



*The SPADES working group at lunch hosted by Margaret Streamer.*

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### It's subscription time

Yes I know you don't have to subscribe to read this *Newsletter*, explore our website and its forums, or even contribute to a VSS project. But it's the subs that make this largesse possible, and especially the research grants we grant to our members (for very good VSS-related reasons, of course.)

Twenty little old NZ dollars, or 30 to join. Do it on our website, at About VSS > Join/Renew. Deadline 30<sup>th</sup> April, please! If you joined in March or April, your sub is valid until 30 April 2014. For your interest, membership hovers around the 50 mark, with maybe half actively contributing in some way.

### RASNZ Conference, Invercargill, May 24-26

Lots of good stuff here, according to the preliminary programme. There's John Hearnshaw (U Canterbury) on his new spectroscopy book, Richard Easter (U Auckland) who researches in cosmology (topic tba), Bob Evans giving the Fellows Lecture reflecting on NZ amateur astronomy, two variable star papers and a poster by me, and a range of other topics. There's no doubt more to be announced but it's not on their website yet (<http://rasnz.org.nz/Conference/#rasnz>). Stan Walker tells me he's submitting something.

I'd also like to have an informal meeting sometime with everyone interested in variable stars, VSS members or not, to discuss our work and where we're heading. Bring along your views!

### VSS research grant to Mark Blackford

Mark (Sydney, NSW, Australia), now regarded as a major authority on DSLR photometry on variable stars, has been invited to attend a closed AAVSO DSLR photometry workshop as a team leader and speaker. This workshop should have important repercussions for DSLR photometry worldwide, and help strengthen our ties with AAVSO. Because of its importance and Mark's core role, he's been granted NZ\$750. I do believe that DSLR work will greatly expand the opportunities for amateur astronomers to do serious variable star research, and I'm looking forward to the growth of this area of VSS under Mark.

### Expansion of VSS eclipsing binary research

As a result of the workshop on SPADES and our eclipsing binary research over the weekend of 16<sup>th</sup> March, the eclipsing binary research group (ten of us) have decided on a big increase in the width and depth of VSS eclipsing binary research. We were doing most of it anyway, but it takes a focused meeting like this to pull it all together. In this Newsletter you will find a major article by me on the new Southern Eclipsing Binary Programme. The existing Equatorial Eclipsing Binaries and SEB-DSLR projects are absorbed into it, and SPADES, looking for exoplanets utilising the light time effect, now becomes just one of six research goals.

The new project is designed for participation by anyone with a camera on the end of their telescope – DSLR or CCD, so long as they can track a star overnight through its eclipse. It is also designed to attract those who want to do computer analysis of observational results as they come in, and even tackle some astrophysical research. (Professionals welcome – we do not discriminate on grounds of employment.) Contact me if you want to try your hand at observing or analysis; and mentoring and guidance will be at hand for you.

Have a read too of George Stockham's article in this Newsletter, where he summarises some of the analysis issues we tackled at the workshop. And be patient if you're looking on our website for the new project – it will take a while to get everything up-to-date. But if you contact me I'll put you in the loop of all developments in the meanwhile.



# Photometry for all (or many) – Tom Richards

Tom Richards (Programme Coordinator) and the Eclipsing Binary Research Group  
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## The new Southern eclipsing binaries programme

Can you put a camera on your telescope – CCD or DSLR? Can your telescope follow one star all night? Then you can join in the Southern Eclipsing Binaries Programme. Would you like to do some computer work analysing the eclipsing binary data submitted by the observers? Whether as observer or analyst, you can join in the Southern Eclipsing Binaries Programme.

VSS has had several eclipsing binary projects up till now – Equatorial Eclipsing Binaries, SEB-DSLR (including the Eta Muscae Project) and SPADES. At the SPADES meeting in Canberra in March, the ten of us decided there was no good reason to keep these projects separate; so we're combining and expanding them and asking you to join in.

## A research programme of observation and analysis

Eclipsing binaries (EBs henceforth) make excellent and valuable targets for night-long time series observation. Find a target that's expected to eclipse that night, set everything going, and go to bed. Over the night your camera will be taking images of your binary till dawn do you part. That is the ideal; in fact you can collect useful data in runs of 4-6 hours, especially for short period variables. German equatorial mounts will require attention when a meridian flip is due.

In the morning you have some hundreds of images. Calibrate them (biases, darks, flats as usual) then carry out photometry – you will be told what comparison and check stars to use. The result: an elegant

eclipse curve as in Figure 1.

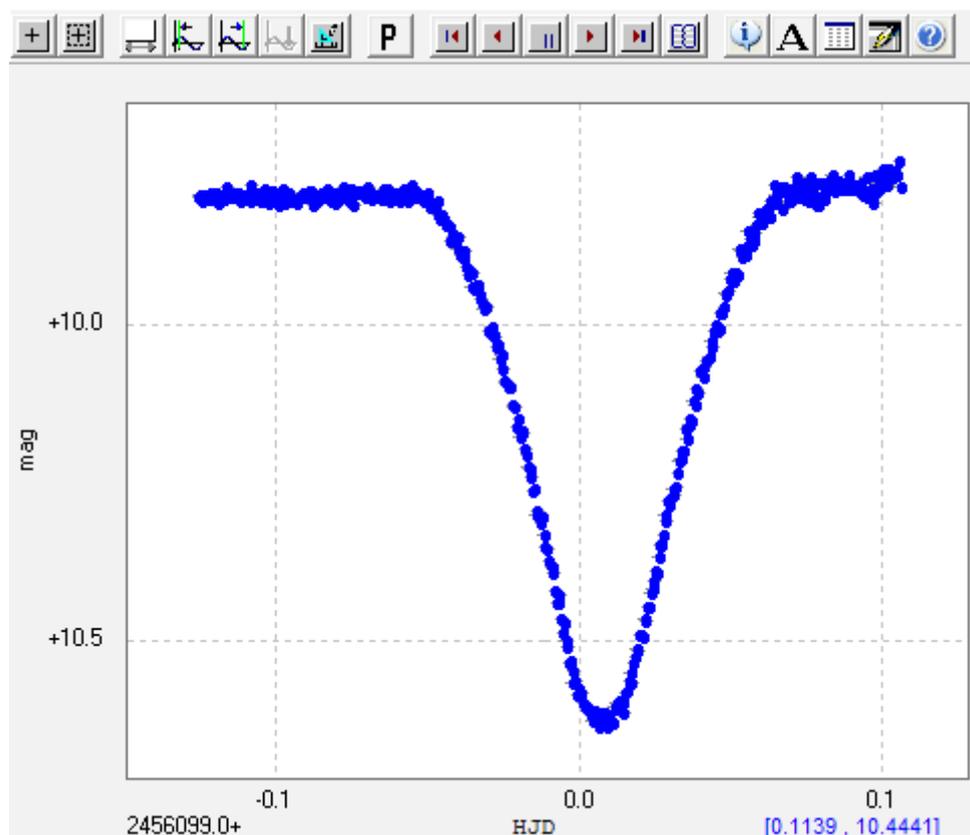


Figure 1. An excellent night's results on AF Crucis by David Moriarty.

Then the analyst steps in. Each EB target is assigned an analyst who receives the observational data from anyone who observes it. The analyst then uses software to find the time of eclipse minimum, which is immediately recorded in our public online VSS Eclipsing Binary Database (see Richards, JAAVSO 40(2) 2012, 983-5). If we have enough minima for that target, the analyst can combine them to derive light elements (the period plus the zero epoch – exact time of one minimum) – from which future eclipses can be predicted. Our light elements, usually much more accurate than existing ones, also go into the VSS EB Database.

For some targets the analyst might decide to take the research process much further. By asking for

observations at any phase of the orbital cycle, not just eclipses, the analyst can start cobbling together a complete light curve – a result of great interest in itself. See Figure 2. And once you have that light curve

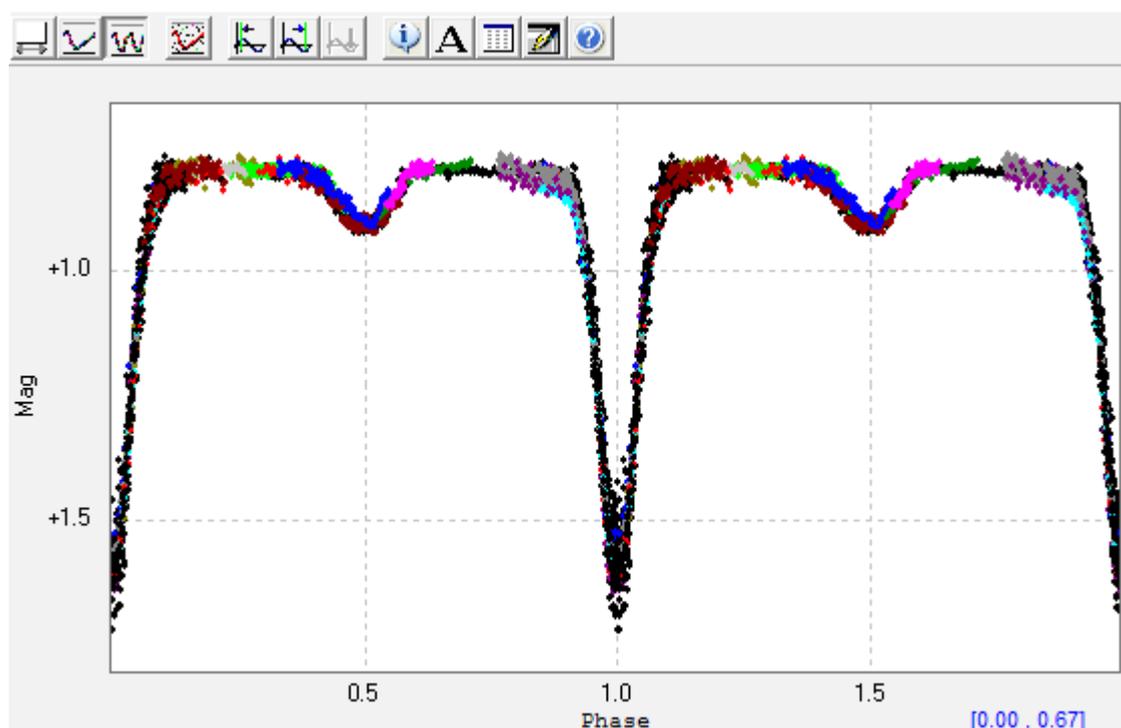


Figure 2. A phased light curve for CU Hydrae synthesised from 52 observing runs by seven observers in the Equatorial Eclipsing Binary Project, now included in the SEB Programme

and a little other easily obtained data, plus one or two acceptable assumptions, you can start using software to derive many astrophysical quantities about that system – orbit and star sizes, their temperatures, shapes, relative masses, and more – even starspots. Figure 3 shows a 3D model of one system we have analysed. Output files created by the analyst are also stored online, available to all SEB team members.

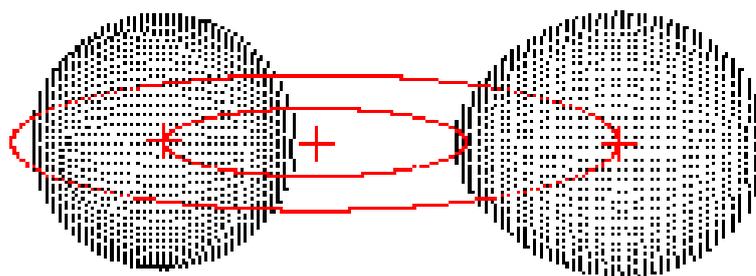


Figure 3. A model of the CU Hydrae system, derived from the light curve in Figure 2 by Col Bembrick

Investigations of the literature on a target system are always important and are part of the programme. Here you might find that the only photometry ever done was at discovery, maybe a century ago, and often poor since it was photographic. For such badly-studied systems, all too common in our southern skies, getting reliable up-to-date photometric data is plainly very important. In other cases there may be some measured minima times in the literature, from which we can prepare so-called O-C diagrams – observed versus calculated times of eclipse minima – to detect if the binary is changing its period, or even undergo-

ing cyclic variations in period. Cyclic variations are extremely important as they may indicate the presence of an unseen third body in the system – perhaps a planet. That is the rationale of the SPADES Project, one goal of many in the SEB Programme. But often such historical minima data can be poor, so then period change and cyclic variations must be detected in our own data, usually needing a few years to show up.

Aside from all these research goals, the unexpected can always turn up. We have already discovered that three well-known bright EBs have a pulsating component; a situation of the greatest importance in studying pulsating star behaviour and evolution. We will be announcing these soon.

All of these results are worth publishing in refereed journals, and the SEB research group will be doing just that, with the name of every significant contributor – observer or analyst – in the author list.

## **Valuable contributions to valuable research**

So why should you join in the SEB Programme? And why are these EB systems worth studying?

Join in because it's fun, instantly rewarding, and you will be contributing valuable scientific data. Since we lay out everything you need to know and do for each target EB in the programme, you can produce good and important data the very first time. You should join because we need more observers and more analysts, so we can make headway on the big number of under-observed bright EBs in the south. And you should join in if you're not deeply into deferred gratification – because your night's work can show an entire beautiful and valuable eclipse curve.

Why are EBs worth studying? The behaviour and evolution of close binaries is not as well understood as for single stars, for which we have rather better models covering their entire lifetime. Close binaries interact gravitationally, by their radiation on each other, and through mass transfer and mass loss from the system thus changing their masses, sizes and temperatures radically. Cataclysmic variables and novae are just two instances of close binary behaviour. When photometric data are combined with spectroscopy for EBs, we can find out far more about the astrophysics of the system, and far more accurately, than we can for other stars or non-eclipsing binaries. It is, for example, the only direct, accurate way of finding stellar masses. So they are exceedingly important and revealing laboratories. Our photometric work on each one of them, important in itself, may reveal many unexpected and intriguing features worth following up on big telescopes by us or professionals.

## **Getting started**

At the time of writing this article, the VSS website, [www.variablestarssouth.org](http://www.variablestarssouth.org), hadn't caught up with the new SEB programme. But read about the SPADES Project and you'll get a flavour of what's involved – except that the observing requirements are very much relaxed. Your equipment now needs to be just a telescope of any size with a good drive, and a CCD or DSLR camera on the business end of it. Three software items are necessary: one for camera control, imaging and image processing; one for aperture photometry; and one to keep your computer clock synchronised to an atomic clock. You probably have the first, and the other two are obtainable as freeware. And that's about all you'll need.

For measuring times of minima in eclipse data we don't need filtered images – and that job is of course the first and basic step in all our work. Nevertheless, photometric filters are a boon, and if your results are to be used in constructing and analysing light curves, images need to be filtered. If you have photometric filters it is best if your data are transformed to the standard photometric system; but if you don't have filters or your transformation coefficients, your data are still most valuable. You'll find far more detailed information about observing requirements and how to observe and analyse, in the SEB Programme area of our website.

Contact me ([tom.richards@variablestarssouth.org](mailto:tom.richards@variablestarssouth.org)) if you want to give EBs a go, and Mark Blackford ([mblackford@bigpond.com](mailto:mblackford@bigpond.com)) if your camera of choice is a DSLR. We'll make sure you know how to start, we'll point you to targets, and we'll provide mentoring. And if doing analysis sounds good, we'll show you how to do that too.

So why not join in?

## An observatory to focus on variable stars — *Carl Knight*

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### The building of Ngileah Observatory 40°08' S 175°22' E

I've always been interested in astronomy. In 2004 the opportunity arose for my family and I to go and live in the UK. I worked in the banking sector not far from the Bank Of England. Coming from New Zealand where everything related to astronomy comes at a premium, living in the UK meant that a telescope was finally an option. I bought a three inch Newtonian. I was hooked. That became an eight inch Newtonian. Then I bought my twelve inch SCT. In 2005/2006 I joined the British Astronomical Association (BAA). There was so much on offer and I was observing anything and everything the UK climate would allow.

Where we lived in the UK was six miles south of Cambridge. I was a scant 15 minutes from the Institute of Astronomy at Maddingley. I was able to attend public lectures and events at the Institute. One of these that was a real highlight was a presentation of preliminary results from the ESO studying the orbits of stars about Sagittarius A\* and the determination of its mass.

Working in London, BAA meetings at Burlington House in Piccadilly were easily accessible. It meant being able to meet and talk to people of like mind.

I decided to focus on what interested me most. I became active in the BAA Deep Sky Section first. I found myself drawn to deep sky objects that are the result of late stellar evolution. Planetary nebulae and supernova remnants and their progenitors fascinate me. This led naturally to variable stars.

I started observing variable stars in 2008. I quickly realised I needed to be organised. I created a wall chart of constellations culminating in a spreadsheet so I could quickly see what was likely to be best placed for observing. I organised my charts by constellation. Alert targets by RA first, then everything else by RA. I was visually observing a variety of targets that I chose to be within the capabilities of my telescope at least at brightest.

I read Col Hellier's book on CVs, how and why they vary and I was fascinated. I re-read the book as soon as I finished reading it to try and take it all in.

I attended a get together of the BAA VSS and the AAVSO held at Cambridge University. I found the speakers fascinating on all variety of topics and I found myself feeling very much at home in the company of people who shared my interests and passion.

Regarding the practicalities of observing, we were fortunate to have a detached house. This meant our house and yard was not as narrow as it otherwise might have been. Because of the early hour that the sun rises in summer in the UK, my wife had made black out curtains for the children's bedrooms. She additionally made a blackout curtain that velcroed around the window frame for the upstairs toilet and bathroom for me. That meant that there was at least one direction from which I could control light pollution. Our landlord allowed me to install some concrete pavers in our backyard. I found the sweet spot in our tiny backyard that afforded the most shielding from artificial light. I bought a hood made of black blackout cloth, like an old photographer's hood to further shield myself from artificial light. With the hood on, like some sort of medieval monk, I observed in a backyard partially illuminated by the universally bad street lighting chosen by councils everywhere, further illuminated by neighbours' house lights and forgetful family members who left lights on in the only places not protected by the black out curtains.

The highlight of my variable star observing in the UK was being the first to observe and report the 2008 outburst of the dwarf nova UW Trianguli. UW Tri had not been seen in outburst prior to that since 1995.

During 2008 the bottom fell out of banking in the UK. My wife and children were ready to return home and I'd told people at work as much. So when the I was made redundant at the start of 2009 in the third round of redundancies in the business in twelve months I simply said, "It looks like we're heading home."

We were back in New Zealand by February 2009. I had every intention of seamlessly continuing by variable star observing. I attended the first VSS Colloquium in Wellington. In June of 2009 we bought ten acres 40km from Palmerston North and about the same from Wanganui. My wife Louise and I chose the property from three we were looking at after she organised a drive around all three at night so I could check

the light pollution and night sky – that was her idea, not mine because she was concerned she'd never hear the end of it if we bought somewhere with light pollution issues after what the UK had been like.

The property needed a lot of work. It was ten acres with a single fence dividing it in half. It is very dry in the summer and very wet in the winter. 35cm of soil to a clay base ensures that. I found myself fencing, fixing, feeding animals with little time for any astronomy and more often than not the set up time for the telescope prohibiting what I could get done.

I still managed to write articles for the Webb Deep Sky Society Journal, to prepare and give talks on various topics to my local astronomical society, and to do observations for the BAA Deep Sky Section, but infrequently and certainly not in an organised fashion.

I find it difficult to do things other than how I want to do them. My variable star observing had shrunk to nil. I decided I needed to do the following before I could properly pursue it again:

- Get our stock properly controlled. Cattle, sheep and goats don't know they should respect things like telescopes. That meant getting the fencing done. I have observed with the assistance of our goats in particular. They are the most inquisitive of our stock.
- Give the telescope a permanent home with as little set up time as possible.

Breaking down the reasons I was not getting the observing done that I was increasingly desperate to do, there was a simple problem to be solved.

Plenty of observing opportunities of one to two hours, but it took too long to set up the 12" SCT to take advantage of them. There were also many more occasions where forecast cloud prevented me from setting up only for said cloud to not eventuate, or worse still, after taking the time to set up and align – something in the region of an hour – the cloud would set in and I would have to have to pack everything away again.

The solution was an observatory.

Whatever design I chose it would have to alleviate the next big problem after the set up time and my airborne watery nemesis ("cloud") which is wind. We are located on the plateau on State Highway 3 as you head from Bulls towards Wanganui. Great skies and horizons but you discover what the "roaring" is about in "roaring forties". So wind is the next big issue. Trying to observe with the scope being buffeted by wind is difficult to say the least.

And finally there are the children who despite the best of intentions forget that Dad really does not need artificial light to suddenly burst forth from their bedroom windows when trying to observe faint variables.

Originally I was looking to build a dome, it was very quickly apparent that the money available was not going to stretch that far. So having ruled out a dome as too expensive, I decided to explore the idea of a roll off roof observatory. Some of the requirements I needed to consider were:

1. It must shelter the scope from the wind. This will require high sides with the possibility of one side opening to the North to provide views to the horizon.
2. The roof must roll off and on easily as high sides will limit the amount of "push" I can give from on top of steps or a ladder.
3. It must be weather proof.
4. It must be made of permanent materials. I don't want to have to do this again for a while.
5. A pier – if I can't afford one now, I must not preclude the installation of one later.

I had a look at various designs on line and visited Steve Chadwick, a member of the same astronomical society I belong to. Talking to Steve it was readily apparent that neither of us would make much use of skies below about 30° in altitude due to their soupy nature anyway. And indeed, just talking over my observing with Steve, I realised I rarely if ever did observe that low on the sky anyway.

I began to contact the local manufacturers of suitable sheds to modify. Mentioning modifications and observatories seemed to result in some not even returning phone calls or emails. They wanted to sell me a shed and send me on my way and were not interested in anything else. I won't mention them in the article, but I will mention the people who were more than willing to supply everything I needed.

I looked at a design next where the roof rolled back but could never satisfy myself that it was sufficiently weather proof.

My next design was a roll off roof with what I called a “shoebox” flashing around the top of the walls for the roof to lift off and on of. By this stage I’d found a supplier, Totalspan Manawatu, who was not terrified by my intention to do something different with their product. They made sensible suggestions, discussed my design, pointed out structural weaknesses to reinforce and were willing to supply a kitset and the additional materials I needed.

Subsequently my next design was made with their Utility 9 Shed in mind. The difficulty, having decided on a flashing that allowed the roof to lift on and off like a shoebox lid, therefore providing excellent weather proofing, was a mechanism to lift said roof.

My first design attempt was overly complex and I believe if made, would have been prone to mechanical failure.



*Figure 1. Lift and rollback.*

With this in mind, I went and spoke to a neighbour and friend of mine who happens to be an engineer. His suggestion was far simpler, more robust, met the weather proofing requirements and was the final design chosen.

The notion was to use enclosed garage door track and rollers as these solve all issues with guiding the roof back and operating smoothly, and to have a 90° lift and roll back design (Figure 1 and Figure 2). The rear roller is at the top of the roof, the front roller is at the bottom of the roof and the difference between the two provides the lift necessary for the roof to clear the “shoe box” flashing.

We had already purchased the Utility 9 Shed from Totalspan Manawatu.

A company called Diamond Homes was more than happy to manufacture a flashing for the top of the walls to my specifications.

Through Totalspan Manawatu I got in touch with Glideaway Garage Door Systems and they provided the garage door track and rollers.

There was quite a pause waiting for ground conditions to be suitable, finally in the 2012 Christmas Holidays the build got underway with assistance from one Ian “Coops” Cooper Esquire. Ian is the president of the Palmerston North Astronomical Society and a bit of a character.

The first thing that was built was the frame for the roll off roof. My neighbour welded the 80mm x 40mm C section for the roof and welded the rollers in place.

We broke ground for the foundation, got it wrong, moved south 3m and started again. Rather ambitiously I was going to build the whole observatory in the three weeks I took off work for Christmas. After the driest November on record the ground was horrendously hard to dig. Everything took way longer. I had to wet the ground and wait before I could drive in pegs to any depth, let alone excavate the foundation.

I ran alcatene pipe between the house and the observatory. Eventually this will carry power to the observatory.

By the last day of 2012 it was ready to receive a concrete pad. The concrete pad was poured with the help of Ian Cooper and a friend of mine, Ronald Van Maarseveen.

The framing went up by the middle of January, and the cladding was on after that in short order. My son Joshua helped with a lot of the work. He was a willing pair of extra hands for all of those moments when three or four hands are required.

By the end of January the “shoebox” flashing (Figure 3) was on, and the concrete was poured to secure



*Figure 2. Handles for the lift.*



*Figure 3. Shoebox flashing.*

The sun had set by the time I was finished, but I still took some photos to celebrate.

The roof rolls on and off as smoothly as platitudes from a politician's tongue!

As luck would have it, there arrived some horrendous thunderstorms in the next few days after getting the roof on. In the heavy rain and wind the observatory passed with flying colours.

Once I was happy with the observatory's weather performance I performed the final step: install the telescope.

Since then I have been organising my observing projects.

I've also had neighbours come to observe, a reporter from the Rangitikei Mail and a group from The University Of The Third Age – an organisation of retired and elderly folks who continue to study topics of interest academically – to come see or use the facilities.

We held a public open day and were frankly astonished at the community response. We had around 50-60 people come through the observatory. I don't know the real numbers but I was busy shuttling people through the observatory and I was told we had two dozen cars in the paddock we set aside for car parking at one point.

I'm an insomniac by nature so I have already been in the observatory doing variable star observations odd hours. I was recently woken by a smoke alarm in our house and when unable to return to sleep got up and did a couple of hours of variable star observations from 2am to 4am.

the rear posts.

I have left a round plastic insert in the middle of the floor of some 600mm diameter. I poured a weaker brew of thinner concrete into this. This is to allow the concrete to be easily broken out for the excavation of the ground to install a pier at a later date.

Ronald was on hand again to secure the track brackets and the track to the observatory and the rear posts. Then I put the roofing iron on the roll-off roof and with the help of my family we lifted the roof up and into the track and rolled it on to the observatory for the first time.



*Figure 4. The roof is installed 03/02/2013.*



Figure 5. Pipped Reverend Pete and Budget Neutering for front page!

I was determined to submit an observation in support of the HST observations of V485 Cen, but we had high cloud with some breaks, I was in the observatory for five hours and got one single decent observation in the whole time.

Thus far the observatory meets all of my initial criteria. It provides excellent wind shelter. It is weather proof. A pier can be installed at a later date. And it is quick and easy to operate.

I have already resumed submitting observations to the AAVSO and the BAA VSS. Finally, I have rejoined Variable Stars South now that I am able to contribute.

**Postscript:** I've changed the way I organise my observing for efficiency. I have now organised my charts into one hour and half hour (depending on number of targets) blocks of RA and then from most positive DEC to most negative DEC so that I can minimise slewing and best cover targets at or about the meridian.

I'm also in the process of selecting what stars in particular I am going to give most coverage, especially as dense star fields yield more targets than I can reasonably do justice.



Figure 6. The final product.

## Some notes from 2012 observations at Wellington Point, Queensland

Tom Richards gave a brief overview of the SPADES project in the December 2012 Newsletter. The aim of the project, the search for circumbinary planets, requires very accurate timing of primary and secondary minima of eclipsing binary stars. For many targets, eclipse minima could not be found at first, generally because the systems had not been studied since discovery many years earlier and small errors in epoch or period had multiplied over time. Therefore, updating the ephemeris light elements for the eclipsing binary stars in the VSS SPADES target lists through observation and literature searches was a major part of the work in 2012, continuing from data obtained in 2011. In addition to timing eclipses accurately, we are also obtaining data on complete light curves for several targets to allow astrophysical modelling of the binary systems.

When I started observations of eclipsing binaries two years ago, the periods for several targets were found to be either double or half those given originally in the GCVS catalogue and the SPADES target list. We now use the Ephemerides programme with the database that is kept up to date with the most recent data from the SPADES project by Margaret Streamer (see Newsletter 2012-2, p13). Here, I present data from some targets and notes for follow up in 2013. For the first half of 2012, Brisbane was unusually wet, so many observing runs prior to August were aborted or interrupted due to clouds.

### V0775 Centauri

The ephemeris elements listed on the SPADES target list are not correct; the actual period is half that given. A primary minimum was recorded on 2012-05-27 and a secondary on 2012-06-19. The period determined from my 2011 and 2012 data is close to the period of 0.663641 determined by Dvorak (IBVS 5542). That is quite a short period for a detached eclipsing binary. There was no significant change in period over the time since Dvorak's analysis of ASAS data and probably no change since its discovery in 1937 (Dvorak 2004, IBVS 5542).

### AA Crucis

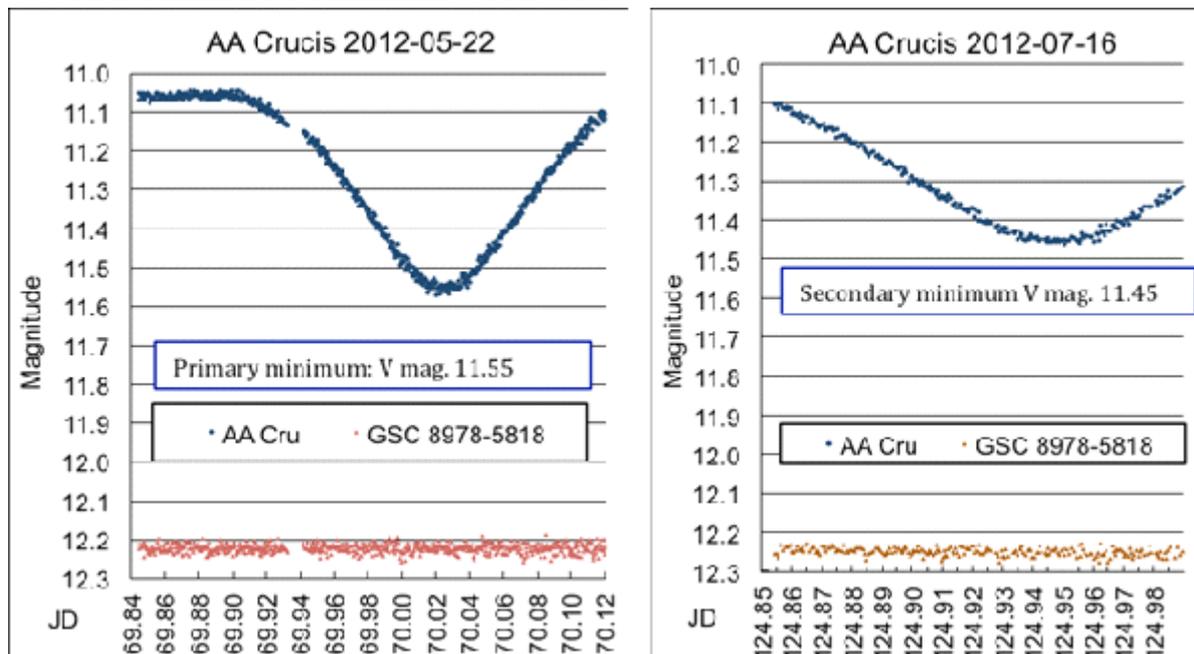


Figure 1. Comparison of primary and secondary minimum depths of AA Cru.

AA Crucis has been discussed in several newsletter articles previously, but requires more detailed study.

Observations made on 9 nights between May and July 2012, together with a secondary eclipse recorded

by Margaret Streamer, confirm the results from 2011 indicating that the period is double that given originally in the GCVS and SPADES targets list (1.89 days). The difference between primary and secondary eclipse depths was 0.1 magnitudes (Fig 1). If the period was 1.89 days, then a secondary minimum should have been occurred on 2012-03-08 and 2012-05-23, but no change was observed (Fig 2).

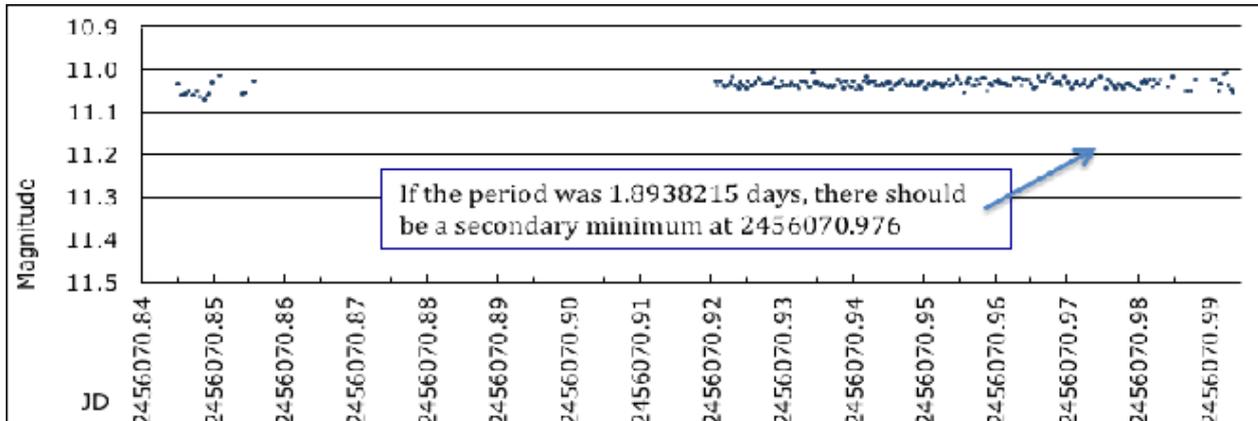


Figure 2. AA Cru 2012-05-23. Confirmation of period as 3.787633 days.

When I first studied AA Crucis in 2011, the recommended comparison star was GSC 8979 0134, V magnitude 10.37. The photometric data for AA Cru and the check star were very noisy, due to the fact that when exposure times were selected to provide a signal to noise ratio > 100 for AA Cru at minimum, the ADU values for the comparison star were above the linear range for the ST8 CCD camera. The comparison star was changed to GSC 8978 5801 and all the images from 2011 were reanalysed and the revised data sent to the AAVSO and uploaded to the VSS SPADES observations files.

## TZ Crucis

My observations of TZ Cru in 2011 indicated that the GCVS ephemeris elements were wrong, whereas those in the Motl database (ASAS and O-C Gateway) were probably closer to the correct values. However, I could not find a minimum in 2011. The search for an eclipse was successful in March 2012, when I recorded a primary minimum (Fig 3). Observations on 10 nights showed that the true period was double that given in the GCVS catalogue.

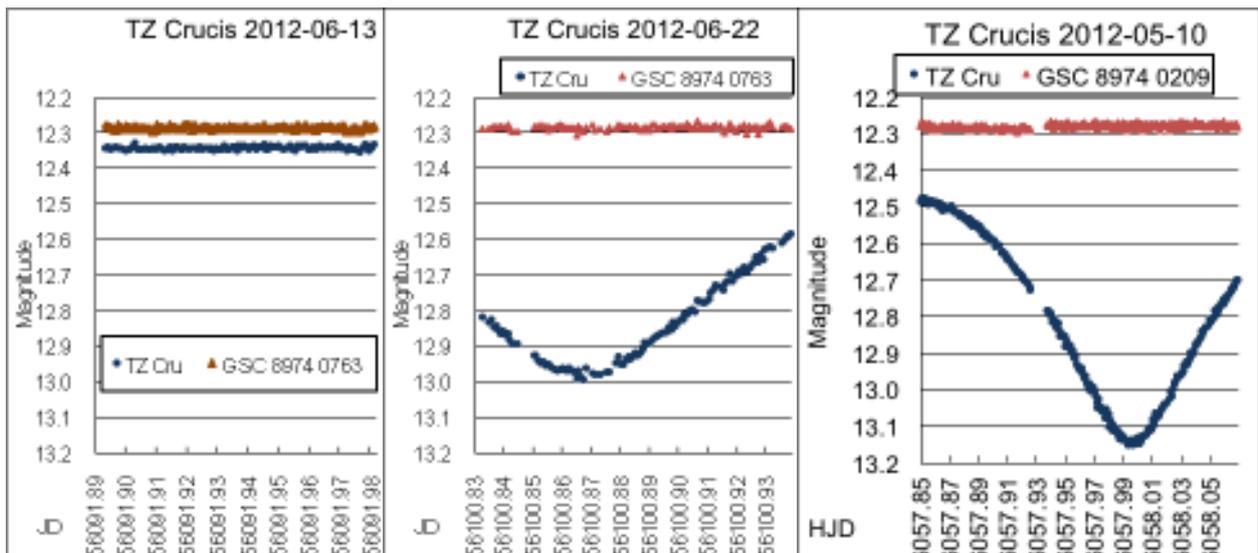


Figure 3. Primary and secondary minima of TZ Cru and confirmation of its period as 2.09 days.

## V0490 Scorpii

This target had not been observed previously in the SPADES project and no other data were available

except ASAS. I recorded a minimum at V magnitude 12.32 close to the time predicted with Dvorak's elements (Fig 4). Margaret Streamer subsequently recorded minima at V mag 12.32 also. Dvorak's updated period and epoch show the minima recorded in 2012 to be secondary, whereas the epoch used by GCVS and Motl indicate the minima to be primary. The GCVS 1936 epoch was based on photographic plate data, so it is possible that the minimum chosen for the initial epoch was a secondary.

We can check this in July 2013, when the minima at half the phase will occur in the evening. If the magnitude at minimum then is  $12.42 \pm 0.02$ , that will confirm them to be primary and Dvorak's epoch is correct, whereas if the minima are around 12.2, then the

GCVS epoch would be correct. As the period is 3.004 days, it is not possible to observe both primary and secondary minima in the same observing season in Australia.

## Equipment

**Telescope:** A Celestron EdgeHD 14 optical tube assembly was purchased with a grant from the Edward Corbould Research Fund of the Astronomical Association of Queensland and installed in May 2012 on a Losmandy G11 mount with the Gemini 1 controller. The image quality was much better with the new telescope, compared to the 280 mm Celestron (C11) that I used previously. Photometric studies of eclipses were also better, as the larger mirror allowed a faster cadence with better signal to noise ratios than the C11. The EdgeHD 14 has mirror clutches that, when tightened after focusing, hold the mirror firmly and prevent focus drift due to movement of the mirror. Focussing is done by FocusMax and a Robofocus unit.

An SBIG ST8XME camera was replaced by a Moravian G3-6303e CCD camera in November 2012; it has double the CCD area of the ST8 and a linear response up to 64,000 ADU. The G3 camera has a two stage cooling system allowing operation at 45 degrees below ambient, and thus dark current and noise in images is much better than achieved with the ST8.

A research grant from Variable Stars South was used to purchase PEMPro from CCD ware. That has enabled better polar alignment of the Losmandy mount and improved periodic error correction in the RA drive. Exposures of up to 2 minutes can be made without guiding using astrometric resynchronisation in Maxim DL. An off-axis guider with a Moravian G1-0300 CCD camera is used for guiding for longer exposures.

The observatory is a Sirius fibreglass 2.3 m dome — the second one that was made; it was installed in 1986. It has now been fitted with automatic dome rotation linked with the MaximDL image acquisition programme, so that it can be left unattended for long photometry runs. However, meridian flips have to be done manually.

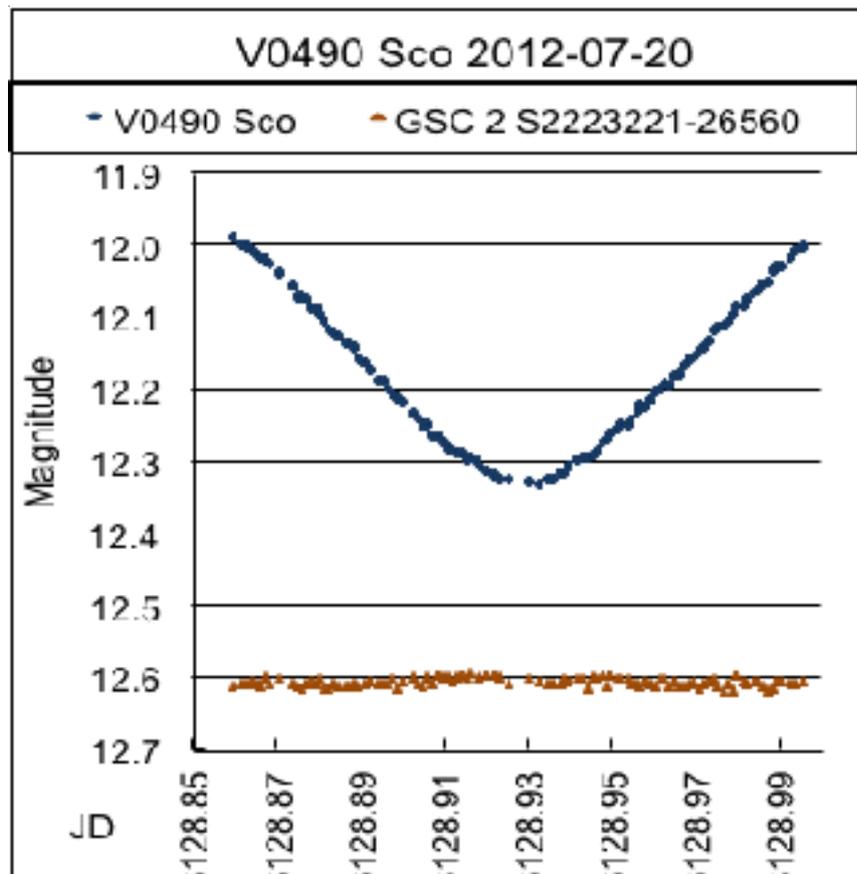


Figure 4. V0490 Sco. A primary or secondary minimum?

# Robotic research for the easily bored – David O’Driscoll

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At the recent SPADES workshop (see George Stockham’s article on page 17), Tom Richards and I were talking about the way I use robotic telescopes to undertake photometry (and other) work, and how there are key differences to the way those with local equipment work. Tom suggested I pen this article to describe some of the pros and cons of the method.

## Why did I go robotic?

I’ve been active in astronomy since 2005, after a hiatus of about 20 years. I live in the outer western suburbs of Brisbane, and while not exactly dark, I could still make some use of the skies available.

However we live on the side of a ridge, and the only flat space for an observatory is a small courtyard strategically placed between the two storey house on the uphill side, the palm trees in our garden, the mammoth African Tulip tree of our downhill neighbour and the 3 or four street lights the local council feel were necessary to light our street!

Combine this with a wife who strangely feels that this small space should be turned over to our children rather than an observatory, and you might get an idea of the challenges involved.

## Starting the adventure

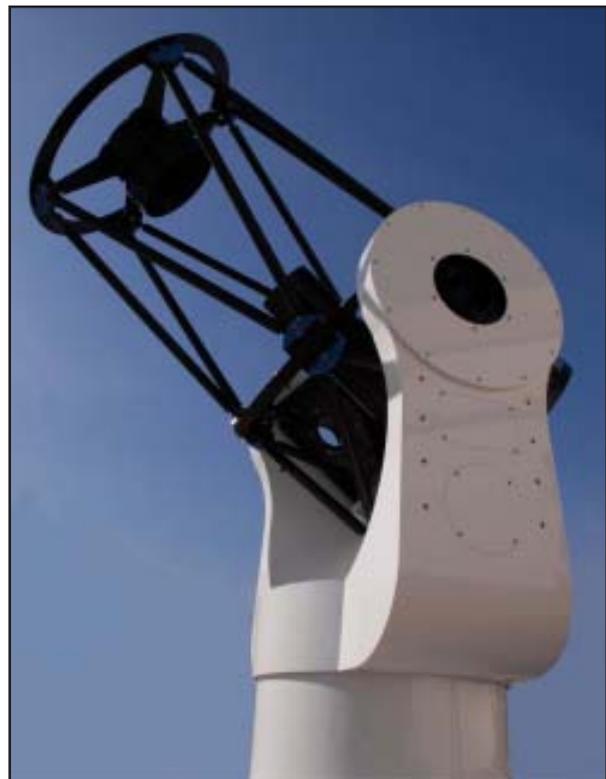
In April 2008, I stumbled across a reference to a commercial operation that provided access to a range of robotic telescopes around the world, based on a subscription model. This was Global-Rent-A-Scope (GRAS), and they provided a free trial period. Interestingly, they also provided some innovative software to undertake photometric measurements of the images taken (then called Photometrica).

I decided to have a go, and given that I work in IT, I found the system very straightforward and easy to operate. I had only recently been shown how to do variable star estimates using a pair of binoculars by Tony Dutton, one of the more experienced members of the Astronomical Association of Queensland (and now a member of VSS), and had been really interested in pursuing more photometry work.

I started corresponding with Gier Klingenberg, the developer of the photometry software, as he was actively enhancing this new system. Through him I was introduced some months later to Bill Dillon from the USA, who invited me to join a research project they were starting to study Southern Equatorial Binaries. I was one of only two team members in the southern hemisphere; the other was none other than Tom Richards. Little did I know where that would lead!

## Advantages of going robotic

The first and most obvious advantage of using this mode of observing was the quality of the gear that I could access. My own equipment is very modest, but using GRAS, I was able to access 12" to 16" (0.3m to 0.4m) scopes and mounts the quality of which I could never afford. The monthly subscription was substantially cheaper than a divorce!



*iTelescope.net has plans to install a Planewave Instruments CDK 0.7m Alt-Az scope in Australia and make it available for rental.*

In addition, these telescopes were located in dark locations around the world (New Mexico, South Australia and Israel), had high quality CCD cameras, and many were equipped with quality photometric filters (while a large number of the GRAS scopes were aimed at astro-imaging, about a third were identified as science platforms).

Moreover, the equipment is all automated, and by paying a slightly higher subscription, you get access to the ability to execute scripted imaging runs at reserved times, allowing you to conduct an entire imaging run while asleep, watching TV or drinking a pleasant glass of red wine: armchair astronomy at its finest!

At the end of the imaging run, flats, darks and biases are all automatically applied to the images from an extensive library for each telescope, and the resulting calibrated images then transferred to the photometry server ready for analysis.

While I am sure that there are purists out there that regard this all as cheating, I can only describe this as incredibly efficient. I was able to easily get to grips with identifying fields, measuring flux and analysing data (which is really what this was all about), without first having to purchase expensive equipment, get it polar aligned, learn how to take darks/flats/bias images, process them, etc. This made the entry to the field a lot easier, and while I know that one day I will have my own observatory and have to deal with all this, I will do so from a perspective of somebody who knows that it is worth persevering with.

### So what are the downsides?

Access to these scopes is not exactly cheap. I'll go into more details of that later though. But like I said, it's still cheaper than a divorce! There are other issues though that you need to understand before getting involved.

Firstly, you have no control over what is available, as such. Some of the equipment is owned by the organisation, and they configure this for the audiences they might want to attract (mainly imagers). Many of the other scopes are owned by what are termed "affiliates" – people who have purchased a high end scope and pay to have it hosted on the network. VSS member Peter Lake is one such affiliate.

Of course they can't possibly use the equipment 24/7, so the organisation makes them available to people like me who pay the subscriptions. The affiliates then get some of the money to offset the hosting costs. All in all, it works very well for all concerned.

But this means that the scopes are configured to match whatever interests the affiliates have. This can result in some interesting combinations of filters, and not all of them include photometric filters. They also decide what CCD camera will be used, the mount etc.

You also are relying on the operator to keep the gear working, and my experience has been that they are very good at



*iTelescope.net operates a Planewave 0.5m scope and FLI - PL6303E CCD camera at Siding Springs in Australia.*

this. However, loss of an internet connection to the site means you no longer have access to the equipment, something that isn't going to happen to your local observatory.

You also need to pick the sort of work you are doing. For me, undertaking a couple of hours imaging of a primary eclipse is ideal. However doing all night runs in search of an eclipse for a target with an unknown period can be an expensive exercise.

In summary though, these are minor issues compared with the advantages to be obtained. I have been using the equipment now for some 5 years, and am very pleased with the benefits to be obtained.



*Planewave 0.5m astrograph fitted with a FLI Proline PL1002M CCD camera. This package is stationed in New Mexico.*

## Changes over the years

The network has undergone lots of changes over the five years I have been working with it.

Last year, GRAS changed its name to iTelescope.net, which reflected some changes in ownership (it's now Australian based). The Israel site left the network early on, but has since been replaced by a site in Spain. And recently iTelescope.net announced plans to establish a second site in the USA. The Australian site moved from South Australia, via Melbourne, to its new home at Siding Springs Observatory.

The equipment has only gotten better and better. Originally, a 16" (0.4m) scope was the largest they had. Now, this would be considered small! 20" (0.5m) scopes are common, there are several 0.5m scopes and they have just announced plans for a 0.7m scope in Australia, which hopefully will include a spectrograph.

Photometrica changed its name to VPHOT, and is now managed through the AAVSO, but the images are still transferred automatically. It also supports some astrometric functionality.

## So what does it cost?

Assuming you've read this far, you'll probably be wondering about cost. As I said, you can access a free trial, although this is limited to their One Shot Colour telescope.

Subscriptions are charged every 28 days, and range from \$20 to \$1000 (this is Australian dollars). For every dollar you spend, you get a point. Each telescope then has a cost in points per imaging hour, which depends upon the nature of the scope and its equipment, and the level of your subscription. For instance, T11 is a 0.5m Planewave, and on a \$40/month plan costs 198 points per hour. This drops to 43 per hour on the \$490 plan, and so on. The more you pay, the better value you obtain. And all charges are based upon the number of minutes of actual imaging (ie not slewing etc).

There are also discounts depending on the phase and altitude of the moon, which can help you stretch the dollars further for some types of work. You can also buy additional points if you are embarking on particular projects.

And while this is a commercial operation, they do support research and outreach. The project that first brought Tom and me together was one such project, funded entirely by their research group.

## In summary

If you already have a massive investment in equipment, you may think it is unlikely you will want to rush out and start using this equipment. However, I can think of several instances where access to such a network is invaluable: months of bad weather locally (welcome to Brisbane!), the need to get measurements from other time zones or with equipment combinations you don't have access to.

Or, if you are like me, you don't yet have the necessary site or equipment, robotic scopes can be a realistic way to get involved in astronomical research. Without this sort of system, I would never have been able to get involved in doing research.

I hope that this article has given you insight into another way of doing research. If anybody has any specific questions about my experiences, please feel free to contact me.

## SPADES workshop — *George Stockham*

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On the weekend of 17-18 March, all the active workers on the SPADES project met to discuss progress to date and to share their experiences. Many thanks to Margaret Streamer, who both proposed this meeting and offered her home at Murrumbatman, NSW as the venue.

Present were Tom Richards, Margaret Streamer, David Moriarty, Jeff Byron, David O'Driscoll, Mark Blackford, Col Bembrick and George Stockham. Two New Zealand participants (Roland Idaczyk and Randal McIntosh) had an audio link to the meeting via Skype. Margaret's husband, Dave Herald (occultation and asteroid expert) was also there as "tea-lady" etc.



*The SPADES group. L to R: David Moriarty, Col Bembrick, George Stockham, Tom Richards, Mark Blackford, Margaret Streamer, Jeff Byron, David O'Driscoll*

Major topics were discussed as follows:

**Existing and future targets.** There was a lot of discussion about results to date and where to go next with the limited number of active observers we currently have. We have started to collect new estimates of periods for many stars, and hints of other features of interest for some of them. The eventual conclusion was that firstly we need all analysts to write up their conclusions on all stars studied to date, with recommendations on which are worthy of high priority study in the future. A "review board" of 2 or 3 of our best

analysts will then assess which stars require high priority in our observing plans, and which can be retired from further active research.

**Moving towards publication.** We have enough data now on some stars to think about publishing results – mostly new periods and epochs. Discussion focussed on where we should aim to publish such results, and the mechanisms involved. JAAVSO or possibly IBVS were seen as the mostly likely places. As a first step, the above review process should identify which stars are getting close to the publication stage, and determine what happens from there. A related issue was to get our house in order – check we are not releasing on our website (or elsewhere) any working data that later we intend to publish as part of a formal paper. We will not get formal papers published if the results are already “publicly released”.

**Peranso.** All of us use the Peranso tool to estimate time of minima from observational data. Although we are mostly happy with it, there is ambiguity as two different users might tweak the modelling parameters differently and get slightly different results for the same data. Much discussion, no firm conclusions. Advice was to be sought from the expert in this field, Bob Nelson.

**Astrophysical modelling.** Col Bembrick showed how he used the Binary Maker3 tool to model binary stars using mostly the variable star light curves. A good initial model can be produced which closely fits these light curves. Without radial velocity data and similar information, you cannot get a complete solution. However models of similar standard have previously been considered worthy of publication, and that is Col’s eventual aim.

**Delta Scuti type stars.** Three of our SPADES targets were identified as having pulsating components of this type. Margaret Streamer demonstrated how she used the Period04 tool to analyse these stars and identify the periods of pulsation.

These were the highpoints of the workshop. Many other issues and details were raised. Everyone found it helpful. In particular, the two NZ participants found it so, despite all the problems of having an audio link only. Our thanks go to Margaret Steamer and Dave Herald for hosting this weekend.

## Smoke and Mirrors — *Tom Richards*

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Building a new house is a great opportunity to rethink your life with an observatory – particularly if you’re in your 70s. At our previous property in Eltham the observatory had a first-rate functional design: an



*The dome is hoisted onto the observatory building.*



*Tom inside the new observatory.*

ante-room for computers and other gear, and a couple of steps up to the telescope room. Contents: an Astro-Physics 1200 GTO mount on a 30-cm steel pillar, an RCOS 0.4 m Ritchey-Chretien with an Optec filter wheel (BVRcIcC filters of course), a Van Slyke slider, and an Apogee U9 camera giving a half-degree field. All under a 2.4 m dome by Astrodome. Computer control was provided by ACP (scriptable telescope, mount, filter-wheel, focuser, camera, dome rotation and dome shutter controls), weather sensing with system shutdown by Boltwood Cloud Sensor and Clarity, dome and shutter control hardware by MaxDome, automatic focusing by FocusMax, periodic error control by PemPro, imaging and image processing by MaxIm.

Sounds great, but with one big drawback. The observatory was way downhill at the bottom of the property, 70 metres from the house. And despite all the automation and remote observatory computer access from the house computer, you do have to be there a lot of the time, setting up, closing down, dealing with runtime problems, and enjoying the glorious feeling of a night under the stars with a wide-angle eyepiece. And worrying your wife when she finds an empty bed beside her at 3 am – is he OK, has he fallen off the ladder, is he getting cold the silly man?

So in the new house it's the same design of observatory, same contents, but the observatory is attached to the study. Run it from the study, and walk through a door to the dome in your pyjamas if a check-up is needed. Even hearing in bed the faint but comforting sound of the dome turning occasionally to slave to the moving telescope, reassures that tonight's script is still functioning. And most important of all Lyn has stopped worrying when my side of the bed is empty at 3 am.

Altogether it took about two years from when I de-commissioned the old observatory to having the new one up and running properly. A better site, higher than before and rather further from Melbourne. Seeing is usually under 2 arcseconds; and no, having an adjacent house roof, chimney and hot water service doesn't spoil the seeing at all.

One other thing is different from the old observatory. Up here on the Pretty Hill ridge in Kangaroo Ground, the soil is a very rich black sticky volcanic clay, and very deep and mobile. The builders had to bore down nearly 3 metres before finding something that we could deem to be a subsoil on which to rest the concrete pier block. So far I haven't detected any movement in the pier, but I don't know why not.

Having this level of automation is wonderful. Last week I observed three variables in Crux all night long, taking three V images of the first, slewing to the second for six more images – three in B and three in V, slewing to the last for three V images; then back to the first. All night long. At dawn the system took a whole lot of flats, then parked the telescope, warmed up the camera, and shut the dome. Also knowing that the telescope will maintain perfect focus for months on end, no matter what the ambient temperature, saves a lot of setup time. Just synchronise on a star and set the script for the night running.



*Tom's wife Lyn (and dog) outside the completed observatory.*

But it does go wrong. My automation setup is probably as good as any, but the gremlin rate leaves me a little sceptical of the reliability of unattended remote robotic telescopes. Sometimes, inexplicably, the telescope can get lost, communication between the multiple control applications, tasks and drivers goes wrong, or there's a power outage, or you make a non-fatal error in the night's script. That happened to me one night when the script finished observing one star and slewed to a second – but I had entered the declination coordinate a degree wrong. No way of telling until I processed the images a few days later.

Finally, back to my title. I've told you about the mirrors, the observatory. But what about the smoke? This has been the hottest, driest summer on record in Australia, and in Victoria the viciously hot summer is lasting well into autumn. The "new normal", according to the climatologists. And with that weather come bush-fires in this the most fire-prone place on earth. The long long parade of cloudless summer and autumn nights has been spoiled by smoke – greasy brown layers visible in the sunset, drifting overhead, filling your nostrils, and wrecking your seeing. Smoke isn't like thin cloud which is essentially "grey" and dims the stars but doesn't change their colour. Smoke traps the blue, now more, now less, now more in this part of the image, now more in that as a thin wisp drifts by. Differential photometry becomes a mess. I have been waiting since last last year to obtain my transformation coefficients, and I think I'll be waiting a lot longer.

Or maybe tonight.

## AAVSO DSLR workshop - *Mark Blackford*

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In March I attended a three day workshop at the AAVSO headquarters in Boston, MA. The aim was to write a beginners guide to DSLR Photometry, along the lines of the CCD Observing Manual available from AAVSO's website.

DSLR cameras were employed as photometers during the very successful Citizen Sky (CS) campaign to monitor the recent extended eclipse of epsilon Aurigae. Initially there was very little in the way of published articles or websites detailing how the beginner could undertake DSLR photometry, indeed there were very few experienced practitioners.

CS participants produced several tutorials and had an active online forum where questions could be raised. But a consolidated, coherent guide was still needed. AAVSO successfully applied for a National Science Foundation grant to assemble a team of people for a workshop to produce such a document and make it available to anyone interested in DSLR photometry.

Thanks to travel grants from Variable Stars South and AAVSO I was able to attend and contribute where I could. Most of the 23 delegates were from the US but there were participants from Scotland, France, Germany and Canada as well.



*Figure 1. Workshop delegates during the initial briefing session*

Those of us already in town converged on the AAVSO Headquarters on Thursday evening, March 21st for a meet & greet session. It was great to put faces and voices to some of the people with whom I'd had email correspondence over the last few years. In particular it was a pleasure to meet AAVSO identities Arne Henden, Mike Simonsen and Rebecca Turner.

Des Loughney from Edinburgh, Scotland, was the most experienced DSLR photometrist present and is considered a pioneer of the technique. His articles in the Journal of the British Astronomical Society and elsewhere, as well as our email correspondence, were invaluable when I was starting out in this field. So it was great to meet Des in person. We had several very interesting discussions during the evenings.

The workshop kicked off the following morning with an hour long joint meeting to introduce ourselves and outline objectives for the week-end. Individuals' DSLR photometry experience ranged from zero to many years, but all had a desire to produce a manual useful for personal research, public outreach or school science projects.

We broke up into groups of 3 or 4, each group concentrating on

specific sections of the manual. I was assigned co-leader of the software overview section. Heinz-Bernd Eggenstein (Wunstorf/Luthe, Germany) was the other co-leader. Martin Connors and Ian Doktor (both from Edmonton, Canada) rounded out the group.

Heinz-Bernd is a software engineer who recently moved from the commercial world to a position within Einstein@Home, a distributed computing project similar in concept to SETI@Home but looking for continuous gravitational wave sources. He'd been heavily involved in the CS epsilon Aurigae campaign, helping to develop reduction routines and publishing peer reviewed papers.

Martin is in the Department of Physics & Astronomy at Athabasca University with research interests in aurora and robotic DSLR photometry.

Ian, a high school maths teacher and a (former?) student of Martin's, has been developing his DSLR photometry skills for a short while and I have to admire his commitment – winters in Edmonton are cold!

As the Software Overview group, we were tasked with writing the chapter describing how computer programs can be used in all aspects of DSLR photometry. Not only for calibration & measurement of images, and reduction of the data to magnitudes ready for submission to the AAVSO International Database. But also for planning observations, time synchronisation, control of mounts, image acquisition and focusing etc. This was a very broad topic and required a lot of thought as to how much to include in the beginners' manual. Hopefully the final result will be an appropriate mix of essential details and useful extra information that the user can choose to delve into after first mastering the basics.

We allocated specific topics to individuals and created a shared Google document to which each of us could contribute our sections. It was fascinating to see the document evolve. While I typed away on my computer I could see in real time what the others were typing.

After two and a half days of fairly intense discussion and writing all the groups had produced substantial documents, but with quite a bit of further work required. From the start it was clear our chapter would have significant overlap with other chapters, in particular image acquisition and image analysis. Also, the writing style of each group was different. The difficult task of melding these separate chapters into a homogeneous single document will be carried out by a small group of mainly AAVSO staff and Citizen Sky leaders. All workshop participants will have an opportunity to review the combined manual again before it is made available to the public, hopefully within a month or so.

I thoroughly enjoyed the workshop and will maintain contact with many of the participants. Jetlag was a bit of a problem so my contribution may have suffered in the afternoon sessions. On the positive side, it did allow me to watch some beautiful sunrises over the snow covered Boston suburbs.

Don't hesitate to email if you have any questions about DSLR photometry. If I can't provide a satisfactory answer, I now know who else to ask.



Figure 2. Mike Simonsen's car with its AAVSO number plate

The VSS website has been in operation for about 2 years now, and accordingly it is time for it to get a bit of a refresh. This is driven by a number of factors, one of which is that the underlying software used has been upgraded twice since we started using it, and the new version includes features that will make it substantially easier for me to manage the site including upgrading the software and various components used.

The other major driver is the need to keep the site fresh and learn from the last two years of usage. Tom has asked me to make the site a little more dynamic, as much of our content has become quite static.

I have several ideas on how to do this, and will hopefully be spending my time over the Easter long weekend “slaving over a hot keyboard” implementing these changes. It is possible that I will need to take the site offline for a period during this time in order to cut over to the new version, but I will know closer to the time.

However I would be keen to hear from anybody with good ideas or suggestions about content that they would like to see in the new site. No idea is too outlandish (although whether or not I can implement them remains to be seen), so please ask, regardless of whether you think I can or can’t do so!

I am also interested in hearing from people about what sort of web related information you would like in this Newsletter. I have tried to include “how to” articles about common functions on the site, but these are the thing I think you want to know about, which may not be what you actually want to know! This is especially true of those of you less comfortable about websites, something which is difficult for me to assess given my profession.

So, any ideas, questions or suggestions for the site or for articles here are welcome. Please send them to webmaster@variablestarsouth.org. I look forward to hearing from you.

## Publication Watch

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The following paper was published by David Benn in JAAVSO Volume 40, 2012, p852 and is available for download at <http://www.aavso.org/sites/default/files/jaavso/v40n2/852.pdf>

### **Algorithms + Observations = VStar**

**David Benn**

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**Abstract** Vstar is a multi-platform, free, open source application for visualizing and analyzing time-series data. It is primarily intended for use with variable star observations, permitting light curves and phase plots to be created, viewed in tabular form, and filtered. Period search and model creation are supported. Wavelet-based time-frequency analysis permits change in period over time to be investigated. Data can be loaded from the AAVSO International Database or files of various formats. Vstar’s feature set can be expanded via plug-ins, for example, to read Kepler mission data. This article explores Vstar’s beginnings from a conversation with Arne Henden in 2008 to its development since 2009 in the context of the AAVSO’s Citizen Sky Project. Science examples are provided and anticipated future directions are outlined.

## Software Watch

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### VStar update

The most recent release of David Benn's Vstar analysis and visualisation software was on January 20 2012. The change log contains details of this and all previous releases:

<https://sourceforge.net/p/vstar/code/960/tree/trunk/ChangeLog.txt>

The December 2012 eJAAVSO (Volume 40, Number 2) has an article entitled, "Algorithms + Observations = VStar":

<http://www.aavso.org/sites/default/files/jaavso/v40n2/852.pdf>

The author's blog now has a section to collect VStar related posts:

<http://dbenn.wordpress.com/category/astronomy-science/vstar>

The AAVSO VStar forum is the place to ask questions or make comments:

<http://www.aavso.org/forums/about-aavso/vstar>

Development continues slowly, as time permits. The priority of features, enhancements, and bug fixes is often dictated by the expressed needs of VStar users.

## About

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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** 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

### MEMBERSHIP

New members are welcome. The annual subscription is NZ\$20, 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 e-group (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 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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