



Newsletter 2011/1

2011 February

www.variablestarssouth.org

From the Director

Tom Richards

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Another year gone, and a new one...

Welcome to the third year of VSS in its new incarnation. If our first year was mainly a matter of getting the outfit running and setting up membership, 2010 was a year of consolidation. I've just written the annual report for 2010 for our parent body the RASNZ, who will publish it in *Southern Stars*.

2010 was significant in consolidating our work around the projects and activities that were working and well supported, and in developing a proper professional website under David O'Driscoll. Membership increased slightly to 54 at year's end, 27 from Australia, 23 from NZ, and one each from Cook Islands, North Cyprus, UK and USA. I was greatly and willingly assisted in running VSS by the following, to whom my grateful thanks:

Bob Evans – finance

David O'Driscoll – website and database manager

Alan Plummer – Visual Research adviser, who has also started a variables column in *Australian Sky and Telescope*

Stan Walker – Newsletter editor, pulsating variables adviser

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The projects on our books at year's end are:

Beginner's Project (leader: Alan Plummer)

R/Eta Carinae Project (Alan)

Dual Maxima Miras (Stan Walker)

Bright Cepheids (Stan)

QZ Carinae (Stan)

Cataclysmic Variables at Minimum (Stan)

Equatorial Eclipsing Binaries (Tom Richards)

SPADES (Search for Planets around Detached Eclipsing Stars) (Simon O'Toole & Tom)

Our financial situation stayed roughly constant, with NZ\$3751.36 in the bank at year's end. Income was entirely from subscription (\$20 pa) and expenditure entirely on Internet costs and banking fees. In the new year Internet fees will be substantially reduced since we have obtained free website hosting through Flexi-hostings.

In 2011 I hope above all we can look forward to better observing weather. Further development of the website, especially the online database, can be expected. I will be looking into establishing an online VSS refereed journal of some sort, and would welcome suggestions – and offers to be editor! I would like to see some new project proposals from inside and outside VSS, and also to the development of specialist areas such as DSLR photometry. All offers are welcome – contact me! Remember, you do not need to be a VSS member to set up a project, or indeed to partake in one (though it's always appreciated).

Membership Renewals

Membership renewals deadline is April 30th. Several methods of payment are available, online and snail. See our website at **About VSS > Join/renew** for all details. Note that if you join VSS in March or April this year you will not have to renew on April 30th – your membership remains valid until April 30th 2012. The annual membership fee is NZ\$20.00, with no joining fee.

Research & Equipment Grants Scheme

Regrettably there were no applications for this last year. There will be another call for applications in the May *Newsletter*.

Variable Stars Symposium, Easter 2012



We are beginning to plan a one-day symposium in conjunction with the 25th NACAA Conference in Brisbane over Easter 2012, April 6-9, hosted by the Astronomical Association of Queensland. Our symposium will be on the Monday, in parallel with the Trans-Tasman Symposium on Occultations. More details later in the year. Meantime, give a thought to how you could contribute to make this an outstanding first symposium for the VSS. The NACAA website is www.nacaa.org.au.



Lecture theatre for NACAA 2012 and the Variable Star Symposium

Newsletter Editor

It is with great regret and sadness that I have accepted Stan Walker's resignation as editor of this *Newsletter*. Stan has created a most important and interesting publication, thoroughly imbued with his great knowledge of southern variables. Stan tells me that whilst he has enjoyed putting the Newsletter together, he considers his time would be better employed making observations.

Accordingly, I must now find another editor. It is plainly very important that the *Newsletter* continue as a centrepiece of VSS. The main requirement is to solicit articles and put them together in Microsoft Word or similar, and make a PDF of them. If you are willing to take on this task, please email me directly at tom@prettyhill.org.

A personal note

I have recently acquired both sciatica and shingles, two extremely painful maladies that are rather sapping my energies. Hopefully I will be over both of them in a month or two, but in the meanwhile I may not be as assiduous in my duties as Director as I should be.

VSS Website Update

Thanks to everybody who has supported the roll out of the new website over the last couple of months, especially Tom Richards, whose support and faith have been greatly appreciated. Like all technology projects, it has sometimes had it's little hiccups, but on the whole things appear to have gone very smoothly.

User Access

There are three normal levels of access to the site: public, web and member.

Public access is available to anybody who goes to the site, and generally speaking covers almost everything on the site from a read only point of view. That way potential new members will be able to see what we are about, garner useful information for their own use, and hopefully decide we are worth joining.

The next level up is the web access level. These are people who have decided they want to get more involved, and have registered for a user ID and password. This will allow them to participate in our online discussion forums.

The final level is VSS membership. All members were issued with a user ID and password when the site was set up: if you don't have yours, feel free to contact me at webmaster@variablestarssouth.org. Note that most allocated IDs are in the form "givenname.familyname", eg "david.odriscoll". Members can submit articles to the site, which are then edited (standard practice) before being published to the site. I would love to see member articles, and if we have the interest, I can create new menu categories to support this.

Current Activities

I am currently bringing VSS into the social network world, with a Twitter feed of new articles planned as soon as I can sort out some technical issues! There are also major activities going on under the SPADES project, with the old manually prepared articles being replaced by data published directly from our database that is being built. Stay tuned for updates on this in the coming days/weeks.

Ideas

Ideas from the site users are always welcome. If you think of something that would be useful, or see some good ideas on another site, let me know and I'll see if it can be added to the site. The VSS website is there to serve the needs of the VSS community, so please tell me what you want.

Clear skies

David O'Driscoll

VSS Webmaster and Database Manager

THOUGHTS FROM THE EDITOR

As usual at this time of year astronomy is not exactly flourishing. But there are still a few people who can stay awake until it's properly dark about 10pm. There seems to have been much cloud and enough rain to keep the lawns growing—Aline mentions that Wellington endured the tail ends of three tropical cyclones in a week—whilst here at Wharemaru we had 308mm in that week—thankfully not the winds that came with Yasi. I see that Neil Butterworth is still doing some astronomy in spite of the floods and wind in Queensland.

We all grow old and recently we heard the sad news of the death of Arthur Page—an obituary by Greg Bond appears on page 26—and a rather bad stroke which has affected Tom Cragg. Neither were members of the VSS at this time but in the past have contributed greatly to the old RASNZ VSS and Arthur to the RASNZ Photometry Section.

I first met Arthur in Sydney at the 1973 IAU General Assembly, from memory on one of the double decker bus tours, and we collaborated on many occasions over the years. Initially in the flare star projects along with people like Bruce Slee and his team and we were for a time members of the working group on flare stars—in Sydney we met Sir Bernard Lovell and concluded that Australia was well ahead of the UK at that time in this field. Some time later, in 1978, Nicholas Vogt coordinated one of the earliest international collaborations involving amateurs and professionals in Australia, New Zealand, South America and South Africa. Arthur was one of the most enthusiastic participants. The Auckland PEP group knew Arthur well—we'd meet at the odd IAU Regional Meetings, as well as several of the pro-am PEP Conferences. Indeed, at Hanmer about 1992, Arthur was insistent that we should hold PEP 5 in Australia, preferably Queensland, and that *'soon, before he became too old to enjoy it'*. This was at Toowoomba about 1996, largely in conjunction with the University of Southern Queensland, and was a memorable event—made so by Arthur's role on the organising committee. Since then we've been in touch on occasion and it's sad that we can no longer look forward to seeing one another at VSS meetings.

Tom Cragg may not be so well known in this part of the world but he has been resident and active at Coonabarabran for a number of decades. Recently he suffered a major stroke which resulted in what to an astronomer must be one of the worst tragedies—a loss of sight. His wife Mary reads emails and other articles to him so a few words to Mary mecragg1@me.com would brighten his days quite a lot. Some time ago Tom was the AAVSO Cepheid section director and we still use some of his measures and refer to some of his papers in the RASNZ VSS Communications.

On the astronomical side I don't have much news but one of our newer members, Mark Blackford, has been doing some very good work with a Canon 450D DSLR camera. I was quite surprised by the effectiveness of this camera and Mark has been using it well as is described in the article on page 12. Resulting from this Glen Schrader has become involved and also has produced a small note about webcam photometry.

I'd hoped for a progress report about BSM South—now called BSM Australia—from Peter Nelson but the following email to him from Arne Henden about 10 February puts it better than any article could do. It will be interesting to watch the results. I think that the mention of Cepheids should relate to Double Maximum Miras—so Aline, Glen and others, don't feel you're suffering unfair competition!

"I've uploaded 1290 targets for the survey (basically the bright variables between +20 and -40), and will be uploading Stan Walker's set of cepheids later tonight. At this point, the scheduler is ready to go, so the first clear night, let it rip. Arne"

So we're on the way. Just have to sort out where the images are stored each night. They have to all go into one folder so that Fling (an ftp file transfer program) can automatically send them to aavso.

With Tom Krajci's help I think this is about licked. Learning the nuances of ACP and Scheduler is a bit of a curve as to get the finer points working you have to get into .vbs scripts. Getting things going formally over the next few nights.

Cheers, Peter

There's also a later item on page 26.

Before receiving this I had written the article on page 10 about the impact of surveys on the variable star scene and this emphasise the point.

With this Newsletter my two year involvement as Newsletter Editor concludes. It's been enjoyable to see what is being done by our members but I can now go back to my first astronomical love—serious research—that is, provided the body is still up to it.

My chief disappointment is that, during this time, we've not had an effective meeting involving most members and our links to the professional community, which we need to give clear purpose to our endeavours, may not have been developed as well as they might. Some of the more experienced amateur observers and researchers have not considered it worth their while to join this group.

I'd hoped that those involved with CCD photometry might follow along the path of the old Photometry Section of the RASNZ, the management of which helped set up Variable Stars South—and also passed over a few dollars in funding—but this has not happened. The Photometry Section, with strong support from Carter Observatory, the University of Canterbury and the Auckland Observatory, sponsored a series of PEP Conferences which were well supported by professional astronomers in the Variable Star field. From small beginnings at Carter Observatory—the 'Banquet' was fish and chips from the local takeaway at lunchtime—PEP moved on to Auckland where Canterbury students made a lasting impression, to Blenheim where we even attracted anti-US demonstrators, then Hanmer and across the Tasman to Toowoomba—a miscue at Auckland, then a final flutter with Conference 2002 in Nelson.

But on the positive side it's clear that there are many good observers and researchers amongst our membership. Many of these have contributed to the success of the Newsletter with interesting and informative articles. And Tom's policy of encouraging photos of contributors has put faces with the names. I've learnt a lot whilst I've been doing this and I'd like to thank everyone who's contributed. Not everyone likes to write, or has the time for it, but Rod Stubbings and Albert Jones have been helpful in sending datasets which it's simple to turn into informative graphs—and usually the accompanying emails have enough to make a good article.

Other observers contribute directly to the AAVSO and there's good material in these for articles. With my interest in Cepheids—as mentioned, this was inspired by Tom Cragg—it was great to see the observations by Neil Butterworth on the International Database, even if the presentation methods are designed for TSP, not colour photometry, and take a while to sort into a usable format.

From looking around in the ID I'm a little puzzled by the low accuracy level of much of the CCD photometry. With all its advantages—simultaneous sky, comparison, variable and check star measures you'd expect an accuracy down in the millimagnitude range. Conventional PEP makes these measures sequentially, yet manages to attain 0.005 without much trouble. So one project is working with some of the observers to see why CCD photometry is not attaining this accuracy level and to ensure that it does.

And whilst everyone seems to be trying to measure stars at the limits—see the article on page 10—there's still a great amount to be learnt about the brighter objects with observational baselines going back a century or more. Mark Blackford has been doing some interesting work, with Glen Schrader and I helping with the data analysis, and there seems almost to be a case that the DSLR camera in good hands can compete favourably with much more expensive cameras.

One thing I've been remiss about is getting material onto the website. I'll now have the time to do this, although David will have to give me some guidance. But there will be much more up to date information on most of the pulsating variable projects.

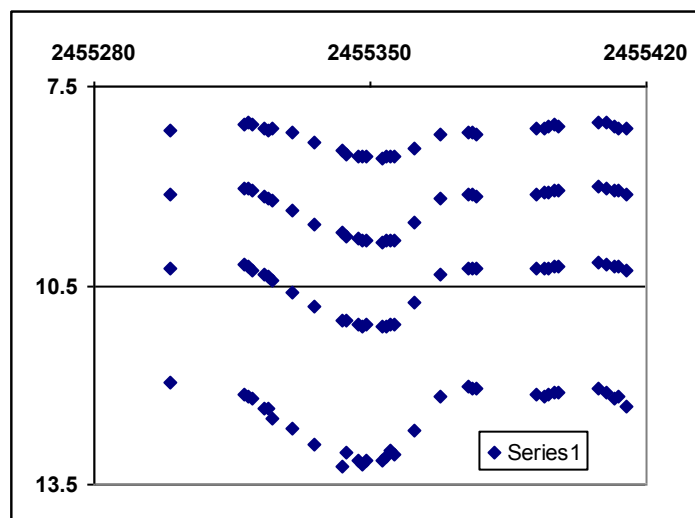
My Newsletter involvement in the future will be, perhaps, an article or two about how the projects I'm involved with are progressing. I'll certainly have a lot more time for this! And maybe time to rescue my long defunct website. Even get out there and do some UBV photometry of bright stars.

Thanks for the help—Stan.

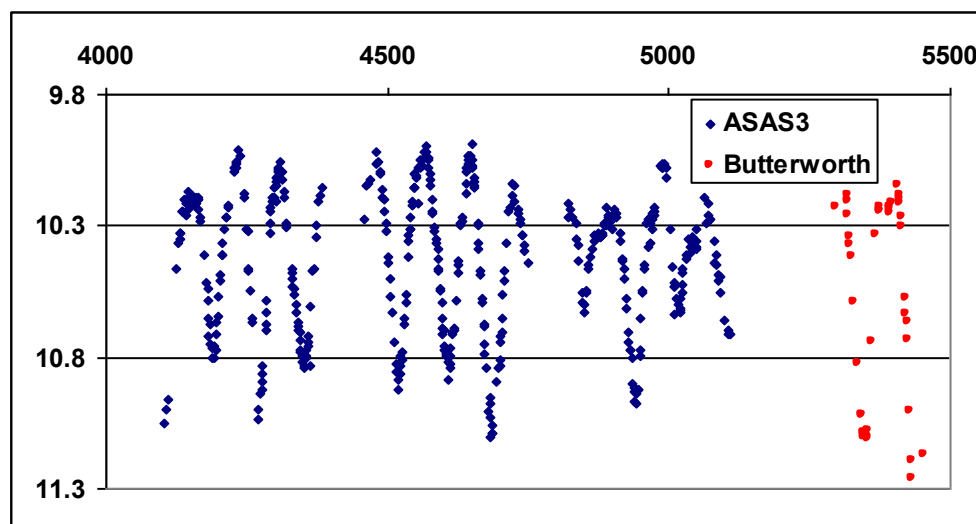
STARS OF THE QUARTER

V641 Centauri *The Measures of Neil Butterworth and ASAS3*

In measuring a variety of southern Cepheids Neil Butterworth found that this star did not have the period of 35.216 days as mention in the GCVS. He drew attention to this on AAVSO Discussion where both Mat-



thew Templeton and Sebastian Otero attempted to categorise it. Neil's measures are shown in the graph to the left. Mention of this in the AAVSO Discussion group led to some suggestions of what it might, in fact, be. Berdnikov and Turner in an IBVS suggested that it might be an SRd variable—giants and supergiants of spectral classes F,G,K—but its B-V colour of ~2.0 conflicts with this. Templeton of AAVSO found a period of 83.09 days, double this as an RV Tauri star. He also suggested an RV Tauri possibility if the SRd idea wasn't proven—whilst Otero likes the RV Tau idea because of several deep minima. He also offers a possibility of something intermediate between CWA—a type II Cepheid—and the RV Tauri stars.

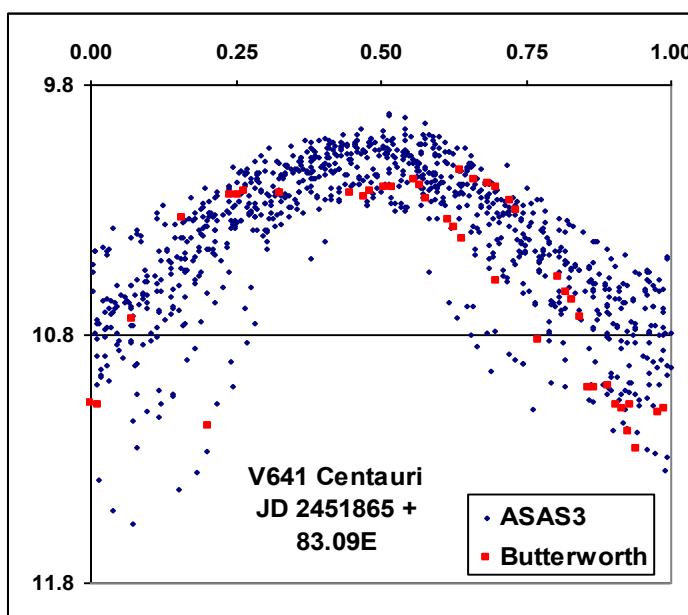


The B-V colour does not fit these ideas well—it's too red and whilst it's hard to tell in the absence of U-B the star does not appear heavily reddened—which changes the B-V colour a bit. In the last thousand or so days before ASAS records cease it looks

very much like an SRa star—reasonably repetitive light curve, low amplitude, late spectral type. This is supported by a period analysis of the data in the above graph which gives a primary period of 83.1 days with a strength of 75.7% and a secondary period of 68.4 days, strength 17.8%, a typical SR period ratio of ~0.82.

Otero uses a possible infra-red excess to support his ideas, but then most cool, pulsating stars have shells of gas and dust giving rise to higher than normal UV and IR radiation.

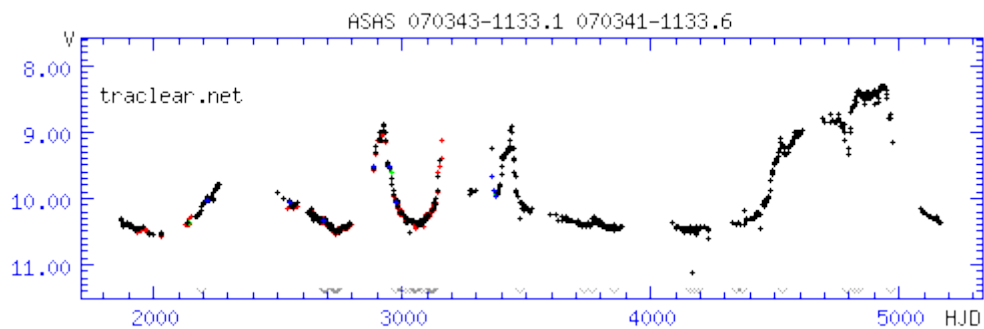
The message is clear. There's a lot yet to be learnt about some of the more well-known stars in the sky without having to look amongst the stars at the limit of your telescope.



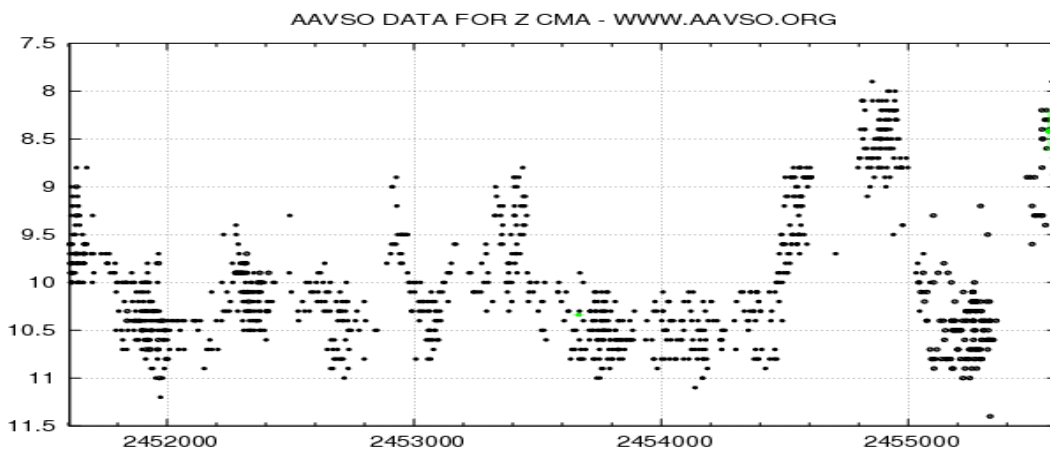
Bright outburst of the pre-main sequence variable Z CMa

On 2011 February 4, John Bortle, Stormville, NY, reported to the AAVSO that the pre-main sequence binary variable Z CMa is in outburst, according to his observation of 2011 February 4.0 UT at visual magnitude 8.5. Observations in the AAVSO International Database confirm this outburst, which may have begun as long ago as April 2010, when it began brightening slightly from visual magnitude 10.7. When Z CMa emerged from its seasonal gap in November 2010, it was already 9th magnitude.

The current outburst is as bright as the one that occurred in 2008, the brightest in the star's known history. Z CMa is a very interesting object, a binary composed of a Herbig Be star and an FU Ori star. The Herbig star is embedded in nebulosity. The system is an x-ray source and has an x-ray jet. According to Stelzer et al. (2009, *Astronomy & Astrophysics* v.499, p.529, and astro-ph arXiv:0903.4060), the FU Ori star is the source of both the optical outbursts and the x-ray emission.

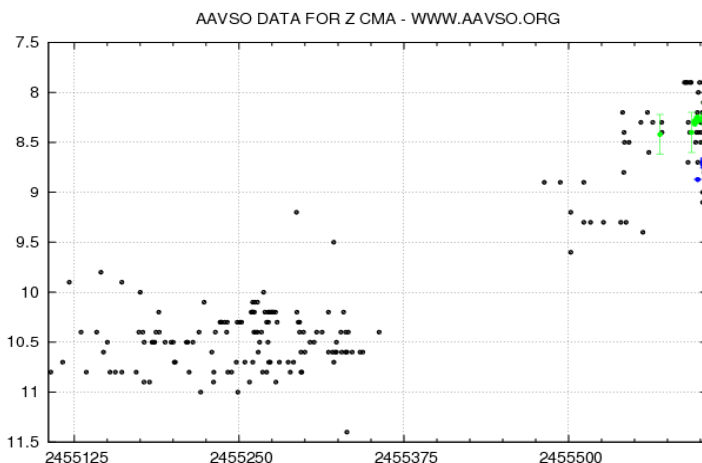


ASAS3 measures of Z CMa from JD 2451850 to JD 2455200 when they apparently ceased showing these on the website. Scatter is about ± 0.03 and there is a very clear picture of the star's outbursts.

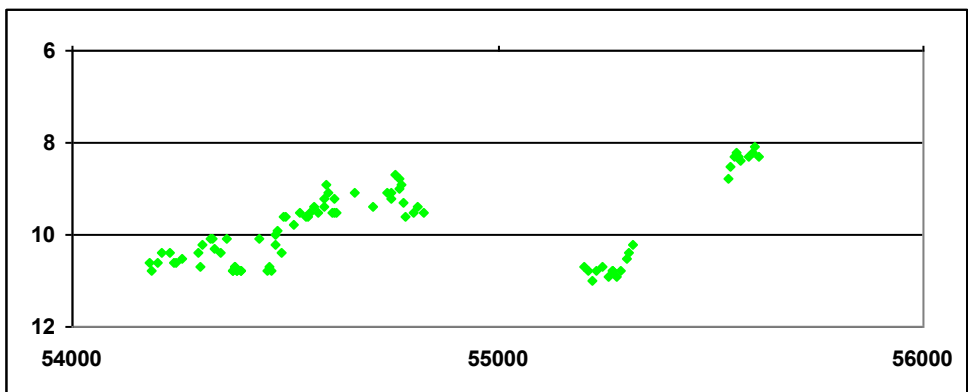
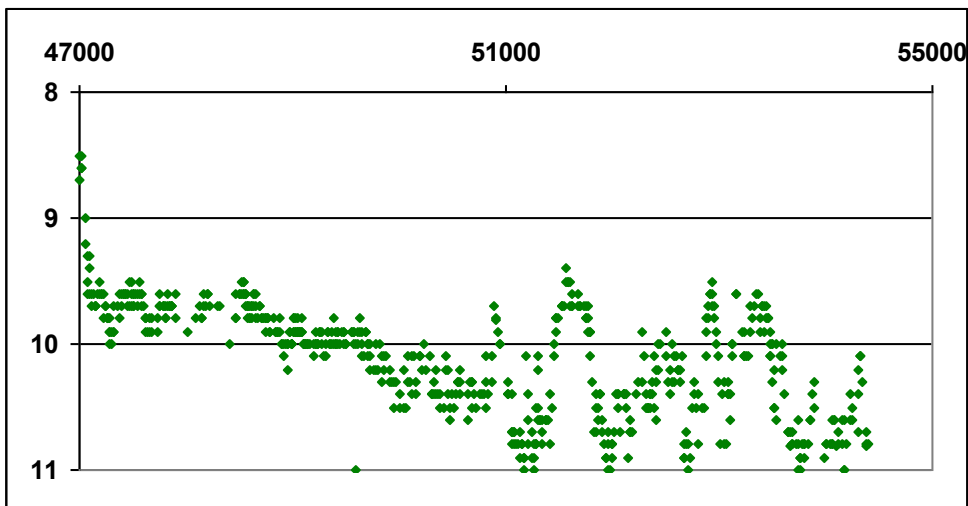
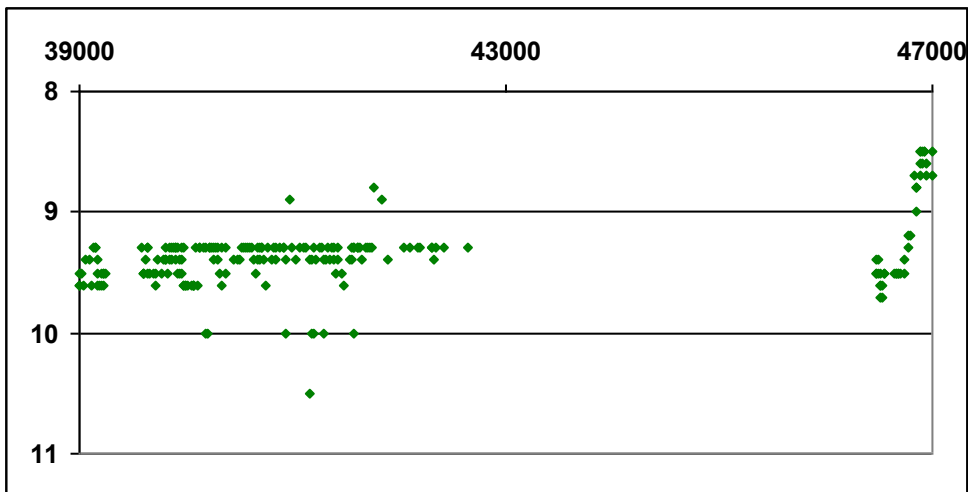
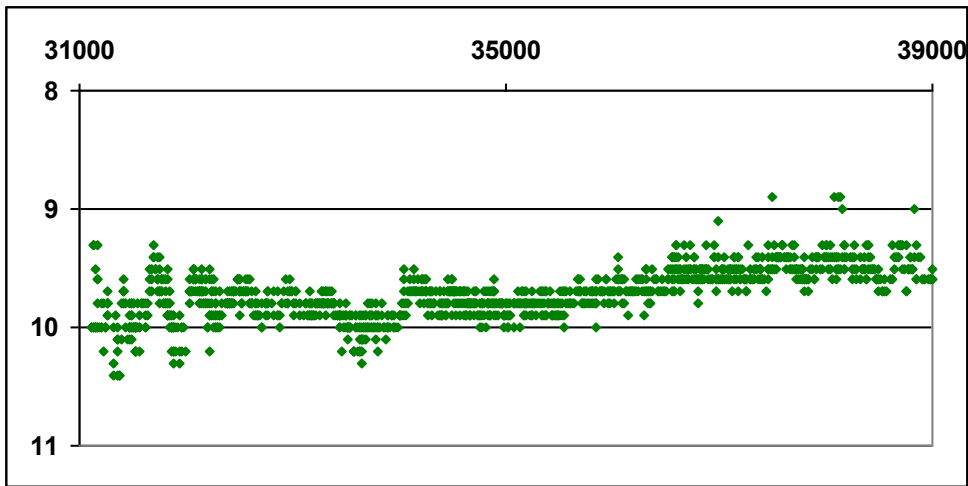


A similar period from the International Database which shows a similar but much less detailed light curve.

Elizabeth O. Waagen, AAVSO: "Observations of Z CMa Position: RA 07:03:43.16 Dec -11:33:06.2 (J2000.0) are strongly encouraged, both during the current outburst and throughout the observing season. With its range of visual magnitude ~ 8.0 -10.5, it is an excellent visual observing target. Visual, PEP, and CCD observations are welcome. Our thanks to John Bortle for drawing our attention to the current outburst of this interesting system!"



Whilst the measures from ASAS are much better they seem unavailable at present and the behaviour of Z CMa over the last 500 days can be seen in the graph at left. Some BVRI measures at about weekly intervals would be useful and, since it's a blue star, anyone with access to UVB photometry would be really valuable. Visual observers should use the RASNZ VSS charts which are more reliable than the AAVSO VSP charts in this case.



These three graphs show the recent history of Z Canis Majoris as observed by Albert Jones. It seemed active when Albert first began in 1944 but then it entered a long period of little change except for a slow brightening of half a magnitude. By the mid 1970s there were many other stars requiring attention and for a time it fell into neglect. Toward the end of 1987 it managed a quite bright 'outburst'—maybe an attempt to emulate the LMC supernova of earlier in the year—which seems to have preceded a period of decline from around 9.5 to almost 10.5.

After this it has entered into what seems a quite active state with about 8 assorted outbursts in the period up to the end of 2007 and more since.

The scales on these graphs are much more compressed than those on the previous page but the three show the resolution that can be obtained by plotting—not the observations of all observers—but those of one competent observer.

And to finish, the last few hundred measures by Albert. With his recent health problems, Albert is still out there batting.

A great effort on Z Cma, Albert.

ASAS3—SOME HINTS ON ITS USE

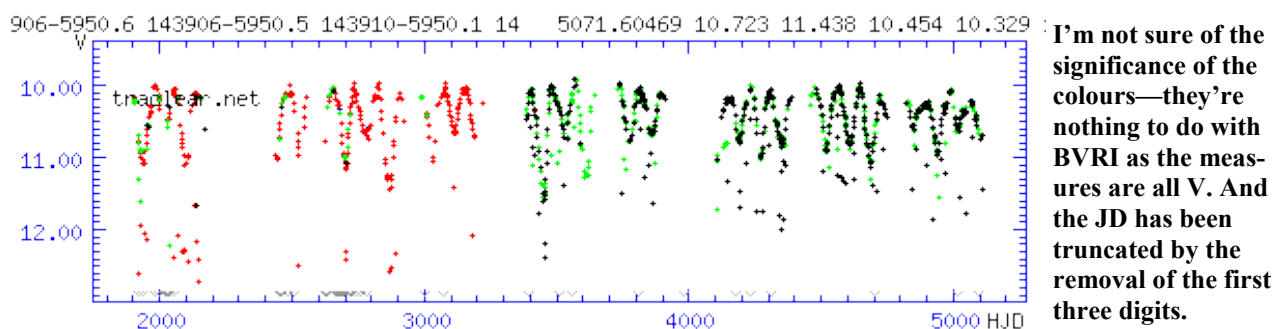
Stan Walker

As mentioned in the article about V641 Centauri, ASAS3 is a very useful resource for southern hemisphere stars in the magnitude range 7-12. It can also be used for brighter stars, but beware of saturation effects, and for fainter objects the data can become very noisy.

The website is found at www.astrouw.edu.pl/asas, and to get observational data select 'Photometric Catalogue Search; V Band'. If the star is a known variable getting the observations is quite simple—if not, you need to know the RA and Dec in the following format: **RA DEC** (5.45 -81.5 or 5:26:50,-81:35:12). It's also a good idea to set the radius at 60" as the position of some variable stars is not always well known.

At this stage you will be presented with a list of coordinates, mean magnitude and standard deviations, as well as the number of measures in several datasets. Usually the variable is easily recognised. Stars surrounding the variable are also listed with the same information and occasionally one will turn out to be variable. Fainter than about twelfth magnitude the SDs can be quite large and cannot be taken too seriously. Selection of one of the objects in this list will produce a small graph of the type shown below.

ASAS 143908-5950.2 Light Curve (asas3)



If a graph like this excites your interest then it's worth downloading the observational data. Select 'retrieve data' and in a few seconds all the measures of that star will be displayed. It's best to use CtrlA to highlight the whole set for copying. This dataset should then be saved in .txt format.

At this stage the material is a bit messy and it needs cleaning up using Excel. But keep the original file for reference purposes. ASAS3 does not transform the observations, nor does it apply secondary extinction corrections. Differential primary extinction is small, due to the size of the fields, but is present at low altitudes. Considering all of these aspects it can be assumed that we're looking at 5% photometry, say +/- 0.05 magnitudes, but improving to 0.02 at high altitudes and with stars in the range 7-11, sufficiently accurate for a large variety of variable star targets.

It will be clear from the original graph above that there are some discordant measures so some simple method of removing these is necessary. The bulk of the measures will be in a number of datasets, with magnitudes and errors through 5 different sized apertures. Along with these there is a large amount of non-observational material which gets in the way using the spread sheet. Note which order the apertures are in the dataset (with V641 it was 2,0,1,3,4, with aperture 2 being selected by ASAS as the most reliable). If you lose this information it's in the .txt file. The error estimates are based on a computer algorithm and are not particularly reliable so these can also be discarded.

The result of all of this is a file comprising HJD in the form ####.##### and values through five different apertures. You will also see non-measure values of 29.999 and 99.999 at times. You now need to create a column determining the SD of each row of aperture measures—STDEV(B#:F#) will do the job nicely. Then sort the data by column F, the standard deviation. With V641 there were 1069 measures, of which 117, or 11%, had an SD of >0.05. These were moved across into columns J-N to be out of the way, but still available

if necessary. The SD of the 952 SDs used in the analysis was 0.0104 which was quite impressive. After this treatment the data now need sorting into JD order.

For better looking and understandable graphs most people use a modified JD where the first two digits, 24, are dropped. This covers the period AD 1859-2131—good enough for all except a few variables. So you need an extra column to convert the ASAS measures to this system. Since the ASAS people have selected an aperture as the best this need not be changed. It's a good idea for the first graph to show all the data and you should modify the scales on both axes to your taste. This graph will give you an insight to the data, even if you're dealing with a short period variable.

It also facilitates the preparation of more detailed graphs as these can then be copied from the main graph and the interval changed to suit other requirements.

At this stage it's easy enough to split off CSV files and modify them for use with other software such as Peranso, to determine periods or whatever.

ASAS now has a 10 year database and this can be used very effectively with short period stars such as EBs and Cepheids. In most cases the data from a single cycle is meaningless due to the ~3 day sampling interval but, depending upon declination, there are usually 100-200 measures each year. The measures are separated into seasonal bins (usually one year each) and analysed that way. This involves using an epoch and period to phase the data. This will immediately reveal period changes as seen in the article about Neil Butterworth's Cepheid measures on page 21. However, it cannot provide an accurate instantaneous period—for this you need seasonal epochs fitted to an O-C diagram.

THE STARS OUT THERE & TELESCOPES TO SEE THEM

Stan Walker

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In his first comments the new Chairman of Commission 27, Variable Stars, Gerald Handler, of Austria, mentioned the coming data avalanche in this field and the likely difficulties in cataloguing and analysing the vast amount of expected observations. I was reminded of this by a friend who is contemplating how large a telescope he can acquire once he retires—and how faint an 82cm, or 32" mirror, will allow him to see.

In several items in the old RASNZ VSS Circulars it was suggested that the visual limit at the Black Birch site in Marlborough using a 5" refractor was magnitude 14. When scaled down to the unaided, dark adapted eye with a diameter of 7mm this equates to a visual limit of 7.5. Even allowing for the altitude of ~1300 metres and the clarity of the sky on Mt Altemarloch this seems rather optimistic. Some observers have claimed the ability to see to this faint level but in most cases the claims are easily disproven. Adopting the more probable naked eye limit of 6.5 this equates to magnitude 13 at 12.7cm, or 5".

The limiting magnitude increases by a whole magnitude for each 1.585 times increase in the diameter of the mirror so 80.15cm provides another 4 magnitudes to 17. The extra 2cm diameter probably makes up for the size of the central obstruction. So Mati is going to have to keep these faint comparison charts coming! During the Halley's Comet appearance I had some long discussions with a US amateur who was using a 40" Cassegrain to watch it and there appears to be no end to the growth of the Dobsonian mirror sizes, although my friend suggests a Naysmith mounting might be more useable. This involves three mirrors, a primary, a secondary like a Cassegrain, with or without the amplification, and a diagonal between the two reflecting the light out through a hollow trunnion at the axis. The next magnitude step is around 129cm—probably a bit large for most amateurs!

Now what about the targets—how many stars are there of 17 or brighter? This is a bit hard to estimate. We're trying to count the number of stars in a sphere centred in a spiral arm of what is a disc shaped spi-

ral galaxy. We might adopt a multiplication factor of about 2.6 for every magnitude step which gives about 225×10^6 stars but this might be on the low side judging by some catalogues. One of the problems is the difference in filters so that the brightness of stars is not well standardised. But it's still a large number of stars — whether the estimates are high or low!

How many of these are variable? If we refer to *Allen's Astrophysical Quantities* we see that almost half of the 100 brightest stars are variable. But these are mostly quite luminous objects in advanced evolutionary states. Stable main sequence stars are not well represented in that list of 100. But with the limit of $V = 17$ many of the cool red main sequence stars will be visible — a large proportion of which show flare star activity or rotational variations of the BY Draconis type.

And how long will the visual observers stay purely visual? Will the quest for fainter limits see the eyepiece replaced by a computer screen from which our observer makes measures — thus extending the limit by a magnitude or two? Maybe the elusive magnitude 20 is attainable this way? Going back in time the US astronomer and site evaluation specialist Merle Walker was doing some incredible things with what I think was called a reticon tube and a 16" telescope — I've a vague recollection of magnitude 22 but this seems far too faint!

Returning to the first paragraph there are now a large number of automated surveys similar to ASAS in action or contemplated. ASAS provides information on many bright stars with known variability, but also manages to find a large number of relatively bright variable stars not listed in any catalogue. Many amateurs have given up observing in favour of data mining this and similar surveys. The Catalina group in the US have a project which targets one type of variable star — cataclysmic variables — and is quite frequently finding new objects, often quite bright.

Data mining is creating a very messy situation with the same stars appearing in a variety of places as a 'new variable'. In the rush to rack up large numbers of successes the traditional concept of providing a reasonable physical analysis of the star or stars has disappeared. This situation will get worse as the automation, which is an essential part of the survey analyses, must of necessity be somewhat broad in its classifications.

What methods of analysis and listing will cope with some millions of known variable stars by 2015? The Sternberg State Astronomical Institute which maintains the General Catalogue of Variable Stars abandoned publication in book format about 1987. It's now available on line with well over 40,000 stars listed — but there are probably that many known variables not listed — maybe more! The AAVSO maintains VSX but it seems destined to become a list of variable stars discovered by amateurs, mainly through data mining. There are a few detected by amateurs monitoring CVs and minor planets and the bright star monitors being set up by the AAVSO will undoubtedly discover more.

And to conclude — recently there has been some discussion as to whether the ASAS3 project has ceased. Unfortunately its founder, Bohdan Paczynski, died several years ago and it has carried on in a limited manner, but the lack of published data suggests that all is not well. So, all of you visual observers, get back to measuring those LPVs as frequently as possible. Astronomy needs you — and the measures!

CVs at Minimum Project

This has been stalled due to several things — we're all too busy to do some of the needed background work, comparison stars at these levels — magnitudes 15-17 are hard to find and drawing charts is time consuming. Mati Morel has produced some excellent charts and these now need matching with targets — APASS is also producing magnitudes for comparisons and for the detailed charts needed — but it's not easy to put all of this together.

In the next two months we hope to be able to come up with the initial target list and references to charts. Perhaps Mati will also be able to use the APASS data to produce some more charts — whilst the concept of on line 'draw your own' computer drawn charts is fine in theory it seems to be far from foolproof in practice and we don't want a lot of false alarms about novae arising from stars omitted from the charts. So be patient — the project is not forgotten, it's still being developed after a rather premature announcement.

DSLR PHOTOMETRY—A PRACTICAL EXPERIENCE

Mark Blackford and Glen Schrader

There has been considerable interest in DSLR photometry and similar digital photometry for some time but the methods and results have been hard to acquire. Des Loughney wrote about his EB techniques in the BAA VSS Newsletter and Ed Budding and his colleagues used DSLR cameras to measure the night sky brightness at Canakkale in Turkey. But there's little about how to get started so in this article we'll outline some practical aspects and how Mark went about finding out what was possible.

The menagerie of variable star types is vast. Some with large magnitude ranges and long periods, others with shorter periods or shallow light curves. Colour changes can be significant. The tools employed to measure these changes depend on the requirements of the observing program. Visual estimates are perfect for some but photometry with electronic detectors is necessary for others. Similarly, accurate timing of observations and frequent measurements are critical for some programs but not for others.

For stellar photometry one would ideally use a scientific grade astronomical CCD, or photoelectric photometer, and standard photometric filters. These are expensive bits of kit which Mark doesn't have access to just yet. However, he does have a consumer level DSLR so why not give it a try?

The emergence of DSLR cameras over the last decade has added another tool to the arsenal of techniques available to the photometrist. But which programs are DSLR observations best suited to? Bright short period Cepheids with shallow light curves and bright eclipsing binaries are two potential niches.

We should bear in mind that we're using a camera designed for photography of people, landscapes, animals and a wide variety of objects—but not really for stars. The R, G and B filters in these cameras are not intended to match the B, V and R of the astronomical UBVRI colour system and they have different bandwidths and effective wavelengths. That it can produce good scientific measurements is an added bonus. This article looks at just how good these measurements can be.

The camera is a Canon 450d with a Nikon 180mm f2.8 lens operated at f4 for better images. It's piggy-backed on an 8" Celestron telescope on a CGEM mount (Figure 1). Raw images are 14 bit, giving 16,384 greyscales with a field of view of $\sim 7.0 \times 4.7$ degrees. All of this is located in Chester Hill, Western Sydney. Canon EOS Utility software running on a laptop automates image acquisition. Dark frames are secured in the normal manner and flat frames are made using an electro luminescent sheet.



Figure 1. The observatory from which Mark observes. The Canon 450d camera can be seen mounted piggyback on top of the telescope. Space restrictions required a novel solution to the problem of permanently mounting the telescope. The long wall is hinged in the middle and the end wall nearest the camera is equipped with wheels allowing it to easily swing round to enclose the pier. The split roof can then be closed to protect the telescope when not in use. When open for observing there is ample room in which to work, inspiring Mark to paint the outside TARDIS blue. However, when closed, friends have compared it, rather unkindly, to an outhouse.

Initially images were made in the RS Puppis field which has a good range of stars—both magnitudes and colour. The images are slightly defocused so longer exposures are possible to help with scintillation and avoid saturation. The effective star aperture radius is 55.8 and the sky annulus from 93 to 155 arcseconds. Sets of images - 30 x 20 seconds - were obtained and analysed. These form the basis of what we're discussing here.

AIP4WIN was used to extract R, G and B images (approximately corresponding to Johnson R, V and B filters) from each of the 30 raw images. These were separately analysed to obtain average r, v and b raw instrumental magnitudes for 22 comparison stars. Comparison star true V magnitudes and (B-V) values were obtained from Guide 8 (Project Pluto by Bill Grey) based largely upon the transformed Tycho data.

Detector response should ideally be linear and to check this we plotted the measured v magnitudes (adjusted by a fixed zero point of 20.256) against the true V for each of the comparison stars (Figure 2). A straight line least squares fit to the data (constrained to pass through the origin) has a slope of 0.9996 which confirms the DSLR response is linear - so long as saturation is avoided.

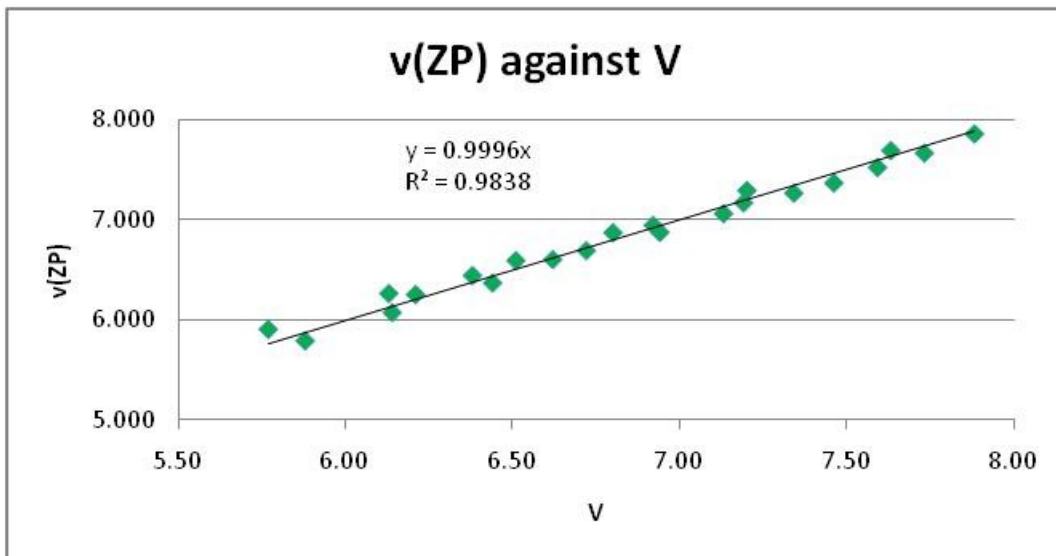


Figure 2. Measured v magnitude (adjusted by a fixed zero point offset) as a function of true V magnitude. All 22 comparison stars are shown. A small amount of scatter is evident but linearity is good.

A plot of measured b magnitudes (adjusted by a fixed zero point of 20.503) against B is shown in Figure 3. Scatter is significantly greater than in Figure 2, but the best fit slope is also very close to 1 indicating linear detector response.

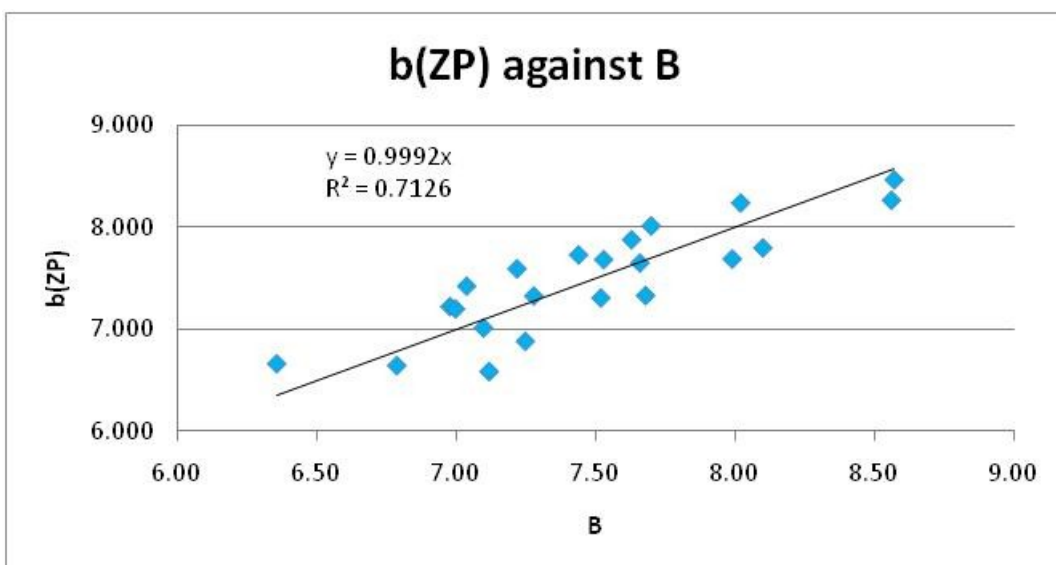


Figure 3. Measured b magnitude, adjusted by adding a fixed zero point offset, as a function of true B magnitude. All 22 comparison stars are shown. Scatter is significantly greater than the V channel data.

The encouraging result is that for these relatively short exposure times magnitude 8 is being achieved. Whilst the effective lens aperture is 45mm it should be realised that due to the Bayer matrix filter there is only $\frac{1}{4}$ (for blue and red channels) or $\frac{1}{2}$ (for green) of the collecting area of a similar diameter telescope us-

ing a CCD where RGB/BVR are measured sequentially. Since the telescope is tracking, much longer exposure are possible to reach fainter magnitudes without introducing trailed star images. The worrying thing is that the system appears inherently noisy—but this is actually an illusion as we will show below.

We begin by taking the blue magnitudes but separating them into four star colours. O, B and A stars are blue-white, F and G are yellow, K stars are orange and M stars red. It's immediately clear from Figure 4 that all stars of any one colour lie along a line which is different, but more or less parallel, to stars of another colour. It's not ideal as we're dealing with an actual set of comparisons, not a specially selected set with matched colours to illustrate the idea.

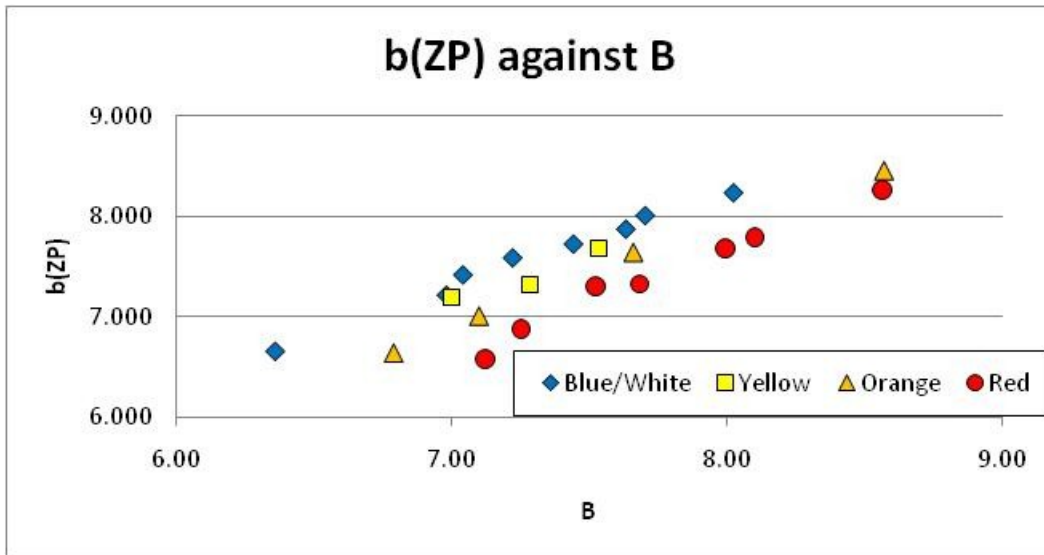


Figure 4. The same data as shown in Figure 3, but with stars assigned to one of four groups according to their B-V colour values. Clearly the measured b magnitude is influenced by the star's colour.

It's now clear that the apparent lack of quality of the b measurements is not poor photometry but results from the way the colour of a star influences its measurements.

What is required is to determine the colour corrections to be applied to each set of measurements. For background refer to the article "High Precision Photometric Transformation to the Standard UBVRI Colour System" in the November 2010 Newsletter, page 26. That article discussed the 'how' in some detail but whilst Tom Krajci explained the 'why' there were no useful examples of this. Figure 4 shows one of Tom's concepts well. We'll detail the steps necessary to determine, and apply, transformation coefficients for the Canon 450d (or any other camera) in a future article. In the meantime we will develop the argument for why transformations are required and make some observations on our assessment of the camera's performance.

The first necessity is to determine the Hardie 'scale factor'. It reveals how the difference between the effective wavelengths of G, B and R differ from V, B and R of the UBVRI system. To show this we calculate the b-v colour of the uncorrected measures and plot this against the known B-V values. Then we plot uncorrected v-r against true V-R (which we had to estimate from the reported B-V data for the comparison stars since Guide 8 does not contain this information).

Compared to conventional PEP and CCD photometry the slopes of these graphs for the Canon 450d are unusually large. But, apart from a few badly fitting points, the slopes are consistent and it is easily possible to get good transformations to the standard system.

Figure 5 (next page) presents the measured v (adjusted for zero point) plotted against true B-V. The three labelled points in the graph are anomalous and need to be analysed. C16 and C17 are bright stars which have been affected by saturation of some of the pixels.

This brings us back to the aperture radius of 55.8 arcseconds mentioned earlier. At Auckland Observatory Stan Walker and colleagues found that a 30 arcsecond aperture was correct for stars fainter than magnitude 5.0 but for brighter stars they needed to use the next aperture in the range—60 arcseconds. That was with a 50 cm telescope. With a camera lens about a tenth of that diameter the resolution is much poorer and, with

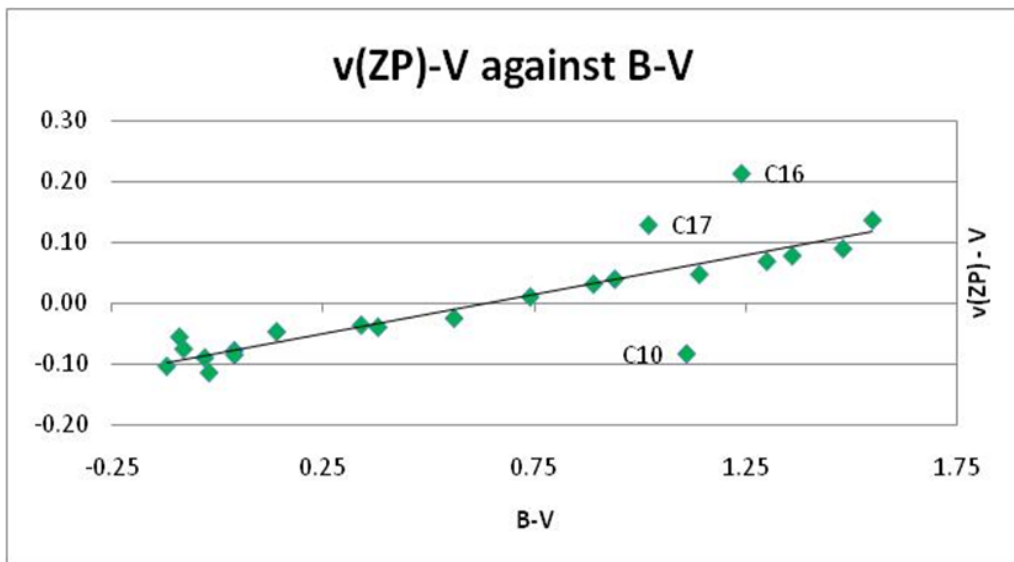


Figure 5. The difference between measured v magnitude (zero point adjusted) and true V magnitude plotted against true $B-V$. Taking all 22 measures the standard deviation is 0.045 and there is a significant colour dependence (slope). The three labelled discordant stars are discussed in the text.

the images defocused a little, scintillation effects may be present. With classical PEP we'd have to remeasure the stars—but with this photometry all that is required is reduction with a different software aperture! A check of various apertures showed no trace of scintillation—in fact the radius could be reduced to 31 arcseconds before this became significant.

CCD practice is to keep the software apertures as small as possible in the belief that this improves the signal-noise ratio. There are no good values for sky brightness in Sydney but it's probably about magnitude 18 -20 per square arcsecond. This means the total sky background in an aperture of ~112 arcseconds diameter would be 10 magnitudes brighter. But this is not a concern as the noise is the variation in this background—not its actual values. Since the photometry is simultaneous only passing cirrus is likely to create any problems in that area.

Stan Walker looked into the anomalous star C10 using Guide 8 and noted it was double. The primary is V 6.14 while the companion star is V 8.66 which would make the combined magnitude about 0.1 brighter in V . It would also make B much brighter as B mags are 7.25 and 8.57 so the effect might be as much as 0.3. As well as this, Tycho suggests binary induced variability. This is usually variation caused by ellipticity but they're too far apart for tidal effects. In any case it shows an error value of 0.015 which over the short time interval it was measured suggests probably greater variability. The spectral class is G1Ib - a supergiant - and variations in these stars are quite common.

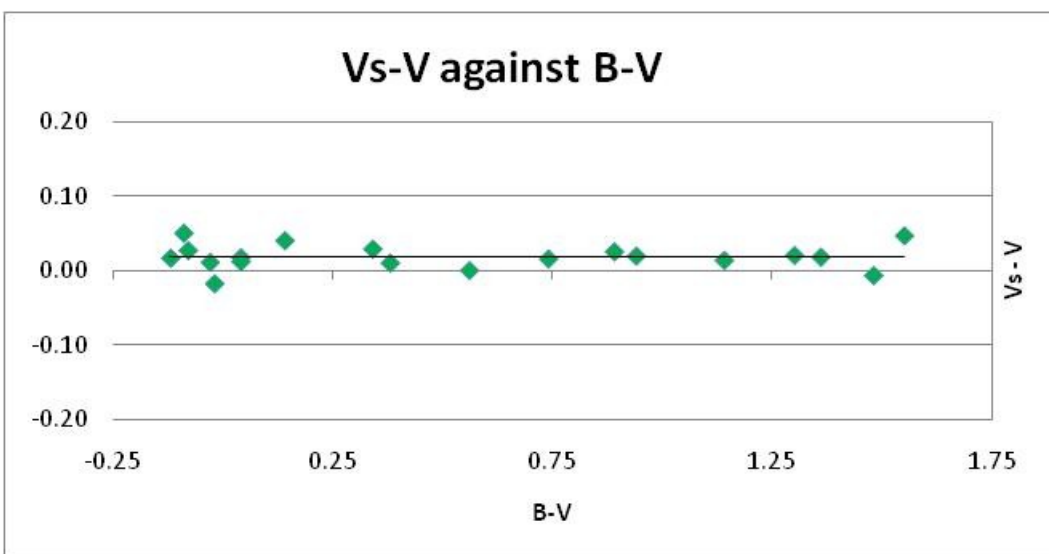


Figure 6. After discarding the three discordant stars and applying colour corrections, the transformed V_s magnitudes show no colour dependence and standard deviation has been reduced to only 0.016.

The uncorrected data in Figure 5 shows a standard deviation of 0.045 which is quite poor by CCD and PEP standards. Figure 6 shows the same plot after removing the three anomalous stars and applying transfor-

mation coefficients to the measured data. Standard deviation has been reduced to 0.016. Very impressive and comparable with good PEP.

Details of the transformations and results will be reported in the next Newsletter. However, early results are encouraging. Figure 7 shows Giorgio de Scala's V light curve of RS Puppis, one of the target stars in the VSS Bright Cepheids project. Also plotted are four observations by Mark with magnitude measurements corrected using transformation coefficients determined in this study. Agreement between the two sets of data is very good.

Some of the remaining error can no doubt be attributed to the quality of available comparison star V and B-V values and estimated V-R. Work is in progress to image a standard E Region field for which precise photometric values have been determined. Analysis of this data will be reported later.

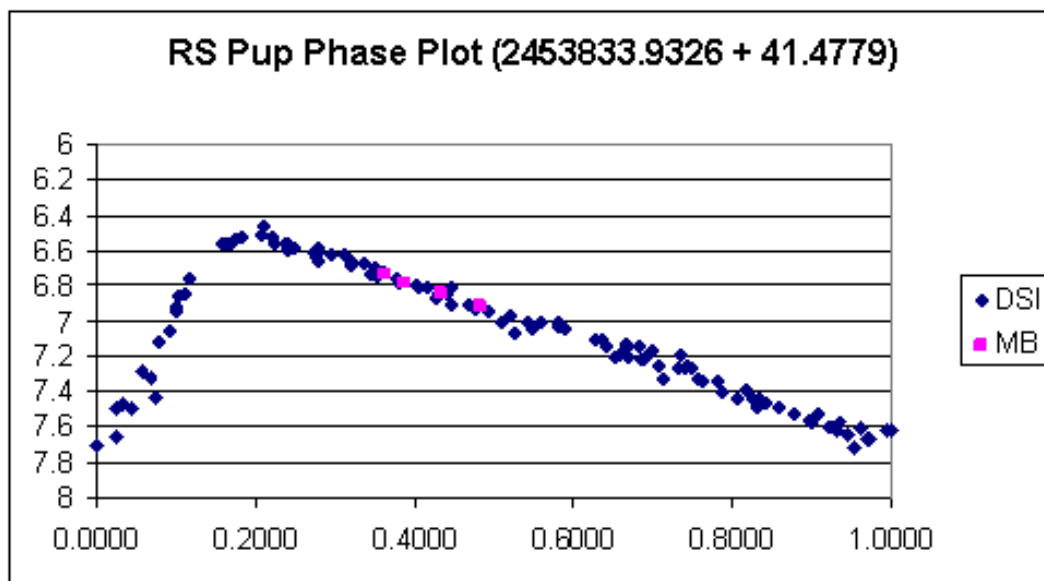


Figure 7. V light curve of RS Puppis by Giorgio de Scala. Superimposed are four observations by Mark using the Canon 450d. These DSLR magnitude measurements were corrected using transformation coefficients derived in this study.

Until then all transformation coefficients, standard deviations and transformed magnitude measurements quoted in this article should be regarded as preliminary.

A study by Stan Walker of CCD colour photometry performed by amateurs and recorded in the International Database suggests an accuracy of between 0.02 and 0.04. Can DSLR photometry compete with this? The answer appears to be yes, but the cameras are operating at different levels. Unless the telescope is stopped down CCD photometry begins at about the magnitude level where DSLR photometry begins losing images. The DSLR response to very blue and very red stars is a question that we hope to look into in the near future.

In summary, good photometry is achievable with a consumer level DSLR camera provided care is taken to determine and apply colour transformation coefficients. To minimise the required corrections comparison stars with colour similar to the variable should be chosen. Furthermore, the camera does not have the dynamic range of PEP so it's also preferable to use a comparison of similar brightness, say within 1.5 magnitudes on the brighter side.

The authors wish to thank Stan Walker for his encouragement and guidance during this exercise.

And as a supplement to this article:

Introduction to "Webcam" Photometry

Glen Schrader

We have just been introduced to some promising early results where a consumer grade DSLR camera has been used to gain some useful photometric results of RS Puppis. I have recently been experimenting with another tool, the humble web camera, which is also providing some surprising results.

You may have seen some wonderful planetary images of Jupiter or Saturn over the past few years by amateur photographers using these webcam devices. Essentially they are a CCD camera (or CMOS based as is the DSLR) with the ability to take from 5 to 100 frames per second videos. They have a similar blue, green and red Bayer Matrix to the DSLR camera and so, in theory, we can generate images in separate blue, green and red just as Mark has done. However the advantage of this device is that it can be used on an untracked telescope such as my 8" Dobsonian.

The V-Gear CCD Webcam



There are some issues though—we need to mount the camera on the telescope and we need to create a single image from an AVI video file. The first is quite simple for someone who is only slightly handy with some basic tools and thankfully there is some free software to help with the second which produces 16 bit fits files. The full process will be outlined in detail in the next newsletter.

The question is, can this thing produce reasonable results? The answer will be refined going forward but for now there is great promise. I have performed some colour transformations on 7 stars from the “Jewellery Box” in Crux using transformed Tycho magnitudes as the standard with B-V ranging from 0.1 to 1.45 for these stars. The standard deviations for the errors here are 0.04 magnitude from the single frame used. Photometry from 12 consecutive frames showed a standard deviation for individual stars of 0.017 magnitude across these frames. Next step will be to repeat this test on one of the E regions.



**Mark Blackford
at the computer
where—as he
puts it—I seem
to be spending
most of my life
these days. But
very profitably,
as shown by this
article.**

I'd like to add a footnote to this article. Like many people I had believed that the colour response and linearity of a DSLR camera would differ from the conventional BVR system so widely that it would, at best, produce rather crude magnitudes. This opinion has been expressed by others. What Mark and Glen don't mention, and this requires further confirmation with the planned E Region measures, that the errors in B-V and V-R will probably be similar to the V value of 0.016.

Some readers may contend that the narrowness of the response—and it's evident that the three passbands are compressed when compared with standard BVR filters—restricts the stars that can be measured. Perhaps so, but the camera response appears ideally suited to Cepheids with largely F,G and K spectra. Then there are many other bright variables with similar colours. So these investigations open up an entirely new area for amateurs—and since you can also use it as a general purpose family camera there's a good excuse for the expenditure. We'll await the next articles with great interest!

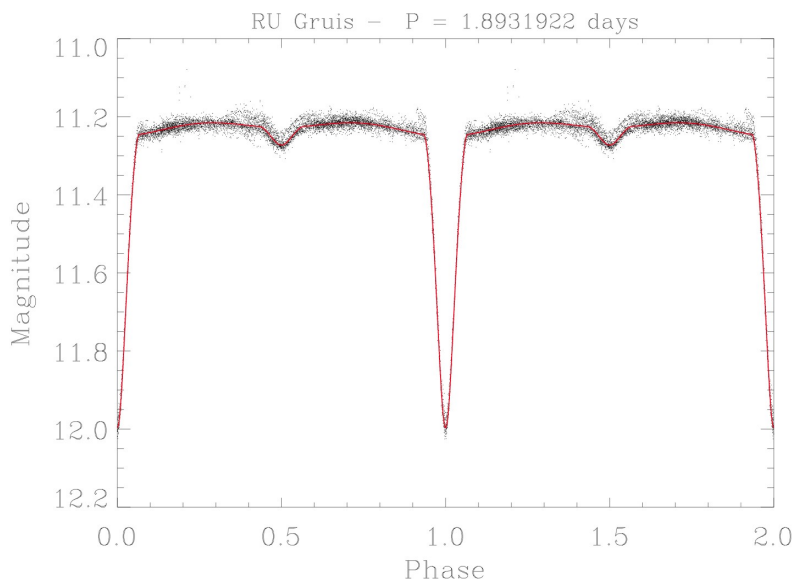
Editor

AN UPDATE ON THE SPADES PROJECT

Simon O'Toole (Australian Astronomical Observatory)

The Search for Planets Around Detached Eclipsing Systems (SPADES) project is designed to look for substellar companions orbiting around eclipsing binaries containing Main Sequence or Sub-giant stars with spectral types from A to M. The project is a professional-amateur astronomer collaboration between VSS through Tom Richards and the Australian Astronomical Observatory through me; we also plan to work with undergraduate student programs where appropriate. You may recall from our original announcement that the conditions of joining the SPADES network are access to a telescope with a minimum aperture of about 30cm, a CCD camera, and an accurate method of calibrating and recording observing times (see the VSS website on SPADES for more details). We will use the eclipse timing method discussed above and involve multiple telescopes at different sites. The eclipsing systems have been selected from the General Catalogue of Variable Stars, have orbital periods between 1 and 5 days, and are Algol-type binaries where the stars are detached; i.e. there is no mass transfer between them. By selecting targets in this way, we are ensuring that the eclipse minima are sharp and can be measured with high precision, and the eclipse durations are short enough that a whole eclipse can easily be observed in one night.

Some of you may be wondering what is happening with the project, since we announced the project last year. While the weather in Australia and New Zealand has not been kind to us, work still continues on SPADES. An important starting point has been to search for already existing high quality observations of our targets in public archives and databases. Here at the AAO, we had a summer student from the University of Canterbury (Scott Thomas) examine various online data archives such as WASP (Wide Angle Search for Planets, see <http://www.wasp.le.ac.uk/public/>) and ASAS (All Sky Automated Survey, see <http://www.astrouw.edu.pl/asas/?page=main>), to see which of our targets have been observed enough times to measure accurate light elements. He then fit the light curves and deriving parameters using JKTEBOP (Southworth et al. 2007), and we plan to publish a catalogue of these values, focusing on interesting objects, of which there are several. Scott has also developed software written in Python to make JKTEBOP a little more user friendly.



An example of his results in Figure 1 shows the partially eclipsing system RU Gru; in this case, the minimum eclipse time is accurate to ~4 seconds over the approximately two years of data. The aim of SPADES is to achieve an eclipse timing precision of approximately 1 second per epoch, which would allow us to detect a Jupiter-like planet in a Jupiter-like orbit, however, the eclipses of some of our targets may not be sharp enough to achieve this. Even with timing precisions of 5 seconds per epoch, we will still detect companions with only a few Jupiter masses in four years. Jupiter-mass planets

are more likely to be formed and stable at these kinds of periods (Pierens & Nelson 2008). With higher S/N ratios from larger telescopes (the WASP cameras are only 11.1cm in diameter), we are confident of achieving our target precision of 1 second for the majority of systems. Scott looked at individual eclipses for each of the 20 systems with usable data, and we are currently investigating the results of this work.

I should also mention that a lot of work has been going on behind the scenes at VSS as well. Tom Richards and David O'Driscoll are doing an impressive amount of work getting the SPADES database set up and Mati Morel is doing a great job sorting out comparison and check stars for each of our targets. All we need now is

a long stretch of dark clear weather!

References

Pierens & Nelson 2008, A&A, 483, 633
Southworth, J. K., et al. 2007, A&A, 467, 1215

OBITUARY FOR ARTHUR PAGE

Greg Bond *Astronomical Association of Queensland*

It is with sadness that I announce that Arthur Anthony Page—founding member of the AAQ—passed away in the early hours of Tuesday morning 1 February, 2011.

Arthur was known to many past and present members of the AAQ and many in the wider astronomical community. While his attendance at meetings had waned, his enthusiasm for astronomy had not. Arthur's contribution to astronomy earned him membership of the International Astronomical Union (IAU) in 1985 and at that stage, he was the first Australian non-professional astronomer to be admitted to the organization. He also became a member of The Astronomical Association of Australia (ASA) and later in life reached Honorary Fellow status. He was also recognized for his achievements by the University of Queensland with an Honorary Doctorate of Philosophy (Science) in 1994.

Arthur was born on 3 August, 1922, in Yokohama, Japan to Anton & Elena Pappadopoulos. The grandson of noted Russian astronomer Professor Artemic Robertovich Orbinsky of the Pulkova and Odessa Observatories, Arthur was destined for the stars. Arthur settled in Australia in 1941, and the following year joined the army. After the war Arthur studied Physiotherapy and began work at the Commonwealth Rehabilitation Centre on Swan Road, Taringa. During that time, Arthur joined the army reserve in 1950 and retired with the rank of Colonel in 1972. Arthur and second wife Berenice built an Observatory at their residence in Cherm-side and both collaborated with the CSIRO Division of Radiophysics flare star program. The Berenice Page Award for Excellence in Amateur Astronomy, bequeathed after her sudden death in 1970, was inaugurated by the ASA in 1972.

In 1971 Arthur married Aileen and in that same year he moved his observatory to Mt Tamborine. The observatory was officially opened in 1973 by the then Chief of the CSIRO Division of Radiophysics, Paul Wild. The opening was attended by visitors to the 54th Symposium of the IAU held on the Gold Coast. In 1978 the telescope was upgraded to a 12" f15 Dall-Kirkham Cassegrain coupled with a photoelectric device which steered Arthur's research program on a new path. Arthur retired as Senior Physiotherapist in 1983 but remained very active in the Astronomical arena taking up an honorary chair in the Physics Department at UQ in 1987.

Arthur was a founding member of the Astronomers' Association of Queensland (AAQ) and was its first President in 1969. In 1993 Arthur donated his equipment to the UQ Physics Department and through their collaboration with USQ, the Mt Tamborine observatory was dismantled and the mount was moved to Mt Kent and re-housed with a 16" Cassegrain telescope in a new fibreglass dome.

Arthur published a book in 2008 entitled "Between Victor and Vanquished" covering his time as an Australian interrogator in World War II and a copy is held in the AAQ library.

I met Arthur as a teenager in 1976 at my first AAQ meeting and was somewhat in awe of his achievements but considered that he would have no interest in what I did. This proved far from the truth and my association with Arthur, his family, Mt Tamborine Observatory and like-minded members of the AAQ (Joe Cali, Peter Mitropoulos and Lindsay Ball) cemented an enduring friendship.

In 1992 as President of the AAQ I had the great pleasure of awarding Arthur with an Honorary Membership of the AAQ. Arthur has promised to hold an area of sky in a new development in the Eta Carina complex for those interested.

Arthur Page will be sorely missed as a friend and mentor.

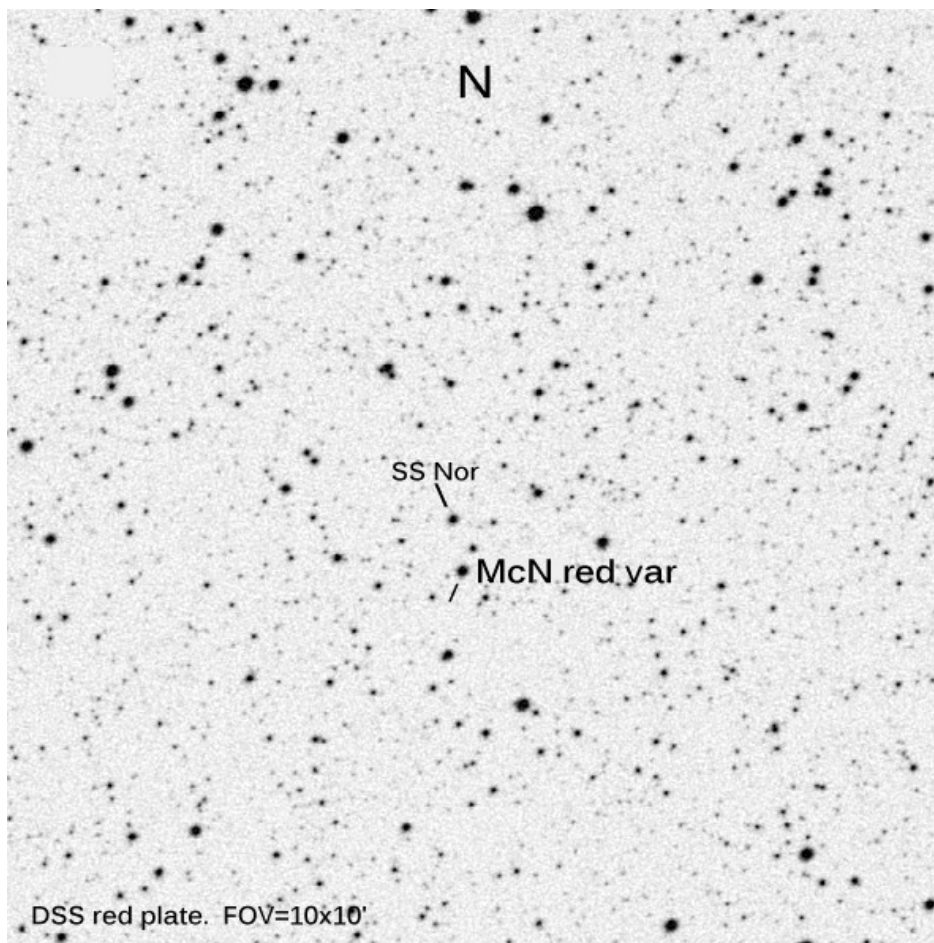
SORTING_OUT SS NORMAE

Mati Morel

mmorel7@bigpond.com

SS Normae is a Mira variable, range 12.2-16.0p, plotted as a minor variable on VSS chart 934. Another Mira variable, QR Nor, seemed to be so close to SS as to be possibly identical. In late 1986 I was preparing chart 934, so I put this question to Rob McNaught at Siding Spring Observatory. His investigations pinpointed a red, apparently variable star about 33" south of SS Normae. This star was assumed to be QR Nor, and was duly plotted as such on chart 934. This conclusion is now known to be erroneous. Subsequent investigations have shown that SS = QR Nor, as follows.

SS Normae = CoD-59°6051. (J2000) 16 13 21.85 -59 46 57.3 UCAC2



Discovered on an objective prism plate (MF8046, 1923 July 3). Announced by A.J. Cannon in Harvard Bulletin 837 (1926). Original rough published position is identical with CoD-59°6051, which however is in error, being 49" NNE of the true position.

In ASAS-3, it is known as ASAS 161322-5946.9, range 9.9-(14.8V, period 464d.

QR Normae = 767.1935.

In 1935 W.J.Luyten published a list of his own variable star discoveries (1936AN....258..121L) among them being a new one in the vicinity of SS Nor. Approx. position (1900) 16h4.8m -59° 30', range 15.8-17p. The position is rather poor, but from subsequent investigations, including a

re-examination of Luyten's plates at Harvard by Martha Hazen in 2002, it is pretty certain that Luyten had rediscovered SS Nor. He was probably looking for SS at the erroneous position given by Cannon. When SS did finally appear at a somewhat different position to what was expected he concluded that it was a new variable. For many years Luyten's discovery was labelled a suspected variable, CSV 2591. It was finally designated QR Nor in Name List 63 (IBVS 1414, 1978 Apr. 21).

But what of the red variable south of SS Nor, found by Rob McNaught?

McNaught's red variable.

An examination of the ASAS-3 dataset reveals that there is indeed a Mira variable at McNaught's position, and hitherto overlooked, Its designation is ASAS 161321-5947.5, range 12.2-(14.8V, period 210d. A final GCVS name is yet to be assigned. Astrometric position is :

(J2000) 16 13 20.75 -59 47 29.6 UCAC2

Conclusion.

There is no doubt that SS Nor and QR Nor are the same star. ASAS 161321-5947.5 (McNaught's star) is a new variable, but NOT QR Nor. See Fig. 1, a red DSS print. Users of VSS chart 934 are advised to amend that chart accordingly.

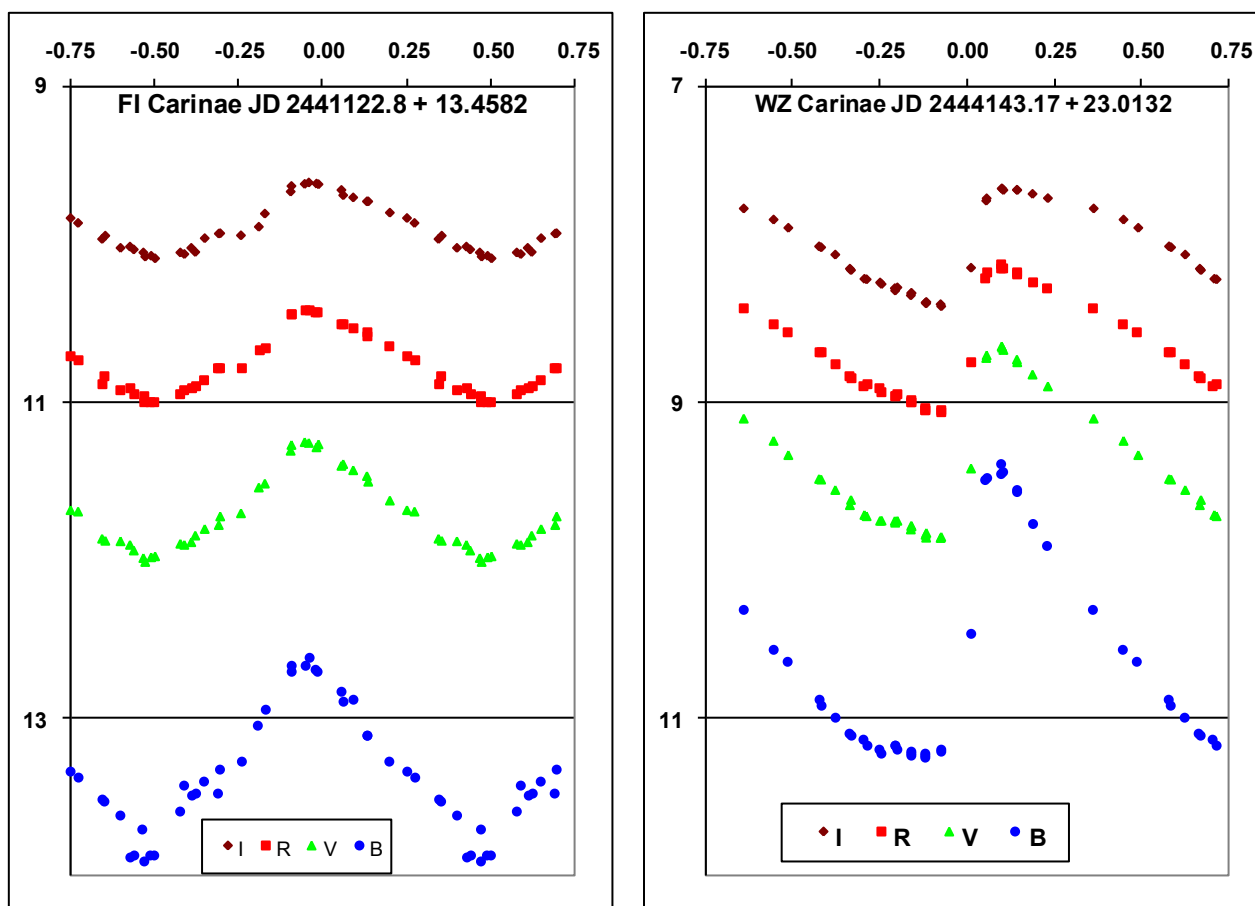
Acknowledgements.

I acknowledge Dr Nikolai N. Samus of the GCVS team, Moscow, and Sebastian Otero for some stimulating emails in January 2011, which made this report possible.

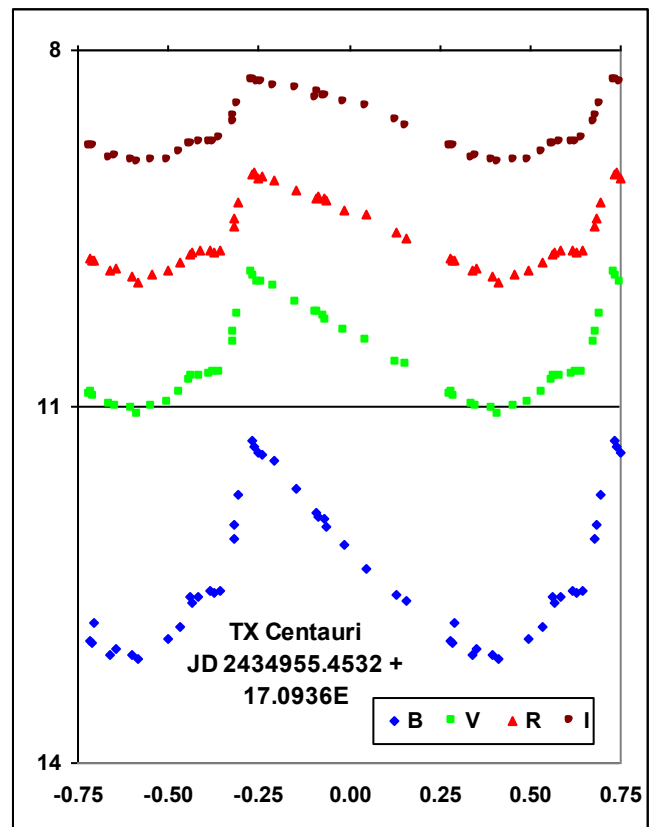
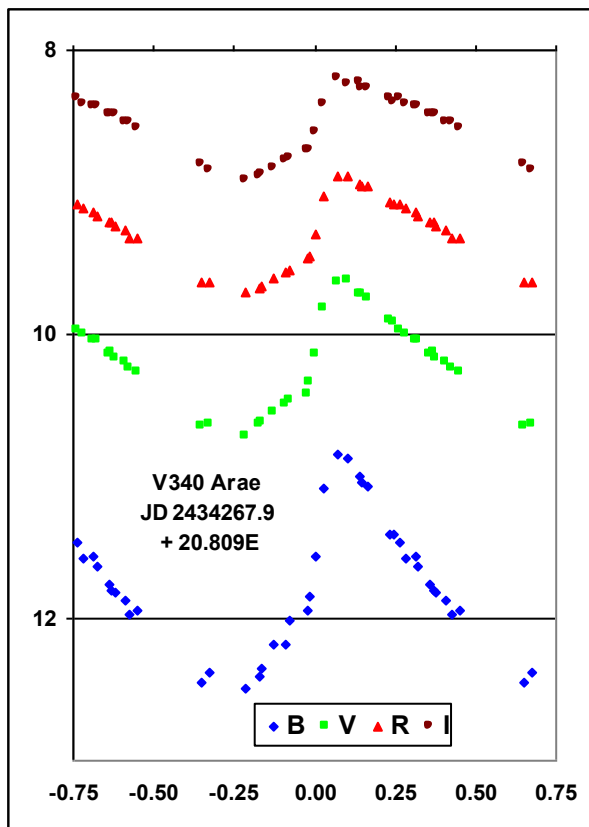
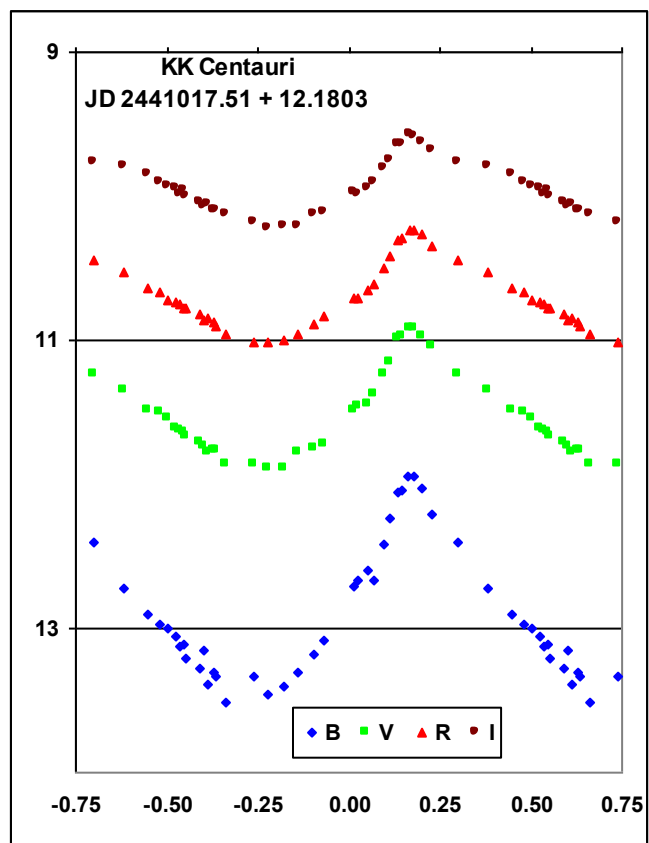
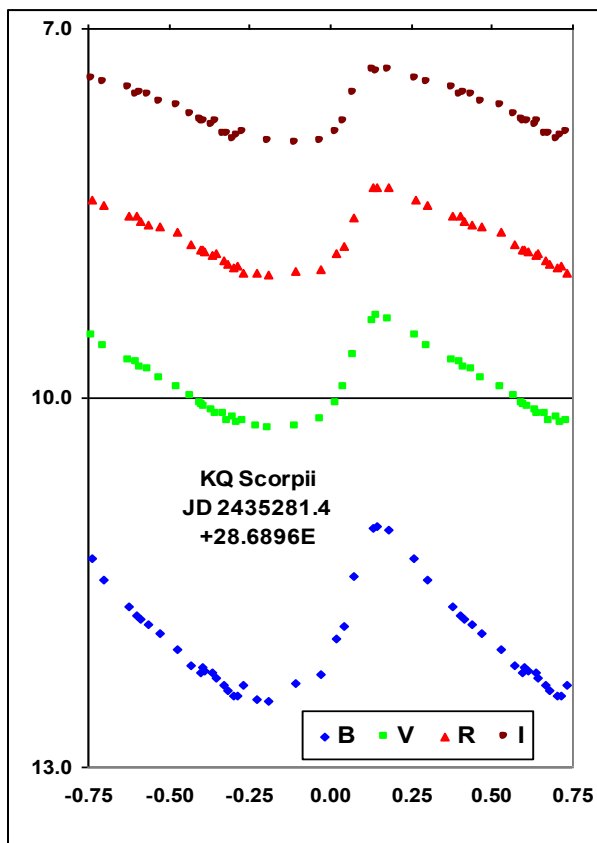
CEPHEID MEASURES IN 2010

Neil Butterworth reported—"during my last observing season (southern hemisphere winter), I took a break from my normal RR Lyrae and LPV observing, and observed some southern Cepheids. I observed them once per night in BVRcIc." There were 25 of these stars with periods ranging from GU Normae at 3.452877 days to KQ Scorpil at 28.6896 days.

Some sample graphs are included on these two pages. The plots are in the transformed colours and it is quite clear that whereas they are brightest through the Ic filter, the amplitude is greatest in B. The amplitude ratio is usually in the region of B:I = 2-2.5:1. Cepheid light curve shapes are quite varied—FI Carinae shows an almost symmetrical rise and fall whereas WZ Carinae has an abrupt rise and a much slower decline.



The period of WZ Carinae is only 19 minutes longer than 23 days so some points appear doubled. The phasing is based upon the published GCVS values, with -0.75 equivalent to 0.25 , -0.25 is 0.75 , etc. Clearly there are some small period changes in both these stars—but in opposite directions. Some other light curves are shown on the next page—KK Centauri, TX Centauri, V340 Arae and KQ Scorpil. All show evidence of period changes but epochs need to be determined and plotted on an O-C diagram to evaluate these.



These are four representative light curves plotted according to the GCVS elements. They show an interesting variety of shapes and some maxima are displaced from the expected maximum at phase 0.00. An interesting project for someone. Neil assures me he's an observer — 'I leave the analysis to someone else!'

There are some inconsistencies in the plots—mostly the fault of the editor—but sometimes due to Excel's tendency to change things around a bit.

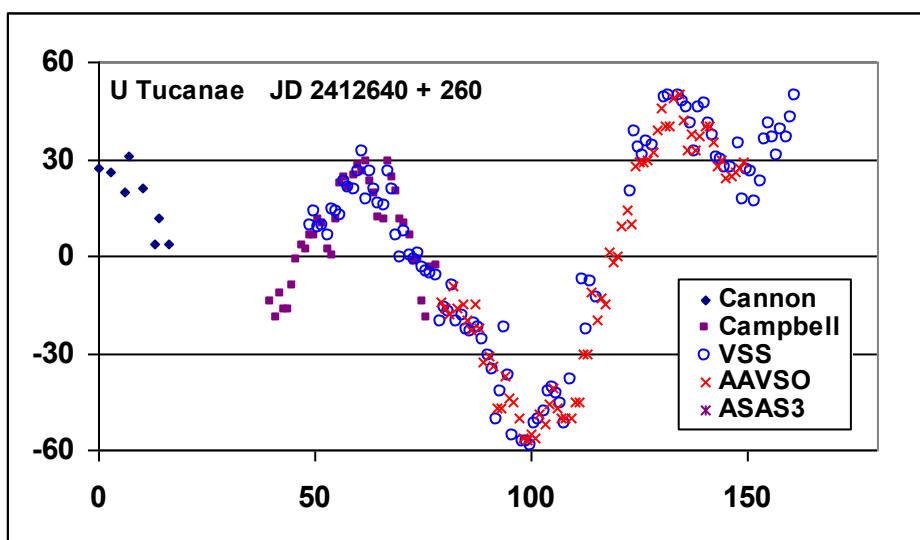
THE O-C DIAGRAM AND PERIOD SEARCH SOFTWARE

It's clear that many users of Peranso and other period search software do not realise the capabilities and limitations of some of these packages. A large portion of variable star astronomy is based upon the concept that as stars evolve the periods will change for a variety of evolutionary reasons.

Before computers the derivation of periods and the checking for period changes was, at times, a rather tedious business. Over the last half century a large amount of computerised software has made these things much simpler but too often observers do not use them correctly.

The best illustration of period determination occurs in the field of eclipsing binaries. If we had timed the moment of the centre of an eclipse 50 years ago and then repeated this exercise today then provided we had counted the number of orbits correctly the elapsed time interval divided by the number of orbits provides an accurate period. But it's not so simple if the period is changing, either continuously or erratically as shown below.

Rather more interest has been taken in the pulsating variable field and a quick look at the GCVS will reveal many stars where the periods are thought to be changing. The most common examples are Mira stars where alternating periods make it almost impossible to determine a true period in this manner. The figure below shows epochs of maximum over a century and, whilst the average period of U Tucanae is close to 260 days, a period derived from any two epochs will usually differ from this.



Shown here are epochs of maximum of the Mira star U Tucanae. Three periods are immediately evident—a mean period close to, but probably a fraction of a day more than 260 days. This is made up of two alternating periods—a shorter period of ~257.7 days and a longer period of ~263.5 days. The vertical scale is days early (-) or late (+) and the horizontal scale is cycles since 1893. ASAS3 data is not included but would be interesting.

This illustration gives much other information. At times there are brief changes from one period to another, sometimes the mean period dominates. Unfortunately this means that an analysis of any ten year interval will provide a period close to the true one, but still incorrect due to the reversions. We're probably looking at periods of 256–265 days making up a mean period of 260.2 days.

Is the period changing? How can we tell? This is the most discouraging feature—namely that it's almost impossible to deduce an answer from the data available. We might compare the slopes and say—yes, the rises are steepening—but the declines are also steepening. Maybe the amplitude of the alternate periods is increasing?

This is the whole concept of the O-C Diagram. It takes an average period for a star and calculates epochs of a certain event—in this case time of maximum brightness—and then plots the observed deviations against this. It gives a good historical view of what's happening—something for the theorists to explain. Not all O-C diagrams are so puzzling. Binary star evolution suggests that the deviations, if any, will fall along a parabolic line which is easier to explain.

The advent of computers has allowed some different approaches and these have their uses—but their limitations need to be understood. Provided there are observations covering more than a single cycle these can

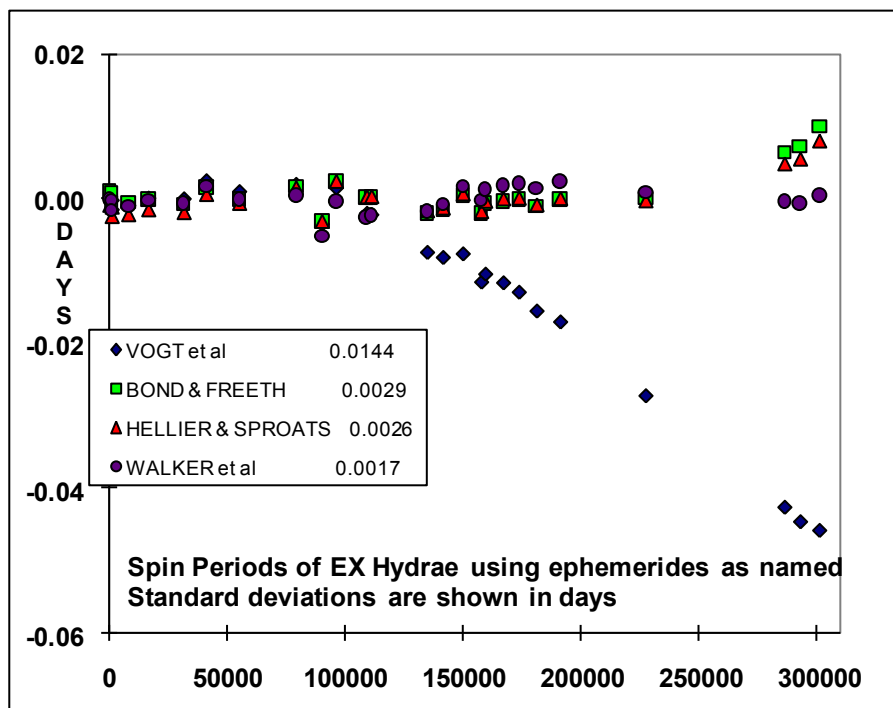
be tested to find the best fit to a repetitive light curve. But 200 measures per cycle over 3 cycles will give a far more accurate picture than a total of 30 measures over 2 cycles—and to be really useful the baseline should be many dozen, even hundreds of cycles in length.

One field where high numbers of measures are obtained is in time series photometry of CVs and it is usually possible to determine an approximate period of a newly discovered CV in a single night. In contrast the BVRI measures of V641 Centauri by Neil Butterworth discussed on page 5 could not provide a period—but the ASAS3 database with about a thousand measures over ten years largely resolved this problem. So these computerised methods provide a good approximation of the star's period but probably not better than 1-2%.

Determining epochs of some particular event on the star—maximum light is usually the best for pulsators, mid-eclipse for eclipsers—is laborious. So several different computerised techniques have evolved. One of the most common is wavelets, with ampscan and others also used. The problem here is resolution—small, short term period changes are hard to detect. Others take data samples from ends of a long time interval of data and examine these for secular changes. Most of these would determine that the period of U Tucanae is constant but noisy.

The quality of the measures is important. CCD TSP of CVs is usually internally consistent at <0.01 magnitudes whereas visual LPV measures are at about 0.2-0.5. But this latter is adequate given the large amplitudes of the target stars.

One CV that has been studied for a long time is EX Hydrae. George Mumford began measures of this star about 1960 in the belief that it might show evidence of period changes due to gravitational radiation. Here we get two for the price of one—EX is an eclipsing CV but is also an intermediate pulsar. So there is an ~98.25 minute eclipse cycle as well as an ~67.03 minute spin cycle of the accreting white dwarf. This makes for messy light curves and the near 3:2 resonance is no help. A graph of the O-C spin cycle appears below.



This shows seasonal epochs of EX Hydrae up to 2002. These are obtained by fitting a sine curve to observations made over a series of nights—usually comprising about 50-200 cycles.

The original analysis by Vogt et al assumed a constant period. It is clear that this is not the case. Bond & Freeth and later Hellier & Sproats calculated parabolic elements—much closer, but now diverging.

Observations made by Stan Walker, Bill Allen, Jennie McCormick and Fred Velthuis seem to suggest that the white dwarf spin period is subject to small but abrupt changes.

We're hoping to analyse measures made by Neil Butterworth to update the plot.

When this level of accuracy is needed then the slowing of the Earth's spin must also be taken into account. We're running a couple of minutes late, maybe more, compared to time in 1900. There is no possible way that period search routines can provide the extreme level of accuracy required in this type of situation.

What the O-C diagram cannot do quickly is handle multiple periods. Many stars have two or more periodicities. One of these is probably V641 Centauri as shown on page 6—the main period of ~83 days is modulated by the ~68 day period resulting in amplitude and shape variations of the light curve. The convention is to use the stronger period although with polars and intermediate polars plots of both periods are normal.

Equatorial Eclipsing Binaries Project

Tom Richards, Project Leader

The target for this project until April is **CU Hya**. Results are already coming in, discussed below. When planning your observations, you can find times of minima by downloading and using the spreadsheet on our website at **Info and Resources > Useful Calculators**. Margaret Streamer suggesting adding a local time column, so I've done that. Just insert your offset from UT in the **Enter Data** panel.

UV Psc was observable from about October to February. Neil Butterworth in Townsville provided good data on the secondary and primary minima on October 26 and 29 respectively, in transformed B and V. In the primary eclipse, a reddening of ~ 0.1 mag in B-V was observed, see Figure 1. That indicates the brighter, eclipsed, star is bluer than the secondary. Neil's observed out-of-eclipse colour (B-V ~ 0.92) is quite close to published values (~ 0.8) – an excellent result. Neil's work is very high quality; he observes with a 200 mm SCT on an altazimuth mount from his driveway.

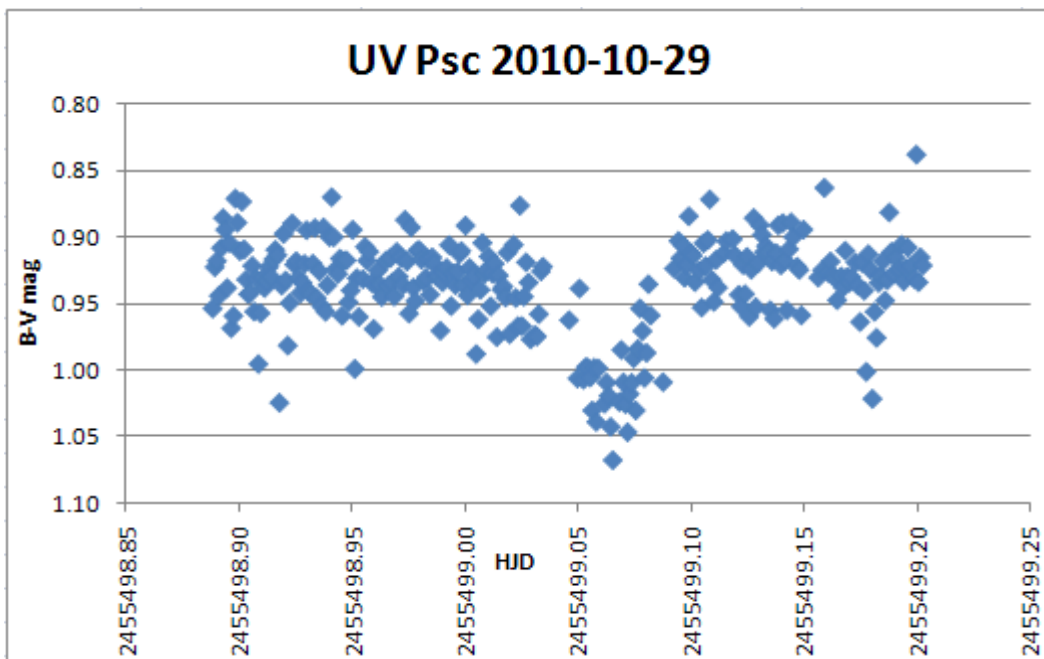


Figure 1.

Changes in B-V colour of UV Psc at primary eclipse on 2010-10-29, from data by Neil Butterworth.

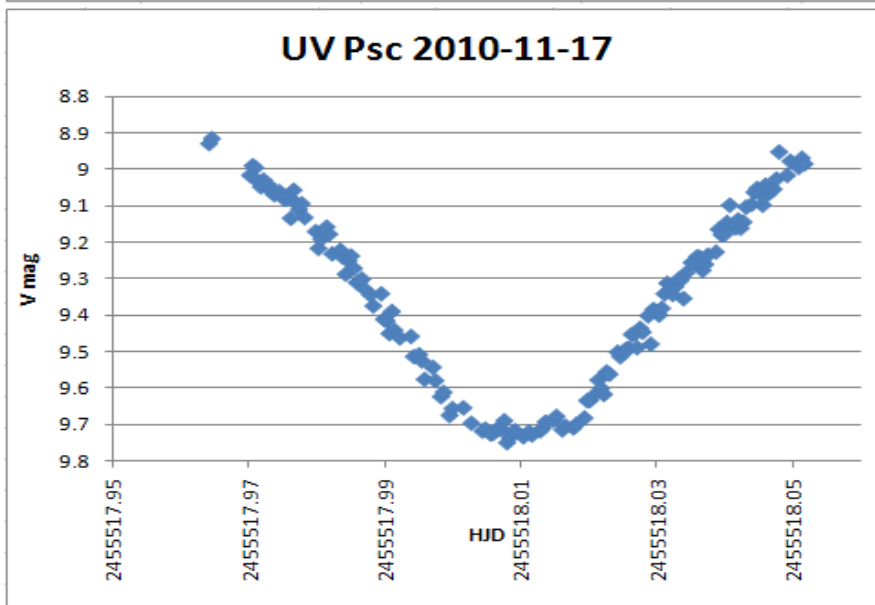


Figure 2. Primary eclipse of UV Psc on 2010-11-17, observed by Margaret Streamer.

Then the monsoon season closed in on him and Margaret Streamer took over in Canberra, with two nights in November. Figure 2 shows her very good primary eclipse. Then floods and house moving understandably took up her time!

Roger Pickard then took up the baton during an unusually bitter English winter, providing no less than nine heroic nights of data in December and January.

The season is closed now, and I'll analyse and write up the results shortly. Meanwhile, thank you all three for your data.

CU Hya is well placed for observation now until April. Roger Pickard has already provided some data (Figure 3). Last season's results were discussed in the *Newsletter* for August 2010. It would be good to finish off our study of this star, but we need more observations of the secondary eclipse and colour data (B and V, transformed or not) for all phases.

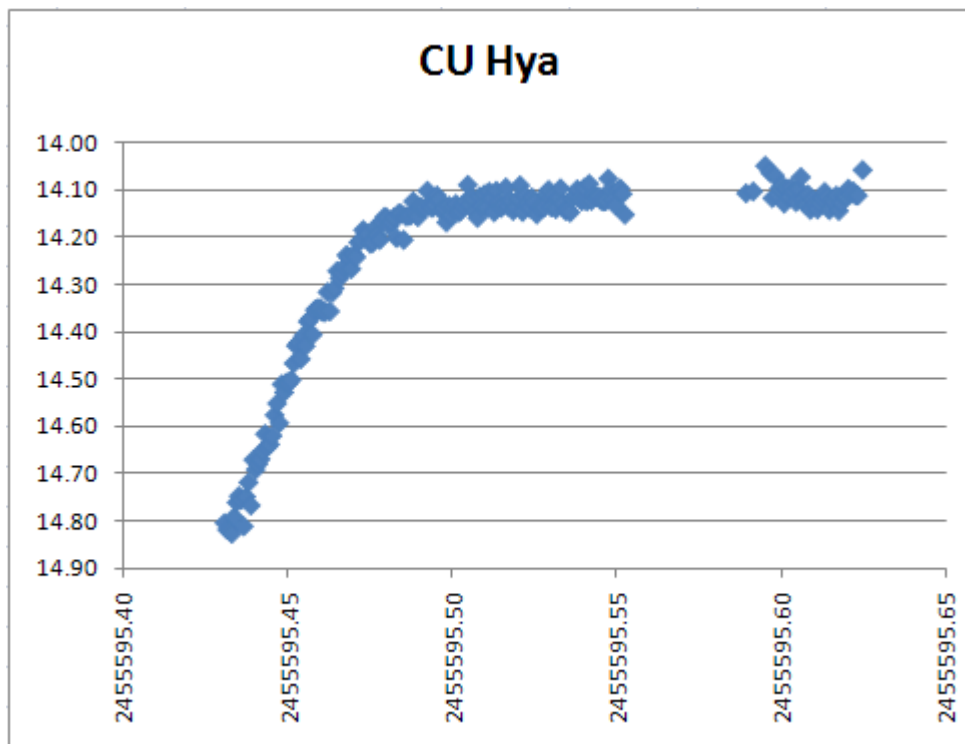


Figure 3.

Ascent from a primary eclipse of CU Hya on 2011-02-02. V mag vs HJD. Data by Roger Pickard.

MORE NEWS ABOUT BSM SOUTH

Peter Nelson

pnelson@dcsi.net.au

In the last article I described BSM South which is being set up in Ellinbank, Victoria. Reference to the first Bright Star Monitor in the Northern Hemisphere can be found at: <http://www.aavso.org/aavsonet> <http://www.aavso.org/bsm> Links to the construction of BSM South can be found at: www.ellinbankobservatory.com

Experience has shown that physical construction of BSM was the first half of the venture. Getting to learn the software, particularly ACP and Scheduler has been the second part. We are pleased to announce that BSM became fully operational on 25/2/2011. Leading up to the full operation, problems such as the Celestron CGEM driver becoming lost in the computer played havoc. However, everything came together, and images were acquired through ACP/MaxIm, zipped into a folder and then sent to AAVSO. As each image is stored the upload is initiated. I was concerned about my network speed (which is wireless, the Telstra broadband cable is not available at home). Fortunately, my internet provider upgraded my system and has enabled me to get a good transfer rate, almost comparable to cable. This is good, as each zipped image is 1.5MB, and working full tilt we expect about 500-800 images a night.

If you have an interest in brighter variables and would like data on them, please feel free to send your request to: pnelson@dcsi.net.au.

Thanks,
Peter

The AAVSO All-Sky Photometric Survey (APASS)

Arne A. Henden Director, AAVSO

(arne@aavso.org)

Through a grant from the Robert Martin Ayers Sciences Fund, the AAVSO is conducting a 5-filter photometric survey of the entire sky. Like what UCAC or USNO-B has done for star positions, APASS is designed to provide calibrated magnitudes for nearly every star in your field of view. It saturates at $V=10$ and has a limiting magnitude of about $V=17$, and obtains photometry through the Johnson B and V filters, along with the Sloan g' , r' and i' filters. Each star will be imaged once on each of four nights during the course of the survey.

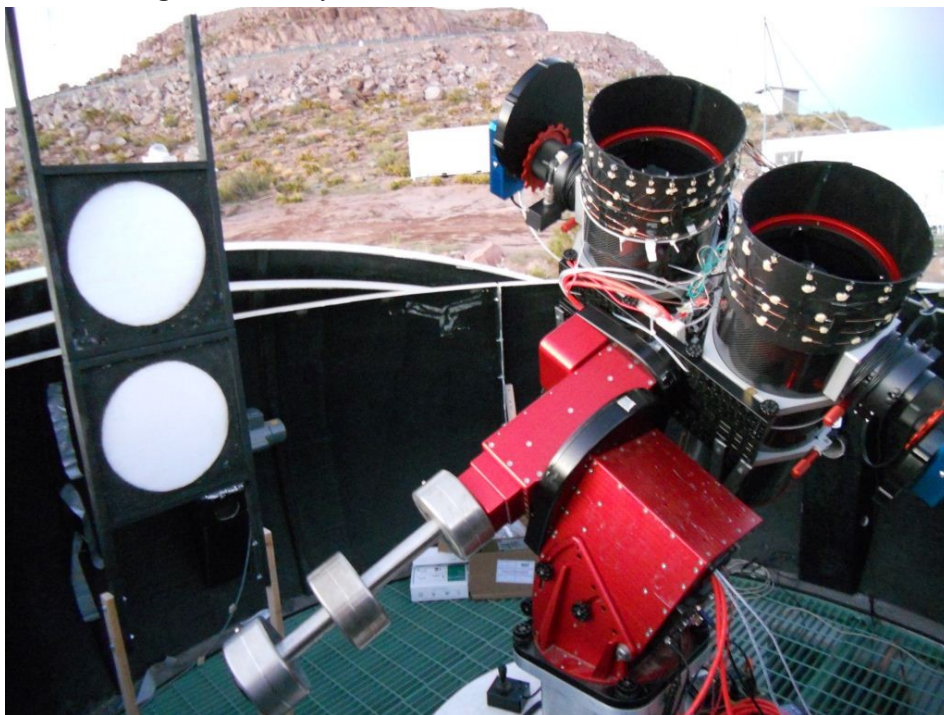
The survey is being conducted at two sites. In the north, a system is set up at Tom Smith's Dark Ridge Observatory in New Mexico. In the south, we have an identical installation at Cerro Tololo Inter-American



Observatory (CTIO). Each system consists of twin ASA 20cm astrographic Newtonian telescopes on a common Paramount, with an Apogee U16m 4kx4k CCD camera and filter wheel attached to each telescope. Both telescopes point to the same location in the sky. During the observation of a given field, one telescope takes images in B and g' (the blue filters, with longer exposure times); the other telescope takes images in V, r' , i' (the red filters) during the same time interval. In this manner, we can cover about 500 square degrees of sky each clear night, with additional images of standard-star fields during the night to accu-

The APASS-north installation at Dark Ridge Observatory, Weed, NM.

rately calibrate the results. So what is the benefit to you? The Tycho2 photometric catalog does a pretty good job of calibrating the bright stars for your research; say down to about 10th magnitude or sometimes a bit fainter. Below this, however, you have to rely on either crude magnitudes from the photographic surveys, or find someone with good weather to calibrate a sequence around the object that you wish to study. Many of the southern variable stars do have good sequences; Mati Morel has



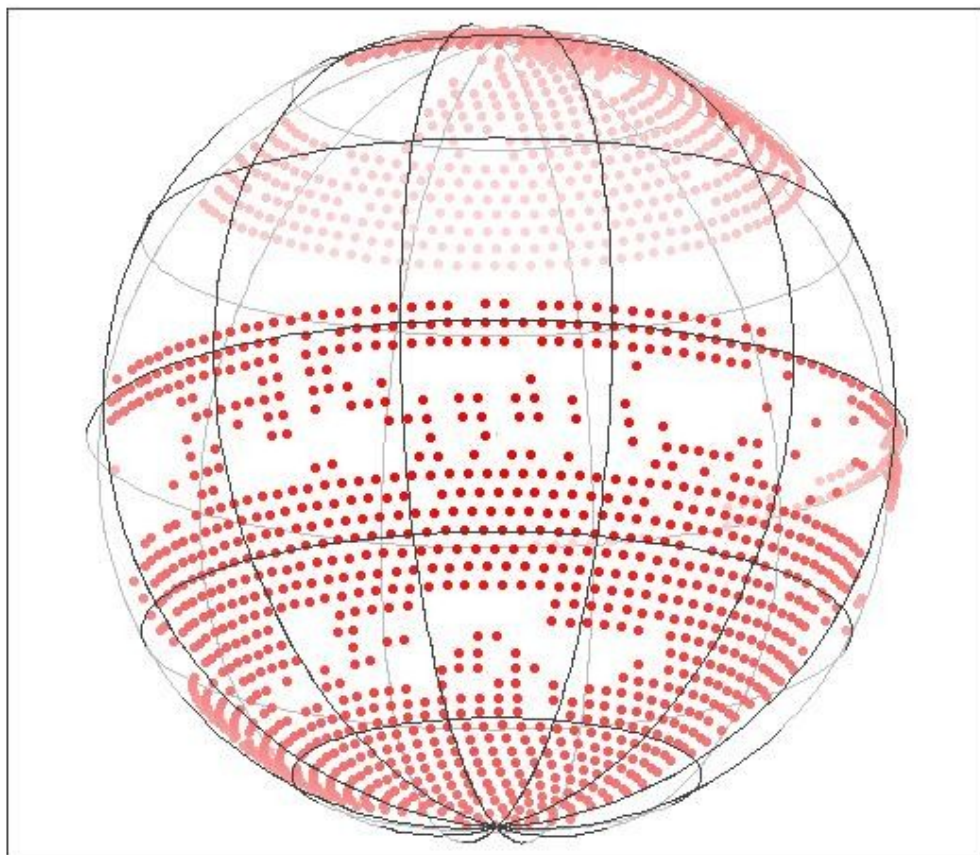
The APASS-south installation at the CTIO site in one of the PROMPT clamshells.

done an excellent job of finding calibration photometry near southern variables, and in many cases defining a set of sequence stars for you to use. Still, there are lots of important variable stars in the southern sky that never get observed because no one has set up a suitable observing sequence. APASS gives the sequence maker the raw material: a list of stars with magnitudes and colors so that you can choose the right spread in brightness along with consistent color to help the observer estimate the brightness of the target.

The usefulness extends beyond this simplistic description, of course. If you are using a CCD system to monitor the rotation curve of an asteroid, the APASS catalog will give you calibrated stars as the asteroid moves from one field to the next during the course of several nights. If a new nova or supernova is discovered, you can immediately measure its brightness with respect to known stars. If your research requires a list of all the blue stars in Norma, you can search the APASS catalog and pick them out. Other researchers are using APASS to calibrate photographic patrol plates of the SMC, or to monitor the brightness of geosynchronous satellites. Having calibrated photometry everywhere you can look is a tremendous time saver for the professional observatory, as they no longer have to observe standard fields to calibrate their research targets.

APASS issues "data releases" every few months. Right now, DR2 is available, including coverage of the re-

gion from about
RA = 0 to
RA=10hours and
DEC=0 to DEC=-89
degrees. We ex-
pect to issue DR3
during May, ex-
tending the south-
ern coverage to
include nearly the
entire southern
sky. The survey
still has another
two years before it
is fully complete,
but these interim
releases are of high
quality. There are
two main methods
of accessing the
catalog. You can
use a simple inter-
face to query
based on coordi-
nates and magni-
tudes, returning an
html table of stars.



A 3-D representation of the fields that have been covered by APASS, with RA=5hours in the centre. Each dot represents a field centre for which at least two nights of calibrated data are available.

Or, you can use

our Seqplot Java

display program and get a graphical display of a field, and with an interactive cursor, click on any star and obtain its information. Both of these access methods are given on the web page below. The AAVSO Sequence Team is also available to help provide sequences around any southern variable star that is of interest. Contact Tim Crawford (tcarchcape@yahoo.com) to request a new sequence. Such sequences can be plotted using our Variable Star Plotter (<http://www.aavso.org/vsp>).

You can read more about the APASS survey at <http://www.aavso.org/apass>. If there is any other way that we can help the southern observer, please do not hesitate in contacting me!



This final illustration is the SMC, as taken from CTIO using the Sloan g'/r'/i' filters. Note that this makes HII regions turn out turquoise since H alpha falls mostly in r', which is mapped to "green" in the RGB conversion.

CORRECTION NEEDED

In the article beginning on page 26 of the 2010 November Newsletter there was a formula to derive V using the methods described. This was copied from the original article but when I came to use this on some of Mark Blackford's measures I remembered that there was a typo back in 1972. The formula should read

$$V = (dv - (SF * (dB-V)) + Vc$$

where dB-V is the B-V of the variable (as computed first from the observation) - the catalogue B-V of the comparison. Note that B-V of the target star must be calculated first.

ABOUT VARIABLE STARS SOUTH

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.VariableStarsSouth.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 here too.

WHO'S WHO

Director Dr Tom Richards, FRAS.

Treasurer/Membership Bob Evans

Newsletter Editor Stan Walker, retiring, see page 3.

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

MEMBERSHIP

New members are welcome. The annual subscription is \$20NZ, and the membership year expires on April 30th. 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 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 egroup (see above), and you will also receive a password to access the members' areas of our website.

NEWSLETTER ITEMS

These are welcomed and should be sent to the Editor. I'd appreciate them unformatted, with figures and tables separate, although if you wish a particular layout send a format-ted version *as well* and we'll ensure that this is followed as closely as possible. The main problem occurs when figures or tables run over into the next page but this is not usually too difficult to overcome. Publication dates are February, May, August and November—the twentieth day of these months—copy deadline is the first of each of these months.