

VARIABLE STARS SOUTH

Royal Astronomical Society of New Zealand, Variable Star Section

Active membership continued to increase in 2015 with more than a dozen additions, some of whom made presentations at conferences or published refereed papers.

Members also attended conferences; eight were at the Mt John Anniversary Symposium with fifteen or more at the associated RASNZ Annual Conference. A poster paper was presented at the former, two spoken papers and three posters were presented at the latter. As well, our editor, Phil Evans, attended a meeting in Hawaii of current and past Swinburne University master's students where he introduced VSS to a number of attendees. Andrew Pearce, an enthusiastic visual observer, presented a poster paper at the Spring Meeting of the AAVSO.

The new Director of the American Association of Variable Star Observers, Stella Kafka, with some financial assistance from this section and the RASNZ, attended both the Mt John meetings and also spoke to the Auckland and Wellington societies. This allowed a useful interchange of views between our management committee and Stella which has continued with an on-line meeting in October with another to take place shortly.

Our director, Tom Richards, retired at the end of December, 2014, and Stan Walker took his place. A slight change of structure was introduced with the setting up of a group, known as the management committee for convenience, as the scope of our activities is becoming too large for any one person to lead effectively. At present this group comprises the director, plus Tom Richards, Mark Blackford, David Moriarty, David O'Driscoll, webmaster, Phil Evans, editor and Bob Evans, treasurer and membership secretary.

Tom's efforts since 2009 - and unofficially before that - have seen the rebirth of serious amateur variable star astronomy in Australia and New Zealand and a fitting tribute to his enthusiasm and inspiration was the award by our parent body of Honorary Membership of the Royal Astronomical Society of New Zealand at the 2015 annual general meeting.

An interesting innovation was set up by Carl Knight of Manawatu who helped a local year 11 student, Tessa Hiscox of Freyberg High School, in a practical project involving CCD measures of the Cepheid, UU Muscae, for her participation in the August 2015 science fair in Palmerston North. This resulted in a Distinction Prize for Tessa but the more lasting and practical result has been a series of meetings with school science teachers in the area and a general discussion about what cooperation is practical and realistic.

Also in the outreach area Alan Plummer continues to write a monthly article for Sky & Telescope, Australia, Alan Baldwin contributes items for the RASNZ newsletter, Stan Walker has written articles for Southern Stars and the Auckland Society's Journal and our website, maintained by David O'Driscoll, is very popular with many visitors.

Phil Evans edited four Newsletters during the year and these are available to anyone on our website at: <http://www.variablestarsouth.org/>. These cover a wide range of stellar topics and are well supported - even those going back years are still frequently accessed. David has also arranged that most presentations at the VSS Symposia and other conferences are also available.

Visual observing continues to be strong.
Andrew Pearce's following summary is typical:
Intensive visual coverage of about 400 LPV's between declinations 10S and 60S with the aim of detecting long term changes in period and the investigation of anomalous features such as humps on the ascending branches of the light curve and double maxima, etc.

Monitoring of RCB stars in the same declination range. I'm able to follow any fades down to about mag 15.5. During 2015, V854 Cen was especially active and a few others that had been below visual threshold for many years, brightened (V CrA, UW Cen, etc.).

Visual measures of all southern Milky Way novae. Highlights included V5668 Sgr which rose to 4th magnitude. V1369 Cen continues to be followed visually during its very slow decline.

Observations of bright southern Cepheids and semi-regular stars (brighter than 10th mag). Most interesting star in 2015 was L² Pup which displayed essentially a constant brightness near

minimum (or a very narrow range of less than 0.5 mag) since July 2015.

Good coverage of southern eclipsing binary BL Tel

Other active visual observers include Peter Williams, Alan Plummer, Paul Camillieri, Rod Stubbings, Bob Evans and Stephen Hovell.

Peter Williams contributes the following summary of one long-term project.

BL Telescopii 2015 Eclipse Observations Summary from Peter Williams:

Members of the VSS have successfully observed the 2015 eclipse of the Algol type eclipsing binary, this being the 12th eclipse monitored in this ongoing program. Although primarily a program for visual observers, this and the previous eclipse have also been well monitored by observers using DSLR/CCD equipment and it is interesting to note that such electronic equipment was not generally available to amateurs at the onset of this long term program.

This visual light curve indicates mid eclipse occurred on 2015 Aug 28.9UT (GJD 2457262.4), an interval of 778.4 days since the 2013 eclipse. The total duration of the 2015 eclipse was 75 days, slightly longer than average and the longest eclipse duration so far observed. A minimum brightness of magnitude 9.2 was observed.

Based on these visual results, the next eclipse of BL Tel will be centred near 2017 Oct 13 when this field will be well placed in the western evening sky at the end of twilight.

It is interesting to note the BL Tel program has recorded 12 eclipses spanning an interval of 11671 days, some 32 years, and is amongst the longest continually running programs to observe a specific star thus far coordinated through the VSS and is a tribute to the dedication of all observers.

Alan Plummer: V694 Monocerotis Project

V694 Mon is a well observed bright Z Andromedae star that has been in my visual observing program since late 2005. Over that time my observations of V694 Mon have been patchy. The farther north a target lies, the less interest I tend to have, plus, I noticed early on that my observations were noisy, which I found discouraging. (I now know 'noisy' is the nature of

this beast's lightcurve.) Then take into account the warmer months not being good for observing from my location, a couple of years of *totally* bad observing conditions, and it's lucky I have a light curve at all. However, I have been able to keep it up through 2015, to see a spike in the light curve in early 2016.

Figure 1 from Leibowitz and Formigini (2015) shows data from 1928 until 2015. Archival survey observations are used until 1990 and, in response to that obvious brightening, amateurs (mostly Albert Jones) started observing the star. The data are clearly improved with the object being placed on the RASNZ VSS observing program. Figure 1 shows the ongoing value of visual observations. Z And stars are binary systems, and a subtype of cataclysmic variable stars. Leibowitz and Formigini found V694 Mon has a 5.3 year period, somewhat evident in the light curve, reflecting possibly a pulsation period of a red giant, the (eccentric) orbital period of the binary system, or the precession of an accretion disc around a white dwarf.

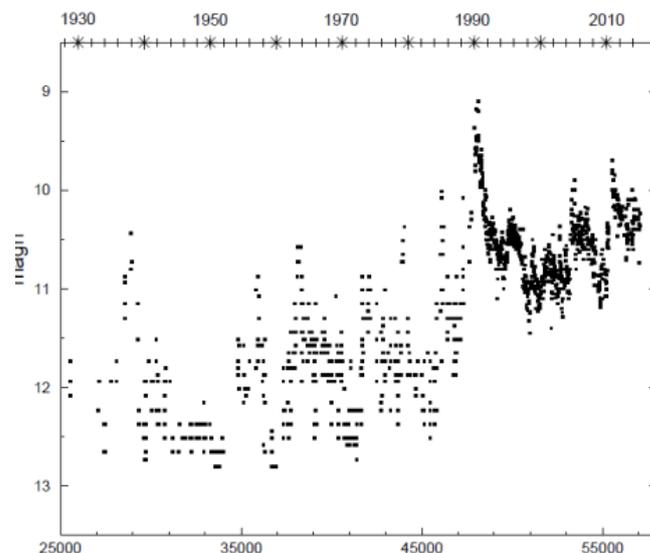
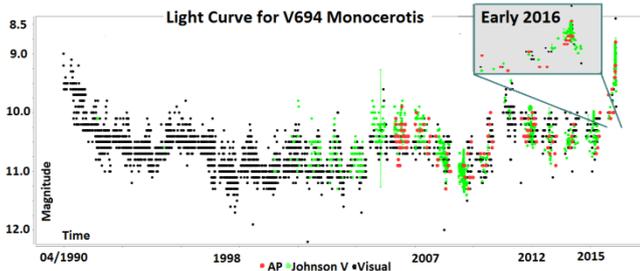


Figure 2 shows the raw International Database data from 1990 until now plotted with VStar. This data—comprising VSS measures—can clearly be seen in Figure 1. A look at the recent data shows VSS members David Boyd, Eric Blown, and myself contributing. (Apologies to anybody missed out.) My observations are in orange, Johnson V are green, and other visual observers are black. It can be seen that the current outburst of V694 Mon has been brighter than ever measured before. There is not space here to go into the physical nature of this exciting star; I

encourage you to do so yourself. And observe it, of course.



2015 DSLR Activity from Mark Blackford:

The EB and EW Binaries Project received DSLR observations from the following:

Mark Blackford: NT Aps, RR Cen, BO Ind, MW Pav, V0386 Pav, EE Aqr

Neil Butterworth: V0878 Ara, eps CrA, DE Mic, UX Ret, V0883 Sco, V0954 Sco

Col Bembrick and Jonathan Powles have conducted light curve modelling using 2015 and earlier observations collected under this project. Their results will be presented at the Variable Stars South Symposium No. 4 on Good Friday, 2016.

M. Blackford also collected DSLR observations of:

QZ Car (QZ Car Project led by Stan Walker and Ed Budding)

HX Vel, V0454 Car (Burcu Ozkardes)

Eta Mus, V0831 Cen, del Pic (Ed Budding)

BL Tel (Peter Williams)

KX Vel (Pavel Mayer)

David Benn has been doing DSLR photometry of R Car and BL Tel mostly, since Jan 2015 after taking Mark Blackford's DSLR course for AAVSO. Also some untransformed DSLR photometry (Tri-color Green) of novae.

Neil Butterworth is also active in the DSLR field. He comments:

Further to Mark's report, I also observed the following Cepheids:-

ST Pup, RS Pup, RZ Vel, SW Vel, RY Vel, XZ Car, WZ Car and U Car.

Also Mira or LPV stars: BH Cru, T Cen, R Cen, V744 Cen, NU Pav, V819 Ara, V3877 Sgr, V383 Nor, EY Cir and DP Ara

Roy Axelsen reports:

During 2015, I was able to get time series DSLR photometry on the following delta Scuti stars:

V393 Car, V1338 Cen, V1430 Sco, V1307 Sco and AD CMi.

Eclipsing Binaries:

The eclipsing binaries field has seen some changes. Initially it was divided into two sections - Algols, which have rather regular light curves and a rather complex group comprising beta Lyrae stars, W Ursae Majoris stars and others where the light curves show almost continuous variations. This left out some of the more interesting objects, eclipsing stars where one component is a pulsating variable and ignored completely the cataclysmic variables which are all interacting binaries.

The observations and analysis of binary systems is complex with a wide range of people and techniques involved. No longer do the VSS targets fit in neat little packages with easy solutions. This has resulted in structural changes in projects, which the comments below from David Moriarty illustrate. "As reported in the last newsletter, the EA Project has been closed as such, and absorbed into a wider Eclipsing Binary Project with the EW-EB Project. The EA Project was originally designed to search for circumbinary planets via eclipse timings; however, that requires a long time frame and many observers. Several VSS members contributed in the first few years, but all have now withdrawn. The last active observers were Margaret Streamer and David Moriarty. In the interim Tom Richards and Mark Blackford will co-ordinate the eclipsing binary projects, but the sheer complexity of these will probably lead to some interesting and valuable discussions at VSS4".

Changes within the eclipsing binaries programme — David Moriarty comments:

In 2015, my observations and research have been mostly on contact and near contact binaries and a few of the original EA set. The following were observed in B, V & I pass bands: V775 Cen, YZ Cha, AF Cru, TW Cru, BC Gru, RV Gru, RX Gru, V Gru, V626 Sco and AW Vel.

I and Margaret Streamer have resigned as leaders of the EA Project. The reasons are set out in extracts from an email to Stan: "*In my case, I find contact and near contact binaries very interesting and have been reading and studying papers on contact binary formation and evolution in order to write up my work with TW Cru over the past 5 years and more recently with BC Gru, RV Gru and V Gru. I am working now on papers on BC*

and RV Gru (the latter with Tom), as well as preparing for the work with UQ on the spectral project, for which V775 Cen and ST Cen are the principal targets. The latter are probably near contact, or close to being near-contact, binaries. In future, I would like to expand observations and modelling of near contact and contact binaries as well as semi-detached binaries, i.e. studies appropriate to the EW-EB project.

Margaret has now enrolled at ANU in a 4 year part time M.Phil. Degree, which will include course work and research that will concentrate on her interests with some of the oscillating eclipsing binaries."

I will be supervising an Honours student at the University of Queensland to obtain high resolution spectra of several eclipsing binary targets from which spectral types and radial velocities can be determined and thence combined with my photometric data to develop accurate models of the binaries. Sarah Sweet (a postdoctoral astronomer at the ANU Research School of astronomy and Astrophysics) and Michael Drinkwater (Professor of Astrophysics at UQ) are collaborating on the project. We will use the ANU 2.3 metre telescope at Siding Spring Observatory in April, 2016.

A paper with the work of the EA Project group was published in 2015:

M. Streamer, J Byron, D. J. W. Moriarty, T. Richards, W. Allen, R. Axelsen, C. Bembrick, M. Blackford, T. Bohlsen, D. Herald, R. Idaczyk, S. Kerr, R. McIntosh, Y.Ogmen, J.Powles, P. Starr, G.Stockham. Revised Light Elements of 78 Southern Eclipsing Binary Systems. 2015. JAAVSO **43**: 67-73.

Tom Richards reports on the Eclipsing Binaries Project - CCD results:

In the past year three observers have recorded 65 minima in the project database (Phil Evans, Rarotonga (15 minima); Robert Jenkins, Adelaide (2 minima); and Tom Richards, Kangaroo Ground (48 minima). Target systems were MR Aps (4 minima plus light elements), V676 Cen (17 minima plus light elements), YY Gru (4 minima), NSV 1000 Hya (8 minima plus light elements), DI Mic (5 minima plus light elements), GZ Pup (5 minima plus light elements), CP Scl (8 minima plus light elements), AD Phe (7 minima plus light elements), BU Vel (6 minima plus light elements)

and W Vol (1 minimum). A paper on these results is under construction.

Publications by members of the CCD group: Moriarty, DJW, Period Analysis, Photometry, and Astrophysical Models of the Eclipsing Binary TW Crucis, JAAVSO 43, 2015.

Southern Binaries Programme: An overview from Ed Budding

A programme of studies of (relatively neglected) southern eclipsing binary systems has been underway in recent years, involving spectrographic observations at the Mt John University Observatory, as well as important new photometric contributions coming from members of the VSS.

While it is relatively well-known that the '*eclipse method*' can yield absolute parameters of stars, such as luminosities, masses, radii and distances, it is less well-recognized that top quality local instrumental development, such as the Hercules facility at Mt John, is now pushing results to a new high level of precision. When such data are combined with the remarkable and proven capability of VSS photometry, including new multicolour DSLR data, at least for stars brighter than $V = 8$, resulting parameters are used to test the latest developments of theory. For example with the incorporation of wind-driven mass loss, more advanced models of convection or tests of composition.

The special access (due to location) to the great 'stellar nurseries' of the southern hemisphere, such as the Sco-Cen OB Association (the nearest such formation in the Galaxy), gives added significance to this collaborative research. Recent papers from the Southern Binaries Programme in leading journals establish the exemplary quality of the findings. We are demonstrating the ability to check and clarify contemporary areas of study in stellar astrophysics, from the formation of stars through their evolution and ultimate fate.

This is a list that I recently prepared on radial velocity measures made (but not yet published) using the Hercules spectrograph at Mt John.

delta Cap
QZ, V454, V462 and V486 Car
V655 and V766 Cen -- partial coverage.
V851 and V863 Cen -- good coverage

HZ, UW, LZ, MS, and tau CMa.
eta Mus (ongoing , follow-up work)
delta and VV Ori -- a lot of data;
delta Pic,
pi, PU and V410 Pup
HX, NX, V356 Vel
But completion of the (difficult) QZ Car project is
a bit of a priority at present.

Beginners & Outreach from Alan Baldwin, Beginners Program Coordinator:

During the year sets of charts have been sent to a few enquirers who have made contact either by way of the web-site or by referral.

With the visit of Dr Stella Kafka, Director of AAVSO to New Zealand in May, publicity on variable star observing was given at meetings of the Auckland and Wellington Astronomical Societies and at the RASNZ Conference at Tekapo. In addition presentations were made at the Swinburne Conference in Hawaii by Phil Evans and at the Foxton StellarFest in the Lower north Island region by Alan Baldwin.

There has been considerable discussion in the background on ideas for projects for people new to astronomy to introduce them to observing and so generate skills which can be built on with more sophisticated projects. This year this has led to a focus on projects for secondary school age students; these could particularly be conducted through Science Fair projects. In Palmerston North we had an example with Tessa Hiscox monitoring UU Mus for a Science Fair project, who was mentored by Carl Knight and Stella Kafka. Some guidelines for this activity were given by Carl Knight in an article in the December 2015 issue of Southern Stars (Vol 54, No 4, pg. 10. Some more sharing of ideas of suitable projects for this space would be welcome.

It is helpful to have the mentoring role distributed and it seems logical to have the mentor, if the match is reasonably close, to live in the same region. Some of this has happened in this past year and I appreciate the help of VSS members who have assisted in this way and we hope it will bear fruit in due course. I hope other members will be willing to help if approached.

Pulsating Variables - a Summary from Stan Walker:

Most of 2015 was devoted to setting up a Cepheid monitoring programme aimed at stars brighter

than $V = 10$ with periods in excess of 10 days and amplitudes greater than one magnitude. These stars are easy to observe visually with acceptable accuracy. These have been observed for decades by some observers but using classical visual techniques which are not entirely suited to Cepheids or other small amplitude pulsators. Considerable improvement in accuracy can be obtained by using comparison sequences better suited to such stars and this is being developed. A presentation about the type 2 Cepheid, ST Puppis, was made at Tekapo and later published in JAAVSO. Neil Butterworth, DSLR BV, and Andrew Pearce, visual, continue to follow this unusual and challenging object. Butterworth has followed 7 other Cepheids. Pearce and Williams are observing others visually.

Some attention was given to colour changes in certain Mira stars showing abnormal light curves but it is a slow process and requires patience. Eight of Butterworth's stars are Miras and LPVs.

Delta Scuti stars are monitored by Roy Axelsen and Margaret Streamer is working on these objects in binary systems. Even the BL Telescopii project involves pulsation as it is a good example of a complex system with a hot star, the companion to which is a semi-regular pulsating star.

Semi-Regular Star Analysis: Aline Homes

Preliminary analyses for three bright semi-regulars, T Muscae, T Centauri and L² Puppis have been completed so far and results have been summarised in a poster presented at the RASNZ Conference in Tekapo. Most of the variation of T Mus can be accounted for by the interaction of two cycles, a primary cycle of 375.5 days and a longer secondary cycle of approximately 1001 days. There is still some variation to be accounted for. The amplitude of variation for this star has more or less doubled in the past few years, mainly due to deeper minima. Only visual data are available and colour data for T Mus are urgently needed.

Where colour data are available, maxima and minima in V have been found to lag behind those in other wavebands by 20-25 days. This is particularly marked in T Centauri. Dust emission events have been detected in both T Mus and L² Pup and these appear to have caused perturbations in the behaviour of the star, as well as dimming. The dimming of L² Pup has been particularly

marked and persistent, but analysis of available observations on this star is ongoing. Pressure of other work and the need to find and train a new analyst have meant that not much progress has been made since the Tekapo conference, but work should begin again shortly.

Exoplanets from Phil Evans:

Phil Evans continues to pursue exoplanet transits and during 2015 published observations of ten transits on the Exoplanet Transit Database maintained by the Czech Astronomical Society. They were WASP 28b, 31b, 50b, 57b, 64b (2 transits), 75b, 97b and HATS-1b & 5b.

has been expended trying to ensure that the site remains secure and available. VSS also has an active discussion forum hosted by Google Groups that allows the VSS management and members to ask questions and share information.

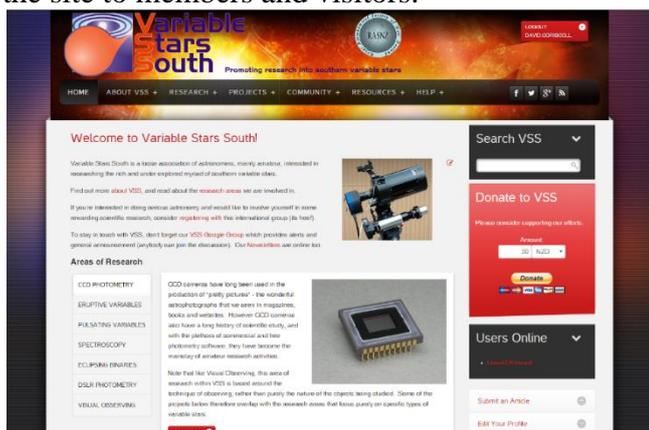
Webhosting and software costs are the only significant costs incurred, and have been managed through the use of free software where possible. 2015 saw the site transferred to a new hosting provider who could provide a more stable environment for the site.

Stan Walker Director RASNZ VSS

The VSS Website:

VSS has managed a website as its primary method of communication since its inception.

This website supports over 120 registered members of the community as well as external unregistered guests. Over 1000 pages of content and more than 1050 individual files are served by the site to members and visitors.



Countries					
Countries		Pages	Hits	Bandwidth	
United States	us	3,271	13,088	490.22 MB	
China	cn	2,148	2,784	389.55 MB	
Ukraine	ua	1,679	1,737	91.06 MB	
France	fr	1,198	2,384	152.39 MB	
Ireland	ie	1,051	8,264	210.81 MB	
Austria	at	840	840	107.50 MB	
Australia	au	564	5,179	235.75 MB	
Germany	de	439	1,000	165.78 MB	
Russian Federation	ru	373	526	25.96 MB	
Canada	ca	301	527	42.15 MB	
Unknown	zz	218	822	41.84 MB	
New Zealand	nz	203	2,119	86.06 MB	
Great Britain	gb	146	1,157	57.82 MB	
Netherlands	nl	125	183	15.12 MB	
Brazil	br	116	208	31.17 MB	

The site serves approximately 1500 unique visitors every month who access an average of 13,000 pages, representing over 2Gb of data. Site visitors come from all over the world, although some of these represent attacks on the site which need to be defended against! Significant effort