Variable Stars South

Newsletter 2010/1

2010 February

From the Director

Tom Richards *tom.richards@varstars.org*

TOOs and RFOs

Have you noticed the latest one-upmanship game? Use acronyms but don't decode them. Then your reader feels most inferior for not knowing instantly what those capital letters mean. Why, I've probably committed this sin in my articles in this Newsletter. And I could go on about the wonderful opportunity acronyms offer for wandering apostrophes too (or TOO). Anyway, on to TOOs (not TOO's). Or should I be a real pedant and talk of TsOO like GsG for Governors General?

A most significant part of the contribution an amateur VSO (heh heh – it's you, an observer of variable stars) can make, as we all know, is to contribute observations of something important that has just happened – a Target of Opportunity. The commonest class of such events are the outbursts of one sort or another of cataclysmic variables, from a nova eruption to a dwarf nova superoutburst. There have been a spate of such down-south events lately among them the recurrent nova U Sco, the peculiar dwarf nova VX For, and novae in Eridanus, Ophiuchus and Sagittarius. Other types of events get people excited too: the outburst of the luminous blue variable R71 in the LMC (surely you know

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that acronym?), and the brightening of Eta Carinae, are just two that come to mind.

But sometimes it's not just a celestial event that gives us a small window of opportunity to do something, but a campaign. There has been increased interest lately in the behaviour of dwarf novae in quiescence and long period variables at minimum – times when the behaviour of such stars is "normal". With DNe (just told you!) the flickering can tell us about the accumulation of transferred material into the quiescent disk. With LPVs is there any modulation that may tell us about gross chromospheric changes? Or about possible companions? Is there any flickering? So watch for Requests for Observations on (say) T Pyx, even though nothing spectacular is in the offing.

My concern about events (TOOs) and campaigns (RFOs) is how to get the news to you, dear VSS member. I have been forwarding relevant emails to the VSS-members egroup, to which you all belong. I have been putting news blurbs (sorry, media releases) onto our website – but I have been doing neither very consistently or assiduously. Aside from that being a possible reflection of my biased interests, it mainly has to do with my own pressure of time. So, don't rely on me -- how can you find out for yourself? Here are my favourite sources:

Center for Backyard Astrophysics. CBA runs monthly campaigns on southern (also northern) cataclysmic variables. See their website http://cbastro.org/ for current targets, observing and data submission requirements. Their campaigns are kept as simple as can be so that anyone with a CCD can contribute - but don't expect any feedback. Go to http://cbastro.org/communications/mailing-lists/ to join their email lists.

American Association of Variable Star Observers will email alerts as well as having useful email groups. Visit http://www.aavso.org/publications/email/ to see their numerous offerings and to sign up – especially to the Special Notices, Alert Notices, and the General and Photometry discussion groups.

The Austral Variable Stars Observers Network (http://tech.groups.yahoo.com/group/AVSON/) regularly gets more TOO alerts from Rod Stubbings and Peter Williams than you could possibly hope to observe.

You. If you want people to observe a particular star, tell the vss-members egroup about it. Send me something to put into the News section of our Varstars website. I'd particularly urge Programme Coordinators to be active in doing this in their areas.

The trouble is, that all amounts to overkill. There are far more outburst alerts in an average week than you could hope to monitor productively – and that's just the outburst scene. So how do you filter down to the important ones? I'm asking Programme Coordinators to help you filter, by sending emails of advice to our VSS-members egroup, and/or by sending me news items for our Varstars website. But I'd urge all members to do the same – don't leave it to the Coordinators.

Stop Press

Spectroscopy Programme

Bernard Heathcote tells me that despite his best efforts to encourage spectroscopy (and he's been working hard behind the scenes), it's confined down south to just him at present; so he feels that a whole VSS Programme is not currently justified. I agree. Bernard will still be there however to give advice and encouragement, and of course he'll be continuing his own work on monitoring H-alpha outbursts on bright Be stars. Contact Bernard at bd-heath@bigpond.net.au.

NACAA and RASNZ Conferences

Cyberspace organisations like VSS can join collaborators in research in a way that could not have been imagined a few years ago; but they miss out on the vital feature of real-world groups – meeting face to face. That makes meeting and talking at conferences all the more important for us.

This year we have two opportunities to remedy this ill – in Canberra at Easter and Dunedin a couple of months later. I hope you can make at least one of them.

NACAA, Canberra, April 2-5, http://www.nacaa.org.au/2010/about. The programme is out and there is a great deal here for VSOs. Aside from papers and posters relevant to us, David Benn is running a workshop on his innovative VStar photometry package, and there are excursions to Stromlo and Tidbinbilla. I'm giving the opening keynote – the first John Perdrix Memorial Address, on variables of course. There will be a round-table discussion on future directions for VSS, so please come along with some good ideas. And it's a good time of year to visit Australia – wildfires are unlikely!

AND A BIT FROM THE EDITOR

With the short nights of summer—as well as surprisingly bad weather over much of our region—observing has been suffering a little. Then there are the other Xmas commitments. So in this issue we have caught up with a few of our members and their observatories, equipment and programmes are described. Even Yenal Ogmen from as far away as North Cyprus has let us know what he is doing!

Tom has described the new AAVSO BSM South project—which in some ways is rather worrying. What about those of us who like to get out under the stars and make non-electronic measures? The areas where visual observations are valuable are becoming smaller each year. Still, even BSM will not be ideal for some of the very bright stars—maybe we'll have to concentrate on Betelgeuse, Antares and a few like that!

Novae and recurent novae are much in the picture at the moment, along with some of the more interesting dwarf novae. Then U Scorpii has come again as predicted—and half the astronomical world is watching it with instruments from hard Xray detectors to radio telescopes. There are a couple of articles here—my apologies for the lateness of this issue.

Yitping Kok has being doing some interesting analysis of recent novae and deducing their distances using various relationships. His conclusions are strongly influenced by values of interstellar reddening, or absorption, and it would be useful to get better values along the lines of sight to each of the novae he mentions. So maybe someone with access to a good UBV system could try to make measures of some of the hotter stars in each region? I had hoped to include his very interesting analysis is this issue but I cannot copy it so have suggested that at be included separately as a supplement on the website.

This Newsletter has been delayed due to a minor accident—bruised hip—which makes it uncomfortable to sit for any length of time—so I haven't been able to reformat some of the items submitted in Word 2007 as previously. Earlier versions are much easier to work with. So an apology for the mixed typefaces, etc.

On this topic I would mention that it's exceedingly difficult to use items which have been formatted with Word 2007. There are major conflicts between this and Publisher 2007 which I am using. One solution might be to do the whole Newsletter in Word 2007 but I'm afraid learning a new language at my age is a little too much. I'm unsure what options are available but use of the standard paper submission form is appreciated: text of the document with no unusual formatting; illustrations at end; captions to figures separate. This allows a little flexibility when transferring to the pages in the Newsletter.

Section IV of the article on Eclipsing Bimaries by Bob Nelson has been delayed due to Bob being involved in a considerable amount of travelling for the past few months. It will appear in May.

EX HYDRAE - SPIN PERIOD UPDATE

Stan Walker ***astroman@paradise.net.nz***

This was the first CV I ever looked at—after reading in the 1960s about George Mumford's study of this star in the hope that, as a very short period EB, it would show evidence of period changes brought about by gravitational radiation. Since then it's been widely observed as it is one of the best examples of an intermediate polar, IP, where the magnetic field of the white dwarf interacting with the accretion stream from its companion is gradually slowing the WD rotation so that in time, and it's a long way off yet, the revolution/rotation periods will be identical.

A decade or so later Nicholas Vogt and Chris Stercken arranged a joint programme with amateur PEP observers in NZ and Australia which was highly successful in determining orbital and spin periods in the system (approximately 98 and 67 minutes respectively). Since then many groups have observed EX Hydrae both optically and with EUV (extreme ultra-violet) and Xray detectors. In a recent paper, Mauche et al, IBV 5876, 2009 February 10, present a new ephemeris of the spin period which differs substantially from that proposed by Hellier & Sproats in 1992. And the star is now at cycle 355,000+ from discovery.

Cont'd page 13 at foot

STARS OF THE QUARTER

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There's little doubt that almost all the action since the last Newsletter has been in the CV field. A fairly normal dwarf nova, TT Arietis, has suddenly declined and is producing some confusing observations—see page 7 for a well researched article by Stephen Hovell—a new object in Eridanus, KT Eri, looks extremely interesting and several novae have been discovered in Ophiuchus and Sagittarius. And, finally, the predicted outburst of the recurrent nova, U Scorpii is taking place as I write this.

A couple of the discoveries seem to have been made by comet hunters so will be well into decline by the time they're usefully observable. That's the luck of the draw, I suppose, but it's rare that these almost twilight objects can be usefully observed. U Scorpii is a little better placed but its outburst is so brief—a rise of less than a day—a decline of about a magnitude a day. The present outburst was detected by Barbara Harris in Florida and Stephen Hovell, after seeing the AAVSO discovery notice, saw it the same night at about 3am from Pamapuria at a visual magnitude of 7.9. I was lucky to see it in earlier outbursts from Auckland in 1979 and 1987 when we made UBV measures over a few nights.

U Scorpii is an interesting object—one of less than a dozen known RNs and similar to T Pyxidis and another in the LMC. It has a massive primary, about 1.36 to 1.38 solar masses which is very close to the Chandrasekhar limit—see the extensive discussions in ***Cataclysmic Variables, by Brian Warner***—and has an absolute magnitude of Mv –7.5 at maximum, based upon the LMC object. This places it at a distance of 14 kiloparsecs and well above the galactic plane—suggesting that these particular RNs are halo objects. The period is 29.63 hours and the mass losing companion appears to be an evolved F8 star. These three stars eject material at rates approaching supernova velocities—but the shell is much less massive and fades very quickly. In fact, as I write this note on 8 February there's a note that the SAAO detected flickering on 5 February, indicating that the shell was becoming transparent, with mass flow and the disc being reestablished. This is reputed to be the fastest nova known and it's certainly living up to this reputation!

KT Eridani seems to be a typical slow nova—which are often the most interesting. I remember observing HR Delphini for months and SN 1987A was another slow object, even if much brighter intrinsically.

Brad Schaeffer's outburst predictions for U Scorpii are based upon the brightness between out bursts, which are related rather closely to the rate of mass flow—a concept from the dwarf nova field which has been around for a while— which underlines one of the most important aspects of the whole CV field—that the behaviour when the object is 'quiescent' is, perhaps, more important than monitoring the outbursts themselves. But it's not as attractive and with many of the faint objects our observers can only see them when they are in outburst. Tom's article on page 30 gives some links to U Scorpii sites of interest.

Another CV of interest is QS Virginis—an interesting eclipsing system comprising a white dwarf and an M4 companion, the surface of which is very close to its Roche envelope. Mass transfer has probably occurred in the past making this a hibernating CV. The system is discussed in detail in an artcle by O'Donohue et al, MNRAS, 2003, 345 Issue 2, pp506-528. Just recently, in MNRAS, 2010,401L, 34Q, Qian et al report the discovery by analysing light time effects of a planet with 6.4 Jupiter masses in a 7.86 year orbit—at a distance of ~4.2AU. The light time effects show as a small amplitude cyclic change superimposed on a long term period change, the latter deriving from magnetic braking and angular momentum loss of the incipient CV. The CV orbital period is 3h 37m, with eclipses of ~16 minutes, ingress and egress being very sharp at 54s. AAVSO VSX shows a magnitude range of 14.27-17.76 in U so it would be easily within the range of many of our members with unfiltered CCDs. Qian et al stress the importance of this object in studying the ultimate fate of planets orbiting both components of a short period system. But so far this is the only example!

Light Time Effects

The method used by Qian et al is interesting and only works in fairly unique situations—where you have an extremely reliable independent timer—in this case the white dwarf eclipses—and a reasonably massive planet. Given the geometry of the system outlined by O'Donohue et al the amplitude of the light time effects would be between 20 and 30 seconds—the time the eclipses run fast or slow during the orbit of the central pair around the 6.4J mass planet. Fortunately the eclipses would be sharply defined and ingress/egress capable of being timed to fractions of a second.

For all this, observations would have required good time resolution and timing, and considerable accuracy, not to say patience to follow the system during its almost 8 year orbital period. Obviously the eclipse jitter noted by the O'Donohue group led to the exercise. Regretfully, once a system such as this turns into an active CV the eclipse times cannot be measured with the same degree of precision.

If you're unfamiliar with light time effects they occur when an event involving one star or pair of stars is in orbit around another body or bodies. The distance from the observer varies in a periodic manner and as this changes light takes longer or shorter times to reach here. A most extreme example is our project star, QZ Carinae, where the distance seems to vary by 100 AU or about 14 hours. S Muscae, a binary Cepheid, shows similar but much smaller variations.

In these case the indepent timer, or clock, runs fast or slow dependent upon the position in the orbit. But it is usually difficult to determine the phase of this clock—Cepheids tend to be a little irregular and the minima of eclipsing binaries is difficult to determine with great precision in most cases. QS Virginis is proof that it's not impossible. So we now have another method of detecting planets around other stars.

QZ Carinae is also moving into a useful spot for observing. The project is described on the website. However, since most observers are now using CCDs, the comparisons have been changed to allow any participants to get appropriate stars on a single frame. A list of suitable comparison stars can be obtained from Terry Bohlsen, terry.bohlsen@bigpond.com. Eclipses are now moving out into the Pacific so this represents the last year for a while that they can be usefully obtained.

TT ARIETIS: AN EXCITING CV FOR AMATEURS TOO

Stephen Hovell

Position:	*RA: 02:06:53.10*	*Dec: +15:17:42.0 (2000)*	
Type: NL/VY	*Range: 10.2–14.5 V*	*Period: 0.137551d*	*Spec: pec (UG)*
Charts:	*RASNZ 879, 880, 881*	*AAVSO Variable Star Plotter (you can plot whatever scale you want, whatever orientation, and whatever limiting magnitude)*	

I am approaching this from the perspective of an amateur visual observer with virtually no knowledge of the deeper esoteria (if that is a word) of cataclysmic variables. I observe. I leave the interpretation to others. Having said that though, one can't help but be intrigued by the strange behaviour of this star over the past several months. So I have reviewed as much of the literature as possible. A very comprehensive but by no means exhaustive list of references is appended for those who are interested in further reading.

One thing I found in preparing this, and maybe someone has a suggestion, is how to access more recent journals. It was possible when I was at university two or three years back, but now I don't have subscriptions to the databases.

TT Ari was discovered to be variable by Strohmeier, Kippenhahn and Geyer in 1957, with a range of 10.2–11.8. Originally it was thought to be an RCB star because like RCBs, TT Ari goes "into action when it fades to minimum". Warner (1976) described the star as nova–like, that is, a dwarf nova with very extended standstills. Bortle (1980) recorded the star visually as less than mag 14, much fainter than ever recorded before. The RASNZ Charts for TT Ari list the star as a UGZ (Z Cam subtype). According to the GCVS, "Z Camelopardalis-type stars…show cyclic outbursts, differing from UGSS variables by the fact that sometimes after an outburst they do not return to the original brightness, but during several cycles retain a magnitude between maximum and minimum. The values of cycles are from 10 to 40 days, while light amplitudes are from 2 to 5 mag in V." Krautter et al (1981) examined spectra of TT Ari during the minimum of November 1980 and concluded that the star was indeed a dwarf nova, their study being the first example of a NL turning out to be a DN. However the range of variation at standstill, 2–3 mags, was much greater than the typical 0.5 mag variation. Warner (1983) described the star as an intermediate polar. The AAVSO Variable Star Index describes TT Ari as a NL/VY. VY Scl stars, according to Skillman (1998), exhibit "occasional drops to a low state" (eg V=17 for TT Ari). Hutchings and Cowley (2007) state that "TT Ari is classified as a VYScl variable, since it occasionally fades by ~5 mag, presumably when the mass transfer decreases and the accretion disk begins to dissipate."

Based on simultaneous WBVR photometric observations, Suleimanov et al (1996) proposed "a new model of the tilted precessing accretion disk together with reflection from secondary or hot spot … to [explain] the photometric variability of TT Ari".

According to Gänsicke et al (1999), NL variables have high mass–transfer rates which keep the accretion discs in a permanently hot state, making it difficult to detect the component stars. However in the VY subgroup, the brightness of the disc drops significantly due to a decrease in the mass transfer rate, thus allowing the two components to be observed. Gänsicke et al. (1999) carried out optical and ultraviolet spectroscopy during the 1982–86 low state. Throughout this period the accretion activity had virtually ceased, enabling the two components to be identified as a hot white dwarf (T = 39,000 K) and an M3.5 secondary. They also determined that TT Ari is at a distance of 335±50pc.

Stanishev et al (2001) detected superhumps with a period of 0d.14815 and an amplitude of 0.13–0.14 mag. Through 1988–1998 negative superhumps, where the photometric period was less than the orbital period ($P_{phot} < P_{orb}$) where recorded, while later positive superhumps ($P_{phot} > P_{orb}$) were noted. Superhumps are usually associated with UGSU stars. They also reported TT Ari to be a non–eclipsing binary. However more recently, Hoard (2008) suggests it could belong to the SW Sex class. According to Ringwald (1992) SW Sex stars are "characterized by absorption events of the emission lines at spectroscopic phase 0.5, accompanied by large phase lags between the lightcurves and the radial velocity curves and strong high-excitation emission".

Baykal and Kiziloglu (1997) found that TT Ari was a hard X-ray source. Their studies suggest that the flickering in X-rays may be associated with an accretion disc corona. More recently Mukai (2009) reports that at times when visually inactive on 16 October 2009, TT Ari was observed to vary widely in the X-ray spectrum, even when optically quiescent. They further noted that TT Ari is "one of the most luminous X-ray sources among non–magnetic CVs".

Tremko et al (1996) suggested the star exhibits transient quasi–semi periodic oscillations (QPOs). They reported "that in TT Ari we observe contributions of several instability mechanisms". Suleimanov et al (1996) proposed that the QPOs were "possibly connected with orbiting blobs in the accretion disk." Tremko et al also acknowledged that TT Ari "remains one of the most interesting objects of this class due to a variety of phenomena observed at different times scales from seconds to months" (p121). They refer also to "extreme events such as 'dips' and 'flares'" (p122). Andronov et al (1998) describe the star as having " the usual bright (B~10 mag) state punctuated by excursions to a faint (B~16mag) state lasting several weeks or even years." What these researchers say is most certainly true in the recent fading of the star.

This all seems very complicated. However the star is classified, TT Ari featured as Variable Star of the Month on the AAVSO website for January 2002 and the following point is made. "TT Ari is an extremely complex system " and "Fickle in its behavior, TT Ari's bizarre characteristics allows it to elude exact classification". From what I have read, that sums up TT Ari most succinctly.

Most of the above research papers are way beyond my understanding. The one thing I picked up on though is that TT Ari is a really interesting star, bright for many years, decades in fact, then takes a big drop. It has very short term variations of up to 2 magnitudes, and small fluctuations even on 2 minute time scales, and astronomers have not really worked out what is going on. This makes it exciting for the amateur (both visual and CCD) to observe, especially NOW (November 2009 – January 2010 and who knows for how much longer).

Described by Melikian et al (2008) as one of the brightest CVs, the star has a range from 10.2–14.5 V according to the AAVSO VSX although it has been right down to mag 18 in the current activity. The star fluctuated between mag 10–11 for about 24 years, from the 1982–85 event through to this current fading. The latest decline was first reported by T. Gomez, Spain, when he recorded it at 12.57 on 3 October 2009. I have been observing TT Ari on and off from the late 1980s using the VSS RASNZ Charts. All of my observations were around 10.5–11.0, that was until I looked on 16 October, 13 days after Gomez' observation. I recorded it at 14.6 This fits in with the data on Chart 1 below. Note that this only the second time that this star has gone into decline. As mentioned elsewhere the last time was from 1982–86 so this could also be a 4 year event.

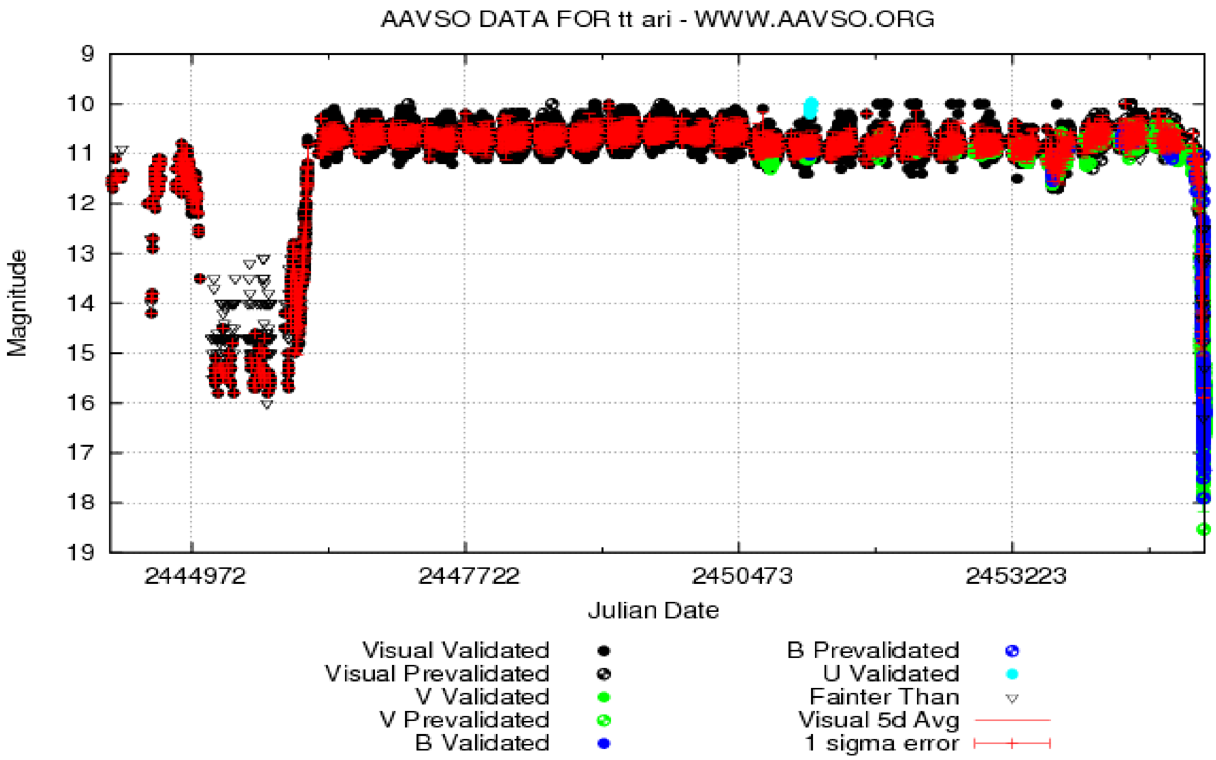


Chart 1: TT Ari from 1979–2009 (AAVSO Light Curve Generator

And what made me look on 16 October. Firstly the night was fine for a change, but more importantly, Aries had risen! The evening observing window is about 4-5 months from northern New Zealand. However the main reason was because of the AAVSO Alert Notice 408 (13 October 2009) and AAVSO Special notice 172 (20 October 2009) which signalled the fading and called for observations of all types— visual and CCD. I stress the following point: if you observe CVs you should subscribe to the AAVSO alert notices.

AAVSO Alert Notice 408
Deep fading event in the cataclysmic variable TT Arietis October 13, 2009

The VY Sculptoris-class cataclysmic variable TT Ari has begun its first large decline since its deep minimum of 1982-1985. Observations of TT Ari are urgently requested. The 1982-1985 event reached a minimum of m(vis)=15.5, where it remained for approximately 3.5 years. Observers are asked to closely follow TT Ari through its current decline, and to continue monitoring TT Ari if and when it reaches a stable minimum. All observations including visual estimates, CCD photometry, and CCD time-series are needed; visual positive and fainter-than estimates are both important.

The first hints of decline appeared in the AAVSO light curve in late September 2009, with a deep decline becoming clear by by 2009 Oct 03 (JD 2455108.4059; m(V) = 12.57, T. Gomez, Madrid, Spain). The star has dropped rapidly, and currently stands at m(vis) = 14.2 on 2008 October 13.063 (JD 2455117.563; G. Poyner, Birmingham, England).

The event of 1982-1985 is the only recorded major fading in TT Ari, so the depth and duration of the current event cannot be predicted; it may reach its historic minimum of 15.5 and remain there for some time. Prior to the long-duration event, TT Ari declined to approximately 14.5 beginning in 1979; it had nearly recovered from this event before going into the deep minimum in early 1982. Because of its unpredictable nature, continuous observations of TT Ari are urgently needed.

AAVSO Special Notice #172
Observing campaign on TT Ari October 20, 2009

The AAVSO requests intensive time-series observations of TT Ari during the current fading episode to fully record its behavior during minimum. TT Ari has entered its first faint state since the event of 1982-1985. However, it is exhibiting very high-amplitude (~1 magnitude) periodic oscillations with a period of 0.371 days. This period is of unknown origin; it is significantly longer than the orbital period of 0.137551 days, and is longer than the pulsation periods of white dwarf stars. Continuous photometry of TT Ari will show whether this long period remains coherent.

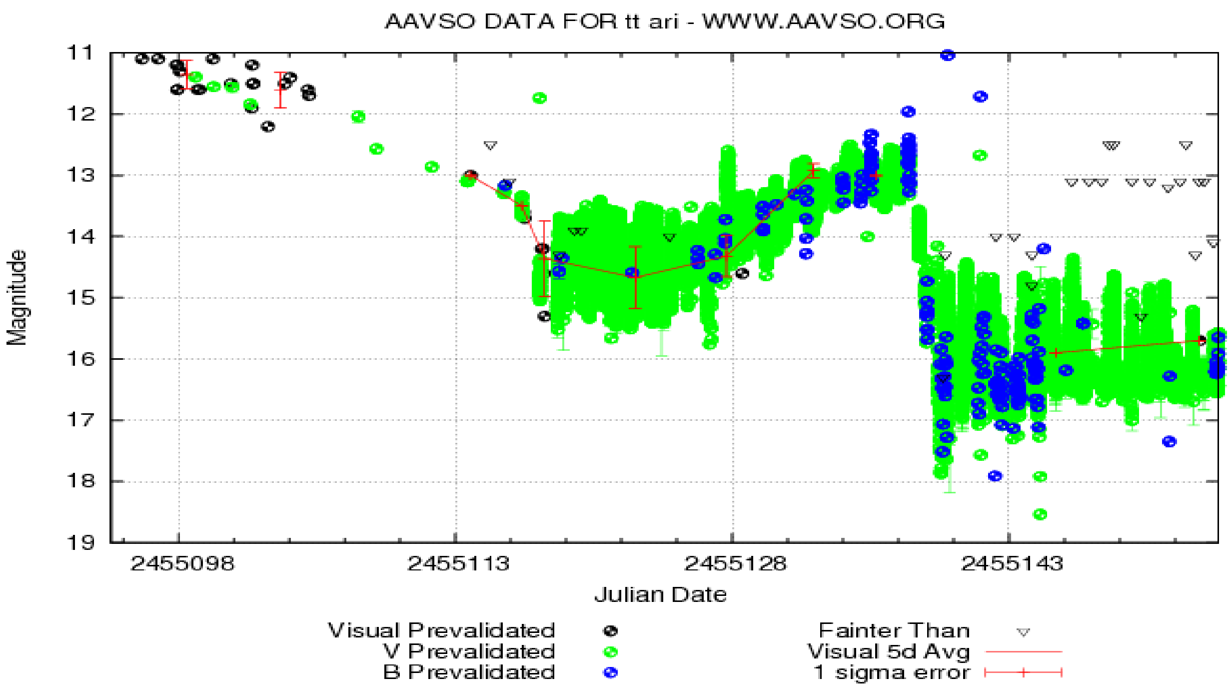
All observations of TT Ari are encouraged including visual observations. Observers with the capability of performing calibrated multicolor time-series photometry are especially needed; such observations may provide additional physical information about the object that is varying (the primary, the secondary, or the accretion disk). For observers with

multiple filters, the suggested priority order is V, Rc, Ic, and B.

There is no fixed duration for this campaign, since we do not know the origin of the periodic variability, or when TT Ari will return to its novalike state. There have only been two well-observed fading events in TT Ari: the 1982-1985 event, and a shorter event in 1979-1980, and neither have extensive time-series data. Observers are encouraged to add TT Ari to their long-term observing programs if possible, and to make time-series observations when TT Ari is well-placed.

This campaign is being conducted at AAVSO Headquarters by Matthew Templeton and Arne Henden.

Chart 2: TT Ari from 23 September to 7 November 2009 (AAVSO Light Curve Generator) - Below



The incredible magnitude range of short term variation in Chart 2 can readily be seen, and also the rapidity of the fluctuations. Also of interest is the drop right down to mag 18.5, significantly beyond my telescope, but maybe not for those of you with CCDs.

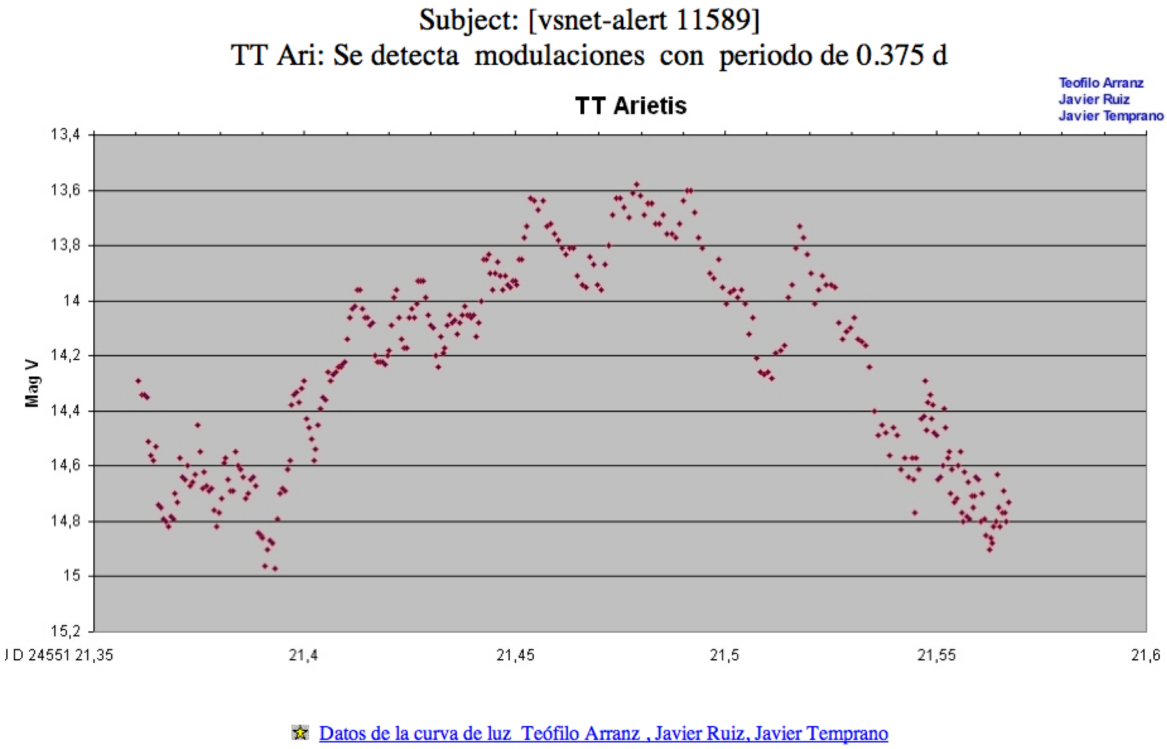


Figure 3: TT Ari 16 October (Arranz, Ruiz and Temprano)

This graph was accessed from http://astrosurf.com/blazar/variable/TT-Ari/TT-Arietis.html on 19 January, and shows the wide variation over a 6 hour period on 16 October. The range is from 13.8 to 15.0. From the graph, it seems the period is around 0.16 days. Yet the caption above the graph gives the period is 0.375d.

Referring to this research, vsnet–alert 11589 notes:

> The data still persistently show large-amplitude oscillations, with a stable period of 0.3750(4) d. The presence of such a stable period, seemingly unrelated to the orbital or superhump periods, is surprising.

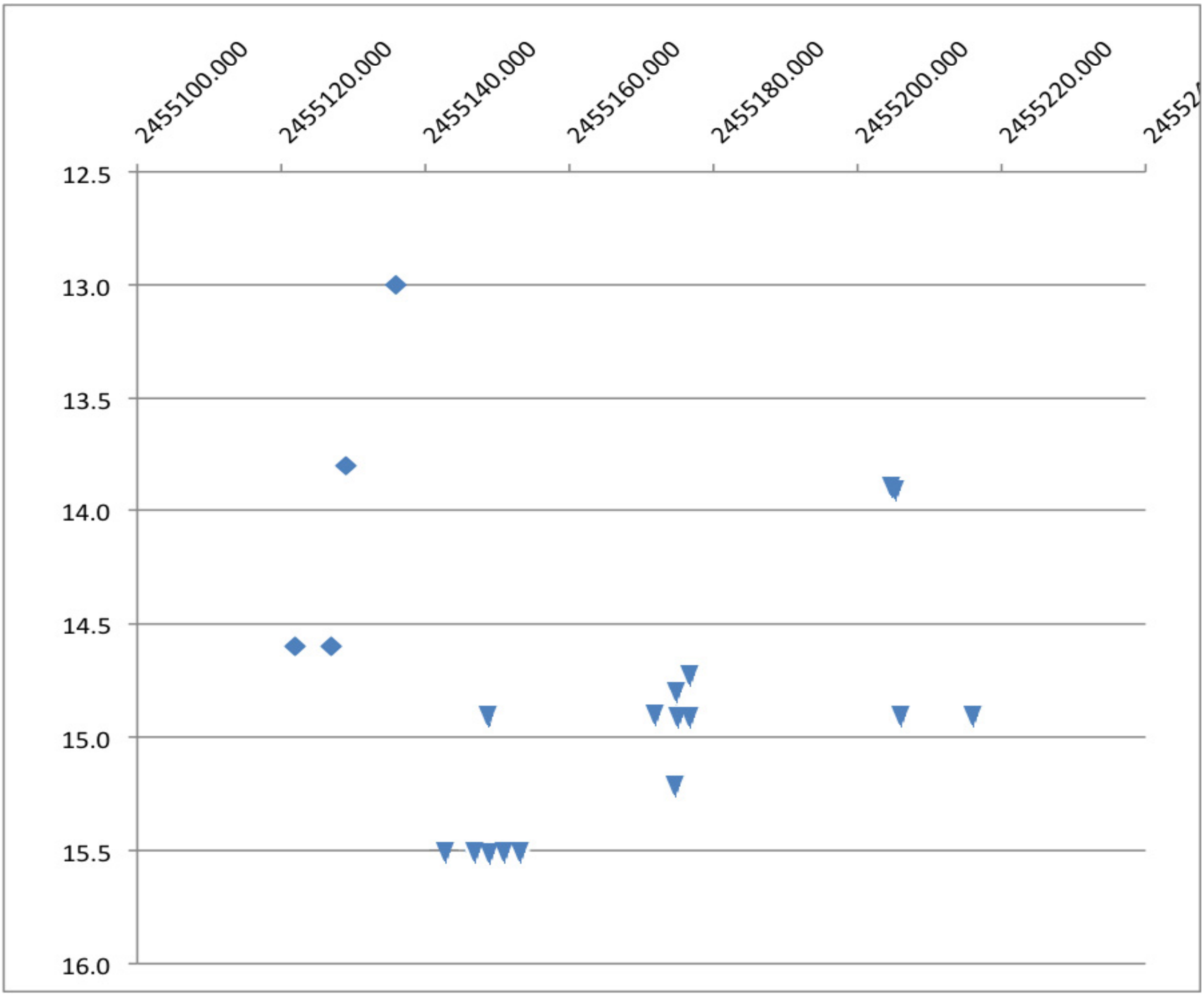
The website gives a number of other graphs taken over a two month period for comparison. If you were observing visually throughout this time span, you could get quite a good light curve. I personally make observations about every half hour when TT Ari is in its active state. The above data were collected by Arranz, Ruiz and Temprano using the RC 40cm f/5.8 telescope at the Observatory of Cantabria, Spain.

Figure 4 shows my observations (nothing over most of December when I had family visiting). The diamonds are positive observations and the triangles, fainter than (<).

I would like to draw your attention to the excellent work done by amateur observer, Peter Nelson http://www.ellinbankobservatory.com/Site/CVs_-_TT_Ari.html . Peter uses a 320mm f/5 Newtonian, and an SBIG ST8XE camera with BVRI filters.

I conclude with a quote from Taichi Kato *[vsnet–alert 11733] TT Ari calmer now*. "Let's see what happens next." I encourage you observers, both visual and CCD to join in the fun and see what happens next. But it may just have to be the more northern observers as TT Ari is getting lower in the north western skies, and as I write this, there is a first quarter Moon just to the east of Aries.
Charts for TT Ari may be plotted using AAVSO VSP: http://www.aavso.org/observing/charts/vsp/index.html?pickname=TT%20Ari

Figure 4 shows my observations (nothing over most of December when I had family visit-



ing). The diamonds are positive observations and the triangles, fainter than (<).

References

AAVSO (2002) Variable Star of the Month: January 2002 TT Arietis http://www.aavso.org/vstar/vsots/0102.shtml

AFOEV UGZ-type variables (Z Cam) Association Francais des Observateurs d'Etoiles Variables http://cdsweb.u-strasbg.fr/afoev/var/eugz.htx

Baykal, A. and Kiziloglu, U. (1997) Low frequency flickering of TT Arietis: hard and soft X–ray emission region. Astrophysics and Space Science, 246, (1). 29-38

Bortle, J.E. (1980) IAU Circular No 3541 TT Arietis.

Hoard, D.W. (2006) The big list of SW Sextantis stars. Retrieved online at http://web.ipac.caltech.edu/staff/hoard/cvtools/swsex/biglist.html on 11 December 2009

Gansicke, B.T., Sion, E.M., Beuermann, K., Fabian, D., Cheng, F.H. and Krautter, J (1999) TT Arietis: the low state revisited. Astron. Astrophysics. 347, 178–184 (1999)

Hutchings, J.B. and Cowley, A.P. (2007) Far–Ultraviolet spectra of TT Arietis. The Astronomical Journal , 133: 1204–1207, 2007 March.

Krautter, J., Klare, G., Wolf, B., Wargau, W., Drechsel, H., Rahe, J. and Vogt, N. (1981) TT Ari: A New Dwarf Nova. Astron. Astrophysics. 98, 27-29.

Melikian, N.D., Tamazian, V.S., Docobo, J.A., Karapetian, J.A., Kostandian, G.R. and Iglesias, R. Spectral observations of the novalike star TT Ari. II. Astrophysics, 51 (3), July, 2008, 372-386

Mukai, K., Patterson, J., Koff, B., Morelle, E., Stein, W. and Oksanen, A. (2009) Swift and CBA Observations of TT Ari on 2009 October 16 accessed online at http://www.astronomerstelegram.org/?read=2254 on 12 December 2009

Ringwald, F.A. (1992) The cataclysmic variables from the Palomar-Green survey. Ph.D. Thesis Dartmouth Coll., Hanover, NH

Skillman, D.R., Harvey, D.A., Patterson, J. et al.(1998) Superhumps and accretion disk precession in TT Arietis. The Astrophysical Journal, 503: L67–L70, 198 August 10

Stanishev, V., Kraicheva, Z. and Genkov, V. (2001) Spectroscopy of TT Arietis in "positive superhumps" state. Astron. Astrophysics 379, 185–191.

Suleimanov, V.F., Zhukov, G.V. and Senio, D.S. (1996) Observations and interpretation of the photometric variability of TT Ari. *Odessa Astronomical Publications, 9, 57 (1996)*

Tremko, J., Andronov, I. L., Chinarova, L. L., Luthardt, R., Pajdosz, G., Roessiger, S., & Zola, S. (1993) Periodic and aperiodic variations in TT Arietis. Results from an international campaign. *Astronomy and Astrophysics, v.312, p.121-134*

Warner, B. (1976) IAU Symposium No 73, 85.

Warner, B. (1983) in: eds. M. Livio & G.Shaviv, Cataclysmic Variable and Related Objects", D.Reidel, Dordrecht, p155.

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Bill Allen and I, along with Fred Velthuis, timed 35 eclipses and 38 spin cycle maxima in the late 1990s and from this concluded that the changes in the period, might be abrupt rather than parabolic as suggested by H&S. The latest paper introduces a second term in order to match the observations—but this, as with the abrupt change idea, conflicts with the expected steady change in period of a binary system. Some support may be inferred from Warner's review in Cataclysmic Variables, where he notes that the orbital period fluctuates in a sinusoidal manner which is not understood.

An interesting star which has attracted much attention. In looking through recent papers I note that whilst the CBA has made this a target on several occasions—and have a considerable amount of good data from observers such as Bill Allen and Robert Rea—nothing has been published from that area. Even tables of spin maxima and eclipse times would help determine whether the changes are abrupt or follow one of the two different parabolic equations. It's perhaps disappointing that the last published optical measures, apart from six scattered points, were those from 1996-1999 in the Southern Stars paper.

A PERSONAL PHOTOMETRIC PROJECT

Eric R Rumbo The Gap Queensland Australia *ERumbo@Bigpond.net.au*

Following up on the editor's recent request for members to contribute a description of their photometric interests to the newsletter here is an account of what will constitute a major part of my activities in 2010. As intimated by the title this is a personal project and does not really form part of any official VSS effort.

It all started when, having achieved a working version of my Nerik Photometry program, I began to go back through my records of fields of particular variables which I had been measuring over the previous few years. For those who may not be aware of the Nerik approach to photometry it operates through a template created for the stars in a particular field. The program then measures all the stars included in the template, rather than just a single variable and associated comparison stars. The program also includes routines for identifying variability in the individual stars as well as plotting facilities. The result of this was that a significant number of variables started to appear that I could not find included in the various databases available. This was not surprising as databases start to peter out at magnitude 14 and, since the number of stars present actually increases with magnitude, it would have been surprising had not more variable stars began to appear.

I had been measuring southern stars appearing in the AAVSO list for 'urgently requiring data' selection. These are mostly long period variables and after two years of measurement the appearance of unrecorded variables just became more interesting than the original variables. I could not see myself continuing with the original list simply to add a few more periods to their records. I decided that I would design a project to search for variables of magnitudes 14 or greater in a region of the southern sky not available to northern regions where most of the observers operate from. I chose a strip of sky centred on -50 degrees of declination. By recording at intervals of 2.5 minutes in right ascension the images would slightly overlap in my system and provide data for a complete strip of sky. The strip would be very narrow, just the height of the CCD image, but it would be easy to manage from a data collection point of view.

Since the objective was simply to identify variables a photometric filter was not required but an infra-red cut filter was considered an advantage. Omitting a photometric filter reduces the length of exposures required and thus allows more data to be collected in a given time. The images to be collected in a session for each field was then chosen to be four of 10s and four of 30s. The reason for the two exposure times was to allow some of the brighter stars which saturate the CCD at 30s to be included. By combining, and appropriate scaling, the four 10s exposures can be combined to generate a fifth 30s exposure. Statistically five records allow the random errors to be at a level which will identify small variations in the stars down to 16 magnitude and also detect errors on individual images arising from other sources such as cosmic ray hits. A maximum of 30s meant that telescope guiding was unnecessary.

My equipment is a Celestron C11 with a Celestron focal reducer/field flattener on a Paramount ME in an observatory in the backyard operated from the comfort of the house. The camera is an SBig ST10-XME and includes external water cooling using a Peltier device. Images are collected using CCDSoft and processed with Nerik Photometry.

As records mount up and variables start to appear the question will be what to do with them. Clearly it would be desirable to follow up the more interesting ones with targeted measurements using photometric filters. From my experience with the number of variables turning up in my previous photometric fields these will be too numerous for me personally to handle. I therefore intend to make them available to the photometric community, exactly how I have not yet determined, so that anyone interested can follow them up and measure them properly, something which should allow for work which could be published in appropriate journals. The methodology is also available for any other observer to choose a strip of sky at a different right ascension and initiate their own search for variables.

I personally find the search for new variables, and identifying their types and periods, to be more interesting than just collecting more data for known variables that may never be put to use. A personal preference and others will disagree and there are, of course, many variables for which new data is of relevance and importance. However if you are interested in the discovery aspect of photometry I would like to hear from you. It is an approach which has negligible support from organizations such as AAVSO, and indeed VSS, probably understandably so because reporting errors might constitute a rather messy problem to deal with, but who knows what interesting stars may just be sitting there waiting to be identified. CCDs have pushed the magnitude limits compared to the huge visual effort of the past and make the effort worthwhile especially in southern latitudes where the discovery pressure is much less.

The project does not, of course, preclude me from pursuing particular variables. I try to record at least one full hour of right ascension on any one night of observing and the rest of the time can be used up following known variables or, if none are accessible, further regions of the -50 degree strip.

BRIGHT STAR MONITOR SOUTH

Tom Richards

BSM (pictured) is a successful AAVSO robotic observatory monitoring a large range of northern stars brighter than V=9.0. It's a 60-mm Tak with an ST8 camera and photometric filters, and is hosted at Tom Krajci's observatory in New Mexico. Read about it at http://www.aavso.org/news/aavsonet.shtml and the link there.

Thanks to a bequest, AAVSO is now funding a second BSM for the southern hemisphere. Peter Nelson who lives near Warragul in eastern Victoria is going to host BSM-South, and with his near neighbours Chris Stockdale and Rod Stubbings – whose names will be familiar to you! – will build an enclosure and set up the computing, electronics and communications it needs – and manage it at night. All data (images including calibration frames) will be fed back to AAVSO headquarters where they will be analysed or made

available to researchers who are running their own projects on it. There will be time available for researchers like you and me, to propose projects through AAVSO or possibly more directly.

It will be quite some months before this observatory is functioning, and it will take time after that to settle down to a viable observing routine. Meanwhile, I'm sure all VSS members will congratulate Peter, Rod and Chris, and wish them well in setting it all up. We should also be grateful to the AAVSO and its Director, Arne Henden, for deciding to have a southern BSM, which will greatly benefit southern variable star astronomy.

THE CROWS NEST OBSERVATORY

Roland Idaczyk ***roland@c-n-o.org*** ***www.c-n-o.org***

Being one of the newer members of the new VSS I certainly should introduce myself to the group. I had been reluctant to do this any sooner than now, because I did not want to over -saturate the local astronomical community with ramblings about myself and the Crows Nest Observatory (CNO). A first introduction of the CNO had occurred with a small poster at the 2007 RASNZ conference in Manukau City, followed by a talk at the 2008 RASNZ conference in Lake Tekapo with a written version published early in 2009 (Southern Stars, Vol 48, No 1, 9-11, March 2009; for those of you who do not have access to a printed copy of Southern Stars, there is a PDF of the article available on the "Publications" page of the CNO website). Therefore I will first tell you some things about myself and then briefly describe the setup, equipment and activities of the CNO.

Born in Cologne, Germany early in the second half of the last century, I became aware of "things up there" early on in the US-Soviet space race. I remember my grandfather pointing out to me one of the first Sputnik satellites. The deciding moment that really sparked my interest in astronomy came with the Apollo 8 mission in December 1968. Two years later I received my first telescope, a very modest 60-mm refractor, which I am still using after a serious upgrade (oculars and HEQ-5 mounting). Later I also acquired a second-hand 4 ½-inch Newtonian on a small equatorial mount, which I have since passed on to a younger generation.

In the early 1980s (already being labelled a "mature student") I did undergraduate studies in astronomy and physics at the University of Bonn, which was and still is one of the astronomy centres in Germany. I then changed direction into software development to make myself more "acceptable" for a permanent residence status in New Zealand. This worked, but got me disconnected from active astronomy for almost 20 years. Finally in 2005 I decided to make some changes. I took on a casual staff position at Carter Observatory in Wellington to deliver evening and weekend planetarium presentations and telescope operation (both of the Cooke refractor and the Ruth Crisp telescope) during public observing sessions, but "retired" from Carter in 2006. In parallel to Carter I had enrolled in a part-time distance course toward a Master of Astronomy degree. It was with great interest that I read Terry Bohlsen's article in the 2009-4 newsletter (page 28), because my course at James Cook University in Townsville was the successor to the one Terry graduated from at the University of Western Sydney. I graduated in 2008 and was awarded a University Medal to round it all off. Because I am still in full-time IT employment, my celestial

activities are generally limited to weekends and pre-midnight hours during the week. Wellington weather further constrains my opportunities to observe and being able to contribute to VSS projects.

The CNO, aptly named after the hill it is located on half-way up to the top at 200 metres elevation. The wind, which can hit from all directions, is the second-biggest problem after cloudy skies. To withstand wind-speeds of 120 km/h and more (in 2009 there were at least two storms of more then 150 km/h measured on Mt Kaukau, some 3 km away), the observatory had to be of a very solid construction. So there are concrete foundations for the standard garden shed (2.70 m x 2.79 m) and the self-designed and constructed roll-off roof is safely held in place with big G-clamps when closed.

The main telescope, a 14-inch Meade LX200R (equivalent to the ACF), mounted on an Ultra-wedge rests on a custom steel pier bolted to a concrete block, which has no physical contact with the wooden floor. An SBIG ST-7 CD camera is usually attached to the telescope. It is equipped with its own auto-guiding chip, which makes it very well suited for high accuracy work. This camera is on loan from the Center for Backyard Astrophysics (CBA) and was previously used by Auckland astronomers who have since been upgraded. There is also an even older ST-6 camera on loan from NASA Ames Research Center, for which I have constructed an adapter to accept a 200-mm telephoto-lens, enabling the camera to record wide fields for survey type work. The ST-6 is either used mounted piggy-back on the Meade or, alone or in parallel to the small refractor, on the HEQ-5 mounting, whereby the instrument becomes very mobile.

While the CNO has a full set of Schüler photometric filters (UBVRI), the lack of a filter wheel to the ST-7 makes their use impractical and prevents me from doing multi-wavelength measurements. However there is also a Meade DSIpro camera with a filter slide that can be employed, but I try not to take the main camera off the telescope unless absolutely necessary.

So far I have not been able to accumulate sufficiently useful data to put me in the position to report any results. I have mainly been working on I-band photometry of a bright southern eclipsing binary star (V831 Cen) and presented a modest progress report at the VSS symposium in Wellington last year. This project is in collaboration with Ed Budding (Wellington), who has been making much better progress with his HERCULES spectroscopy using the 1-m McLellan telescope on Mt John. On the same star I have attempted some speckle interferometry last year to see if I can derive the orbital orientation of the binary, but atmospheric conditions were not good enough and the star was at a pretty high airmass.

Several attempts to observe stars for the VSS last year have not delivered useful results, either due to wind and weather or technical difficulties, which I still encounter every now and then. I also have a strong interest in observing exoplanet transits, which was the underlying reasoning for the construction of the CNO and the specification of its instrumentation. Once I have fine-tuned my operation to the required level, I will be able to also consider projects such as microlensing observations, for which there is an increasing demand. So with a bit luck, lots of commitment and all your fingers crossed I am hopeful to make an appropriate contribution to the efforts of the VSS.

Equatorial Eclipsing Binaries Project
Tom Richards, Project leader
tom.richards@varstars.org

Puzzling Pisces-Cetus Targets

It's time to report on where we've got with the Pisces-Ceti group of targets, which were studied from October through January. In no case have we sufficient data to finalise a report, but what data we have poses some intriguing and unsolved problems.

SZ Piscium – the messy star

The GCVS (Samus et al, 2009, see http://www.sai.msu.su/gcvs/gcvs/iii/iii.dat) lists SZ Psc as an eclipser of type EA/DS/RS – an Algol-type eclipsing light curve / detached (unlike Algol) with a subgiant secondary / and with chromospheric activity and starspots like RS Canum Venaticorum, which is also an eclipsing binary – causing the light curve to vary. Moreover it's a triple system. It's a bright mag 7.44 in V, and with a K3-4 subgiant and F5-8 dwarf. B-V colour is 0.75. Primary eclipse is about 0.7 mag. The Krakow (Kreiner 2004, see http://www.as.up.krakow.pl/o-c/index.php3) O-C diagram is all over the place. Starspots are unlikely as the culprit. Trust only the big black round dots and big black squares (electronic) – the rest is visual or photographic.

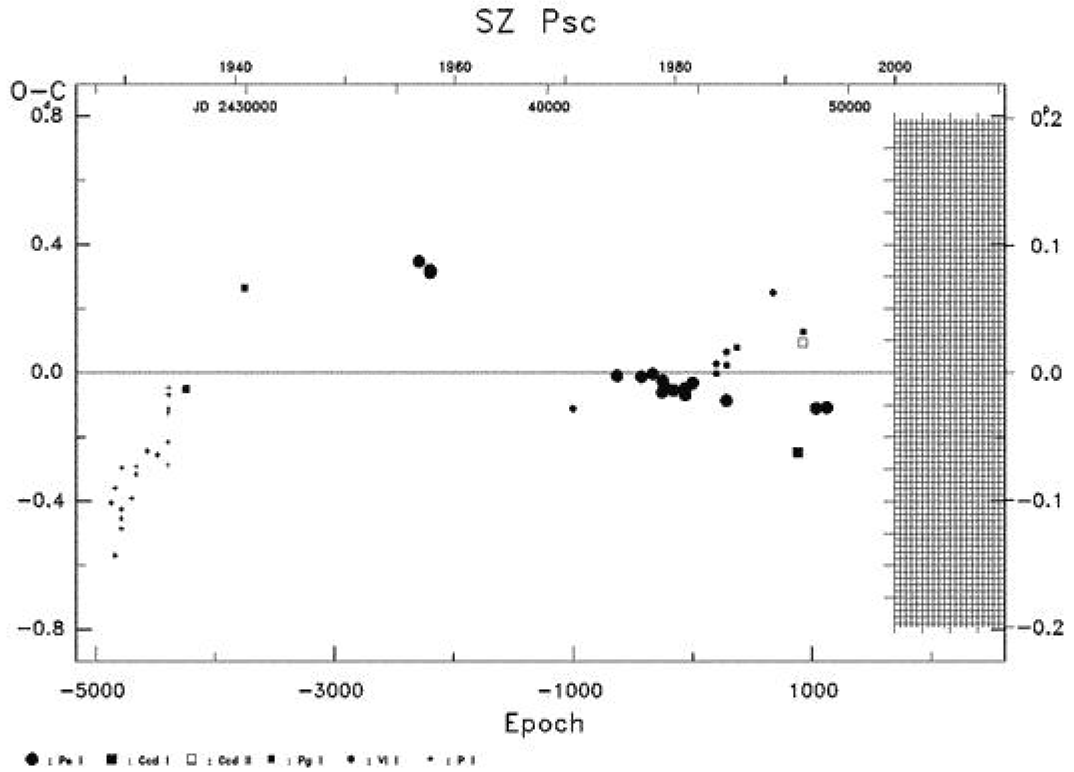

Figure 1. O-C diagram for SZ Psc, from the Krakow online database. Most data before 1960 is photographic and visual, afterwards it's electronic.

The ASAS3 light curve (Pojmanski 2002, see http://www.astrouw.edu.pl/asas/) has a rather shredded appearance, especially in eclipses. There's much to find out here!
So far the only observations received of this interesting system are a short time-series from Andrew Dallow (NZ) on 2009 Oct 14 using a 6-inch telescope and a DSLR camera – more than adequate for this work. His data indicates a brightening of 0.25 mag over an hour, which does not square with predicted times of eclipses. Most intriguing - plainly there is more work to be done here!

UV Piscium – neat but incomplete

UV Psc is listed in the GCVS as type EA/D:/RS – like SZ Psc but they'll only go as far as saying it's possibly detached. (I think it's definitely detached.) The two stars are listed as G4-6 and K0-2 dwarfs, with a combined V mag of 8.91 and a B-V colour of 0.67. It has a fairly well-defined period but apparently no observations of minima over the last 20 years. The ASAS light curve is quite weak in the eclipses.
We had much success with UV Psc in the apparition. Observations were received as follows:

Date	Observer	Minimum observed	HJD min
2009-10-09	Tom Richards (AU)	Primary	2455114.17946(2)
2009-10-16	Roger Pickard (UK)	-	
2009-10-25	David Boyd (UK)	Primary	2455130.53906(1)
2009-11-01	David Boyd	Primary	2455137.4277(1)
2009-12-25(!)	David Boyd	Secondary	
2009-12-27	David Boyd	Primary	2455193.3957(1)
2010-01-07	Roger Pickard	-	

All data were analysed in the Peranso period analysis software (Tonny Vanmunster, www.peranso.com) and times of minimum were obtained as above. Peranso did not deliver a reliable ToM for the secondary eclipse, as it is shallow with a broad flat floor and less data on one side. (See Figure 2 below).
Using ANOVA, which seems to be the best Peranso method for period-finding with EA binaries at least, these four minima yielded a period of 0.86105(5) d. The data sets folded beautifully on this period. The primary minimum in Figure 2 comprises four different-coloured sets of dots with only the red on top showing well, the coincidence was so exact. The light elements are

$$\text{HJD } 2455114.1800(1) + 0.86105(5) \times E$$

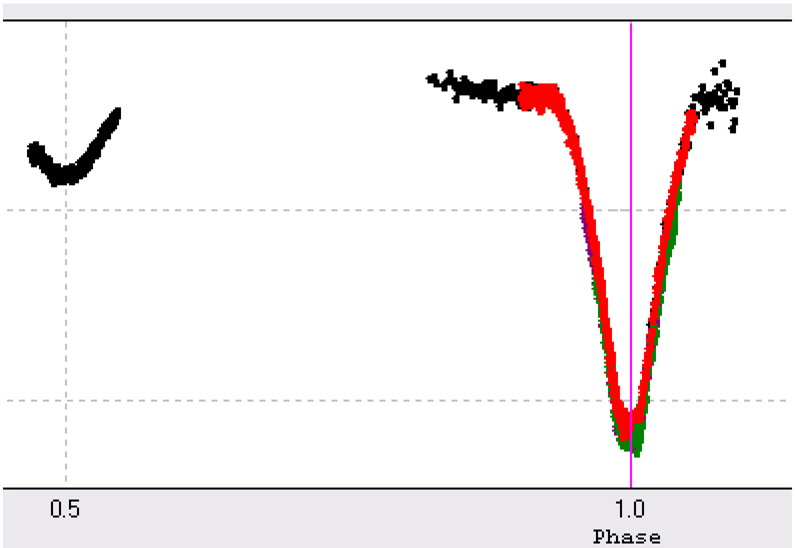

Figure 2. A phase plot of the data for minima of UV Psc.

How do these light elements compare to published ones? The Krakow database gives

$$\text{HJD } 2452500.041(1) + 0.8610466(6) \times E$$

Given the large error in that epoch, our data lies well within the error bar of the predictions derived from these elements. Conversely the Krakow period lies within our error bar. Consequently no change in period has been observed; and indeed the (O-C) diagram for this star in Krakow shows no drift since photo-electric observations began around

1965.
Other timings of minimum are available in the literature. A quick assessment suggests that refined linear light elements can be derived from them plus our data, indicating an unchanging, but more accurate, period:

$$HJD\ 2455114.176656(1) + 0.86104600(1) \times E$$

A more careful analysis will be done; however it would be useful to pursue some more times of minima and a full light curve in the next apparition, especially to see if any starspot activity can be detected. The exact similarity of the four eclipse curves gives no hints of starspots upsetting the photometry.

WZ Ceti – is everyone wrong?

The third and last system of this group is listed in GCVS as an EA/DM pair (detached main-sequence) with a period of 6.645088 d. But look up Krakow and it says 4.61232 d, and look up Hassforther's (2003) analysis of ASAS3 data and you get 2.306112 d, halving the previous. Now if you look at the ASAS-3 light curve (Figure 3) folded on *its* period offering of 4.6122 d you get a secondary minimum at phase 0.5 that looks just like the primary one at phase 0.0, and a suspicion of a dip halfway between the "primary" and "secondary" minima. But wait, there's also Shawn Dvorak's estimate which essentially agrees with Krakow but has a different epoch (Dvorak 2004).

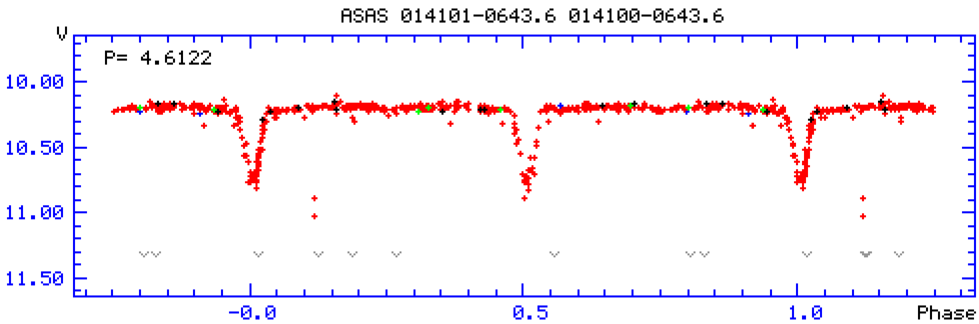

Figure 3. The ASAS-3 light curve of WZ Cet, folded on a period of 4.6122 d.

Summarising all these light elements:

Author	Epoch HJD	Period d
GCVS	2526308.350	6.645088
Hassforther (from ASAS3)	2452198.00	2.306112
ASAS3's own little robot		4.6122
Krakow	2452501.5	4.61232
Dvorak	2441869.578	4.6122

So, are are our observations going to sort his mess out?
We have had five sets of observations of this star, none of which is sufficient to support much analysis at this stage. Tom Richards got four long runs on 2009 November 5, 6, 8 and 24. All boringly flat except the end of the November 8th plot shows the start of a decline to a primary eclipse due an hour and a half later according to Krakow (Figure 4). David Boyd got in an hour and a half on October 25th, which shows a portion of a climb out of another eclipse. The worry about his data is that the eclipse should have happened right in the middle of his observing run – at least according to Krakow! However the Hassforther ASAS3 predictions have the system climbing out of a secondary minimum at that time. So is Hassforther right? No, because he predicts a secondary eclipse at HJD 2455144.058, right in the middle of Richards's run of Nov 8th!

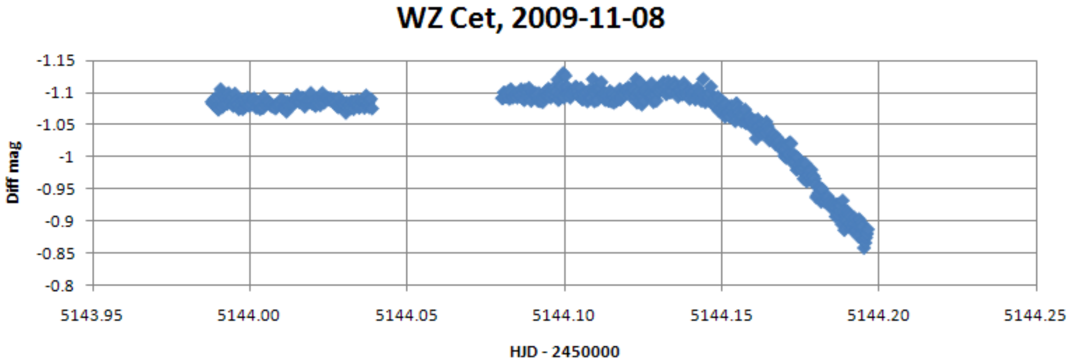

Figure 4. Data plot for WZ Cet on 2009 Nov 8th (Data by Richards).

Admittedly there's a gap in the record at the crucial time (the course of CCD photometry never did run smooth!) but it's not filled by a secondary eclipse, since another decline starts 2½ hours later. Trying things out with the other sets of elements doesn't solve any problems, either.
So what's going on? We won't know until we get some more data.

Conclusion

As the song said, "Wait till next year and hope!"

References

S.W. Dvorak, 2004, IBVS 5542
J.M. Kreiner, 2004, *Acta Astronomica*, vol. 54, pp 207-210.
Pojmanski, G. 2002, *Acta Astronomica*, **52**,397
N.N. Samus, et al., *General Catalogue of Variable Stars* (Samus+ 2007-2009), 2009yCat....102025S.

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star. There is a simple and surprising law about this: precision (in magnitudes) = 1/SNR. For details on this see Steve Howell's *Handbook of CCD Astronomy* (Cambridge, either edition) chapter 4. In fact your precision will always be worse, because this measure is based on only one source of noise – the sky.

When trialling various exposures, I look for the one that gives an S/N of 100 or more on both the target and comparison star. Usually, I go for 200 or more, since the precision error in photometry is affected by the S/N levels on both stars. That gives me the shortest exposure I'll accept; then, if I'm happy that I won't lose short-term changes by lengthening the exposure, I'll set a longer exposure time, keeping below by own ADU limit of 50,000.

Finally, when I have my night's images and am doing my photometry on them, I check my precision error as follows – when I have a time-series of images of the same field to work with. I do photometry on the check star as well as the target, and transfer the output file to Excel, where I can measure the standard deviation (stdev) of the magnitude series for the check star. I take that as my error for the target. (I can't do this for the target directly of course because it's varying.) If the check star is brighter than the target, the error is too small, if fainter it is too large. The theory of compensating for that is rather tricky; but a few shrewd tactics can get around it, like measuring a brighter and fainter star and setting the target's error proportionately between theirs. Or measuring the target along a stretch where its magnitude isn't changing.

And in the wash-up, remember it's better to quote a too-large error than a too-small one (imprecise data is OK, false data is not). And don't rely on the error figures your photometry package may output – they're usually far too small.

What Exposure to Use?

Suppose you are about to take a time series of images with your CCD. The field will contain your target variable star, a comparison star, and a check star. What exposure time should you give the field? This is actually a tricky problem, and simple solutions can lead to tears.

Do you just take some trial exposures and go for one where the three stars look nice and bright? No – that has three big traps in it:

One of the stars – the brightest – and maybe more, could be approaching the saturation level of your chip. To do good photometry, you must keep the brightness levels of your measured stars within the linear response region of your chip – the response levels where the recorded brightness is exactly proportional to the star's actual brightness. Finding your linear response limit by experiment is a little too tricky to describe here, but you're probably safe if you take it as:

halfway to the chip's saturation level for an ABG chip (33,000 ADU for a 65,535 ADU chip)

three-quarters for an NABG chip.

It may mean your exposure time is too long to capture the faster brightness changes you are after. The flickering of a dwarf nova in quiescence, the fast drop and bottoming out of a binary in eclipse, could all be changing faster than your exposure time – this detail is blurred out.

The star images are more likely to trail. This can be due to imperfect polar alignment, periodic error in the gears, differential atmospheric refraction, and a few other things. With my telescope, which I run unguided, this limits my exposures to about 240 seconds.

Well, how about going to the other extreme and making the exposures as short as you can while still being measurable? This has problems of its own:

Camera shutters never give uniform exposures across an image. A blade shutter for example will give more exposure time to the centre of the image. You really need to take exposures of some seconds' length, say 5, to minimise this effect on your photometry.

Atmospheric scintillation over short time intervals can be very non-uniform, so a star in one image may be quite a bit brighter than in the next. Longer exposures smooth this out. In my experience, this and the previous point suggest I should avoid taking exposures shorter than about 10 seconds.

The fainter a star, the more the precision of your photometry is limited by the sources of noise in your system – like listening to a faint shortwave radio station against the static.

Signal-to-noise (S/N or SNR) is a good place to start in figuring out your exposures. Most photometry software will allow you to measure S/N of a star in an image. It does this by measuring the level of sky noise. This puts an absolute limit on the precision of photometry you can do on that star. For example if a star has SNR=100, you cannot get more precise photometry than 0.01 magnitude on that

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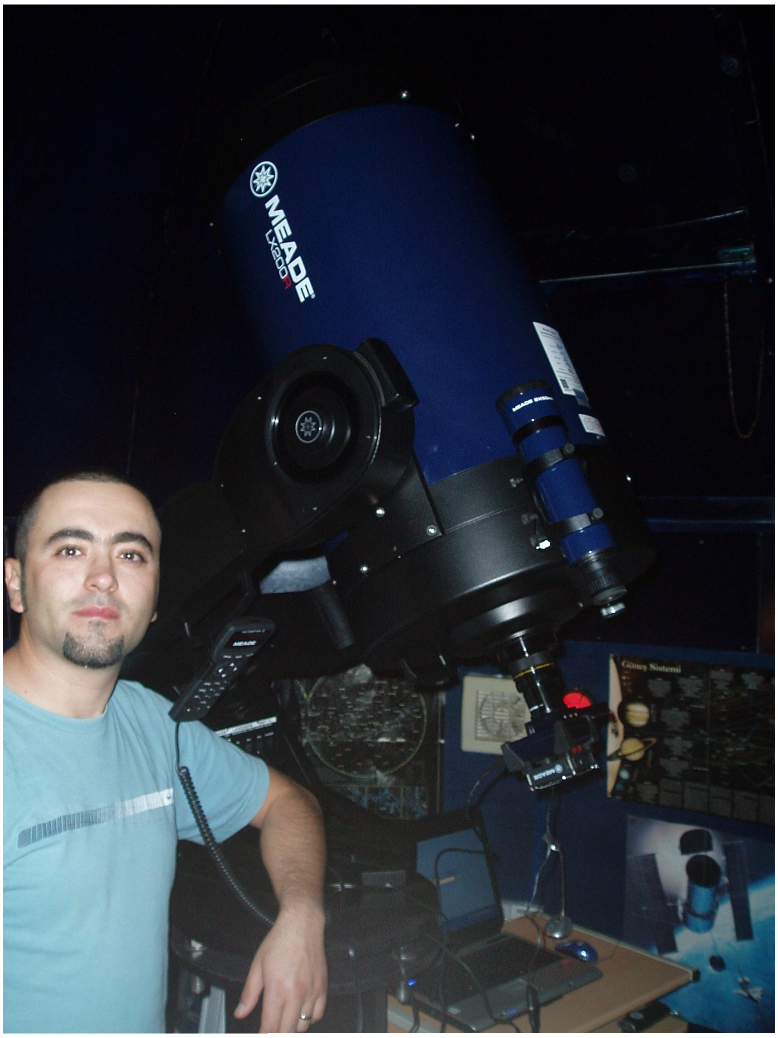
GREEN ISLAND OBSERVATORY

Yenal Ogmen *yenalogmen@yahoo.com*



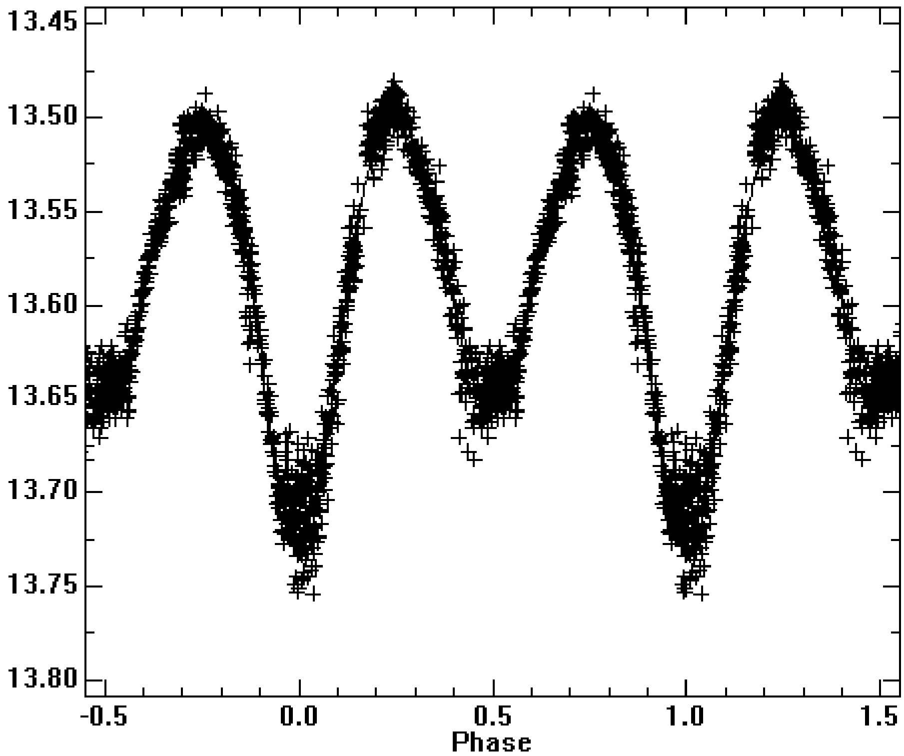
One of our northern members, Yenal Ogmen, pictured with his equipment which he operates from Green Island Observatory (B34), Geçitkale, North Cyprus www.greenislandobservatory.com
Yenal uses a Meade DSI Pro II (loaned from AAVSO) with BVRI photometric filters. I use 14" Meade LX200R with microfocuser, controlled with The Sky 6 software installed on a PC. The telescope is mounted on a Meade Ultrawedge attached to a steel Pier.

And a pleasant and picturesque setting for the observatory itself.

Few words of me: I am Maths teacher (BS and MS) and currently studying for BS degree in

Complete light curve of my discovery is attached. I want to told you that Christopher Lloyd from UK helped me a lot by guiding me after discovering the system, and with this help I could have completed the lightcurve.

I am observing EB-minima and calculate the minima with Peranso and send them to Gerard Samolyk to publish them in his paper. I also participate in AAVSO's photometric compaigns.



VISUAL VARIABLE STAR OBSERVATIONS
AN EXPERIMENTAL TECHNIQUE

Glen Schrader

The "Bright Cepheid" project aims to determine a seasonal epoch and period for a number of these stars with the majority of them having amplitudes of less than one magnitude. To produce a meaningful light curve that results in an accurate determination of period, the observing methods in common use need to be improved upon. To illustrate this point, below are two examples of light curves for the same star, Kappa Pavonis. The first chart, Figure 1, is a collection of data points from the AAVSO data base phased to a period of 9.08 days. This comprises multiple observers, and potentially, sequences. You will also notice that each observation is limited to 0.1 magnitude accuracy. This is damaging to the precision of the overall light curve.

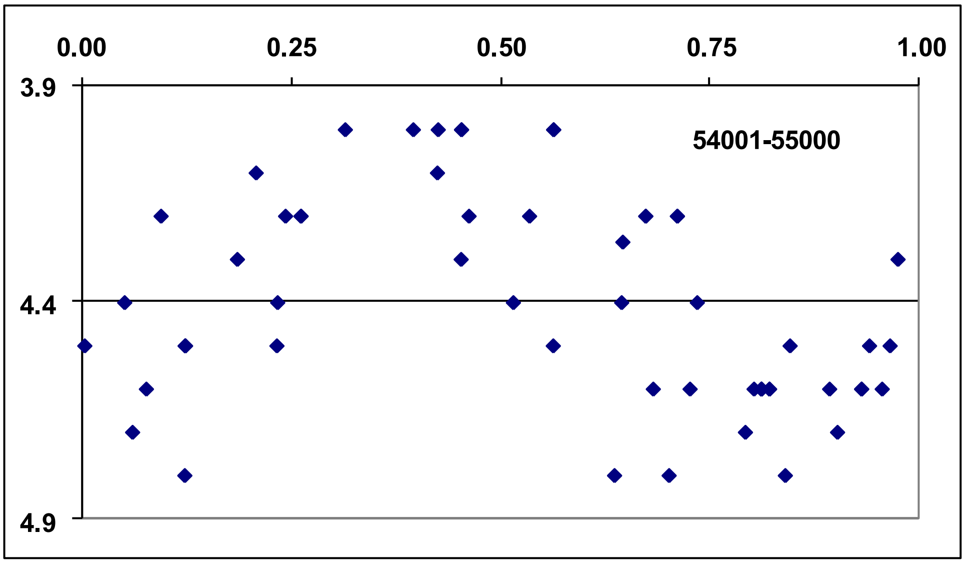


Figure 1: Data obtained from the AAVSO database. Notice the red lines showing that observations are limited to 0.1 magnitude increments.

The second chart, Figure 2, shows what can be done with the right procedures and discipline. It compares results obtained with the new method to that of Otero (visual) and with the Photo-Electric Photometry of Walker and Williams.

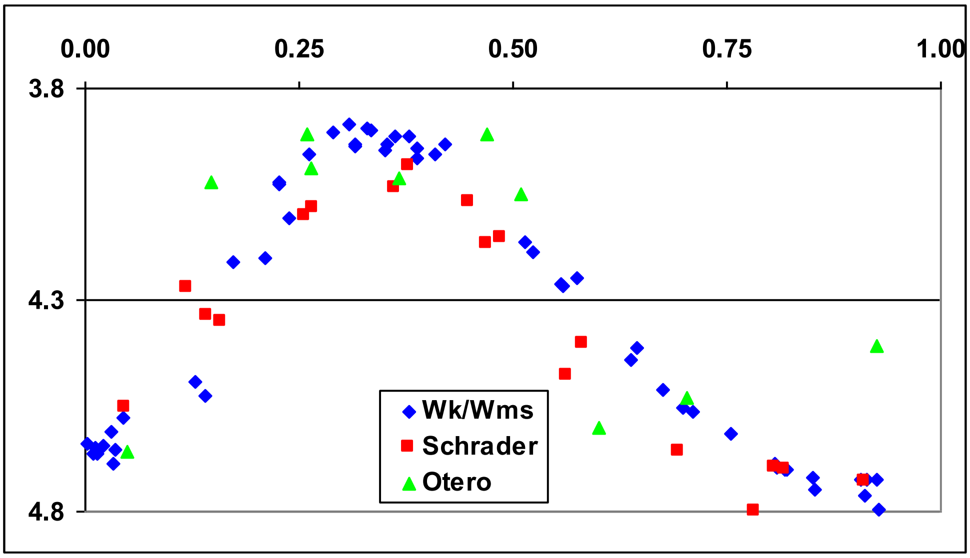


Figure 2: Early results from the "Bright Cepheid" project showing benefit of improved visual observation techniques.

In preparing this graph the three sets of measures have been aligned so that they show matched phases. This star has a very erratic period which is why it is targetted.

The following two chapters explain the new proposed method that is a hybrid of several accepted strategies and the work of myself and Stan Walker.

The Comparison Sequence

To understand what makes a good sequence we should start with the fundamental question of "what are we trying to do"? In simple and obvious terms we are trying to compare the target variable with known comparison stars that are of a constant brightness (unvarying). The eye is quite good at determining if one star is brighter than another and so we "bracket" the variable with one comparison star that is brighter and one that is less bright. In an ideal world we would be able to choose comparison stars where we can barely discern that they are of a higher or lower brightness. Thus we can determine to the best of our eyes ability the magnitude of the variable.

Let's look at an example of this ideal situation where we have determined that comparison star 1 (comp1) is barely brighter than the variable which is brighter than comp 2. Later we look up comp1 and find that it is magnitude 6.6 and comp 2 is 6.8. Obviously this means the variable is somewhere between 6.6 and 6.8. If we can barely discern that these stars bracket the variable then generally we determine the variable to be 6.7. This means that worst case we can be no further than 0.1 magnitude away from the actual magnitude, or is this truly the case? As the sequence used is rounded to one decimal place we know that really the variable can be anywhere between say 6.55 (rounded to 6.6) or 6.84 (6.8). We still record 6.7 as the result (still midway between the two results) however we are now possibly 0.145 magnitude away from the true magnitude of our variable. What do we do if we want to reduce this potential error? In the above example we now learn that comp 1 has been published as 6.63 and comp 2 at 6.77. Using the same observation we are now at most .07 magnitudes away (greatest distance from 6.625 and 6.765) from the actual true measure of our variable, a vast improvement on .145!!!

Going back to the ideal sequence then, this would include comparison stars from below the expected minimum of the variable to above maximum in increments that allow us to barely determine our bracketing pair. To be able to achieve the best possible accuracy from our eyes then the increments would need to be in the order of 0.05 magnitudes. It would be quite unrealistic, however, to expect a comparison sequence to be this good!!

How then can we get the best out of the sequence we have? Firstly at a minimum it needs to include comparison stars measured to at least two decimal places with gaps of no more than 0.3-0.4 magnitudes across the observing range. Secondly we need to do something different with our observing technique.

Modified Visual Observing Technique

When making visual estimates of a variable star there are several factors that limit our ability to accurately determine its true value. The major ones are:

- The quality of the comparison sequence (accurate with a good range of values to choose from)
- The observer's ability to discern small variations in brightness
- Atmospheric effects

Observational technique/recording method

The technique I have employed during the "Bright Cepheid" project doesn't introduce artificial barriers to accuracy due to observational method and also, by default, takes into account "some" of the atmospheric extinction issues.

To explain the method it may be simpler to step through an example of an observation. Figure 3. Below is a copy of the comparison sequence for Kappa Pavonis, one of the target stars in the "Bright Cepheid" project. You will notice that all the comparison stars are determined to 2 decimal places.

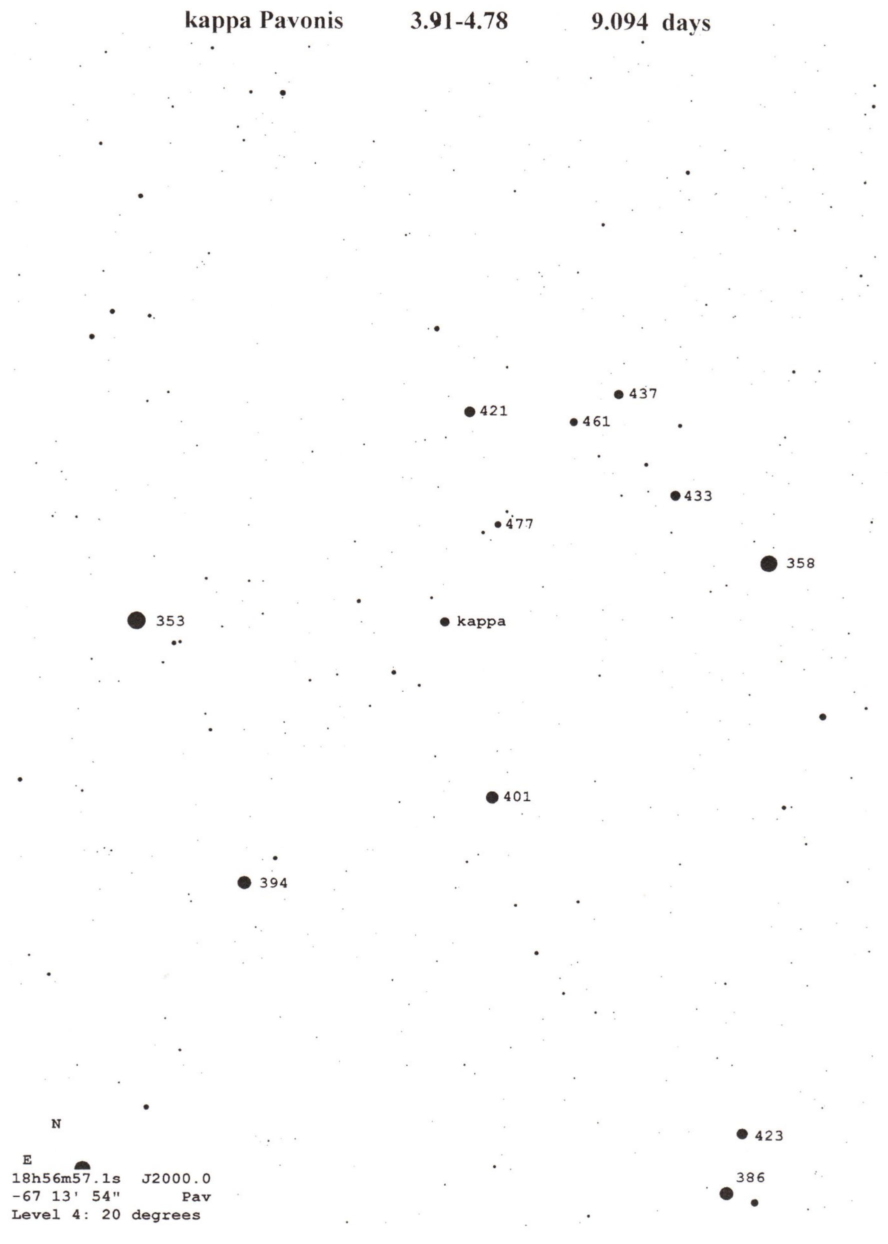


Figure 3: Comparison star sequence chart for Kappa Pavonis, with Spec. and B-V.

353	**G5**	**0.75***
358	**K0**	**1.16**
386	**K0**	**0.92**
394	**A0**	**-0.03***
401	**K0**	**1.13**
421	**B2**	**-0.15**
423	**K0**	**1.06***
433	**A5**	**0.23**
437	**K2**	**1.46***
461	**B8**	**-0.12**
477	**A2**	**0.20**

*** Stars in NSV Cat.**

It is interesting to note that of the 11 stars listed 4 are suspected of variability. The Hipparcos measures—admittedly for only a few years—show scatters of between 0.004 and 0.005 which seems to conflict with this. Kappa's spectral class of F5 and B-V colour of 0.53 lie around the middle of the range of colours. The steps between the stars are close and support the comments in the text.

Step 1

Using the chart, find the variable in the sky and look through the list of comparison stars to determine approximately where it is currently sitting. In this case I have determined that it is somewhere between 4.21 and 4.77 and probably closer to the 4.77 star. At this stage there is no need for real accuracy.

Step 2

Find multiple sets of comparison stars (minimum two however three or more is more accurate) between 4.21 and 4.77 that closely bracket the variable. In this example I will choose 4.21-4.61, 4.37-4.61, and 4.33-4.77. On a note pad write down the comparisons with the lowest magnitude on the left side of the page and the highest on the right. Now draw a straight line between the two as per Figure4. Below (you could draw each line exactly 100mm in length to save time in the following steps).

Step 3

Using the straight line you have drawn as a sort of "infinite scale" determine as accurately as possible where along this line you think the variable is and draw an "X". Repeat this for all the comparison pairs noting the time for each.

Step 4

Back inside take out a ruler and measure the length of each line. If you have drawn this as 100 mm at the start then this is where you save time. Determine the decimal fraction that the "X" is from the <u>left end</u> of the line as per Figure4. In this example I have worked out the decimal fractions to be 0.92 (92mm from the left using 4.21-4.61), 0.54 (54mm for 4.37-4.61) and 0.29 (29mm for 4.33-4.77).

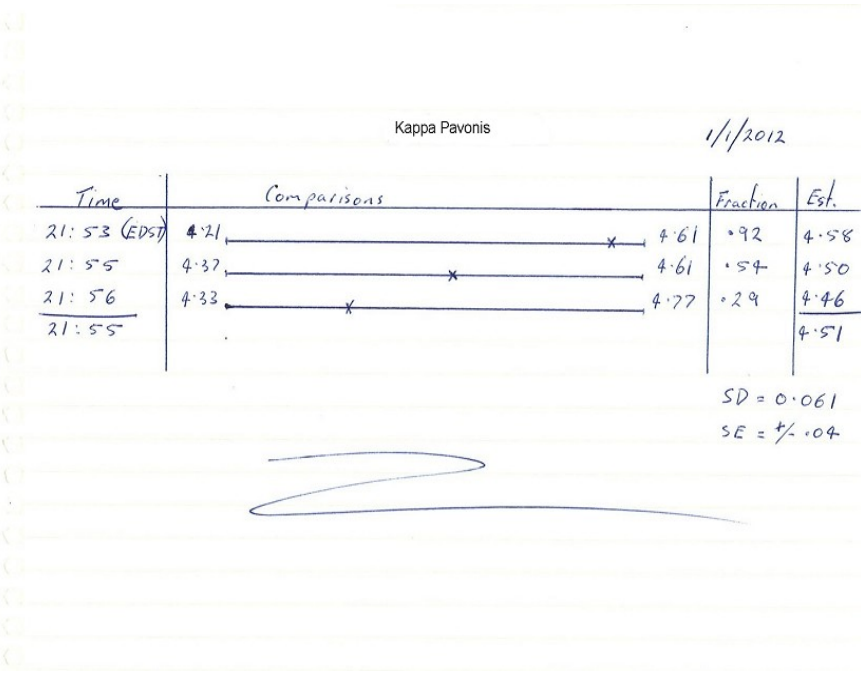


Figure 4: Example of a worksheet used to calculate an estimate using the modified approach.

Step 5

Using the fractions you have just created, determine the visual magnitude for the variable against each of the comparison pairs. They are most likely different, however, you now have three results instead of one and these can tell us a little about how accurate the measurements are. In this case the estimates for each of the pairs are 4.58 (which is 4.21+.92*(4.61-4.21)), 4.50 and 4.46 respectively.

Step 6

Determine the mean (average) and standard deviation of the results as well as the mean observation time. Then determine standard error (standard deviation divided by the square root of the number of observations, in this case three) and add this to your estimate when submitting the results. So after all this extra work we finally have a result. For our fictitious observation we have a mean (average) result of 4.51 with a standard error of 0.04. We write this as 4.51 +/- 0.04.

A Final Word

The aim of every observer should be to make every observation as accurate as they possibly can. In this age with increasing use of CCD's, visual observers wanting to truly participate in the science effort need to work in areas not normally covered by these devices. As an example areas such as very bright, low amplitude semi regular stars or our "Bright Cepheid" project could be tackled with the right amount of discipline and achieve meaningful results.

HOW GOOD CAN VISUAL MEASURES BE?

Stan Walker

In pursuing one of my interests, period changes in Cepheid stars, I've ended up doing a lot of analyses of visual measures in the International Database of the AAVSO. I wrote briefly about this in the November Newsletter. Since then I've been investigating what might be possible if the techniques were varied. Glen Schrader has come up with an interesting approach which seems to work—see page 25.

To a large extent the necessary accuracy has been predetermined with the concentration upon the large amplitude Mira stars—many have a range of more than a thousand times in intensity. Sequences have been determined only to a single decimal place and measures are expected to be accurate to 0.1 magnitudes an accuracy which is rarely obtained—one has only to look at the light curve of eta Carinae in the 2009 November Newsletter—or a graph of omicron Ceti on the AAVSO website. .

Two things should improve the estimates dramatically. The first involves publishing sequences to two decimals, the second is aimed at reducing the step size between comparisons. The first is easy and means that if people try to estimate to a few hundredths they are likely to get at least 0.05 magnitude results. The second is harder as traditionally stars rather different in colour have not been considered good comparisons. But how real is this objection? With Cepheids this is not significant as most have F and G type spectra at maximum, the most important part of the light curve and the differential colour response of the eye would only introduce an error of a few hundredths at reaonable altitudes—say 40 degrees.

Some of the published estimates puzzle me. I noted measures of RS Puppis using stars a magnitude apart in value. Since the star is easily visible in binoculars and there are about 15 stars covering its range within two degrees—which allows selection of stars closely bracketing the variable in brightness—I couldn't see any reason for this. Not surprisingly, the measures didn't match others very well. So we need to push the accuracy of visual measures to their limit. We have selected a range of bright Cepheids which seem to be neglected and are too bright for ASAS3. Other targets are also available—poorly studied bright SR stars, perhaps RV Tauri stars, but let's work on the Cepheids first.

The Nova that everybody's watching (if they can) U Scorpii in Eruption

Tom Richards ***tom.richards@varstars.org***

Yes, novae pop off, and when they do it's always very important to get as much photometric data on them for as long as possible – visual, CCD and PEP. But U Scorpii is creating much more interest than most since it erupted on January 28. The eruption was discovered using a CCD Camera by Barbara Harris of Florida, who has been monitoring it since the call went out last August to watch for it. An army of space telescopes have either been studying it or are about to: RXTE, INTEGRAL, Swift, Chandra, Suzaku, XMM-Newton, MAXI (and that's just the Xray satellites). More in the optical and UV, and many ground observatories from optical to radio bands. Photometry, polarimetry and spectroscopy are all being intensively carried out. Brad Schaefer of the University of Louisiana who is coordinating the main project on it, remarked "This U Sco eruption is on track for being the all-time best observed nova event." It's certainly one of the most important.

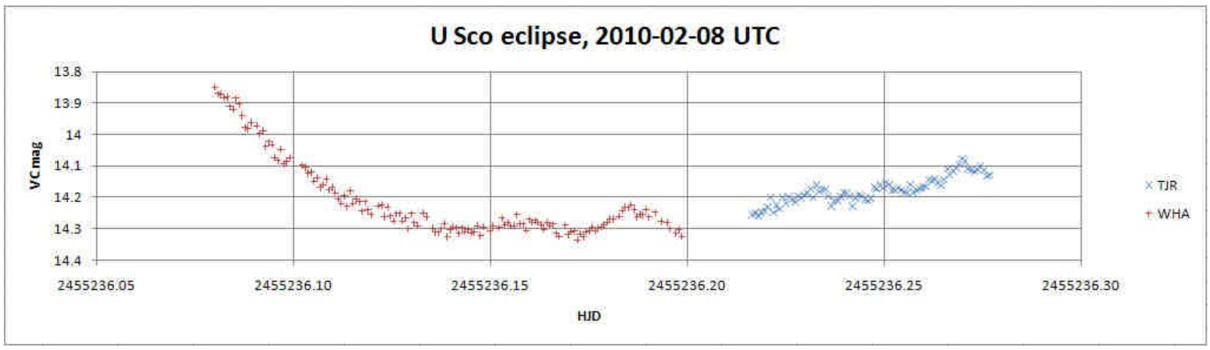
Why the special interest? U Sco is a recurrent nova (RN) – a nova that has been observed to erupt more than once. Only seven such are known in our Milky Way, and one in the LMC. This is despite the fact that novae will erupt many times; however for some the interval between eruptions is too long for repetitions ever to have been seen. All dwarf novae can be expected to go nova many times in their lifetime too. U Sco has been observed to erupt nine times since 1863 – the last in 1999. So RNs are plainly worth close attention just because they are recurrent. But there's more to U Sco than that. For a start it's a very fast nova. Its t_3 figure – the time taken to drop 3 magnitudes from its peak – is only 7 days.

A bit of data. The primary is a white dwarf, the secondary is an F8 dwarf. It's thought to lie about 14 kpc (~45,000 ly) distant, high in the Galactic Halo. Its quiescent magnitude is V~18, and it rises through 10-11 magnitudes to maximum, a flux increase of over 10,000 times. The nova detonation is of a thin shell of hydrogen on the surface, accumulated ultimately from its companion and highly compressed by the extreme gravitational field. The shell, of the order of tens of Earth masses, undergoes a thermonuclear explosion when a critical temperature and density is reached.

What's particularly valuable about U Sco is that it's an eclipsing nova, with an orbital inclination of ~80°. Based on past eclipses the orbital period is 1.23 d. When it erupts however, the expanding shell of dust and gas is expected to blur out the eclipses, and over time they will gradually reappear, providing valuable quantitative information about the dispersal of the shell and the mass ejected. Once they are well observable, will the period have changed? This will give very precise information about whether it has blown off only some of the shell of accreted hydrogen, or all of it, or some of the white dwarf's crust as well.

These two precise methods of measuring the mass ejected are of great significance. A major unknown about the origin of Type Ia supernovae is how the mass builds up on the white dwarf until it causes a collapse of the star's core. We need to know whether novae keep a residue of the accreted mass in each eruption until finally the burden is too great (the Chandrasekhar Limit of 1.4 solar masses), or whether, as some evidence indicates, the nova eruption causes it to lose more mass than it gained. U Sco is uniquely well placed to give us hard data on this question. And because of the role of Type Ia SNe in measuring the universe, the answer to this question is of the highest importance.

Unfortunately, U Sco rises not long before the Sun right now, and there is only an hour or so time window in which it can be observed, less from the northern hemisphere. Eclipses will last rather longer than that, particularly the all-important early ones, so capturing them is hard. To date, although some declines and ascents have been observed, only one eclipse has been, on February 8th. And this was thanks to Bill Allen capturing the decline and minimum from Blenheim, New Zealand, then myself observing some of the rise from Eltham, Victoria. Two windows, nearly overlapping. Here's what the combined light curve looks like.



There's a lot of interest here. Bill's decline is quite smooth with a gentle deceleration, indicating a gradation in the eclipsed object (whatever it is – expanding shell, re-forming accretion disc? An eclipse of a white dwarf would be very sudden.) Then some modulations start, of up to 0.1 mag, and lasting up to 0.03 days (45 minutes). These continue in the gentler climb out of eclipse, but a bit more erratically. Modulations had already been observed, out of eclipse, a day or so before this. This may indicate that the accretion disk, undoubtedly blown away in the explosion, is re-forming. The vertical scale "CV mag", by the way, means Clear (unfiltered) data, using a V magnitude for the comparison star. Both of us were using 0.4 m telescopes.

It is impossible to say from this data when the moment of mid-eclipse occurred, since we can't tell what is being eclipsed when. Maybe HJD 236.18 ± 0.01 is about as good a guess as any. Brad Schaefer reports (personal communication) that it looks a bit early, but that the phase has wandered a bit in earlier eruptions too, so it's not surprising.

Since this eclipse, Bill and I have been clouded out, but are anxiously hoping for another attempt. The star is expected to fade rapidly, though data up to now (Feb 14th) on the AAVSO Variable Star Database indicates it's at a standstill at around V=14.0. If you can possibly get a time-series on this vitally important eruption, please do so, and send your data to the CBA, AAVSO, and to me. We are developing a few web pages on U Sco, and want to get as much VSS data as we can for analysis. Please visit http://www.varstars.org/U-Scorpii-Campaign.html for more, including what to report. With trans-Tasman cooperation we are in a unique position to continue capturing eclipses.

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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. It needs to be expanded a lot more however, and suggestions should be sent to the webmaster.

All VSS members should belong to the VSS-members egroup, as that is the main channel of fast communication between members. If you're a VSS member and still haven't signed up to it, please go to its home page (above) and apply.

MEMBERSHIP

New members are welcome. The annual subscription is $20NZ, and the membership year expires on April 30th. Find out how to join by visiting the VSS website at http://www.varstars.org/Join-VSS.html. 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, do please sign up to the VSS-members egroup (see above). In its personal information section, it would help everyone if you added information about your telescope and equipment, your astronomical interests and anything else you consider appropriate.

NEWSLETTER ITEMS

These are welcomed and should be sent to the Editor. I'd appreciate them unformatted, although if you wish a particular layout send a formatted version as well and we'll ensure that this is followed. Publication dates are February, May, August and November—the twentieth of each of these months and the copy deadline is the first of each of these months.