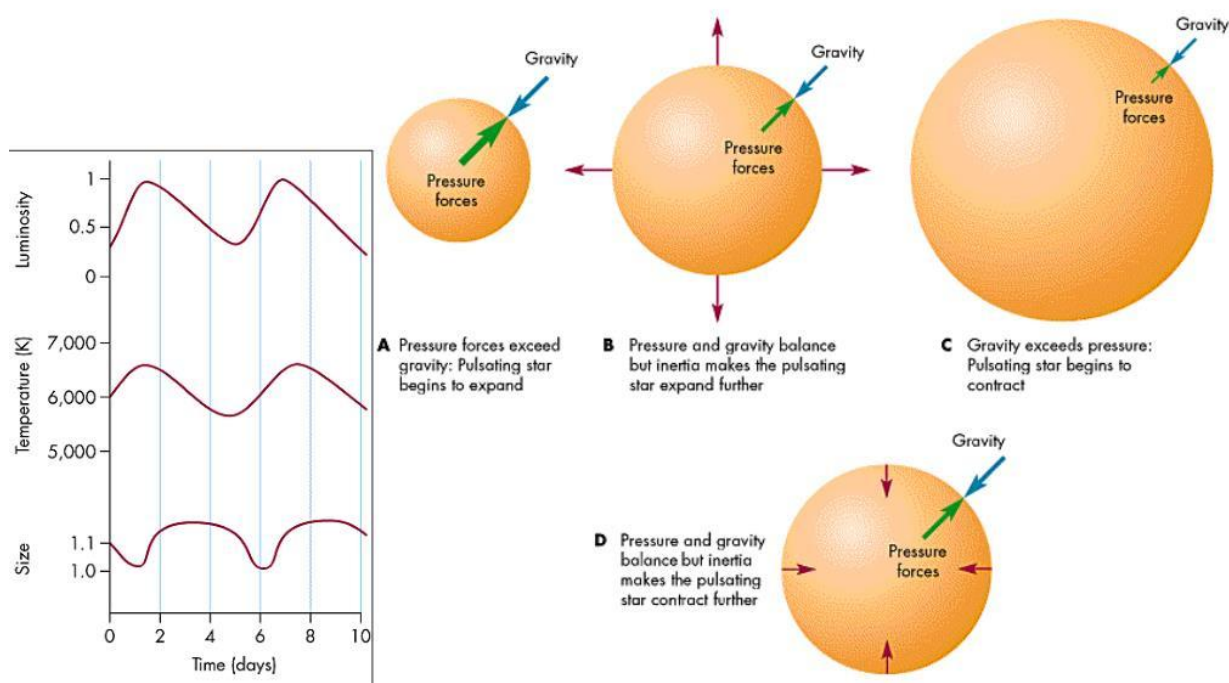


Cepheid Variable Stars



Cepheid pulsations are caused by an imbalance of internal pressure and gravity. See the article by Ed Budding on page 7 of this issue for more details. (Diagram sourced from [Link](#)).

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From the Director – *Mark Blackford*

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Welcome to our first edition of the Newsletter for 2026. In this issue Simon Sikora discusses his experience in preparing for and presenting a talk on his exoplanet project, conducted under the mentorship of Tim Banks. Next, Ed Budding presents the first instalment of a short review on Cepheid variables, stimulated by some work of Stan Walker and Harry Williams a few years ago. Finally, Roy Axelsen and I report our work on refining the orbital period of an eclipsing binary in Pavo.



As always, we encourage contributions to the Newsletter from VSS members and other interested people. Please contact me or the Editor Ed Budding.

Congratulations to Rod Stubbings on reaching an impressive milestone late last year having logged his 450,000th visual variable star observation. May there be many more years of fruitful observing to come.

As mentioned in this column in the last Newsletter, the Tamworth Regional Astronomical Club (TRAC) will be hosting NACAA XXXII in Tamworth, NSW over the weekend of the 3rd - 5th April 2026 (<https://nacaa.org.au/2026>). The conference venue is Wests' Diggers Club. I and several other VSS members have registered, and I encourage others to consider doing the same. It would be great to catch up in person again.

For those who can't make it to Tamworth another opportunity to mingle with like-minded people will take place a few weeks later across the ditch. The 2026 RASNZ conference will be hosted by the Omaka Observatory Trust from 15th – 17th May (<https://www.rasnzconference.org.nz/>) at the Scenic Hotel Marlborough, Blenheim NZ.

There has not been a great deal of activity at Congarinni Observatory over the Christmas/New Year period. Yet again the weather was mostly to blame, with very few opportunities to record the hours long time series images need to measure times of minimum of eclipsing binaries. I've started rebuilding my 15-year-old 10" Dobsonian with the aim of taking advantage of partly cloudy nights to observe deep sky objects and give visual variable star observing a try.

Wishing you all clear skies and good health,

Mark Blackford

Speaking and presenting about exoplanets

Simon Sikora, University of Illinois in Urbana-Champaign (UIUC)

Abstract

Presenting methodology and results is regarded as an important part of the scientific method. This article outlines the author's experience in preparing and delivering a presentation. On that basis, it can be helpful for other students lining up for their first public engagement.

Introduction

In January 2024, I detailed some of my work about exoplanet XO-1b in VSS Newsletter 2024-1. This project, conducted with the mentorship of Dr Tim Banks, leveraged a wealth of observations — including vital amateur astronomer contributions from the NASA Exoplanet Archives (NEA). This past June, I was privileged to present my findings to the Exoplanet Watch community, diving deep into the technical process.

Exoplanet Watch is a NASA-funded citizen science project that engages the general public, from students to amateur astronomers, in the real-world study of exoplanets (planets orbiting stars outside our solar system). The primary goal of the project is to refine the transit timing of known exoplanets, which is crucial for maximizing the efficiency of observations by large professional telescopes like the Hubble and James Webb Space Telescopes (JWST).

Dr. Rob Zellem (leader of the Exoplanet Watch project) invited me to present my results to the Exoplanet Watch community in a live, online presentation. I was excited to share my research experience, which all started because I wanted to understand how scientific discovery is truly made. However, I was also a little nervous as I'd never presented scientific results live before! But presenting methodology and results is an important part of the scientific method. This current note outlines my experience preparing and delivering the presentation. I hope it will be helpful for other astronomy students lining up for their first presentation to the public.

I was lucky that my audience was already aware of what exoplanets are, and were instead interested in how I prepared and reduced my data. This is an important initial step in preparing for a presentation: making sure you know who your audience is (in general terms) and what it is they want to learn from your presentation. My audience was going to be primarily interested in how I did the analysis, and not so much the results. They already understood the importance of the transit timings.

Everyone loves a good story! So I tried to make my presentation one, starting with why we wanted to make our analysis in the first place, then working through the reduction steps to the final key points.

The Quest for XO-1b's Transit Timing

When I began preparing for the presentation, I remembered why I first contacted Harper College inquiring about research project positions, because I wanted to learn about how scientific discoveries were made. My presentation kicked off with the back-story: I explained how Frank Sienkewicz, from the Harvard-Smithsonian Center for Astrophysics (CfA), first provided us with key data on XO-1b. Frank's interest in planet Transit Timing Variations (TTVs) sparked our initial deep dive into exoplanet knowledge. To pursue this TTV investigation, we compiled an observational set of 41 transits from three diverse sources:

1. Harvard and Smithsonian's CfA Robotic Telescope,
2. The NASA Exoplanet Watch Archives (NEA), and
3. The TESS Space Telescope

Analyzing Data: A Multi-tool Approach

For the CCD images, sourced from the Harvard Robotic Telescope and the NEA folders, we utilized EXOTIC, the powerful Python data reduction tool, developed by and for the ExoWatch community. EXOTIC takes images, as collected by the telescope, and processes them to the final light curves. The TESS data, however, was in the form of pre-processed data points, requiring a different analytical approach. For this, we employed R and Python, versatile programming languages well-suited for statistical analysis and modeling. We were able to use EXOTIC inside Python by calling it as a library, and we developed our own R code for additional modelling, in the form of publication-ready graphs.

The Technical Dive: From Pixels to Parameters

To walk the audience through the EXOTIC workflow, I broke down the initial steps. My first technical slide centered on ‘Plate Solving’, which is essential for determining the Right Ascension (RA) and Declination (Dec) of the host star — required input for EXOTIC. After successfully plate solving to pinpoint the host star within an image field, I would create a finding chart to identify suitable comparison stars for photometry.

The most challenging technical aspect of the project, and, indeed, the whole presentation, involved the modeling phase. I had to harness EXOTIC for working with folders of CCD images (the type of data sets from the CfA Robotic Telescope and NEA), that were available online. We used a Markov Chain Monte Carlo (MCMC) approach with the Mandel & Agol equations to fit the TESS transit data (for details see my earlier VSS note). While powerful, the hardest part was troubleshooting why the resulting transit parameters were initially outputting a planetary radius significantly larger than the adopted-as-realistic value. This complex technical challenge underscored the rigours of authentic scientific research.

I hoped my overview would offer a helpful glimpse of the technical rigour and analytical tools involved in this exciting field of research. Indeed, I had many questions from the audience around the methodology, and there was interest in taking my learnings and applying them to their own transit analyses.

What did I learn from the Experience?

The first thing I learned was that careful preparation is key to a successful presentation. Revision is really important, and I tried to build a clean, clear story. I used Google Slides so that I could easily share things with Drs. Banks and Zellem for comments. Google Slides is an online tool. Slide material can be accessed and edited by multiple people around the same time. It makes collaboration much easier.

In preparing the slides I considered the following:

1. **Accessibility:** I learnt to replace technical jargon and advanced terminology (like ‘Monte Carlo Markov Chain’ or ‘plate solving’) with clear, everyday language or relatable analogies. The goal was to maximize comprehension without sacrificing accuracy. It was a good exercise for me, as to make things clear, I had to make sure that I really understood the topic myself, and not just using jargon as a crutch.
2. **Engagement:** I had to think how to craft a compelling narrative around the research, starting with an engaging ‘hook’; (like ‘How I got involved’) and focusing on the motive and impact of discovery, rather than just a dry list of methods and results.
3. **Simplicity:** I needed to master the skill of designing clear, uncluttered visuals. This means using diagrams and simplified charts instead of overwhelming text, ensuring slides like the step-by-step EXOTIC guide are visually intuitive. It was easy to get “lost amongst the trees” and make slides too complex, as I was trying to fit a lot of information in. Then I realised that instead of one complex slide, I could do 2 or 3 more easy-to-read ones, or trim a slide down to its essence.

Slides are there to support a presentation-- not everything needs to be included. The audience is there to listen to you, not read your slides! It was a challenge to cut to the key points and trim out the extras, but that was essential to both the story and the audience comprehension. A good piece of advice I was given was to think about, say, three key things you want the audience to remember, and not to try to cram more in. If the audience wants more details, question time is a great place to engage — if the questioner is really interested in learning more!

Practice, practice, and practice again! I made detailed notes of the points I wanted to talk about in the presentation, and, basically, wrote a script. I made notes, in particular for slides in which I had to explain complicated concepts like MCMC, I would practice explaining those slides out loud and while speaking, I would find myself pausing, reordering, and rephrasing sentences until I could make my explanation concisely. I practiced giving the presentation, while stepping through the slides. This helped me not only time the presentation but also make things smooth (for instance, I revised the order of some slides and added or removed material). I did a dry run with Dr. Banks to get his feedback. Having flashcards also made it easy to recover when something unexpected happened in the presentation, such as someone in the audience asking a question during the talk, or a problem such as jumping a few slides too many when trying to step just one. It allowed me to pick things up again and keep my place.

Knowing how long I had to present, and being sure I could keep to that time was important. No one wants you to over-run. It's also important to budget enough time to answer questions from the audience once the main presentation is over.

Anticipating questions is also key. My first step, before even working on the presentation, was spending time re-familiarizing myself with the research and asking Dr. Banks to clarify questions. I had to think about what the audience might ask. I prepared some hidden slides in an appendix, just in case someone asked about something that needed more detail. It also made me think about my main slides, again not to clutter them with secondary details unimportant to the main story. These might instead trigger distracting questions without leading to a better understanding.

Concluding Thoughts

On top of the benefits outlined above, I found that the overall experience gave me confidence about public speaking. I gained experience in modulating tone and pace to hold an audience's attention and effectively manage nerves while speaking about challenging scientific work. After introducing myself with confidence, knowing that I could fall back on my flashcards, I walked through the slides just like when practicing and the timing and pace flowed naturally. It was good to feel validated: that the work I had done was of good quality and interesting to others working in the field of exoplanets. I was thrilled that they appreciated the amount of work and practice that had gone into the preparation, while receiving very pleasant feedback from the audience.

As mentioned above, communication is an important component of science. It is part of how it advances. So while presenting is scary, it is a skill that I think all should learn and practice. I hope that this write-up will help anyone preparing for their first presentation and smooth their way. Above all, it was actually a fun thing to do. By carefully preparing and practising, I felt much more calm and relaxed in the actual delivery. So, if you're asked to speak on your research, please don't hesitate to give it a go! It was an honour to be asked to present to NASA's Exowatch Group, and I am glad that I took up the opportunity.

The Light Curves of Cepheid type Variables: I

Ed Budding VSS, RASNZ

Abstract

The light curves of classical Cepheids are reviewed as an introduction to their analysis using the 'Baade-Wesselink' technique.

Background

This article has emerged from a return to some observations of Cepheid variables by Harry Williams and Stan Walker, gathered in Auckland during the second half of the last century (Walker and Budding, 2023). These were first reported during 2001, in the *communiques* of a photometric group acting within the RASNZ.

Around three quarters of all registered variable stars are those having some inherent physical variation in luminosity, as distinct from an effect of geometry such as with eclipsing binaries. They are often referred to as pulsating, sometimes vibrating, stars: words suggesting the physical cause of the variation. Although all stars would vary over a sufficiently long timescale, an appreciable variation of light accessible to human inspection implies a very short period compared with general astronomical time frames.

There are physical variables whose light pattern repeats in measurably the same form for many cycles, with a periodicity of comparable constancy to that of eclipsing binary stars. Others show varying degrees of chaotic behaviour. In such 'irregular' cases, the light level wanders up and down without pattern or predictability. Many others show quasi-periodic variations of a 'semiregular' nature. Examples of different light curves of a range of galactic Cepheids are shown in Fig 1.

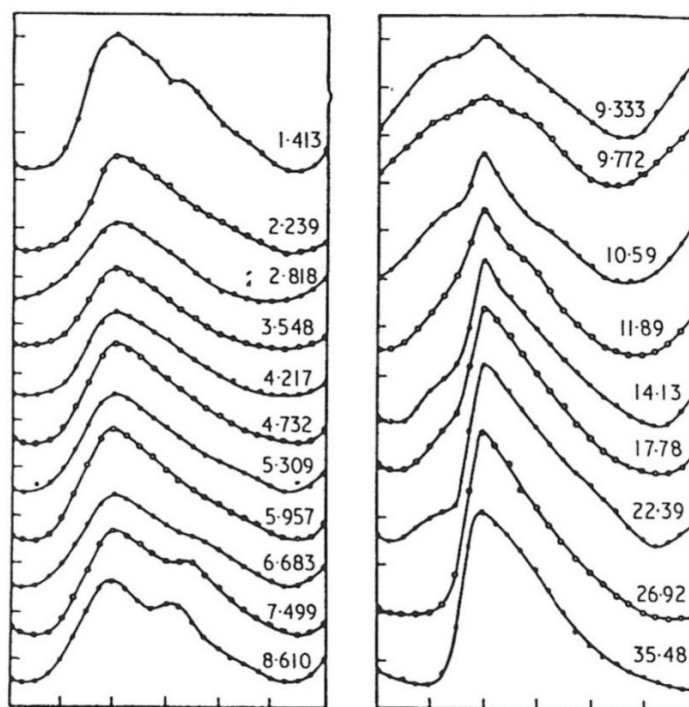


Figure 1: Light curves of a range of galactic Cepheids with indicated periods, presented by J. P. Cox (1974).

Spectroscopy shows that the variations in apparent magnitude are linked with changes of radius. By studying the Doppler shifts of absorption lines in the regular Cepheid type variables (prototype δ Cephei), it was found that these stars oscillate inward and outward in the same period as the brightness cycle, the star being faintest not far from, but a little before, the time when it is smallest.

The rise to maximum brightness takes place over a relatively short phase range, and by the time the star reaches maximum extension it is already well past its optically brightest point, which, by convention, occurs at phase zero. The expansion speed is often greatest near this maximum brightness, the radial velocity (RV) curve thus tending to mirror the shape of the brightness curve.

From such evidence the key role of the temperature cycle could be assessed as something separate from the changes in size. A given percentage variation of surface temperature can be seen to have a more important overall effect than the same relative variation of radius, since the net luminosity is proportional to T^4 , compared with the R^2 dependence on radius. The separation in phase of the radial and temperature cycles refutes the simple idea that maximum temperature should occur with maximum compression, i.e. minimum radius, though accounting in detail for the exact value of the 'phase lag' (surface heating behind compression) has been a challenge to theory.

Separation of the radial and thermal variations, thereby acquiring a more incisive view of underlying physical processes, is central to the so-called Baade-Wesselink (B-W) method. In practice, the procedure is not too clear cut, and a number of different versions of it have been pursued. The essence of the B-W methodology, however, builds in integration of the RV curve and combining that with temperatures determined from photometry involving at least a pair of standard filters. By comparing the result with the observed luminosities, unknown parameters of interest in the linking equations, e.g. the stellar size and distance, can be evaluated. The procedure for doing this, as followed in the results shown in Fig 2, will be outlined in subsequent sections. Before that, a few of the main points about physical variables are noted.

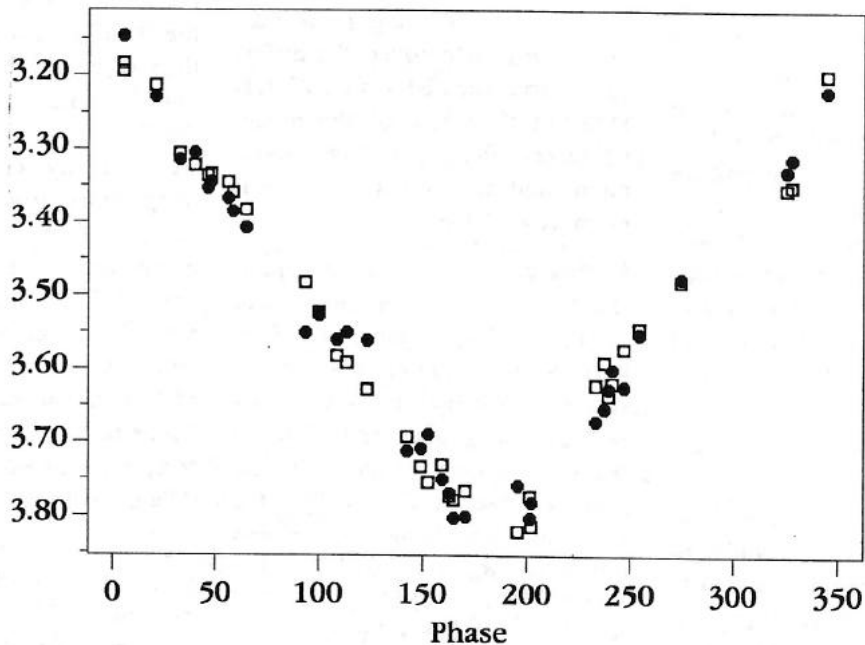


Figure 2: Observed (Williams & Walker, 2001) light curve of β Dor (open squares) and B-W model (filled circles)

Basic features of pulsating stars.

Apart from B-W analysis, which uses simultaneous, or near-simultaneous, spectroscopy, the photometric periodicity itself is a key item in the study of pulsating variables. Collected observational data are searched for frequency structure, which can be compared with an extensive range of theoretical models.

A fairly basic example of the significance of period determination, discovered over a century ago by Henrietta Leavitt, is the period--luminosity (P - L) relation for the normal or 'classical' Cepheids. These supergiant stars have highly repetitive light curves characterized by periods in the range ~ 1 -70 days. The P - L law simply states that Cepheids with longer periods have a greater mean luminosity. In fact, for a classical Cepheid of period P_d days the mean absolute magnitude M_V approximately satisfies a formula such as:

$$M_V = -2.81 \log P_d - 1.43 \quad (1)$$

Different values of the constants in this equation are found from different sources and data sets. In particular, there are two major groupings relating to the P - L law (Fig 3). Apart from the majority of classical Cepheids, a sizable proportion ($\sim 25\%$) follows a different period—luminosity relation. These stars, called after their prototype W Virginis, are associated with the older population of stars in the Galaxy.

Apart from these major groupings, there are sub-groupings; for example, the BL Her subgroup of W Vir-like stars that have periods generally less than 10 d and a somewhat different P - L correlation. General samples of Cepheids show a sizable scatter about the main P - L trends. There has been a large amount of study of this topic, since various possible causes can be thought of, but particular attention has been given to the range of colours of stars susceptible to pulsation, the role of interstellar reddening, and differences in composition and age of representative examples.

It is inferred that longer period pulsators, of given type, are generally of greater mean radius. This takes into account the role of declining mean surface temperature variation across the range of increasing observed periods. This is not difficult to square with the theoretical result that the period should be generally of the order of the inverse of the square root of the mean density of the star, i.e. P varies like $(\rho_\odot / \rho_\star)^{-1/2}$.

This could be expected on basic physical arguments about the vibrations of compressed bodies, but the constant of proportionality varies in dependence on structure and composition. It is then deduced that while slow variables are bigger objects, the mean radius increasing by an order of magnitude over the period range, they contain a total amount of material not greatly more than fast pulsators, i.e. the mass only just doubles over the same range. Hence, slow pulsators must be much more diffuse in structure. The shape of light curve types also varies with period, as can be seen in Fig 1, the pulses with increasing period becoming relatively steeper, at least for classical Cepheids. Some light curves show a prominent bump on their declining phases,

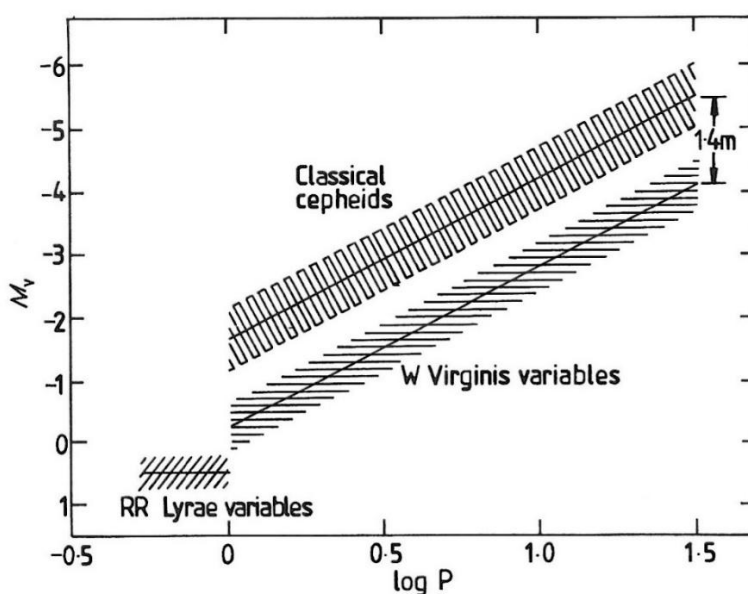


Figure 3: The period--luminosity law for 'classical' Cepheids, and the rarer W Virginis type stars.

There are also Cepheid type pulsators with much more sinusoidally shaped, often lower amplitude, light curves, the so-called 's-Cepheids', generally found at shorter periods, i.e. less than around 7 d. A well-known example is the bright northern star Polaris. It is thought that at least some Cepheids do not have their main vibration within the entire body of the star uniformly, i.e. in the fundamental mode, but in an 'overtone' that has a node or nodes in the stellar interior. For a given size of star, overtone pulsations are of shorter period, so light curve bumps may indicate the presence of higher modes and short period Cepheids may include overtone pulsators among them. There are theoretical arguments allowing the oscillation mode to switch during the course of the star's evolution, and the bump on certain light curves may even become the brightest point (e.g. S Mus).

Stellar pulsation and the colour-magnitude diagram.

Pulsation is strongly related to the position that the star occupies on a colour--magnitude (H-R) diagram (Fig 4). There is a certain relatively narrow but linearly extended region of this plane, which intersects the Main Sequence almost normally in the range of spectral types around A2--A8, known as the instability strip. Many of the more well-known types of pulsating variable are located in, or close by, this strip. These stars are not unstable in the full sense -- they remain intact, though vibrating; 'overstable' is the term that has been used for their condition.

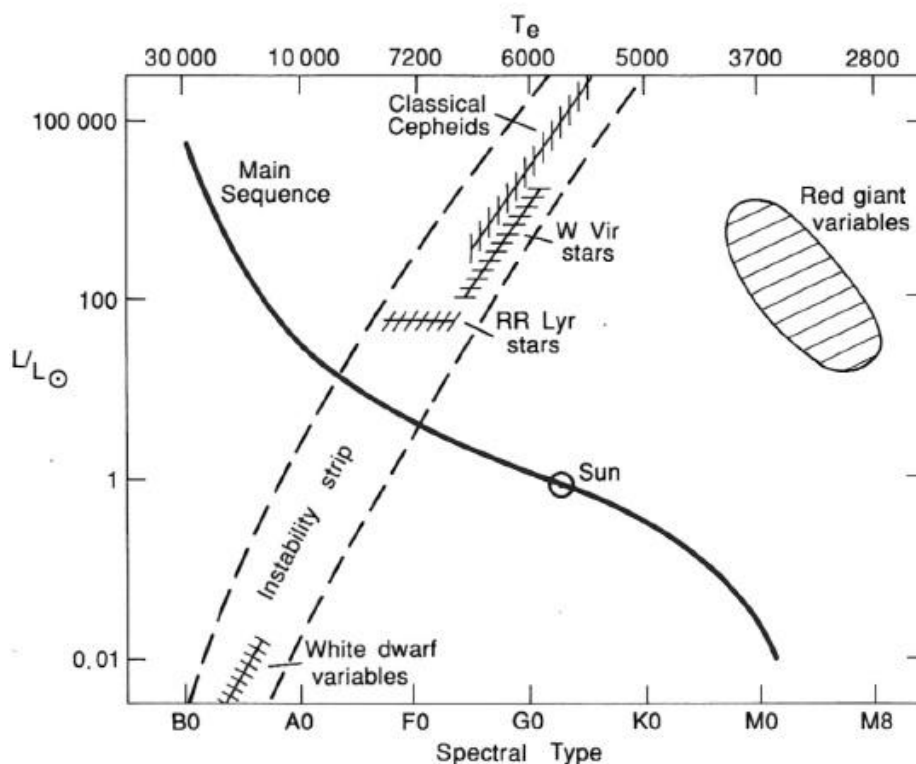


Figure 4: Locations of various kinds of star, particularly variables, in the Hertzsprung Russell diagram.

The existence of the instability strip is interpreted in terms of the relative locations of ionization spheres of the principal constituents of stellar matter, i.e. hydrogen and helium. For parallel strips to the left of the instability strip the ions recombine nearer to the surface; for parallel strips to the right they recombine at a mean location deeper into the star. A temporary slight increase from within of the outward flux of photons, entailing a corresponding ionization increase, would cause expansion of the layer, followed by cooling, recombination and subsequent sinking back to the starting situation; all of which has a characteristic timescale that depends on the location in the H--R diagram. At some particular location, a resonance will occur between the ionization-recombination cycle timescale for such a layer, if disturbed, and a compression wave travel time. The specific locations of particular recombination fronts, relative to the distribution of mean internal conditions, are thus of importance to the mechanism driving oscillations -- the 'kappa--mechanism'.

Of course, all stars can, and probably do, oscillate over a wide range of different frequencies, and in non-radial as well as purely radial modes. Of such more general oscillations, those characterized by rapid longitudinal variations of pressure are the 'p-modes'. Another group is associated with the action of gravity in restoring density differences over spheres concentric with the star --- the g-modes'. In the majority of cases, such oscillations tend to be damped out by non-conservative actions. Under certain circumstances, however, they are reinforced, when a suitable kappa mechanism is present. For this to happen some 'negative dissipation' (Eddington's term) has to operate. This has been associated with appropriately phased withdrawals from the reservoir of ionization energy, particularly that of doubly ionized helium in the case of classical radial pulsators. This occurs when the star is in the right evolutionary stage and the layer of encroaching recombination is in the right position within the stellar envelope.

Resonance between this component of the total heat flow and the elastic response of the star then amplifies the vibration. Kappa is the symbol conventionally used for the radiative absorption coefficient. Its usage in the 'kappa mechanism' points to the role of ion-electron recombination in driving the pulsations.

A key task, in dealing with pulsating stars, is decomposing the observed variability patterns in terms of component oscillations of ascribed mode and frequency, and relating the results to stellar models of given net mass, composition and evolution, confirming or otherwise, their calculated structures. A number of different approaches to this subject have been reviewed in other sources, and this topic will not be pursued further in this present discussion.

Orbital Period Refinement of EA-type Eclipsing Binary ASASSN-V J184530.00-593235.0

*Mark Blackford, Congarinni Observatory
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Abstract

Observations, including times of minimum, of a recently reported EA type eclipsing binary are reviewed.

Introduction

The serendipitous ‘discovery’ of an eclipsing binary in the field of BF Pavonis was reported in an article in the July 2020 edition of this Newsletter (Blackford, 2020). It turned out not to be a new discovery, having been identified as a variable by the All-Sky Automated Survey for Supernovae (ASASSN) Sky Patrol with the identifier ASASSN-V J184530.00-593235.0. The Survey tentatively identified it as a rotational variable, and no period was reported. Using the rather scant data available at the time, Blackford (2020) identified the variable as an EA-type eclipsing binary in an elliptical orbit with a period of 8.15084 d.

In July 2025 another serendipitous recording of an eclipse of ASASSN-V J184530.00-593235.0 was made, this time by Roy Axelsen. The time of minimum measured from Roy’s light curve and from the Transiting Exoplanet Survey Satellite (TESS) light curves have been used to further refine the orbital period to 8.1508035(9) d.

TESS Observations

ASASSN-V J184530.00-593235.0 was observed by TESS in 2019 sector 13 (S13), 2023 (S66), and 2025 (S93 and S94). Each sector covered about 27 days and included several primary and secondary eclipses. Quick Look Pipeline (QLP) files were downloaded from the Mikulski Archive for Space Telescopes (MAST) website: <https://mast.stsci.edu/portal/Mashup/Clients/Mast/Portal.html>

The sector 13 data were collected at a cadence of 1800 s, leading to only a dozen or so observations during each eclipse. The Kwee and van Woerden method of measuring time of minimum is not reliable with these light curves. Peranso (Light Curve and Period Analysis Software) was used to fit a 4th order polynomial to each eclipse to determine the time of minimum and estimate the error (see Figure 1 for an example).

All the other sectors were collected at a cadence of 200 s, resulting in over 100 observations in each eclipse. This allowed the use of the Kwee and van Woerden function in Peranso to determine times of minimum and their error estimates (see Figure 2 for an example).

The time of minimum of each complete eclipse was measured from the light curves of each TESS sector. It is important to note that TESS observations are expressed as Barycentric Julian Dates in Barycentric Dynamical Time (BJD_TDB). However, eclipse times of minimum light are traditionally recorded in Heliocentric Julian Dates (HJD) in Coordinated Universal Time (HJD_UTC). Therefore, times of minimum measured from TESS light curves need to be converted to HJD_UTC before comparing with results from other sources. A written procedure for carrying out this time conversion is planned for a future VSS Newsletter article.

Table 1 lists times of minimum from Blackford (2020) and this present study.

Table 1: All available ASASSN-V J184530.00-593235.0 times of minimum expressed in HJD_UTC.

HJD_UTC	error (d)	Pri/Sec	Observer	Date UTC
2457594.46400	0.0040	P	ASASSN/MGB	24/07/2016
2458654.07299	0.0050	P	TESS/MGB	19/06/2019
2458658.48905	0.0051	S	TESS/MGB	23/06/2019
2458662.22297	0.0053	P	TESS/MGB	27/06/2019
2458666.63906	0.0050	S	TESS/MGB	2/07/2019
2458670.37379	0.0052	P	TESS/MGB	5/07/2019
2458674.78960	0.0049	S	TESS/MGB	10/07/2019
2458678.52517	0.0036	P	TESS/MGB	14/07/2019
2458711.12891	0.0002	P	MGB	15/08/2019
2460101.18007	0.0004	S	TESS/MGB	5/06/2023
2460109.33052	0.0006	S	TESS/MGB	13/06/2023
2460113.06672	0.0002	P	TESS/MGB	17/06/2023
2460117.48118	0.0002	S	TESS/MGB	21/06/2023
2460121.21769	0.0004	P	TESS/MGB	25/06/2023
2460125.63180	0.0003	S	TESS/MGB	30/06/2023
2460830.33750	0.0002	P	TESS/MGB	3/06/2025
2460834.75222	0.0003	S	TESS/MGB	8/06/2025
2460838.48802	0.0001	P	TESS/MGB	11/06/2025
2460846.63843	0.0001	P	TESS/MGB	20/06/2025
2460851.05383	0.0002	S	TESS/MGB	24/06/2025
2460854.78903	0.0003	P	TESS/MGB	28/06/2025
2460859.20440	0.0004	S	TESS/MGB	2/07/2025
2460862.93999	0.0001	P	TESS/MGB	6/07/2025
2460867.35512	0.0002	S	TESS/MGB	10/07/2025
2460871.09132	0.0003	P	TESS/MGB	14/07/2025
2460871.09191	0.0003	P	RAA	14/07/2025
2460875.50598	0.0004	S	TESS/MGB	19/07/2025
2460879.24236	0.0002	P	TESS/MGB	22/07/2025

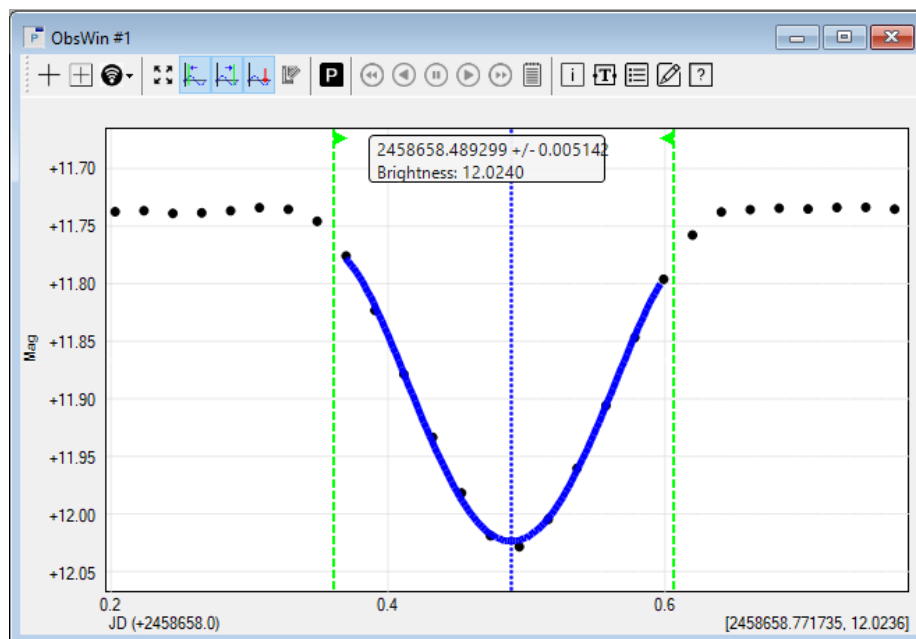


Figure 1: Peranso 4th order polynomial fit to a secondary eclipse from Sector 13 TESS observations.

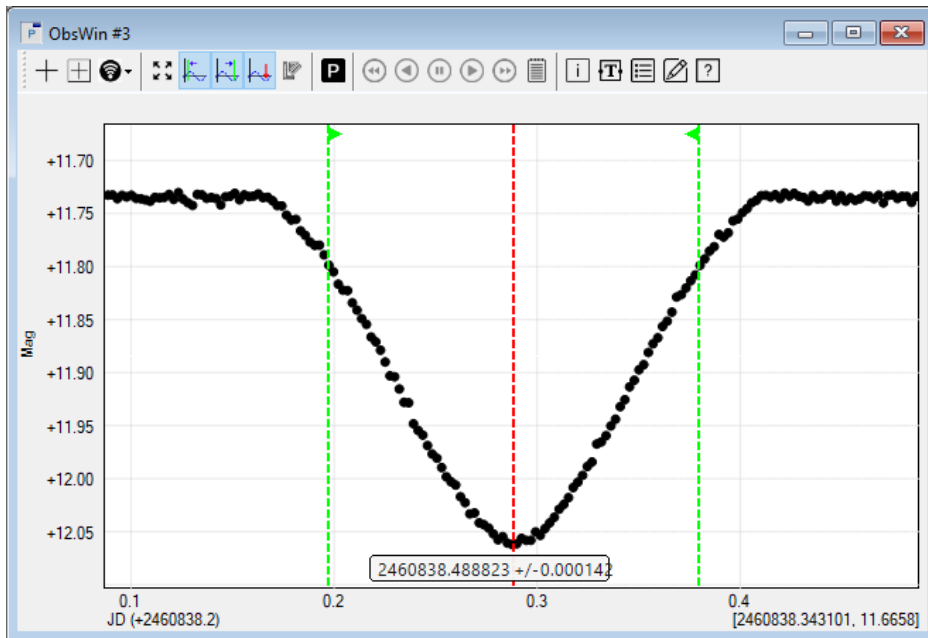


Figure 2: *Peranso Kwee van Woerden analysis of a primary eclipse from Sector 93 TESS observations.*

Observed minus Calculated (O-C) Diagram

The period (8.15079 d) and epoch (HJD 2458711.1287) from the AAVSO's Variable Star Index (VSX) were used to construct the O-C diagrams in Figure 3. Blue and red dots represent primary and secondary eclipses, respectively. The elliptical nature of the orbit, as noted in Blackford (2020), is evident from the separation of the two sets of data in the top panel.

The middle and bottom panels show only primary and secondary data, respectively. In both cases there is an upward trend with time, indicating the assumed period is slightly shorter than the true period.

Linear regression of primary eclipse times of minimum using the first primary eclipse from TESS sector 66 as the epoch yielded a revised period of 8.1508035(9) d. The time of minimum derived from the All-Sky Automated Survey for Supernovae (ASASSN) was not included in the linear regression. Figure 4 shows the O-C diagrams resulting from the revised epoch and period. There is no clear evidence for apsidal motion in the relatively short period of time covered by these data.

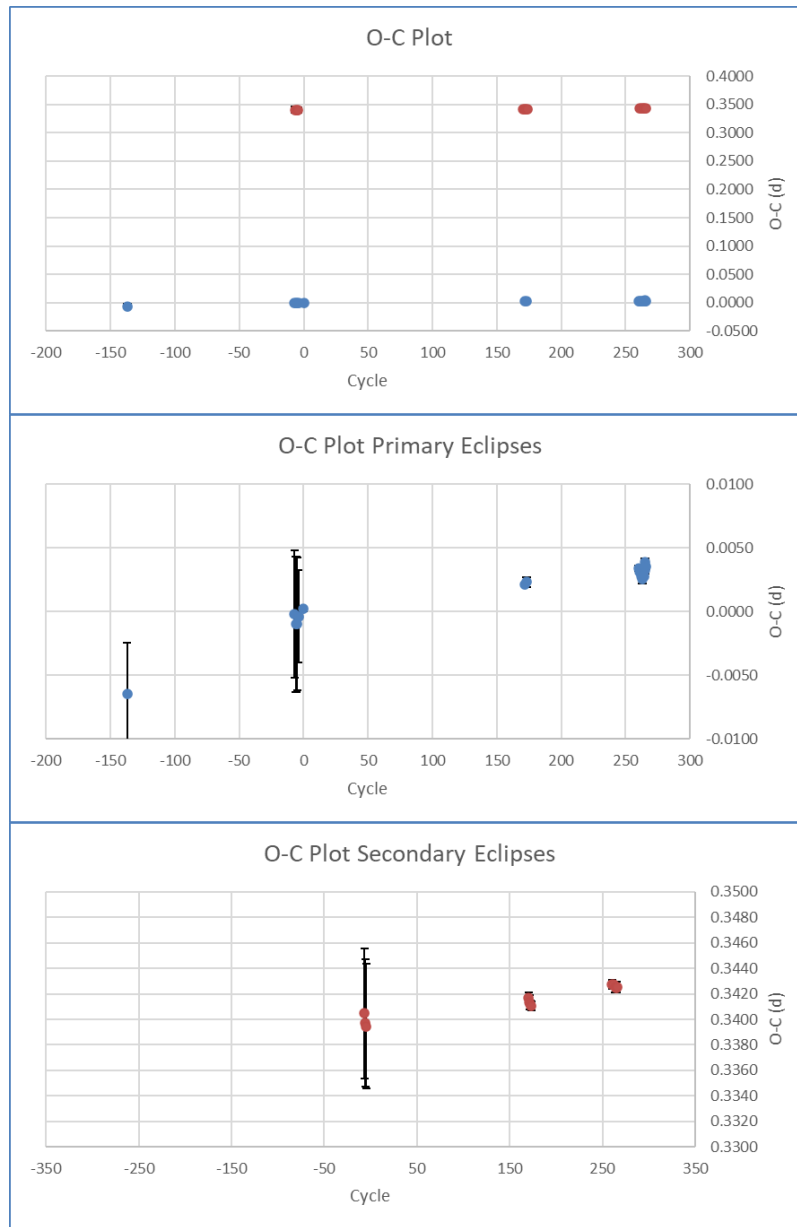


Figure 3: O-C diagrams of ASASSN-V J184530.00-593235.0 using period 8.15079 d and epoch HJD 2458711.1287 from VSX with blue and red dots representing primary and secondary eclipses, respectively. Top panel plots all available data, middle panel plots only primary eclipses and bottom panel plots only secondary eclipses

Conclusions

Using data from Blackford (2020), new observations by Roy Axelsen and data from the Transiting Exoplanet Survey Satellite, the period and epoch of ASASSN-V J184530.00-593235.0 have been revised. The elliptical nature of the orbit is confirmed but apsidal motion is not evident. For predicting future primary eclipses, the following equation should be used:

$$\text{Primary ToM (HJD)} = 2460113.06654 + 8.1508035 \times \text{cycle number}$$

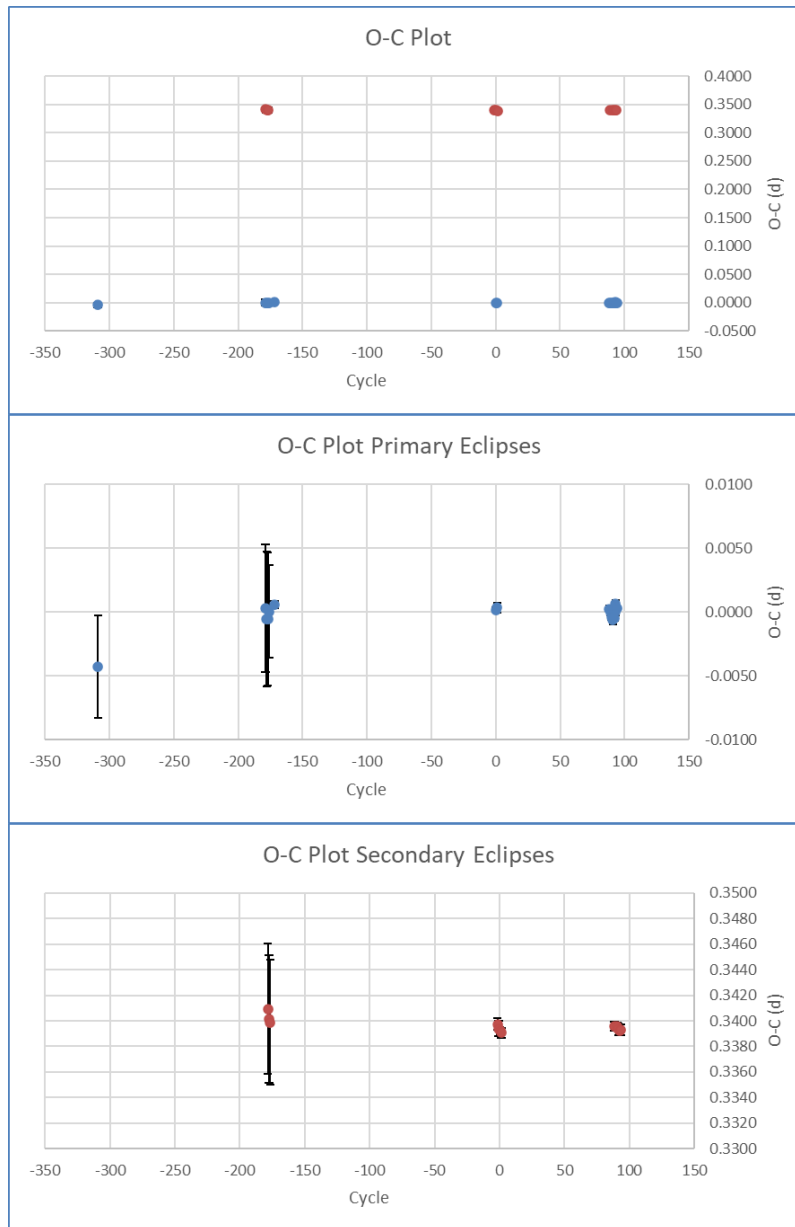


Figure 4: O-C diagrams using period 8.1508035(9) d and epoch HJD 2460113.06654(11) HJD.

Acknowledgements

This research made use of the AAVSO VSX database and data collected by the TESS mission, which are publicly available from the Mikulski Archive for Space Telescopes (MAST).

References

Blackford, M. G. 2020, VSS NL 2020-3

Publications watch

Quadruple system HD 135160 in a unique 2+2 configuration

Zummer, M.; Harmanec, P.; Barlow, B.; Blackford, M.; Švrčková, J.

Abstract

Analysing a large body of observational data, we found that HD 135160 is a quadruple 2+2 system, composed of a massive ellipsoidal binary ('heartbeat' star) with components Aa and Ab in an eccentric 8.234 d orbit and an eclipsing binary (with components Ba and Bb), with a 5.853 d period and partial eclipses that have already been reported from the space photometry secured by the Transiting Exoplanet Survey Satellite (TESS). Our systematic echelle spectroscopy, secured since September 2021, led to the discovery that the optical spectra are dominated by spectral lines of three early-type stars, two moving around each other on a 8.234 d orbit of a high eccentricity, which causes periodic brightenings near the periastron passage, and the third one (component Ba) being the brighter component of the 5.853 d binary. Both pairs are physically bounded and revolve around each other with a period somewhere between 1600 and 2200 days (4.4–6 years). The object exhibits small cyclic light variations of a variable amplitude and characteristic time scale of 0.071 (14.14 c d⁻¹), seen throughout the whole orbit. The nature of these tiny changes deserves further investigation. It also seems that the earlier classification of the object as a Be star is unfounded.

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Pub Date: January 2026

DOI: 10.1051/0004-6361/202557637, 10.48550/arXiv.2511.15544

arXiv: arXiv:2511.15544

TESS Investigation—Demographics of Young Exoplanets (TI-DYE). IV. A Jovian-radius Planet Orbiting a 34 Myr Sun-like Star in the Vela Association

Barber, Madyson G. ; Mann, Andrew W. ; Vanderburg, Andrew ; Barkaoui, Khalid ; Collins, Karen A. ; Carrazco-Gaxiola, Sebastian ; Evans, Phil ; Fields, Matthew J. ; Gillon, Michaël ; Henry, Todd J. ; Hesse, Katharine M. ; Jao, Wei-Chun ; Jehin, Emmanuel ; Jenkins, Sydney ; Johns, Tim ; Rodriguez, David R. ; Schwarz, Richard P. ; Storch, William C. ; Watkins, Cristilyn N. ; Wilkin, Francis P.

Abstract

The discovery of infant (<50 Myr), close-in (<30-day-period) planets is vital in understanding the formation mechanisms that lead to the distribution of mature transiting planets as discovered by Kepler. Despite several discoveries in this age bin, the sample is still too small for a robust statistical comparison to older planets. Here we report the validation of TOI-6448b, an $8.8 \pm 0.8 R_{\oplus}$ planet on a 14.8-day orbit. TOI-6448 was previously identified to be a likely member of Vela Population IV. We confirm the star's membership and rederive the age of the cluster using isochrones, variability, and gyrochronology. We find the star, and thus planet, to be 34 ± 3 Myr. Like other young planets, TOI-6448 b lands in a region of parameter space with few older planets. While just one data point, this fits with prior findings of an excess of 5–11 $R_{\oplus}$ planets around young stars far beyond what can be explained by reduced sensitivity at young ages. Our ongoing searches of Vela, Taurus-Auriga, Sco-Cen, and Orion are expected to reveal dozens more <50 Myr transiting planets.

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Pub Date: January 2026

DOI: 10.3847/1538-3881/ae1b91, 10.48550/arXiv.2511.10734

arXiv: arXiv:2511.10734

About

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

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

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

VSS is entirely an internet based organisation, working through our website <http://www.VariableStarsSouth.org> and its e-group <http://groups.google.com/group/vss-members>. It also encourages members to work 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.

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