signed up to the VSS-members e-group (see above), and you will also receive a password to access the members’ areas of our website.

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These are welcomed and should be sent to the Editor. I’d prefer Microsoft Word (or compatible) files with graphics sent separately. Don’t use elaborate formatting or fancy fonts and please do not send your contribution as a fully formatted PDF file.

Publication dates are January, April, July and October, nominally on the twentieth day of these months and the copy deadline is the thirteenth of the month though earlier would always be appreciated.

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