



The Seestar S50 is one of a new breed of so-called smart telescopes employing star tracking and automatic image taking. Andrew Pearce has been using one for most of 2024. See his report on page 5 of this issue.

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From the Director – *Mark Blackford*

Welcome to the fourth edition of the Newsletter for 2024, and the last for our editor Phil Evans. Phil took over the editorial role from Stan Walker back in May 2011 and has produced 54 consistently high-quality Newsletters over the years. On behalf of everyone, I thank Phil for his long-term commitment to VSS and wish him well in continuing his remote observing of transiting exoplanets and the occasional eclipsing binary.

To date no one has put their hand up to take over as editor. This is an important role, but not too onerous once you get the hang of it. Phil is happy to provide any assistance required to get the new editor up to speed. If you can help, please contact Phil and/or me. In the interim, Ed Budding has offered to help until a more permanent appointment is made.

Also, Treasurer Bob Evans, has stepped down after serving in the role 2009. Bob was also in charge of membership for many years until annual subscription fees were dropped in 2014. I would like to thank Tom Love who has agreed to take over as Treasurer.

The 7th Variable Stars South symposium will be held on Friday May 9th, 2025, immediately before the RASNZ conference in Whakatane. The venue is the Whakaari Room of the East Bay REAP (Rural Education Activities Programme). Glen Rowe has visited the facilities and found them well suited for our meeting. Registration fee looks like being \$NZ45 for those attending in-person, including lunch and morning/afternoon teas. More information will be provided in the following Newsletter and VSS Google Group, but please start planning to attend and present your work. For those who can't make to Whakatane, there will be an opportunity to participate via Zoom.

Congratulations to Andrew Pearse for his co-discovery of V1725 Scorpii (NOVA Scorpii 2024 No. 3) in September. Andrew has produced an excellent video on YouTube describing the Seestar S50 smart telescope that he used for the discovery. A link to the video can be found in Andrew's article later in this Newsletter.

Tom Love asked on the VSS Google Group if there was any interest in running a VSS journal club where people could take turns to present a research paper that they found interesting, perhaps followed by some discussion about any implications for the various research projects that we do. A few people responded positively, so we will try to get that up and running soon. If you are interested, please contact Tom or me.

I've managed a reasonable number of nights of imaging at Congarinni Observatory in recent months. Current I am using two small refractors, equipped for photometry of bright targets, mounted on a single German equatorial mount. My 14" RC should also be back in operation soon after spending most of this year in storage. Hopefully the weather this summer will be better than last year.

Wishing you all clear skies and good health,

Mark Blackford



When I took up the editor's role of the newsletter in 2011 I never gave any thought to how long I might last. I just kept going and the articles kept appearing in my inbox. It wasn't until I'd been producing it for nine years that I said to my wife Wendy that "this tenth year will be my last". Of course I forgot I'd said that and just kept going. Each year after that I said the same thing until finally at the end of last year I wrote to Mark that 2024 would be my last year. And so now here is my last offering after 54 issues and over 500 articles from just over 50 individual authors.



A selection of the cover pages from the 54 issues I have produce over the last 13 years.

I have been helped enormously along the way by a small group of very prolific contributors - I have to name Mati, Stan, Tom and Mark as standouts - but I've also been delighted to receive occasional material from many diverse sources such as Tim Banks' college students and Carl Knight's high school students. These youngsters, I hope, will be the backbone of our future organisation. Recently I have received contributions from our South American members but none yet from South Africa.

In giving a year's notice I hoped that somebody would offer to take up the job and it is quite disappointing that nobody has publically offered. It's not an especially difficult job, we are not a learned journal but a newsletter letting our group know what we have been doing. In my last day job I was managing a daily newspaper (albeit a very small one) so I had some experience with layout software. Specifically I used Adobe's InDesign, the last non-subscription version, but advances in Microsoft Word have been such that it can easily be prepared in that Office product. Adobe products are expensive and subscription based so I do not recommend them. Alternatively there is a very good open source layout program called Scribus that I do recommend and which is free, but to be honest if I was starting again today I would choose Microsoft Word. If you put your hand up for the job then I will help all I can but don't be tempted to copy my rather dated layout - make your own and stick to it. Use templates and style sheets to make the job easier.

While not producing the newsletter I will still be observing from my remote site at El Sauce in Chile. (El Sauce means 'The Willow' in Spanish and is pronounced 'el sau-seh') As a member of TESS SG1 subgroup I have been privileged to assist with the discovery of many exoplanets but having signed a NASA non-disclosure agreement I have not been able to tell you about them. With a CDK500 system in Chile my 25 year-old 10" Meade now lies disused in my home observatory. Unfortunately mould has eaten into the optics but the MI-250 German equatorial mount is still operative and is for sale for a modest sum (make an offer) to anyone who can arrange shipment from Rarotonga - be warned shipping anything from here is expensive.

So now I will sign off and hope that someone will take up the role of editor. I hope to be a contributor of sorts in the future. My best wishes to you all. *Phil Evans*

Conference report: Symbiotic stars, weird novae, and related embarrassing binaries – *Tom Love, Peter Velez*

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This conference on symbiotic stars was organised by Jaroslav Merc, an astronomer at Charles University in Prague.¹ Jaroslav has worked actively with amateur spectroscopists to classify and monitor symbiotic systems, and this conference was intended to be both an update to research on symbiotic systems (SySt), and an opportunity for professional and amateur astronomers to meet and consider new collaborations. The last full day of the conference was specifically dedicated to professional-amateur presentations, although we attended for the full week of the meeting, as did the US amateur spectroscopist Forrest Sims. The French 2SPOT group, who operate a remote spectroscopic facility with a telescope in Chile, also joined the meeting though mostly for just the final day.²

Symbiotic systems are, broadly, binary stars with a red giant component and a smaller accreting star that are interacting via some kind of wind mechanism. They are typically much more separated than short period eclipsing binaries that interact directly, but exhibit a rich variety of phenomena that are difficult to classify in a consistent manner. A general discussion during the conference about the definition of a SySt was inconclusive, with disagreement on how precisely different properties could be characterised. It was clear that, over the years, SySt have sometimes been a sort of residual category of system into which otherwise unclassified nova-like or similar systems have been attached with relatively little consistent analysis of properties. Which probably explains the title of the conference. While there is still much to work out for this complex group of systems, a number of people present suggested that there was much more clarity about the definition of SySt than there had been in the past.

Part of the interest in SySt lies in the diversity and complexity of the behaviour of the different systems involved. This was clearly represented in the range of topics covered during the conference. Subjects ranged from methods for detecting SySt, and estimates of how many undiscovered SySt there may be in the galaxy³, to the analysis of Raman scattering mechanisms and what they might tell us about the evolution of SySt.⁴ There was a lot of research on the accretion mechanisms around white dwarf components of SySt, and a number of papers on the system R Aqr which is a very well studied, but complex, example of a SySt. These included an extraordinary presentation of direct imaging of the components and surrounding dust clouds of R Aqr.⁵

The amateur material on the Friday morning was largely based on work from the 2SPOT team. The standout example was from Lionel Mulato, who presented an approach to detecting new symbiotic systems based on searching GAIA data, and conducting followup observations with the 2SPOT 30cm telescope.⁶ This earned spontaneous applause when one of the researchers present remarked that 2SPOT were finding symbiotic systems faster than professional astronomers, and with fewer resources.

We both attended this conference as a part of taking a longer holiday trip to (different parts of) Europe. Spending the time at the meeting was a worthwhile use of a week within the longer trips that we had planned. We made a number of valuable connections with professional astronomers who were interested in working with amateur observers. We have already made a number of observations for some of these researchers, and there are others with whom we expect to develop fruitful relationships in the future. It was also good to meet each other, Forrest Sims, and the 2SPOT team. We had previously been in touch with all of these people via email and Zoom meetings, but meeting in person is still a worthwhile thing, and it helps to build relationships and understanding about what we want to achieve as astronomers. Overall, attending this conference was a very positive experience, and we will both be looking for other conference opportunities in the future.

¹ <http://symbiotics2024.cuni.cz/home.html>

² <https://2spot.org/EN/index.php>

³ http://symbiotics2024.cuni.cz/presentations/symbiotics2024_sokoloski.pdf

⁴ http://symbiotics2024.cuni.cz/presentations/symbiotics2024_heo.pdf

⁵ http://symbiotics2024.cuni.cz/presentations/symbiotics2024_schmid.pdf

⁶ http://symbiotics2024.cuni.cz/presentations/symbiotics2024_mulato.pdf

The age of smart telescopes is upon us! In January 2024, I took the plunge and purchased a Seestar S50 with a view to understanding whether it will be a useful instrument for scientific observations. This is from a guy that has zero direct CCD imaging experience! 2024 has been a year of discovery with the Seestar and I have experimented in the areas of astrometry (comets, asteroids and transient objects) and photometry (asteroids, comets and variable stars). I have been able to produce some meaningful results and have contributed data to the AAVSO, MPC and COBS/ICQ comet databases.

I have produced a Youtube video which goes into a bit more detail on my journey and the outputs I've been able to produce - <https://youtu.be/EeGEC6ama2g>

The rest of the article will focus on the workflow I follow and some insights from using the instrument for variable star measurements.

Background on photometry

Figure 1 shows the spectral response of the IMX-462 sensor used in the Seestar. The figure also shows the corresponding Johnson standard filters. The scope has a built in IR filter which cuts out all wavelengths greater than 700nm which is a key enabler to getting some reasonable results for photometry. As can be seen the R, G and B channels line up reasonably well with the Johnson R, V and B filters. In reality the 'closeness' is significantly impacted by the stars' colour and whether any strong emission lines are present.

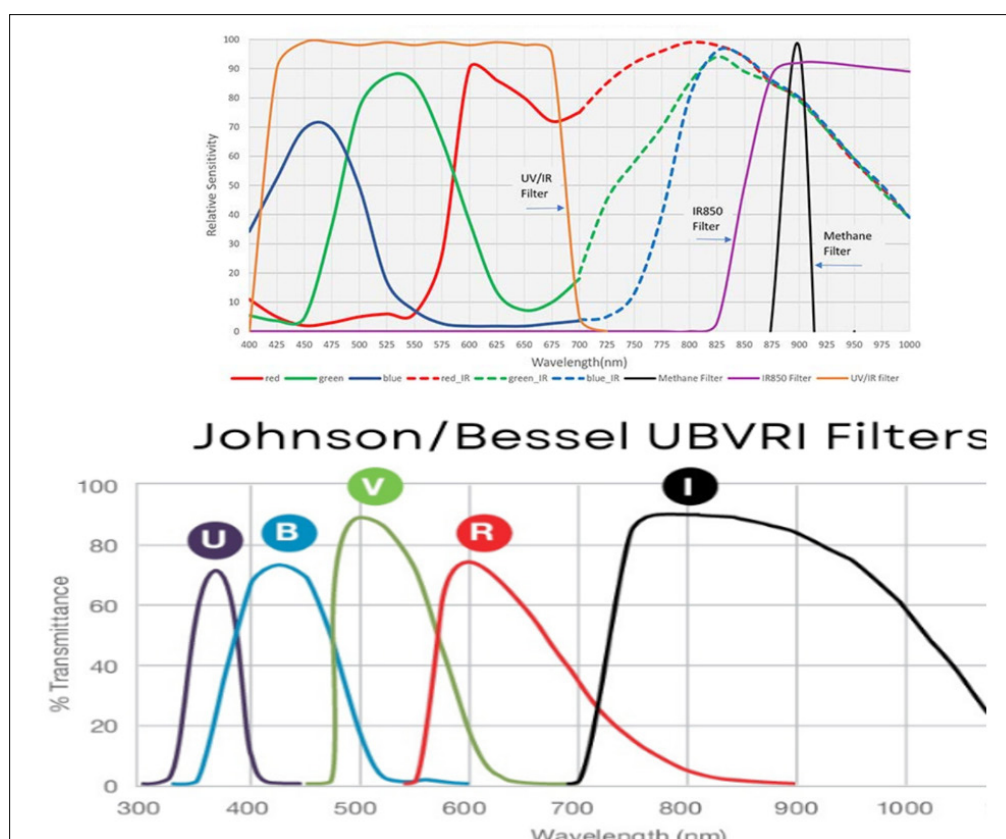


Figure 1 – *Seestar spectral response*

I performed some analysis to determine transformation coefficients using the AAVSO standard star field for NGC 3532 (which is a very good fit for the Seestar with plenty of stars in the 42'x75' field of view). I then used the AAVSO Transform Generator software (TG) to determine the coefficients which are shown in Figure 2 overleaf.

Transformation coefficients:
Load values from INI file
Choose File

Filter Band Coefficients (eg Tb_bv)

T =	0.465	+/-	0.01	Band:	B	Color Index:	B	-	V	X
T =	0.299	+/-	0.005	Band:	B	Color Index:	B	-	R	X
T =	0.016	+/-	0.009	Band:	V	Color Index:	B	-	V	X
T =	0.037	+/-	0.015	Band:	V	Color Index:	V	-	R	X
T =	-0.279	+/-	0.015	Band:	R	Color Index:	V	-	R	X

Add transformation rule

Colorindex Coefficients (eg Tb_v)

T =	1.834	+/-	0.026	Color Index:	B	-	V	X
T =	1.669	+/-	0.018	Color Index:	B	-	R	X
T =	1.455	+/-	0.021	Color Index:	V	-	R	X

Add transformation rule

Figure 2 – Seestar transformation coefficients

The coefficients suggest that Seestar G channel and transformed V magnitudes should be quite close. For stars with B-V = 0.5, the difference should be no more than 0.03 magnitudes. As can be seen the agreement between R and B channels and R and B Johnson magnitudes is not as good.

So far I have rarely applied transform coefficients to my Seestar observations. Figure 3 shows a good example whereby the TG, TB and TR magnitudes can differ to quite an extent for variables with strong emission lines. The light curve is of V1725 Sco (which I co-discovered in Sept 2024). It can be seen that whilst there’s reasonable agreement between TR and Johnson R magnitudes, the agreement is poor between TG and Johnson V and TB and Johnson B magnitudes. Novae, with strong emission lines, make it tough.

Based on my assessment of its photometric performance, I believe it is better suited to time series photometry using its ‘native’ channels rather than considering transformation to the standard system. This is a similar situation to most DSLRs.

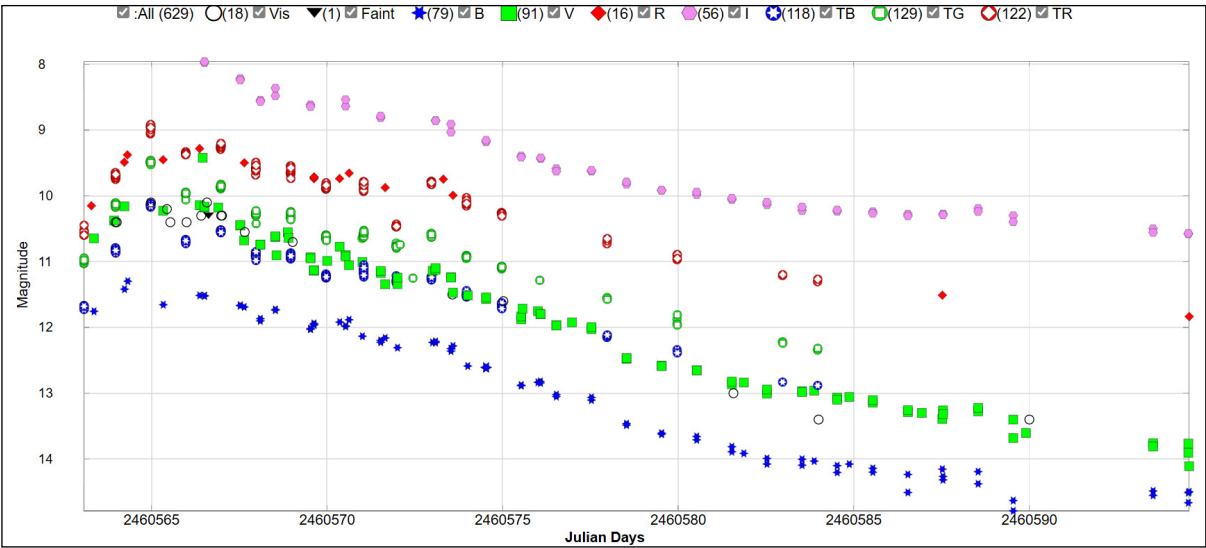


Figure 3 – V1725 Sco Light Curve

Time series photometry

The Seestar takes 10 second exposures and stores them as FITS files which can then be downloaded from the unit at completion of the observing session. With 10s exposures, I find that stars brighter than magnitude 8 will start to saturate. Furthermore, when stacking images and to maintain a useful cadence for the time series, I generally try and keep the SNR above 40-50 and that means that the fainter limit is approximately magnitude 11.0-11.5 in my skies. This sets the bounds for the stars that I follow.

However, there are groups of people out there which have developed very useful non-official apps for the Seestar whereby it is possible to allow shorter exposures than 10s opening up the possibility of performing photometry of brighter stars. However, due to the relatively small field of view (42'x75'), there is a practical limit when following brighter variable stars.

Further these non-official apps allow the Seestar to be set up with a schedule of observations that can be run throughout the night. This is extremely useful for time series photometry. A sequence of observations can be planned in advance and the Seestar left to run all night. I have performed frequent 11 hour sessions in winter.

The Seestar is limited by its alt-az mount in terms of maximum altitude of stars that can be followed (it struggles above 75 deg) and the amount of field rotation that occurs sort of limits the exposure run to 3-4 hours. However, this duration is enough to follow eclipses on EBs as well as following full cycles of short period Delta Scuti, HADS and SX Phe stars.

A 3-4 hour run can produce 800-1000 images (3-4 GB). It's important to have an efficient software package to process the large amounts of data. Thankfully the package that I find fits the bill is Tycho Tracker (<https://www.tycho-tracker.com/>). It's an extraordinarily powerful package for processing the images and managing the outputs. Typical workflow performed in Tycho Tracker is:

1. Remove hot pixels
2. Debayer images and extract G channel (average)
3. Plate solve all images
4. Align all images
5. Interrogate SIMBAD database to identify the variable star on the image
6. Set aperture and annulus size
7. Download AAVSO comparison star data (or use ATLAS catalogue BVR data)
8. Decide on how to stack the images. For example, if a 3 hour run is conducted and a cadence of 1 measure per minute is required and there is 800 images, then the software can be set to stack 3-4 image sets ready for photometry. This is the step where a check is made on target SNR
9. Perform photometry on variable star and check star
10. Review data graphically
11. Prepare AAVSO data output and generate text file
12. Option to download data in CSV files with HJD instead of JD which is useful for eclipsing binaries

I find that 800-1000 images can be fully processed in under 5 minutes based on the workflow defined above. It probably takes longer to transfer the images from the Seestar to your computer than it does to perform this photometry workflow!

Typical results

Figures 4 and 5 show typical results on a Delta Scuti star (EH Lib) and a SX Phe star (CY Aqr). Typical errors were no more than 0.01 mag for EH Lib and 0.08 mag for CY Aqr.

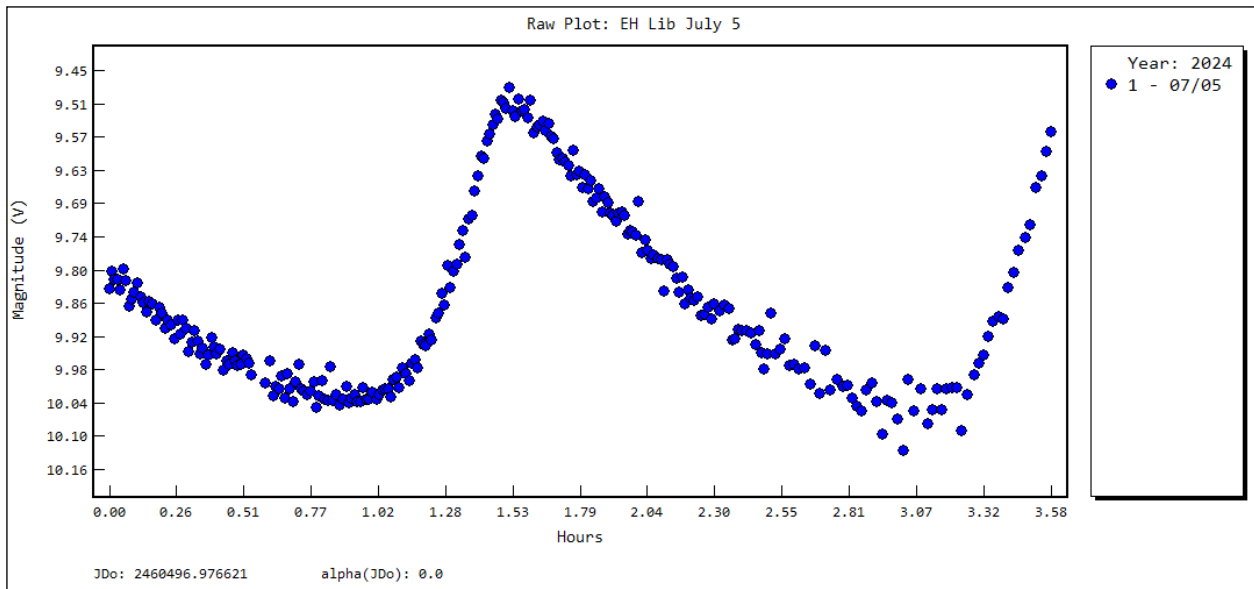


Figure 4 – *EH Lib*

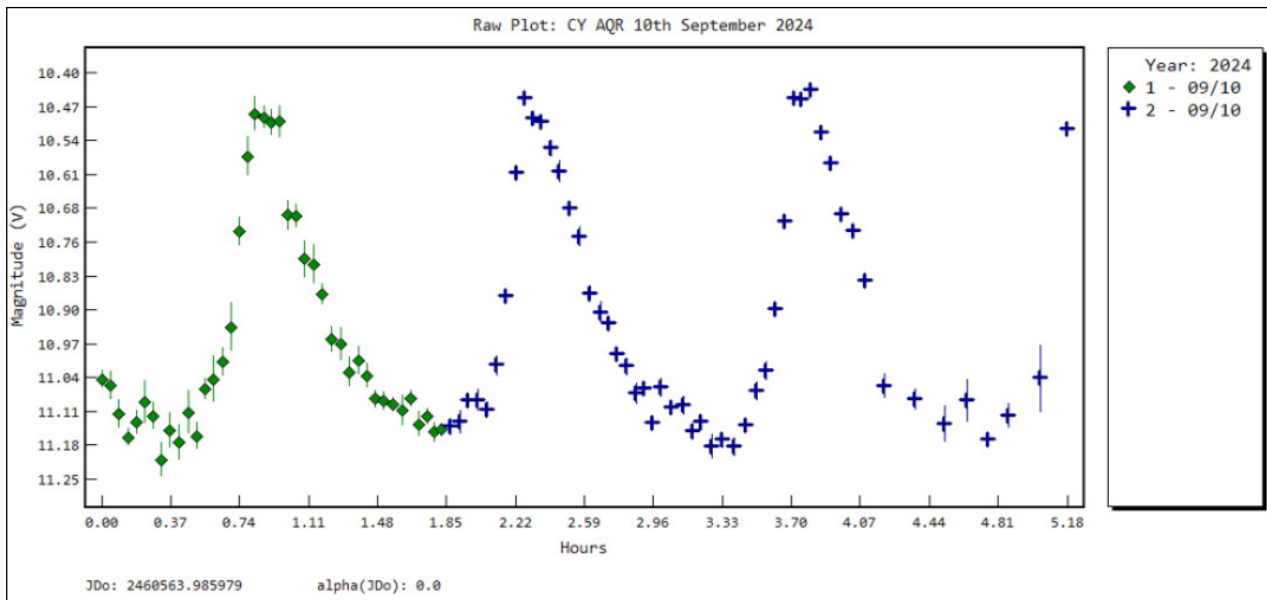


Figure 5 – *CY Aqr*

Figure 6 shows a primary eclipse of the EB star AU Men. I determined a ToM using the Minima Version 27 software with a parabolic fit. All of my EB eclipses have been uploaded to the VSS Southern Eclipsing Binaries Project repository. Figure 7 shows an O-C plot for AU Men and the last two measures shown are from my Seestar. They don't seem too bad, however the jury is still out as to whether the Seestar can provide accurate enough measurements to be acceptable for EB eclipse timings. I would appreciate anyone's view on my observations stored in the database as to whether I should persevere or move on to other targets.

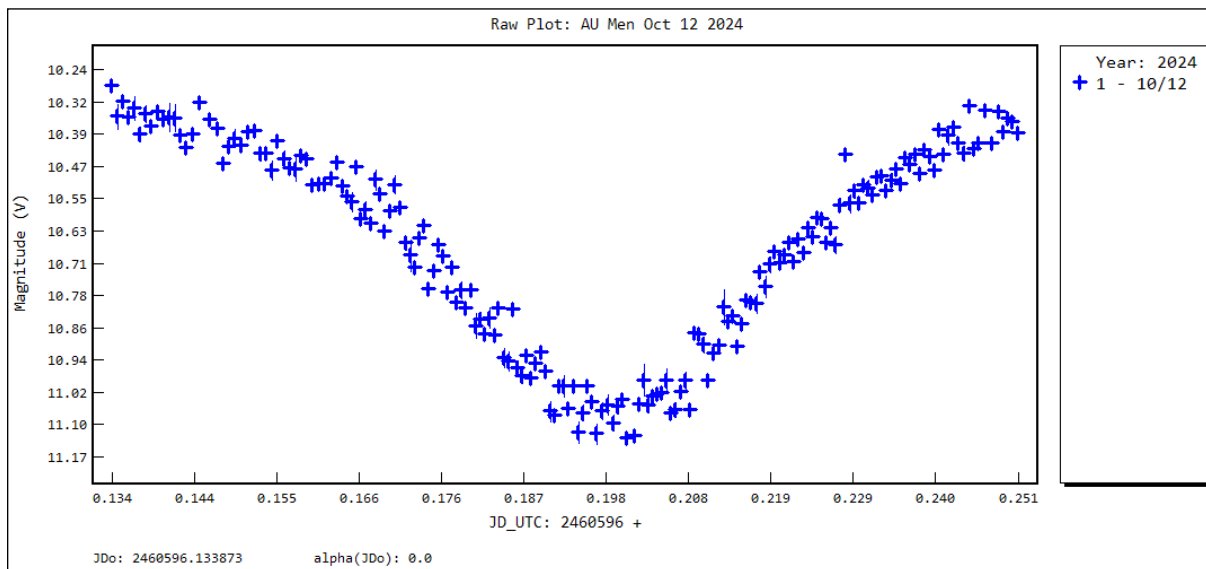


Figure 6 – *AU Men*

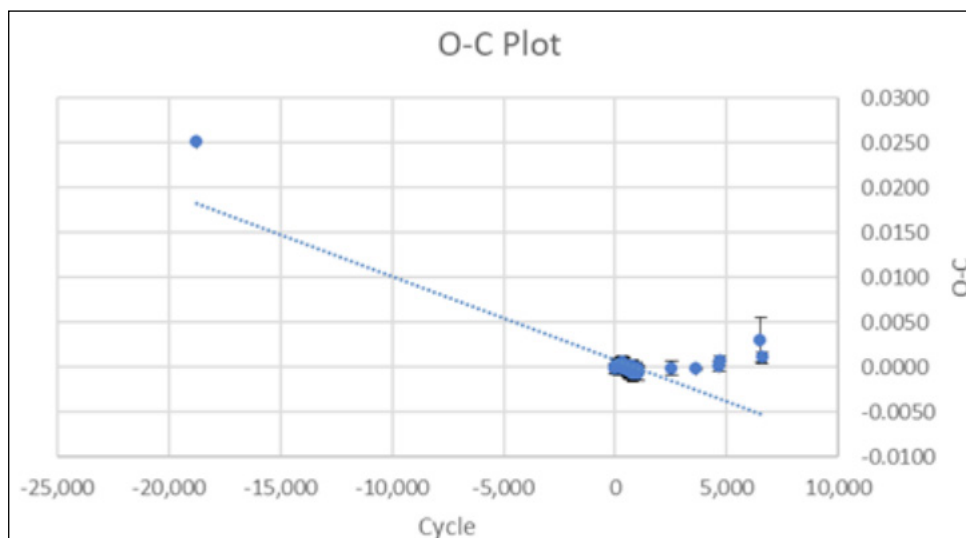


Figure 7 – *O-C Plot for AU Men*

Conclusions

For an instrument that costs less than A\$1,000, it is quite remarkable what the Seestar can achieve (and I would note there are other smarter telescopes out there which probably perform similarly). I believe the Seestar can be used for scientific observations provided that care is taken with the acquisition and interpretation of the results.

What is probably lacking at the moment is some standardized workflows that can be used by everyone to ensure that data is acquired and processed in a consistent manner. I'm aware that the AAVSO has established a working group to look at this issue, so I would hope that we may see the outcome from that in the not too distant future.

In the meantime I can thoroughly recommend the Seestar!

Two binary star conferences within a month — *Ed Budding*

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The first of these recent meetings on binary stars was held in Litomyšl Czechia during the period September 9-13, and was a successor to a similar meeting held ten years ago in the same setting to honour the well-known Czech astronomer Zdenek Kopal (1914-1993), who was born in Litomyšl. Entitled **Binary and Multiple Stars in the Era of Big Sky Surveys**, the conference focused on the latest advances brought about by the vast amounts of new data from modern sky surveys and satellite missions: <https://kopal2024.physics.muni.cz/>

The majority of stars are found with an orbital relationship to a stellar companion or companions, i.e. stars can be regarded, for the most part, as in binary or multiple systems. The subject is thus basic to stellar cosmogony. This alone underlines the meeting's relevance and rationale. But also, a stellar companion can significantly alter the evolution of a star and give rise to a range of unusual objects including type Ia supernovae, symbiotic stars, classical novae and compact systems.

As well, there is the well-known 'Russell paradigm'; i.e. that observational data on close binary stars enable us to measure their absolute dimensions, masses and luminosities, allowing crucial tests of models of stellar structure and evolution. Binaries also introduce subtle dynamical effects into their galactic environments, influencing the behaviour of associations and clusters.



Litomyšl Castle, dating from the 16th century and associated with the influential Wallenstein family, provided a picturesque and romantic setting for the Big Sky conference.

There is no doubt that this field has significantly benefitted from numerous sky surveys and satellite missions, even if those have been primarily focused on exoplanets or pulsating stars. The unprecedented precision and continuity of satellite photometry has revolutionized research on binary systems. Numerous minute effects have been noticed that should be taken into account in modelling. Satellite photometry has allowed new discoveries of long-period and multiple eclipse ('trinary') systems.

Binary star research now encompasses various different types of observational technique, including spectroscopy, astrometry, asteroseismology and multi-site, multi-wavelength photometry – from gamma-rays to radio, not forgetting the remarkable new subject of gravitational wave astronomy. In spite of amazing new advances, many questions about binary stars remain open. We still don't know the full story on formation processes, evolution through common-envelope stages, magnetic activity, or ultimate fate.

Such problems stimulate the ongoing sharing of ideas at conferences. Over 100 participants from a score of different countries exchanged thoughts during seven sessions taking place over five days at Lito-mysl. The attendance was boosted by the presence of remote-access participants online, including this author. While there are undoubted benefits to remote access – particularly in regard to the saving of time spent in travel and, of course, the costs of such travel and accommodation, the lack of closer social interaction is a distinct disadvantage. Going with that, there can be the strain on bodily condition imposed by differences in time zone. This becomes more acute for time differences of the order of twelve hours – as would apply to New Zealand and European locations. This circumstance impinged on alertness to exciting new ideas enough for the magic rather to wear off after the stroke of twelve. Hopefully, some flavour of the conference maybe gathered if I recall a few talks that caught my attention. Naturally, the limiting constraints of space and time will make this invidious task result in a rather arbitrary-seeming selection.

One of the consequences of the high quality data series on long time-baselines is the increasing weight that can be placed on pulsational effects in measured light levels. This, coupled with important advances in theoretical stellar modelling, has enhanced the role of asteroseismology as a key tool in probing the inner secrets of stars. The topic was well presented by Simon Murphy from USQ. Interesting scaling laws applying to the separation of pulsation modes ($\Delta\nu$) and the spread of frequency peaks in stellar seismograms ($\nu_{\max}$) will allow masses and radii to be estimated to within a few percent of their true values, i.e new techniques are standing alongside findings from the historic Russell method of parametrization that combines the results of radial velocity and light curve analysis. Asteroseismology can play a discriminatory role in interpreting the evolution history of observed binaries. Tidal effects in close binaries alter the details of the frequency spectrum. Observed frequencies are also modified by orbital motion. In short, the combination of pulsation frequency analysis with classical methods of binary star analysis extends and enhances the outcomes of both fields of study.

Regarding the evolution of binary stars, a lot of attention has been given in recent years to shoring up and confirming of the route from an initial 'zero age' situation with a detached pair of normal stars, to their believed descendants -- the cataclysmic binaries that contain compact objects, such as white dwarfs, neutron stars or black holes. Clearly a lot of angular momentum has to be lost in the transition, and this is associated with the 'common envelope' phase. The scenario involves the production of a planetary nebula that swells out, eventually to be ejected, leaving the pulled in pair as a 'PCEB' (post-common envelope binary). Reviewing this topic was David Jones of the NOT at La Palma. Spectral observations of PCEBs show peculiarities such as strong forbidden emission lines often with infrared excess. Dust obscuration events are also sometimes observed. Explanatory scenarios differ in details, but the general picture usually includes a hot central star surrounded by a gaseous, dusty disk, together with a near-normal companion star.

But how many 'companions' might a given star have? And what would these companions be like? This question was discussed in some detail on the third day of the meeting by Andrei Tokovinin of the Cerro Tololo Inter-American Observatory, who had assembled various statistical results from catalogued data on multiple stars, exploring such matters as mass, velocity, period and separation distributions within given hierarchical arrangements. High-order hierarchies show smaller velocity dispersion compared to low-order ones: their properties, perhaps expectedly, merging into those of 'moving groups' that contain more than just several stars. Indirect evidence on multiplicity is deduced from Gaia data on wide binaries, whose astrometric noise points to the presence of unresolved inner systems, thus suggesting future directions of research.

This author, though remote, was fortunate to have colleagues closer to the meeting's location, who could attend in person: one of these was Volkan Bakis of the Turkish National Observatory, who observed with the 1m telescope at Mt John (NZ) some years ago. Volkan presented a poster on behalf of our group, summarizing higher dispersion spectroscopy of two bright contact binaries epsilon CrA and S Ant. Although these two binaries are similar in a number of physical respects, their fate may turn out to be quite

different: S Ant possibly becoming a ‘semi-detached’ Algol system of the R CMa type, while epsilon CrA may well form a merger of its two components within a few tens of Myears.

The second meeting of this last September was a follow-up in the ‘Binaries South and North (BSN)’ programme, instigated by Atila Poro of the Astronomy Dept., Raderon Lab, Burnaby, Canada, (<https://bsnp.info/>); and chaired by Kai Li of Shandong University, China. This second international BSN meeting was held at the Weihai campus of Shandong University; during 28-29, September 2024. The meeting concentrated on observations and research in the field of eclipsing binary systems, following on from the BSN workshop that took place in Paris, last November. There were 80 registered participants; 28 of them taking part online. The 4 hour time difference was easier this time for any online participant from NZ, as, of course, was the choice of English as the conference language. But again, my recollections, influenced by alertness and overlap with experience, reflect personal factors in the selection of topics and presentations raised in what follows.



The lecture room at the University of Shandong used for the BSN2 meeting

While the field of close binary stars is recognized as popular and productive in data and studies, its unanswered questions and uncertainties provoke ongoing investigation. Points of interaction with other research subjects were mentioned already. At the same time, new technologies, such as the role of artificial intelligence and machine learning, introduce new avenues of approach. Another goal of the BSN project is to encourage the potential of amateur astronomers to assist professional research and respond to the challenges of citizen science.

The meeting was started, shortly after Saturday noon in Wellington, by Kai Li, who drew attention to the great rarity of observed stellar mergers in contact binaries, although awaited for many decades. A number of contact systems are known to have very low mass ratios, in fact, less than, or at least comparable to, the theoretical limit at which there is an instability and the two components should merge into one rapidly spinning star. More checks are called for with the identified very low mass ratio systems forming a clear target list. The new high-accuracy data, such as from the Gaia mission, should provide better defined parameters.

Short period and contact systems formed something of a theme in the first couple of sessions before the first lunch break. A diversion from this, however, was made by Kaloyan Penev of the University of Texas, who spoke (online) about tidal friction in close binaries. There has been no shortage of ideas about how tidal friction might work, but it is only since the recent explosion of high-quality data that empirical measurements of tidal dissipation have allowed critical tests of modelling. A more confident picture of frictional effects is emerging, at least for Sun-like stars.

Pulsating stars re-appeared in session 3, with an excursion from Lei Zang into the realm of compact supersoft X-ray sources; in particular, the system WX Cen. In the relevant scenario, mass is transferred from a donor star to a massive white dwarf primary via an accretion disk. Some 218 times of light minimum have been collected, using data from TESS and the AAVSO. From the trend in the corresponding O-C diagram, the period is seen to decrease, but this is opposite to what is expected with matter shed from a less-massive donor. This is plausibly explained in terms of angular momentum loss (AML) via a magnetized wind from the secondary or the accretion disk. As a consequence, the evolution of WX Cen is controlled by the magnetized wind with a continuous radiation of supersoft X-rays in the process.

Even further into the field of high-energy astrophysics was Rosa Poggiani's (University of Pisa) account of gravitational wave (GW) astronomy, initiated just 9 years ago with the observation of GW 150914, detected by the LIGO facility (USA). This transient event was caused by the merger of two massive black holes in a distant galaxy. This has a clear relevance to binary system evolution, but the implications of GWs reach much further than that, for example, in testing general relativity theory in extreme conditions, or in determining the behaviour of the early Universe. LIGO sources at cosmic distances allow the rate of universal expansion to be measured, thus putting constraints on dark matter and dark energy. But GW astronomy is not an isolated discipline. Combining its evidence with that of more conventional observations gives rise to 'multi-messenger' astronomy, that allows general astrophysics to be placed on a more comprehensive basis.

Session 5, on the morning of the 29th, took the form of a 3-hour general review of eclipsing and pulsating variables conducted by Filiz Kahraman of COMU, Canakkale, Turkiye. This would have been, no doubt, valuable to younger or non-specialist participants. It preceded a return to short-period and contact binaries in Session 6.

Further discussion of short period and contact binaries appeared in the remote access presentations of Session 7, which also included a 'ProAm'-oriented paper from Filip Walter of the Czech Astronomical Society. This latter organization supports the Exoplanet Transit Database (ETD) that serves the international community of amateur and professional astronomers. The plan for future development of the ETD is to integrate it into the wider purpose 'VarAstro' -- an open network for variable star observation and research.

The final Session 8 was set aside for short presentations on several posters, in which contact and short period systems were again much in evidence. A more general contribution came from Sabrina Baudart of the SAF (France), who, in recalling the oddities of individual binaries, derived insights into the diverse nature of stars. The presentation shed light on the complexities of eclipsing binaries, whose study can lead to the worthy rewards of a deeper understanding of nature.

Linear light elements for targets in the Southern Eclipsing Binaries project – *Mark Blackford*

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The VSS Southern Eclipsing Binaries Project (SEBP) has been operating for over a decade with ~1400 times of minimum recorded from over 200 individual targets. For many of those targets, observers had difficulty initially recording light curves of eclipses. This was because the period and/or epoch (together known as the light elements) used to predict when eclipses should occur were woefully out of date or just plain wrong. This is a common problem with southern eclipsing binaries because, compared with northern targets, they have not been observed very frequently. Poor light elements often lead to predictions being wrong by many hours, leading to wasted nights recording the wrong parts of light curves.

With enough observations, Observed minus Calculated (O-C) diagrams can be plotted to show long-term trends in eclipse timing variations caused by such things as a third star in the system, mass transfer from one star to the other (or out of the system altogether), apsidal motion of an elliptical orbit, etc.

Many SEBP targets have not yet had enough times of minimum measurements to construct detailed O-C diagrams. These targets need many more observations over coming years.

For quite a few SEBP targets, however, their O-C diagrams do show a variety interesting trends. These range, for example, from simple linear plots (for targets with a stable orbital period) to parabolic curves (increasing or decreasing period), sinusoidal curves (due to a third star in the system) and double sinusoidal curves (caused by apsidal motion of elliptical orbits). See Figure 1 for examples.

I have compiled an Excel spreadsheet listing new linear light elements for the SEBP targets based on these O-C diagram (Table 1). For those targets exhibiting linear O-C diagrams the new light elements should provide accurate eclipse predictions for many years into the future. However, more times of minimum, perhaps every year or two, will allow further refinement of the period, and possibly reveal long term deviations from linear trends.

For targets with more complex O-C diagrams, the new light elements are NOT intended to represent their long-term behaviour. However, eclipse predictions over the next 3 to 5 years should be reasonably accurate. These targets should be observed at least once or twice per year so a better understanding of these systems can be gained from more detailed O-C diagrams.

Eventually, observed minima times may deviate significantly from predicted times so revised light elements will be required. I plan to produce a revised list every few years.

Also available is a text file suitable for use as a custom catalogue file for David Motl's free Ephemerides software (<http://motl.cz/dmotl/predpovedi/>). Ephemerides produces a list of eclipses visible from a user defined location and date. The text file and Excel spreadsheet will be available on the VSS website or directly from me.

Through our measurements of eclipse times the SEBP has already made significant contributions to our knowledge of eclipsing binaries south of the celestial equator. However, there is much more to learn, so the project will continue for many years to come. Contact me if you are interested in participating.

Table 1. First 12 entries in the revised light elements list.

Star	Period (d)	Epoch (HJD)	Period Error	Epoch Error	O-C Diagram Notes	Frequency	Last Observed
Ant S	0.64834789	2458518.7094	0.00000030	0.0003	linear?	yearly	8/03/2022
Aps DW	2.31294378	2439209.5019	0.00000010	0.0008	linear?	yearly	9/05/2022
Aps II	0.84222913	2451931.4116	0.00001696	0.1499	eccentric + apsidal motion?	2 per year	23/06/2021
Aps MR	0.52786416	2457159.0100	0.00000014	0.0005	linear?	yearly	26/07/2023
Aps NT	0.29476152	2457208.1356	0.00000005	0.0004	downward parabola?	yearly	23/05/2024
Aps NX	0.40924047	2453879.6580	0.00000007	0.0008	linear?	yearly	27/07/2021
Aps TV	0.64749378	2451903.9390	0.00000039	0.0028	linear?	yearly	30/07/2016
Aps V0354	0.58715812	2453646.5492	0.00000033	0.0028	unclear	yearly	24/05/2022
Aps YY	0.85555501	2453084.4611	0.00000016	0.0011	linear?	yearly	27/05/2024
Aqr AO	0.48933957	2459062.2171	0.00000012	0.0003	downward parabola?	yearly	13/09/2021
Aqr DX	0.94501073	2451808.0000	0.00000003	0.0002	linear?	yearly	13/09/2021
Aqr EE	0.50899620	2452500.0557	0.00000005	0.0006	linear?	yearly	13/09/2021

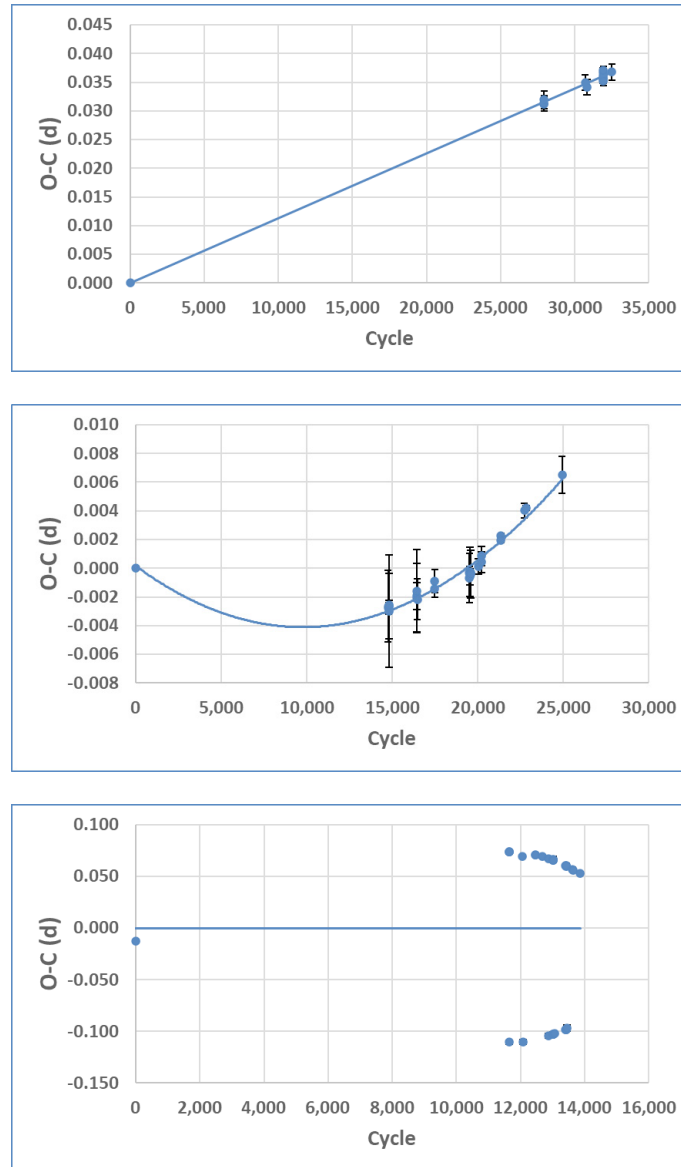


Figure 1. Example O-C diagrams showing different trends. V0535 Ara: linear indicating constant period (top), RW Dor: upward parabola indicating increasing period (centre), GG Lup: double sinusoid indicating apsidal motion of elliptical orbit (bottom).

Publication watch

David Moriarty and **Phil Evans** had a paper published on the arXiv in September.

Liakos, Alexios, Moriarty, David J. W., Erdem, Ahmet, West, Julian F., Evans, Phil. *Modelling of eclipsing binary systems with pulsating components and tertiary companions: BF Vel and RR Lep.* arXiv:2409.04359.

Abstract

This paper presents a comprehensive analysis of RR Lep and BF Vel, two short-period semi-detached oscillating Algols (oEA stars), which are shown to be triple systems. Spectral types of their primaries were determined and radial velocities calculated from spectra observed with the Australian National University's 2.3 m telescope and Wide Field Spectrograph. Spectra of the Na I D doublet confirmed the presence of tertiary components which were apparent in the broadening function analyses and, with H α spectra during primary eclipses, indicated chromospheric activity in their secondaries. Ground-based telescopes were used for observations in several pass bands for photometric analyses. These data were complemented by data from the TESS mission to enable the modelling of the light curves, followed by a detailed analysis of pulsations. Eclipse-timing variation (ETV) analyses of both systems were used to determine the most likely mechanisms modulating the orbital period. We found mass values $M_1 = 2.9 M_\odot$ and $M_2 = 0.75 M_\odot$ for the components of RR Lep, and $M_1 = 1.93 M_\odot$ and $M_2 = 0.97 M_\odot$ for those of BF Vel. By integrating information from photometry, spectroscopy and ETV analysis, we found that tertiary components revolve around both systems. The primary star of RR Lep pulsates in 36 frequencies, of which five were identified as independent modes, with the dominant one being 32.28 d^{-1} . The pulsating component of BF Vel oscillates in 37 frequencies, with the frequency 46.73 d^{-1} revealed as the only independent mode. For both systems, many frequencies were found to be related to the orbital frequency. Their physical properties were compared with other oEA stars in Mass-Radius and H-R diagrams, and the pulsational properties of their delta Sct components were compared with currently known systems of this type within the orbital-pulsation period and logg-pulsation period diagrams.

A number of VSS members including **Mark Blackford, Tom Love, Ed Budding and Timk Banks** had a paper published on the arXiv in September

Bakis, Volkan ; Budding, Edwin ; Erdem, Ahmet ; Love, Tom ; Blackford, Mark G. ; Zihao, Wu ; Tang, Adam ; Rhodes, Michael D. ; Banks, Timothy S. *Comparative study of the W UMa type binaries S Ant and Epsilon CrA.* arXiv.2409.17303

Abstract

Contact binaries challenge contemporary stellar astrophysics with respect to their incidence, structure and evolution. We explore these issues through a detailed study of two bright examples: S Ant and Eps CrA, that permit high-resolution spectroscopy at a relatively good S/N ratio. The availability of high-quality photometry, including data from the TESS satellite as well as Gaia parallaxes, allows us to apply the Russell paradigm to produce reliable up-to-date information on the physical properties of these binaries. As a result, models of their interactive evolution, such as the thermal relaxation oscillator scenario, can be examined. Mass transfer between the components is clearly evidenced, but the variability of the O'Connell effect over relatively short time scales points to irregularities in the mass transfer or accretion processes. Our findings indicate that S Ant may evolve into an R CMa type Algol, while the low mass ratio of Eps CrA suggests a likely merger of its components in the not-too-distant future.

Publication: eprint arXiv:2409.17303

DOI: 10.48550/arXiv.2409.17303

Accepted for publication in PASA. 28 pages, 13 figures, 16 tables

Phil Evans had one exoplanet arXiv article updated to a journal article in MNRAS.

Bryant, Edward M, et al. *TOI-2379 b and TOI-2384 b: two super-Jupiter mass planets transiting low-mass host stars.* 2024MNRAS.533.3893B

About

Variable Stars South is an international association of astronomers, mainly amateur, interested in re-searching the rich and under-explored myriad of southern variable stars.

Renamed from the Variable Star Section of the Royal Astronomical Society of New Zealand, it was founded in 1927 by the late Dr Frank Bateson, OBE, and became the recognised centre for Southern Hemisphere variable star research.

VSS covers many areas and techniques of variable star research, organised into projects such as Beginners' Visual Observations and Dual-Maxima Miras. The goal of each project is to obtain scientifically useful data and results. These may be published in recognised journals, or supplied to international specialist data collection organisations.

VSS is entirely an internet based organisation, working through our website <http://www.VariableStars-South.org> and its e-group <http://groups.google.com/group/vss-members>. It also encourages members to work in with major international organisations such as the British Astronomical Association, the Center for Backyard Astrophysics and the American Association for Variable Star Observers.

To find out more, please visit our website, where, incidentally, you will find PDF copies of all our newsletters. Our website has a great deal of information for VSS members, and for anyone interested in southern hemisphere variable star research. All VSS project information and data is kept here too.

Who's who

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Visit our website to see a list of our area advisers, and to find out about our projects and how to contact their leaders

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These are welcomed and should be sent to the Editor (phil@astrofizz.com). I'd prefer Microsoft Word (or compatible) files with graphics sent separately. Don't use elaborate formatting or fancy fonts and please do not send your contribution as a fully formatted PDF file.

Publication dates are January, April, July and October, nominally on the twentieth day of these months and the copy deadline is the thirteenth of the month though earlier would always be appreciated.

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