

Light curve for of the RR Lyrae type star BH Pav from data taken over seven days by Paul Luckas. Paul calculates the period as = 11.447 hours which compares favourably with the published period of 11.44689 hours.

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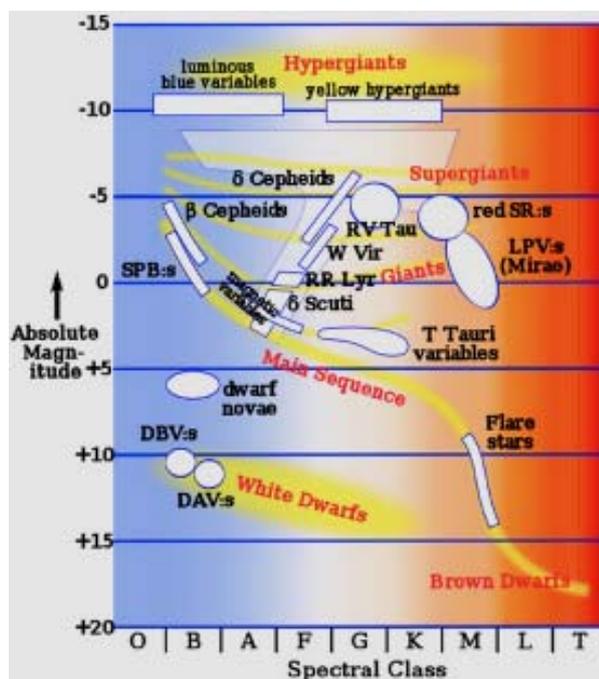
## From the Director – Tom Richards

tom.richards@variablestarsouth.org



### Pulsating stars, anybody?

One of the most remarkable and important features of the H-R diagram is the long Instability Strip of pulsating stars.



Well marked in this diagram ([chandra.harvard.edu](http://chandra.harvard.edu)) it runs broadly from the Cepheids, through the hotter but less luminous RV Tauri, W Virginis and RR Lyrae stars, crossing the Main Sequence at the Delta Scuti stars – only a little hotter than our Sun. It continues down, ever hotter and fainter to the DAB and DBV white dwarfs. Whether a K supergiant or a B white dwarf, they all pulsate due to an unstable subsurface layer. For this reason they are of the greatest astrophysical importance.

Accurate multi-bandpass photometry adds greatly to our understanding of these stars. Stan Walker runs a VSS project on Cepheids, the easiest class to observe due to their long period (1 to 100 days) and high amplitude (up to 2 magnitudes).

### RR Lyraes – a new project

Now, as a result of discussions at the Invercargill RASNZ Conference, Stan has proposed a new project on RR Lyraes, (see his article in this Newsletter). Once called cluster variables since they are commonly found in globular clusters, they are old helium fusing stars with a uniform absolute magnitude, making them good distance indicators. Stan's proposed project should be absorbing and rewarding for anyone who takes part, since the stars are not only well suited to nightly time-series work, but their continuous variation of up to one magnitude and period up to 1.5 days guarantees a satisfying nightly light curve.

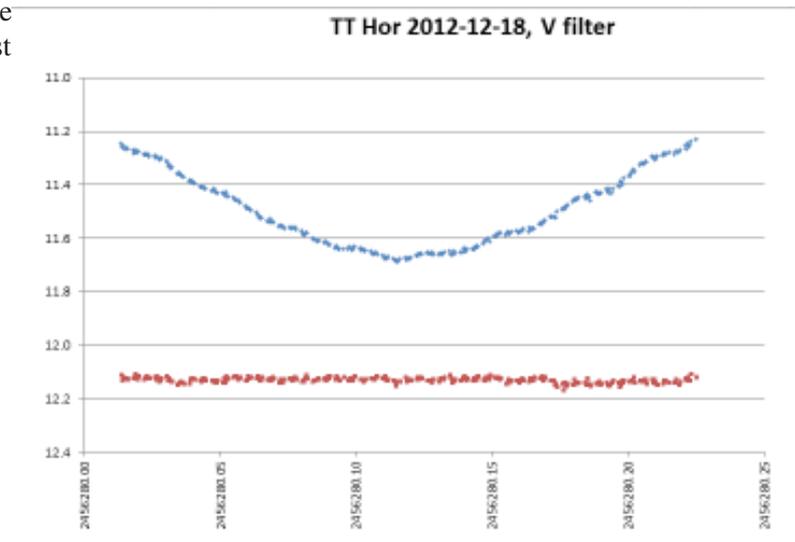
To get this project off the ground, we need a project leader. The role does not require any deep knowledge of RRs – you can learn on the job. What's mainly needed is a bit of organisational savvy: developing a useful web presence along with our webmaster David O'Driscoll who will do the implementing, encouraging observers to sign up, and analysing results aiming (at least) at period and light curve information. I'm sure Stan will be willing to help with this last. So who wants to give it a go? Please contact Stan ([astroman@paradise.net.nz](mailto:astroman@paradise.net.nz))

### Delta Scutis in eclipsing binaries

The Southern Eclipsing Binaries Programme now has 107 eclipsing binaries under active study. Since there has been remarkably little work on such stars in the past, it's not surprising that we have found many surprises. (Yes – that sentence makes perfect sense.) One of the most interesting surprises is the discovery of Delta Scuti pulsating components in several of the systems under study. We have completed an announcement paper on three of these, AW Vel, HM Pup, and TT Hor, authored by David Moriarty, Terry Bohlsen, Bernard Heathcote, Tom Richards and Margaret Streamer.

There is much opportunity for further work in this programme, as observers or analysts. It is the observers who find the pulsations when they do their photometry, and the analysts who tease out the pulsation

periods. In terms of instrumentation, the SEB Programme is very un-choosy, just a tracking telescope and a DSLR or CCD camera. Contact me to join in.



## RR Lyrae or Cluster Cepheid Project – Stan Walker

astroman@paradise.net.nz

### A call for assistance

Pulsating variables make up a large percentage of stars which show brightness changes on a timescale which we can observe. They come in many varieties, from stars where the outer envelope moves radially in and out - and shows temperature changes at the same time - to those where non-radial effects cause the star to distort, with some parts moving in at a time when others are moving outward.

Variable Stars South continues the work of the old RASNZ VSS and its Pulsating Variables group currently has active projects on Dual Maxima Miras and Cepheids. More recently it has become involved with short period pulsators, RR Lyrae stars or cluster Cepheids as they were once known, which are stars on the horizontal branch in the H-R diagram of globular clusters. These stars have periods of a few hours up to a day and a half and are ideal targets for introducing observers to light curves and temperature changes in stars. They are low mass giant stars rather hotter than the Sun.

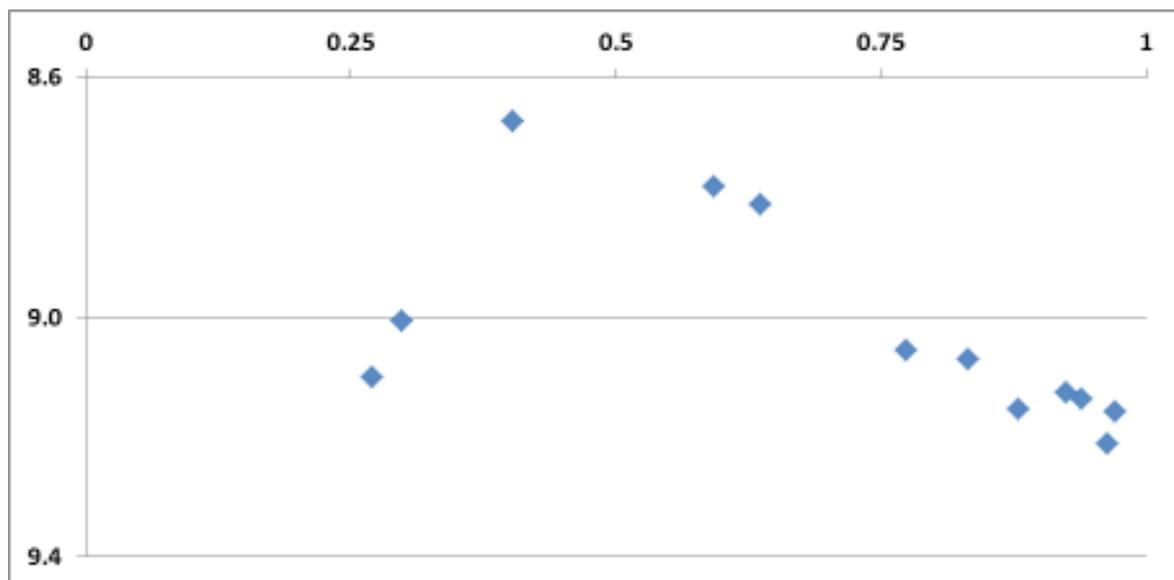


Figure 1. This graph shows the first 12 measures of MT Telescopii by the ASAS3 project, phased using the light elements  $JD\ 2448500.207 + 0.3169$  (epoch and period). The spacings are random over a 43 day period beginning at  $JD\ 2451594.896$ . ASAS3 measures mainly in V.

The shape of the light curve is immediately seen in figure 1, although measures near minimum are  
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absent. But even with only 12 measures an amplitude of about 0.6 magnitudes is apparent. Also, it is clear that the GCVS period is somewhat in error as maximum occurs at phase  $\sim 0.35$ . A more reliable period seems to be 0.3169148 indicating the value of a longer baseline which includes 10901 cycles - but this cycle count may be one or two out.

The project needs assistance in two areas; observations and analysis. Let's look at each separately.

## Analysis

Many discoveries in astronomy are now made by analysing star observations contained in published databases such as ASAS3 and Hipparcos. But both of these were obtained some time ago and current measures are also needed. NASA also provides information on published papers, <http://www.adsabs.harvard.edu/> and there are various sources of epochs of maximum and so on like <http://dbrr.ast.obs-mip.fr/>. The General Catalogue of Variable Stars (GCVS) provides details of individual stars and VSX maintained by the American Association of Variable Star Observers (AAVSO) provides useful references in some cases.

But what are we trying to do? Why RR Lyraes? The fact that a star varies in brightness is usually a sign that it has moved into an evolved state where changes in its behaviour are likely. These may involve a lengthening or decreasing period, changes in amplitude or maximum or minimum brightness, sometimes changes in temperature and colour, often extra periodicities, sometimes eclipses by a companion star.

RR Lyrae stars in clusters are found on the 'horizontal branch' of a cluster diagram in the Hertzsprung - Russell (H-R) diagram. In most cases they are less massive than the Sun but have up to 100 times its luminosity. They are brighter than main sequence stars of the same spectral type so have clearly expanded into a giant stage of evolution and pulsate because they lie on the 'instability strip', in the H-R Diagram, a region where variations in the flow of energy through the star's envelope are strong enough to cause its surface layers to pulsate. No need to understand more than this - but we're curious about the visible changes on the surface.

Some people like observing, others prefer to find out what the observations mean. So we're trying to get together a group comprising both types of amateur observers to work on a selection of these stars and update the known information.

Another thought is that we are seeking someone to take over this project and develop it. Sounds a formidable task? Don't be alarmed - when the members of the Auckland Astronomical Society decided to build and use a photoelectric photometer Council was horrified. But the success of that project was spectacular and known to everyone in the astronomical fraternity. It generated more than a hundred research papers. So all it needs is a clear thinking enthusiast with time and interest to come forward as a coordinator and others to help in and enjoy the project. There are many experienced observers in VSS who can assist if needed. At Tom Richards' request I'm helping in the initial stages but I really need to write some papers with members of the Classical Cepheid group - so if you're interested contact me: [astroman@paradise.net.nz](mailto:astroman@paradise.net.nz) and copy Tom Richards [tom.richards@variablestarssouth.org](mailto:tom.richards@variablestarssouth.org)

## Observing

Our project involves either CCD or DSLR cameras which will make one to three BV or GB measures a night until 15-20 are available. Many CCDs can also measure in the R and I regions. The amplitude of the variation will be greatest in B, least in I. So the B-V colour will be used to study the temperature changes, these stars being bluest and hottest near maximum. As they are compact - unlike many other variable stars - they do not have gas or dust shells so B and V measures to measure brightness and temperature changes are quite adequate.

What do we hope to achieve? Initially it is to introduce people new to photometry to the concept of a periodic light curve. Then the importance of colours in stars. We all know that Betelgeuse is a cool red supergiant and Rigel a hot blue supergiant. These colours are directly related to the different temperatures at the surface of the stars. Fortunately these two stars are close together in the sky and bright enough for the colour contrast to be readily seen. Both are variable but the amplitudes are small and, in the case of Betelgeuse, rather long. So we have chosen another type of star to produce usable data much more quickly.

Figure 2 shows both a V light curve and a B-V colour curve illustrating the concept.

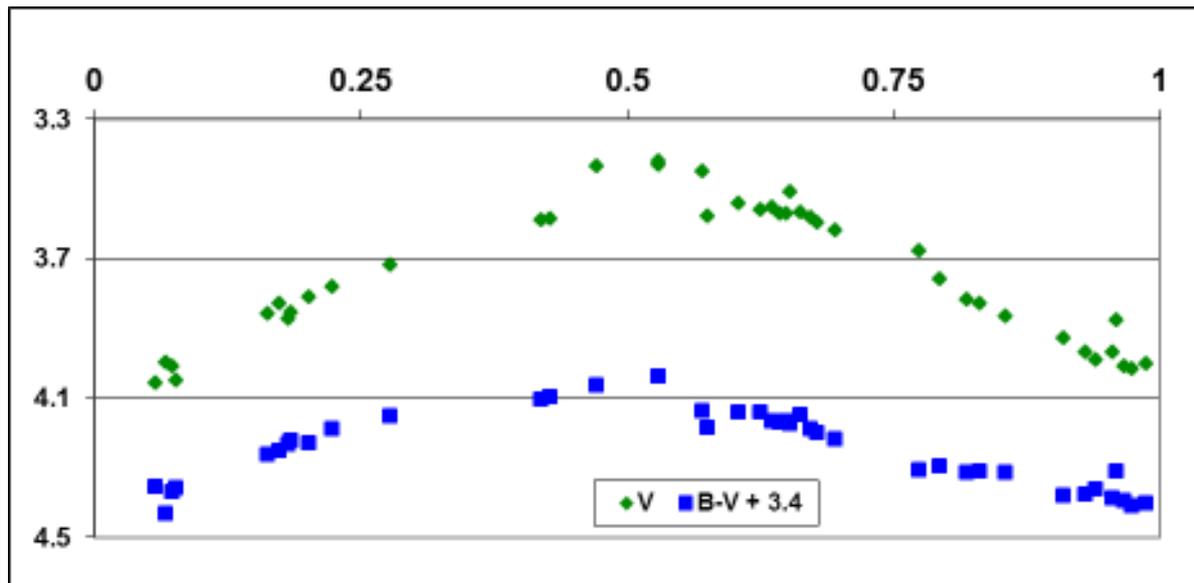


Figure 2. This shows a V light curve of beta Doradus, a Cepheid with a period of  $\sim 9.84$  days and a B-V colour curve showing how the colour changes with phase. This B-V curve has been offset to allow a better scale on the graph - it is actually 0.64 at maximum, when the star is hottest with a temperature of  $\sim 6000\text{K}$ , and 1.01 at minimum, its coolest, at  $\sim 4900\text{K}$ . The phase has been offset by 0.5 to bring maximum to the centre of the plot.

Any person who has the appropriate equipment and would like to participate is invited to contact me for further discussion. Many people do not have BVRI filters but the RGB filters common to most modern DSLR cameras and CCD cameras can provide the same information with a small correction, which we call standardisation or transformation. This is discussed on the VSS website <http://www.variablesatarnsouth.org/techniques/dslr-photometry>.

Moving into detail - the idea is to check periods and publish epochs of maximum which can be used in O-C diagrams - see Changing Periods in Mira & Similar Stars <http://www.variablesatarnsouth.org/community/member-publications/presentations> - which will indicate any period changes; also to verify maxima and minima where these are not clear from the variable star catalogue or are expressed in non-standard filter values such as Hip (Hipparcos) or pg (various types of photographic measures). There are many bright targets for observers. The project is not time consuming - an hour or two per night for 6-10 nights will usually produce reliable epochs for a dozen or two objects - and then on to the next group. Epochs need only to be checked every few years.

The periods are short enough that full light curves in B and V can be measured in one or several nights. The requirement is one or two per year per star. More would be excessive so we will ensure that the VSS website keeps abreast of what is being done. A good task for a non-observer.

An example is the following short report from **Paul Luckas** showing his measures of BH Pavonis and two of the six other RR Lyrae stars he measured in June. Paul writes:

“Seven RR Lyrae variable stars were imaged over 4 nights spanning 12 June to 19 June. Targets were chosen with ‘all night’ viewing potential, to maximise data collection over a single night.

Aperture photometry was performed using MaxIm DL’s photometry function to derive instrumental magnitudes for each target. The resultant light curves were exported as CSV files for analysis in Microsoft Excel.

Excel was used to create light curves for each of the targets. Custom formulae were used to ‘wrap’ time and provide for magnitude compensation. An additional formula was created to align curves by specifying a period based on a starting point determined through inspection of the plotted curves. Changes as small as 0.001 hr were used to fine tune alignment of the 4 curves, allowing a very accurate period to be determined. This ‘calculated’ period was then compared to published periods, available from the AAVSO VSI service.”

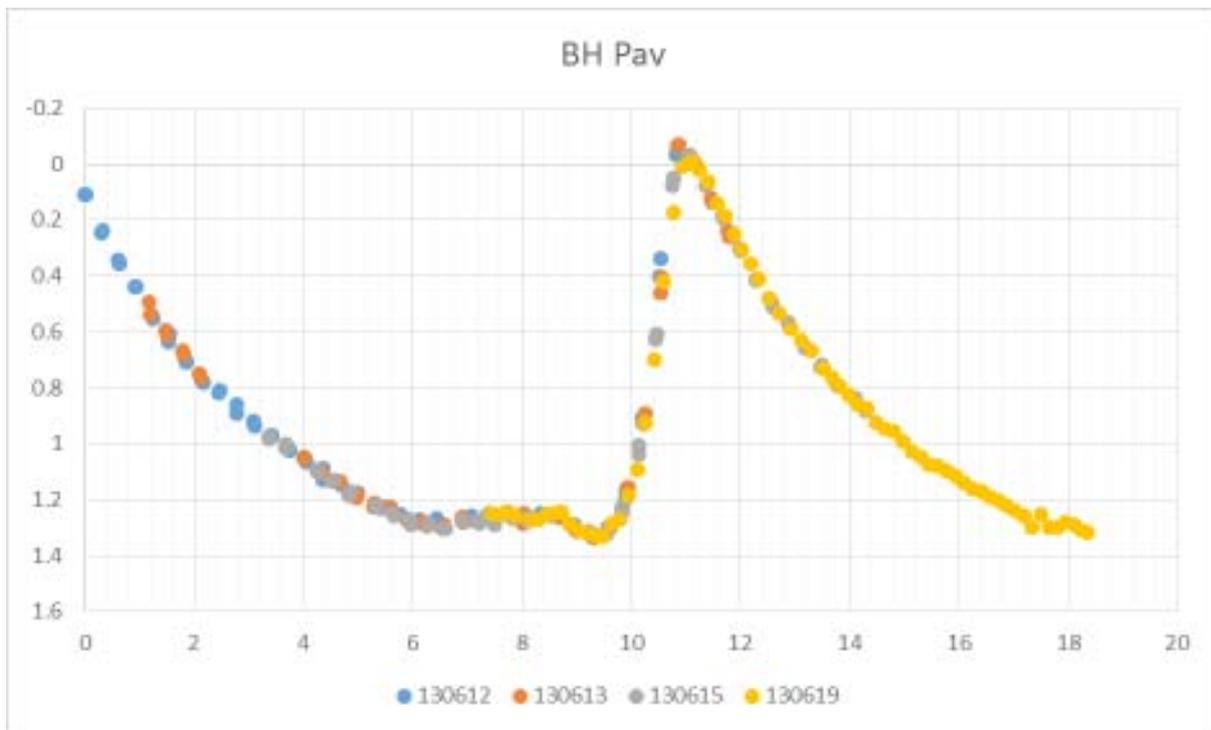


Fig 1. Light curve for BH Pav: Calculated period = 11.447 hours. Published period = 11.44689 hours

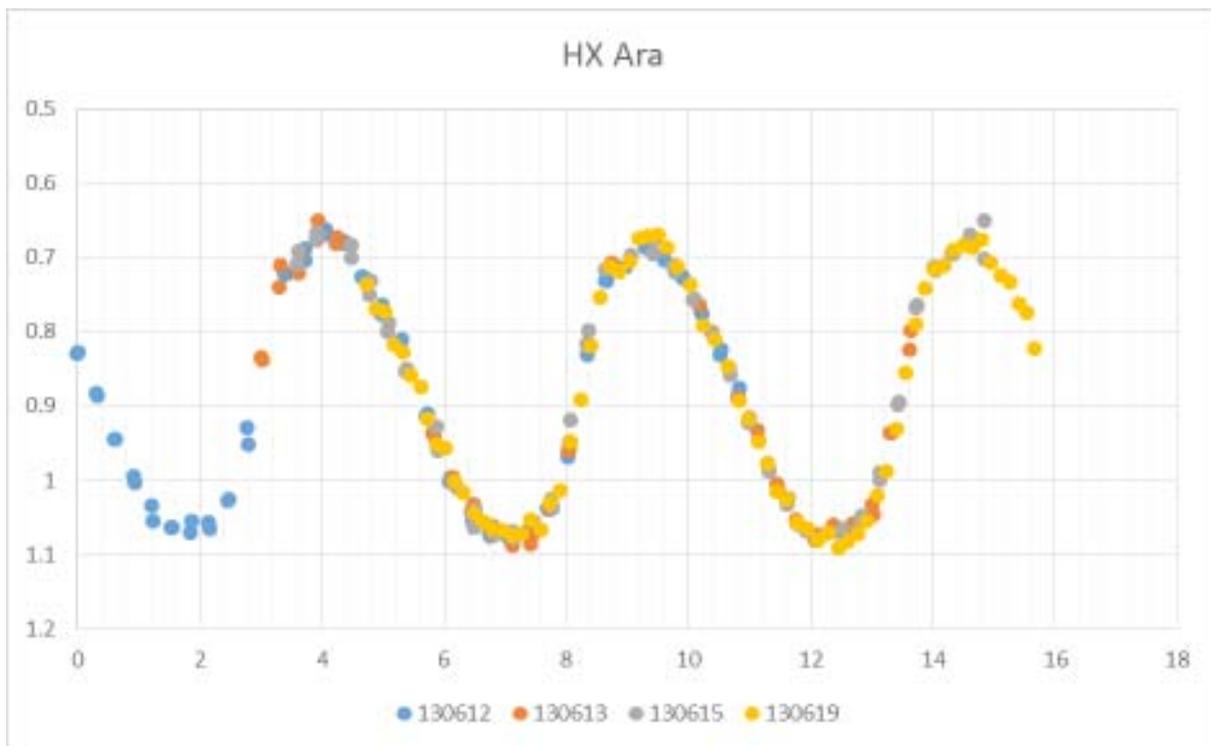


Fig 2. Light curve for HX Ara: Calculated period = 5.265 hours. Published period = 5.256 hours

These light curves are differential photometry through an uncalibrated V filter. But even as such they are very useful. Apart from the dramatically fast rise of BH Pavonis (Fig 1) it also shows the shock bump near minimum. There are minor divergences on different nights resulting from the lack of calibration - the colour changes during a cycle also affect the amplitude slightly and extinction effects are also present. But one of the advantages of CCD photometry is that these corrections can be made in retrospect when the B filter is available. HX Ara is a nice, fast variable (Fig 2) and V487 Sco has an interesting bump just before maximum (see Fig 3). Neil Butterworth is another member who has measured some of these objects in the past as has Giorgio di Scala.

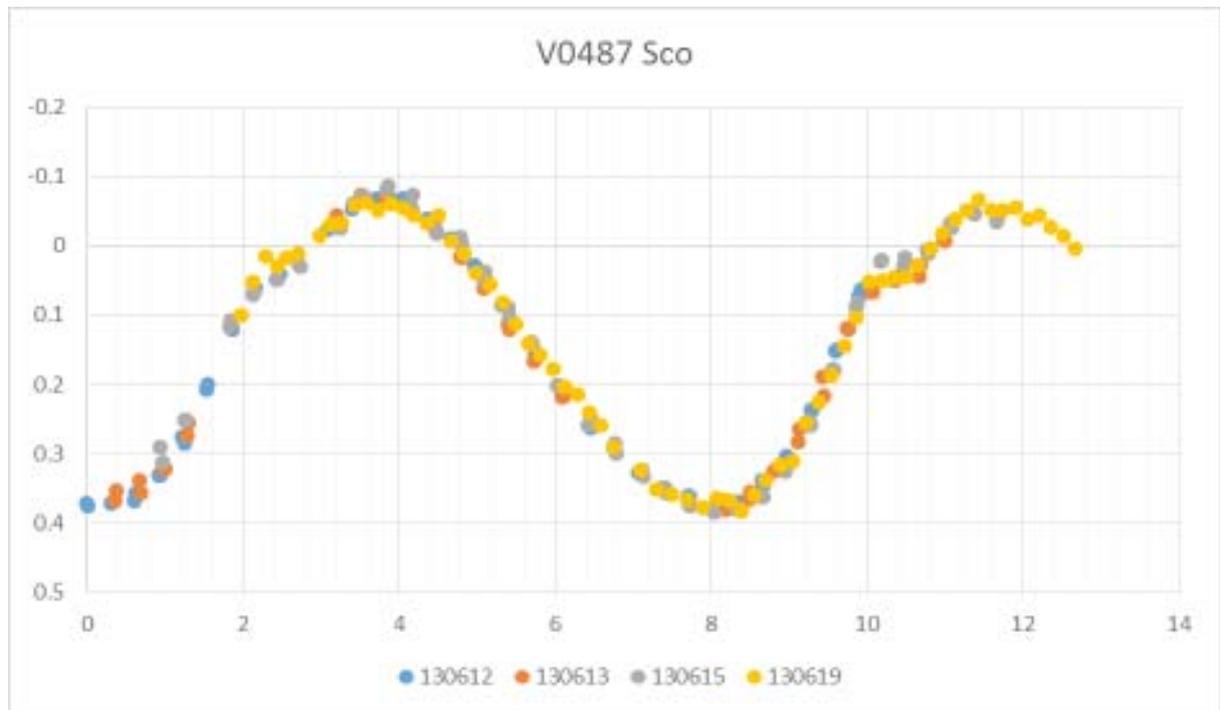


Fig 3. Light curve for V0487 Sco showing an interesting bump shortly before maximum.

## Conclusion

There has been a dearth of measures of these stars, particularly in the southern hemisphere. Many observers feel that everything we need to know about RR Lyrae stars is already known which means they are not followed closely. But I'm certain - along with many professionals - that there's much as yet unknown, so someone needs to look.

Apart from that they vary quickly and the light curves are interesting. Some stars, such as BH Pavonis which rises 1.3 magnitudes in an hour can even be followed visually, although the measures are not accurate enough, but that's moving into astronomy for entertainment.

This project will encourage you to make measures in the standard system - something which is quite simple but avoided by many observers - which limits the value of their measures in the astronomical field. Other simple techniques make you a much more competent researcher, able to turn your attention to more complex projects if you so wish.

A reminder that I'm helping in the initial stages but this project, which fills a gap in the VSS range of variable star research, needs a more permanent leader and group. So if it appeals to you in either category and you have the time contact me at [astroman@paradise.net.nz](mailto:astroman@paradise.net.nz) and copy Tom Richards [tom.richards@variablestarssouth.org](mailto:tom.richards@variablestarssouth.org). Any help or advice needed will be readily forthcoming.

And, finally, the measures will not disappear into a black hole but will be seen in the next year or two as part of various useful astronomical papers.

The RASNZ Conference for 2013 was held at Invercargill and was a great success, with over 90 registrants attending. Australian participants were well represented, with observers from Melbourne, Bathurst and Queensland - and including some from as far away as Perth and Alice Springs.

The programme got off to a good start, with Tom Richards' paper early in the first session on the Saturday morning. Tom spoke on the VSS Southern Eclipsing Binaries programme, which complemented his poster paper on the same theme. Tom gave an excellent overview of the current state of the programme and encouraged competent photometric observers to join in. He emphasised the data accumulated lead to publishable results, a very important point considering the very poorly observed state of eclipsing binaries in the southern sky.

One other presentation of interest in the sessions before lunch was John Hearnshaw announcing the second, updated edition of his book "The Analysis of Starlight - two centuries of astronomical spectroscopy". The first edition is extremely readable and instructive- I have it on my bookshelves. I suspect it would be very interesting to read the updated version - especially in the light of the current state of the art in amateur spectroscopy - as well illustrated by the excellent poster by Bernard Heathcote. Unfortunately Bernard could not attend the conference to speak to his poster.

The afternoon session on the Saturday included a talk by Stan Walker on Dual Maxima Miras and highlighted some of the peculiar behaviour of these stars. The stars BH Cru and V415 Vel came in for attention and possible period changes were discussed. See also Stan's article in the VSS Newsletter of Dec 2012.

The only variable star presentation on the Sunday was again by Tom Richards and covered the analysis of eclipsing binaries - from observation to physical model. CU Hya was used as the example here (see VSS Newsletter, May 2011) and the joint BAA\_VSS campaign described. Emphasis was placed on how a physical model could be developed from observation of the basic light curve. With a number of reasonable assumptions, an astrophysically realistic model of the system can be developed.

Although not directly related to variable stars, we all suffer to some degree from light pollution, so it was instructive to hear Steve Butler's presentation on monitoring your sky glow with a commercial "sky quality meter". Details of this product can be found at [www.unihedron.com/projects/darksky/](http://www.unihedron.com/projects/darksky/). Light pollution also was the topic of John Hearnshaw's talk on the Aoraki/McKenzie International Dark Sky Reserve – centred on the Mt John Observatory. This area is now the third internationally proclaimed dark sky reserve (and the largest) and was the location of the Third International Starlight Conference in June 2012. The substantial Proceedings of nearly 300 pages make very interesting reading – covering all aspects of preservation of the dark night sky.

As always in conferences like this, some of the best moments are the animated discussions over coffee or a wine or two. This proved to be the case at Invercargill.

## A new dataset for Guide 9 – *Mati Morel*

mmorel7@bigpond.com

I have been a regular user of GUIDE® software since October 1999, when I purchased version 7. GUIDE itself has been around for a little over twenty years, since its first release in May 1993. Updates came out fairly regularly in the 1990s - GUIDE2.0 in August 1993, GUIDE4.0 in December 1995, and so forth. The current release, GUIDE9.0, came out in 2012, with the base star catalogue being the UCAC3 (mag limit 16.5), replacing GSC-ACT (mag limit 13-15), however the general functionality and organisation of menus has remained fairly intact over this time. One useful feature is the capability of installing and displaying extra datasets by the user and this feature is one that I have been exploiting since 2004. My latest contribution is potentially very useful as a source of reference stars in the region of the Large Magellanic Cloud.

### Lucke-Hodge OB associations in the LMC

The two authors P Lucke and Paul W Hodge published a list of 122 OB associations (aggregations) of

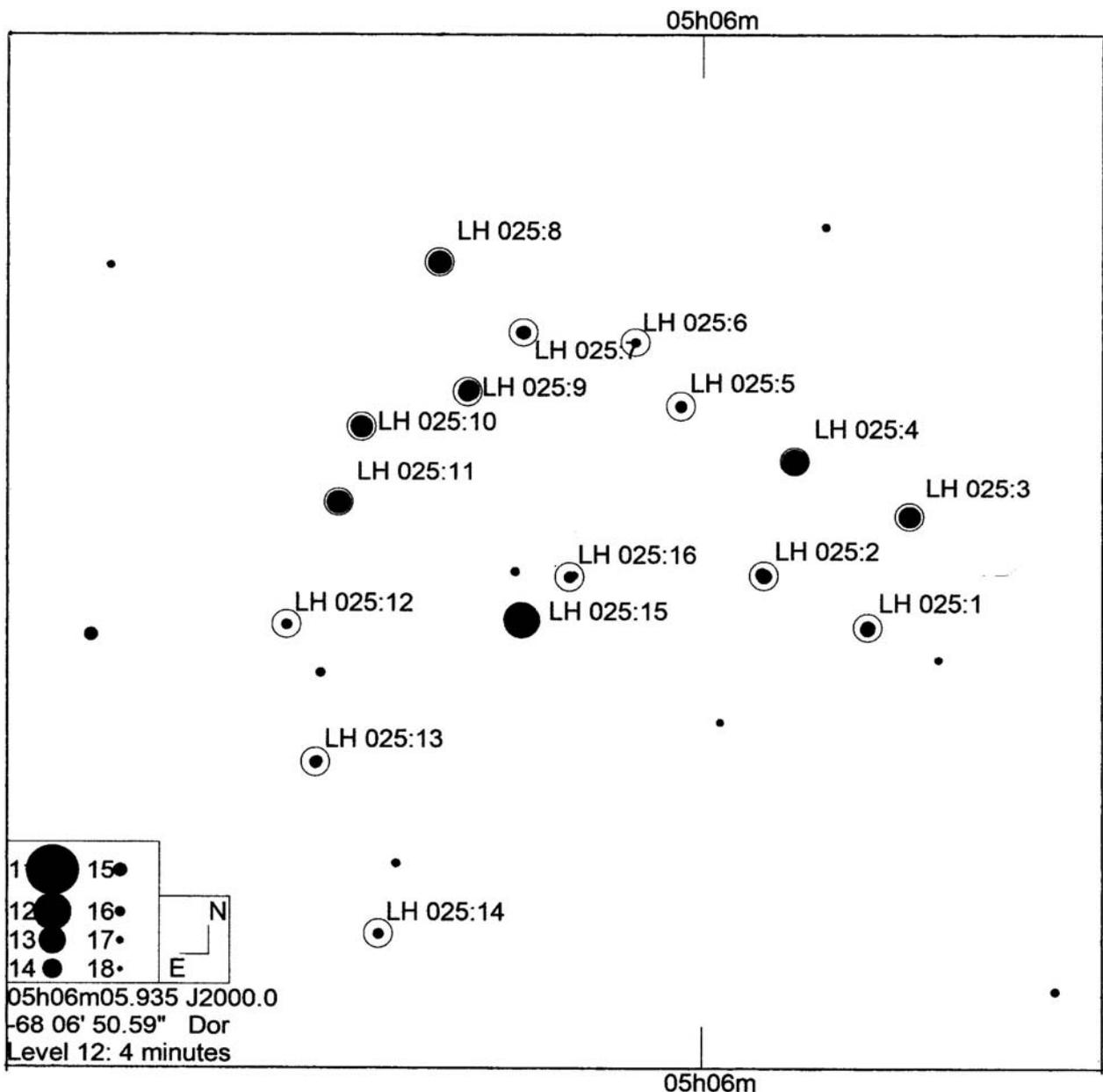


Figure 1. A display of OB association LH 25. A typical example of a GUIDE 9 display. LH 25 is one of the smaller LMC associations. The labels can be toggled on or off. A pop-up box (not shown) will give basic information (position, magnitudes etc) on any selected star. The field is 4' x 4'.

luminous O and B stars in 1970. Some variable stars familiar to southern observers reside in particular associations, eg S Doradus is in LH41, HD 269858 in LH94, and others not observed regularly. In 1972 Lucke produced an extensive catalogue of photometry (with charts) for about 5000 numbered stars in 95 of these OB associations. The vast majority had no published positions, making identification impossible, in the absence of the original charts. In February of this year I set about rectifying this deficiency, by extracting positions from astrometric catalogues, and with the aim of making the entire dataset readable by GUIDE 9. The final table lists precise positions for 5060 stars in 95 associations, mostly following the numbering of stars according to Lucke (1972). Modern CCD magnitudes (V and B-V) have been inserted in place of Lucke's original iris photometry, where possible, taken from APASS and other sources. It can be stated that 97% of the stars in my dataset have V, B-V of varying degrees of precision or accuracy. For example, 1671 stars have APASS data, but crowding is a problem in many LMC fields, and APASS objects have been examined carefully to determine whether they refer to single stars, or a blend of two or more.

## **LH\_STARSv3.ZIP**

The compressed file can be downloaded from the VSS website, by going to

<http://variablestarssouth.org/information-and-resources/catalogues-a-databases> and scrolling down.

LH\_STARSv3 contains the following files:

- 1) LH\_NUMORDER.txt 742 KB A plain text file, listing all 5060 stars, in order of LH association number, and stars numerically arranged within each association.
- 2) Readme.txt 2KB
- 3) lh\_stars\_f.txt The same data as item (1), but arranged in strict order of right ascension, without any descriptive text, or titles. This file is GUIDE 8/9 -specific.
- 4) lhob\_f.tdf A TDF (text definition file), required to enable GUIDE 8/9 to read lh\_stars\_f.txt. Items (3) and (4) must be saved under your Guide directory to be read by GUIDE.

## **Quality ratings for photometry.**

I decided that it would not be practical to reference all photometric data, numbering in many thousands. Rather, it may prove more useful to the user to grade the photometry according to precision. The following ratings have been adopted.

Q1: Highest precision; 3 decimal places. 92% of all data in this class come from APASS. Errors given. Non-APASS data is indicated by a remark.

Q2: Lower precision; 2 decimals (with errors) only. Virtually all are from CDS Cat. II/236 (Massey).

Q3: Photoelectric mags from literature. 2 decimals, no errors being available.

Q4: Photographic mags, to 2 decimal places, with no errors published. Virtually all of these come from Lucke (1972). LH 31 uses data published by Alcaino & Liller (1987).

Q5 : Approximate V magnitude, to one decimal place. Accuracy uncertain. Most are from GSC2.3 cat.

Note: All of my photometric data is formatted to 3 places, regardless. For Q2, Q3 and Q4 data the final (trailing) zero is to be disregarded. For Q5, the two trailing zeroes should be disregarded.

## **Acknowledgement**

I take this opportunity to acknowledge the use of the AAVSO Photometric All-Sky Survey (APASS), funded by the Robert Martin Ayers Science Fund. I acknowledge the use of the VizieR search page to access the catalogue holdings of Simbad, CDS, Strasbourg, which also made this research possible.

## **References**

- Alcaino G. and Liller W. 1987, *Astron. J.* 94,372  
Lucke P. and Hodge P.W. 1970. *Astron. J.* 75,171  
Lucke P. 1972. Thesis, University of Washington.

## NSV 7590 - a spurious variable – *Mati Morel*

mmorel7@bigpond.com

This piece is a summary of my accumulated research on just one obscure variable.

Several years ago I became intrigued by the object NSV 7590 (range 10.4-11.9v) which lies only 5.2' north of the globular cluster M80. The field contains R, S and T Sco (a famous nova in M80 which flared up in 1860). The field has been closely observed, especially since the discovery of T Sco. There is no 10th or 11th mag star at the position of NSV 7590. I obtained a copy of the original report of its discovery by K Nakamura in 1922. It is brief enough to reproduce here, in full, extracted from Kyoto University Observatory Bulletin, No 31.

### New variable star

Mr Nakamura announces discovery of a new variable star probably of long period. Its position is (sic)

(1900) 16h8m30s° 22°32'

(1855) 16 11 10 22 38

This is a star near M80 in the field of R and S Scorpii and missing on Hagen's chart. He obtained following estimation of magnitude on Hagen's scale.

	M
(1922) August 13	11.6
19	11.9
22	11.1
Septem. 13	10.4 [END]

Obviously the quoted equinoxes have been switched, inadvertently. When corrected, the positions are fine, though only rough. The most striking feature is that the object is claimed to have been bright over a time interval of no less than thirty days, and appeared in the midst of some long-established comparison stars for R and S Sco. Two comparisons, BD-22 4136 (8.5v) and BD-22 4134 (10.8v) lie north of M80, with nothing between them brighter than 13.7v. They bracket NSV 7590 and, if it were real, it would have transformed the aspect of the field unmistakably for any diligent observer. There does not appear to be any other report of such an apparition.

Could Nakamura have observed S Sco by mistake? S Sco lies only ~7.5' to the east, but an examination of S Sco using the LCG shows that it was near minimum, somewhere between 13.5 and 14.5, and hence very unlikely to have attracted attention as a "new" variable. Likewise R Sco was very faint, <14.0v. These two stars can be ruled out. Nakamura made 4 estimates of S Sco (all negative) for the whole of 1922, and 5 estimates of R Sco (all negative), here.

STAR	JD	DATE	MAG	FILTER	OBS	CHART
R Sco	2423256.0	1922 Jul 20.500	<11.0	v	Nk	(Hagen)
R Sco	259.0	1922 Jul 23.500	<11.0	v	Nk	(")
R Sco	280.0	1922 Aug 13.500	<12.7	v	Nk	(")
R Sco	286.1	1922 Aug 19.600	<12.7	v	Nk	(")
R Sco	289.0	1922 Aug 22.500	<12.7	v	Nk	(")
S Sco	2423256.0	1922 Jul 20.500	<12.4	v	Nk	(")
S Sco	259.0	1922 Jul 23.500	<12.4	v	Nk	(")
S Sco	280.0	1922 Aug 13.500	<12.7	v	Nk	(")
S Sco	289.0	1922 Aug 22.500	<12.7	v	Nk	(")

Nk = K Nakamura

[Courtesy of AAVSO Database].

If NSV 7590 were a real interloper, apparently not a minor planet, it would surely have been noticed by other AAVSO observers at that time. There was apparently no confirmation, while other AAVSO observers in August 1922 submitted positive observations of S Sco down to 14.5v.

In the years following T Sco's outburst in 1860, some observers paid very close attention to M80 and its surroundings, in case there was a repeat performance. J F J Schmidt of Athens Observatory is said to have observed the field one thousand times, up to 1868. Between 1860 and 1897 G Knott, an English VS observer, consistently followed R and S Scorpii, perhaps 2 or 3 times every month, from 1860 to 1897, but also, pointedly, noted the appearance of M80 with the comment, "M80 as usual", which never varied. As any experienced VS observers knows, the appearance of a frequently observed field becomes imprinted in one's mind, and any change is instantly detected. Mr Nakamura's observing season was apparently rather limited.

Given the long period of visibility, as claimed, there may be the opportunity to check this region on patrol plates, for August and September 1922. This would surely settle the matter, for good. My own suspicion is that Nakamura's observations are a misinterpretation of the field.

## Postscript

In the 1920s there was apparently no official AAVSO sequence for R and S Sco. Observers used whatever visual sequence could be found in the literature. Apart from Hagen's chart, see:

Parkhurst, J.A. 1896, *Popular Astronomy* 4,331-332.

Knott, G. 1899, *Mem. RAS* 52,184.

Pogson, N. 1908, *Mem. RAS* 58,84.

## Publication Watch

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VSS has had its first publication in a peer-reviewed journal.

The paper on CU Hydrae appeared in the June edition of the *Journal of the British Astronomical Association* (JBAA 123:3, 160-162) and stems from Equatorial Eclipsing Binaries Project of VSS.

### CU Hydrae – a neglected bright eclipsing binary

*Tom Richards, Col Bembrick, Terry Bohlsen, David Boyd, Phil Evans, Yenel Ogmen, Roger Pickard, Margaret Streamer.*

#### Abstract

CU Hydrae was studied by seven observers as part of the joint Equatorial Eclipsing Binaries Project of Variable Stars South and the British Astronomical Association Variable Star Section. This observational work was carried out over two seasons in 2010 and 2011, with 57 nights of data being acquired. These data were used to derive new light elements and a phase diagram. Available minima data prior to ours in time was investigated to see if they would support evidence of a period change. A physical model of a near-contact system was developed in BinaryMaker 3 to fit the phase data, though without higher quality temperature or colour data it is not well constrained.

Another paper with a number of VSS authors has appeared on the ArXiv and submitted to ApJ but has not yet been published by that journal. It concerns the campaign to monitor T Pyx. The ArXiv paper is arXiv:1109.0065v2.

### The 2011 Eruption of the Recurrent Nova T Pyxidis; the Discovery, the Pre-eruption Rise, the Pre-eruption Orbital Period, and the Reason for the Long Delay

*Bradley E. Schaefer, Arlo U. Landolt, Michael Linnolt, Rod Stubbings, Grzegorz Pojmanski, Alan Plummer, Stephen Kerr, Peter Nelson, Rolf Carstens, Margaret Streamer, Thomas Richards, Gordon Myers, William G. Dillon*

## Abstract

We report the discovery by M Linnolt on JD 2455665.7931 (UT 2011 April 14.29) of the sixth eruption of the recurrent nova T Pyxidis. This discovery was made just as the initial fast rise was starting, so with fast notification and response by observers worldwide, the entire initial rise was covered (the first for any nova), and with high time resolution in three filters. The speed of the rise peaked at 9 mag/day, while the light curve is well fit over only the first two days by a model with a uniformly expanding sphere. We also report the discovery by R Stubbings of a pre-eruption rise starting 18 days before the eruption, peaking 1.1 mag brighter than its long-time average, and then fading back towards quiescence 4 days before the eruption. This unique and mysterious behavior is only the fourth known anticipatory rise closely spaced before a nova eruption. We present 19 timings of photometric minima from 1986 to February 2011, where the orbital period is fast increasing with  $P/\dot{P} = 313,000$  yrs. From 2008-2011, T Pyx had a small change in this rate of increase, so that the orbital period at the time of eruption was  $0.07622950 \pm 0.00000008$  days. This strong and steady increase of the orbital period can only come from mass transfer, for which we calculate a rate of  $1.7\text{-}3.5 \times 10^{-7} M_{\odot}/\text{yr}$ . We report 6116 magnitudes between 1890 and 2011, for an average  $B=15.59 \pm 0.01$  from 1967-2011, which allows for an eruption in 2011 if the blue flux is nearly proportional to the accretion rate. The ultraviolet-optical-infrared spectral energy distribution is well fit by a power law with flux proportional to  $\nu^{1.0}$ , although the narrow ultraviolet region has a tilt with a fit of  $\nu^{1/3}$ . We prove that most of the T Pyx light is not coming from a disk, or any superposition of blackbodies, but rather is coming from some nonthermal source.

## VS-COMPAS

If you want to know what our counterparts in the far north are doing with variable star research then have a look at a relatively new (2011) group, VS-COMPAS. See <http://vs-compas.belastro.net/>

Here's a peek at part of their home page.

The screenshot shows the Project VS-COMPAS website. The header includes the title "Project VS-COMPAS" and the subtitle "Variable Stars Common Observation Mission in Particular Areas of the Sky". Below the header, there is a navigation menu with links for "News", "Discoveries", "Search", "Bulletin", "Observing", "Articles", "Classification", "References", "Tools", "Statistics", and "Team". The main content area features a news article titled "The first ACV discovery in the project" with a light curve plot and a sidebar for the "Variable Stars Observer Bulletin".

They appear quite active but don't bother trying to download a copy of their monthly journal as it's coming 'real soon now'. They have some fancy analysis software but you have to be a team member to get it.

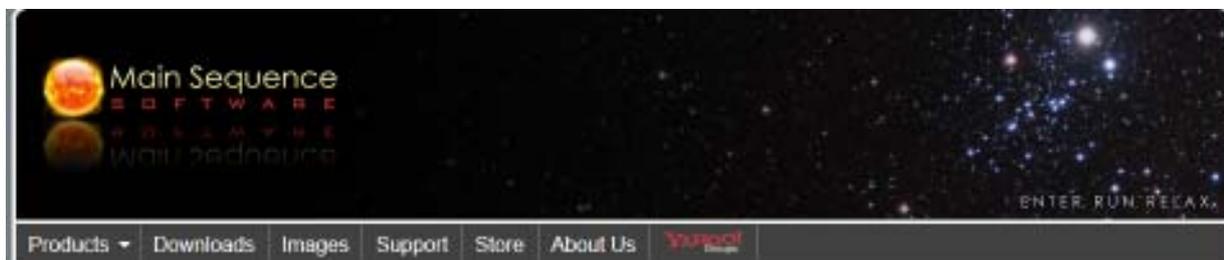
They don't have VSS on their reference list so perhaps we ought to tell them that we exist!

## Software Watch

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If you want to control your telescope, camera, focuser, rotator and dome from your computer but don't want to pay >\$500 for MaxIm DL then take a look at **Sequence Generator Pro**. It'll do all of the above and it's only \$99 (US of course).

It's produced by Main Sequence Software who encourage you to "Enter, Run, Relax".



Here's the blurb:

- Powerful sequencing
- Equipment profiles
- Auto focus
- Automated meridian flip
- Flexible focusing patterns
- Target framing made easy
- Center on any part of an existing image
- Flat frames made easy
- Dither between frames with your choice of three auto guiders (PHD, Astroart and MetaGuide)
- Easily perform frame and focus routines (with support for subframes and high speed cameras)
- Feel at home with our highly customizable user interface (drag, dock and float small modules for almost any action)
- Over a dozen configurable UI modules (PHD graphing, Image Pan and Zoom, TEC control)
- User defined TEC cool down and warm up routines (to minimize thermal stress on your camera's sensitive components)
- Between-frame temperature compensation
- Easily create and run a "flats" sequences from your "lights" sequence
- Detailed documentation and instructional videos
- Near immediate customer support via email or the Yahoo! group

You can read all about it at <http://www.mainsequencesoftware.com/SGPro.html> or even download a free sample to try it out for 45 days.

A couple of caveats: it doesn't handle SBIG's AO units and you need extra software for guiding.

## Hardware Watch

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Not much to report on this time but if you have a GPS unit that uses a **Prolific PL-2303HX revision A** chip to drive the USB connection to your computer don't install Windows 8. You need a model with the **Revision D** chip or the **PL-2303TA** chip. See here: [http://www.prolific.com.tw/US/ShowProduct.aspx?p\\_id=225&pcid=41](http://www.prolific.com.tw/US/ShowProduct.aspx?p_id=225&pcid=41)

## 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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