



Freyberg High School student Joseph Chamberlain undertook a project to measure the period of the WASP-17b exoplanet under the guidance of Carl Knight, VSS's new Education Liaison Officer.

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From the Director – *Mark Blackford*

Greetings and welcome to the final VSS newsletter for 2018. I hope you all enjoy the articles contained within these pages and that they encourage you to write something for a future newsletter telling us about your own projects.

Alan Plummer continues describing his fascinating LMC observing programme. I've been looking forward to reading more about this since his first instalment appeared in the previous newsletter.

Joseph Chamberlain describes his science fair project on the exoplanet Wasp-17b for which he won a swag of awards. Joseph was mentored by Carl Knight who provided excellent guidance and access to his observatory. Joseph is Carl's second science fair student, the October 2015 VSS newsletter contains a short article on Tessa Hiscox's project.



In a new VSS initiative Carl has agreed to act as “Education Liaison” to help foster more mentoring of school students in astronomy related projects. We hope this can be a joint effort with RASNZ.

On a more solemn note, we farewell Ranald McIntosh who passed away recently after a long illness.

The highly anticipated (well, by some of us) eclipse of long period eclipsing binary V777 Sgr should just about be underway by the time this newsletter is published. See Stan Walker's article in the last Newsletter issue. We successfully applied to have V777 Sgr added to the observing schedule of the AAVSO Bright Star Monitor telescopes BSM-South in Victoria and BSM-Berry in Western Australia. These will complement observations by VSS members in New Zealand, Australia and South Africa.

Congratulations to Margaret Streamer on publishing her research on the semi-detached eclipsing binary system, TT Hor. Margaret wrote the following in a post to the VSS Google Group:

“Some of you may remember that members of VSS ‘discovered’ the δ Sct nature of this binary. I have since collected much more data, including spectral data, and have modelled this system as part of my M.Phil at ANU. It's been challenging but rewarding and I've learned heaps. I'm very lucky to have great supervisors – very helpful and supportive.”

See the Publication Watch section (page 28) of this newsletter for more details.

Phil Evans noted in an email to me that data from the Transiting Exoplanet Survey Satellite (TESS) is now available to the SG1 group (Seeing-limited Photometry follow-up to identify false positives <https://tess.mit.edu/followup/>). He is actively working with the group and already has been named as a co-author on a TESS exoplanet discovery paper (see Publication Watch page 28).

Meanwhile, from early July through until the end of August I was blessed with excellent weather at Congarinni Observatory. In that time I've completed intensive observing projects on R Ara for Phill Reed (Kutztown University, USA) and V3792 Sgr for Burcu Ozkardes (Çanakkale Onsekiz Mart University, Turkey). Keep an eye out for reports on these projects in upcoming newsletters.

Clear skies and good observing,

Ranald McIntosh (1933-2018)



It is with great sadness that we report the passing of Ranald McIntosh, Honorary Life Member of VSS. A short article outlining Ranald's contributions to variable star research in New Zealand leading that award can be found on the [VSS website](#), and the [RASNZ Electronic Newsletter for September 2018](#) contains an obituary written by Alan Gilmore & Pam Kilmartin.

Stan Walker provided the following recollections:

I first met Ranald in the 1980s at one of the RASNZ conferences where we discussed our mutual interest in variable stars. We discussed the problems we were having with analysis of the photoelectric measures made at Auckland and he introduced me to a simple but effective programming language, Quick Basic, which proved very useful in organising papers and presentations of this data.

Around this time Ranald also became heavily involved - along with several other helpers - in reorganising the Variable Stars Section's database so that it was available in a useful form to researchers. This took the form of computerising the old hand written cards.

Along the way, in company with Albert Jones, he persuaded the director of RASNZ VSS that the observations were more valuable when used. The computerised database helped achieve this. One example was providing Brian Marino and I with over a quarter of a million visual measures of 88 Mira stars for analysing and presenting at the Tokyo IAU General Assembly in 1994.

During the 1990s and into the start of this century, with Frank Bateson's health and eyesight failing, he worked with Albert Jones, Mati Morel and others such as Alan Baldwin and Pauline Loader to keep the Variable Stars Section's work alive - allowing Tom Richards to formally revive this as a going operation in 2009.

With my semi-retirement to the Far North and Ranald being in Greymouth we both attended the annual conferences less frequently and I certainly missed the stimulating discussions we used to have. But we still kept in touch by email and discussed aspects of the database which, by then, had been transferred to the care of the AAVSO. We're all getting older and few of us remember the days before the Internet. Ranald's passing is a sad reminder of these earlier days.

Stan Walker

For sale

Ranald requested that his Meade LX90 8" telescope be offered for sale to VSS members. It comes with additional items and is still in its box. He had been ill for some time and only got to use the telescope once. So it is in very good condition. Anyone interested can contact Sue McIntosh on 027 208 8568.

Summary

Five variables, first reported by Innes (1915), possibly not properly identified, have been re-examined. By a meticulous study of supporting remarks given by Innes, the correct placements of NSV stars 4809, 4820, 4850 and 5045, and also AR Car are now established.

Introduction

The Union Observatory, Johannesburg, in the early 20th century had a number of telescopes at its disposal for visual and photographic work, namely

- 9-in refractor, erected 1907. Renamed Reunert Telescope after 1924.
- Franklin-Adams telescope: two telescopes on same mount. Erected 1912. A 6-in. photovisual refractor (for guiding) and a 7-in. visual refractor (“star-camera”).
- Franklin-Adams photographic refractor, 10-in. aperture. Used from 1909-1954. Used to take plates for the Union Observatory charts of the southern sky.

The limiting photographic magnitude was generally close to 15.0B, on the modern scale. This is confirmed by comparing Harvard Bruce (24-in doublet) plates of the same era (~1915), and modern photometry (B mags.) from *APASS* and *SkyMapper*. Nevertheless one must be aware the magnitude and positional data reported by Innes for variables can be somewhat loose. In the listing of numerous new variables by Innes (1915) I have selected five stars (with GCVS names) which have supporting remarks in **UOC26**. Two have modern and precise identifications, while the remainder have apparently been misidentified. All of the identifications presented here are in strict accordance with Innes’ remarks, even if, in a couple of cases, his position does not agree.

Correct positions are established here, but not variability. Subsequent surveys failed to turn up any variable close to the spot, leading to doubts on the reality of some his variables.

NSV 4809

Position (1875): 10h12.6m -61°42' (J2000) 101640.7-621926 Range 15 - 17p

Observations (Innes):
1911 Apr. 18 15p
1914 Apr. 27 17
1914 July 13 17
1915 Apr. 17 17

Remark (Innes): “*Near -61°1563, mag. 8.4, which has an 11mag. comp. 36" S.f. and a 16mag. comp. 100" S.f. The variable is between the two companions.*”

Discussion

An inspection of a UK Schmidt B plate confirms the three companions south following CPD-61 1563 referred to by Innes. In order of increasing declination I letter them as follows:

Star	(J2000)	V	B-V	B	Source
A (=11 ^{mag})	10 16 43.80 -62 18 59.4	UCAC5 11.622±0.022	1.012	12.634	APASS
B = NSV 4809	10 16 44.27 -62 19 19.2	UCAC5 14.306±0.0	0.784	15.09	APASS
C (=16 ^{mag})	10 16 44.17 -62 19 34.4	UCAC5 14.212	0.521	14.71	SkyMapper DR1

Note that his offsets from CPD-61°1563 are somewhat off, even allowing for pm of the CPD star. A is offset about 47", not 36"; C is about 79", not 100". B is close to the midpoint of A and C, in agreement with Innes. See Figure 1.

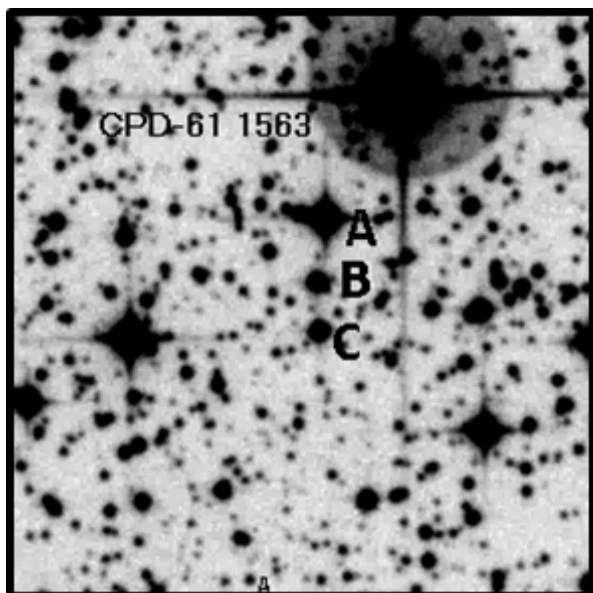


Figure 1. *NSV 4809. UK Schmidt B, 3' field.*
Star B = NSV 4809. North is at top.

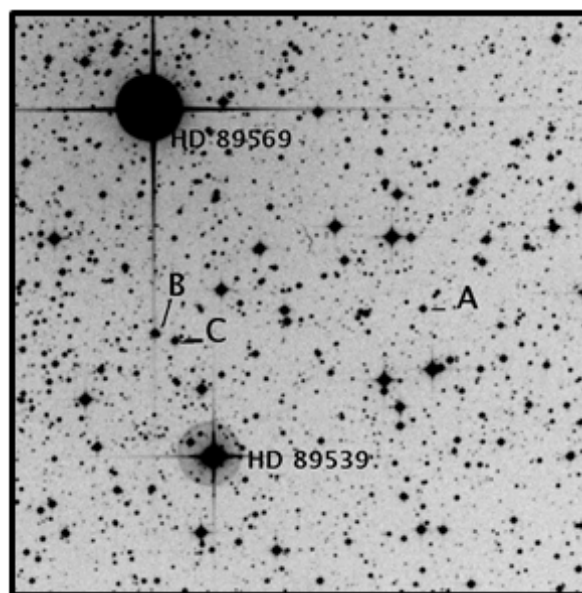


Figure 2. *NSV 4820. UK Schmidt B, 10' field.*
A = GDS_J1018039-560956, B = 16.2.
B = GDS_J1018372-561032 = NSV 4820

There is no doubt, following Innes, that B = NSV 4809, not C as supposed. Its variability is yet to be confirmed. Perhaps dubious. CONSTANT?

NSV 4820

Position (1875): 10h14.0m -55°33' (J2000) 101836.5-561034 Range 14.5-16p

Observations (Innes):
 1910 May 7 14.5
 1911 Apr. 18 14.5
 1914 Apr. 27 15
 1914 July 13 14.5
 1915 Apr. 17 16
 1915 May 5 15.5

Remark (Innes): *“One of a pair of stars (other 16^{mag}) between but a little foll. 2 brighter stars”.*

Discussion

The position quoted in UOC26 yields a very close match to **GDS_J1018372-561032**, at (J2000) 10 18 37.23 -56 10 32.3, V= 13.43, B-V = 0.99, B= 14.41 (VSX), recently found.

The two brighter stars can be identified as HD 89539 (8.96V) and HD 89569 (5.80V). The 16^{mag} star precedes the variable by 2.5s, located at (J2000) 10 18 34.68 -56 10 39.5 UCAC3, V=13.535, B-V=1.536, B=15.071 APASS (29). Everything points in one direction:

NSV 4820 = GDS_J018372-561032

Note. In the NSV and VSX catalogues the RA of NSV 4820 has mysteriously been shifted 30 sec westwards, for no apparent reason. This adjusted position lands, fortuitously, near another new discovery, GDS_J1018039-560956, and is thus matched with Innes' star. When one studies the remarks by Innes, the configuration of stars near GDS_J1018372-561032 is the only plausible match. The other GDS star is probably also too faint, B=16.2. See Figure 2.

AR Car = ASAS J102203-6358.4 (?)

Position (1875) : 10h18.5m -63°21' (J2000) 102232.2-635854 Range 14-15p

Observations (Innes):
 1910 May 7 15p
 1911 Apr 18 14

1914 July 13 14
1915 Apr 17 15
1915 May 5 14

Remark (Innes): *“The mid. of 3 stars, others 13 and 14 mags.”*

Discussion

According to VSX, AR Car is supposedly identified with **IOMC 8964000032**, $V_{\text{med}} = 13.8$, at (J2000) 10 22 32.00 -63 58 48.0. The IOMC finder chart shows no star at this spot, confirmed as an empty field on UK Schmidt plates (R, B and IR), with nearby stars <17B. A bright nearby star 33” south following ($V=12.296$, $B-V=1.227$ APASS) is too bright and essentially constant in the ASAS-3 database. I call it “D”. See Figures 3a, 3b.

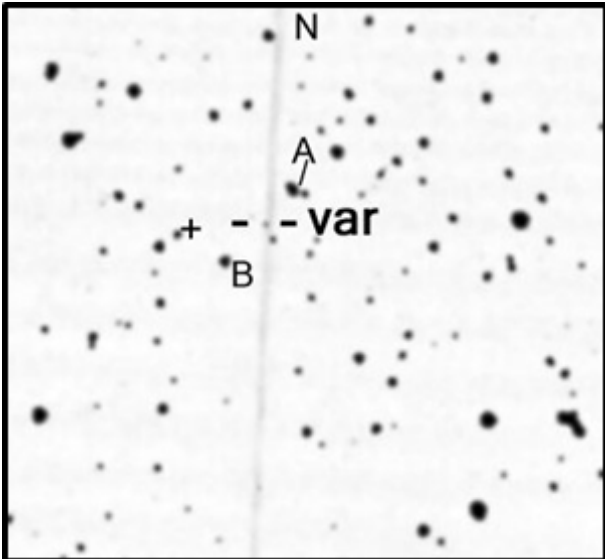


Figure 3a. *Var = ASAS J102203-6358.4, $m=14.3p$. Enlarged extract of Union Observatory Chart -64° No 36; 1929 April 30, exp 30min. Var = AR Car? Cross marks the nominal position of AR Car, which also coincides with IOMC 8964000032, at an empty field. See Figure 3b*

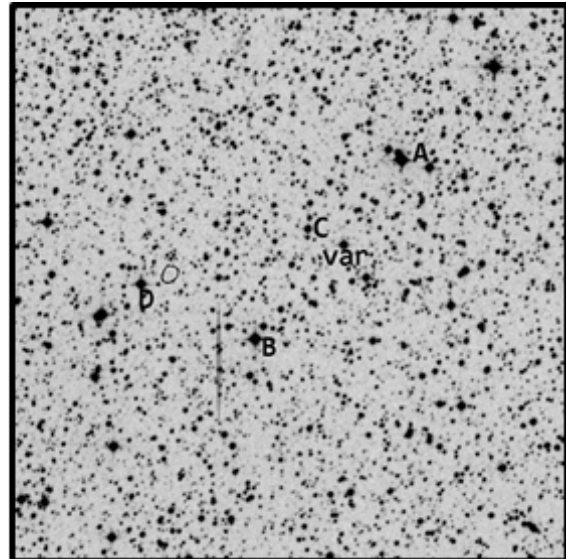


Figure 3b. *Deeper field from UK Schmidt B, 10' field. AR Car / IOMC 8964000032 falls on an empty field (open circle NW of 'D'). A and B are the main reference stars; refer to text for full details. 'Var' = AR Car? N is at top. See also Figure 3a.*

Although Innes recorded his star consistently at 14-15 over a period of years, his position lands on an empty spot near the IOMC position, as I have noted; his description does not fit. It seems that his position contains an error. I note that **ASAS J102203-6358.4**, a known variable, is situated near the midpoint of stars **A** (12.52B) and **B** (12.61B). The ASAS variable is about 14.8B. This configuration matches Innes' description very well, although his RA is too large by ~30s. A poor position? Worssell (1919) repeats the same position and range. I propose that **AR Car = ASAS J102203-6358.4**

NSV 4850

Position (1875) : 10h20.3m -60°58' (J2000) 102436.3-613603 Range 11.5 - 15p
Observations (Innes) : Steady at $m = 15$ on 1910 May 7, 1914 Apr 27, 1914 July 13,
1915 Apr 17, 1915 May 5. Bright. ($m=11.5$) on 1911 Apr 18.

Remark (Innes) : *“One of a group of 5 (12-14 mag.) S.f. -60°1890, mag. 7.5”*

Discussion

From examination of a number of images, from both the 1915 era and more recently, I have concluded that, in this rich star field near Eta Carinae, the “5 star group” mentioned by Innes are those that stand out prominently relative to the background, and above the threshold, $m=15.0B$. I can isolate five stars which

are very likely to be those referred to, in agreement with Innes. I number them as follows (See Figure 4).

Star	J2000	V	B-V	B	Source
1	10 24 24.50 -61 36 53.0	11.226	0.179	11.40	APASS (29)
2	10 24 34.33 -61 36 57.2	12.603	0.267	12.87	APASS (29)
7	10 24 29.26 -61 34 45.7	13.192	0.440	13.63	SkyMapper DR1
10	10 24 32.89 -61 35 20.3	13.596	0.273	13.87	SkyMapper DR1
A	10 24 38.58 -61 35 49.5	13.133 13.307±0.141	1.403	14.54	APASS (29) ASAS-3

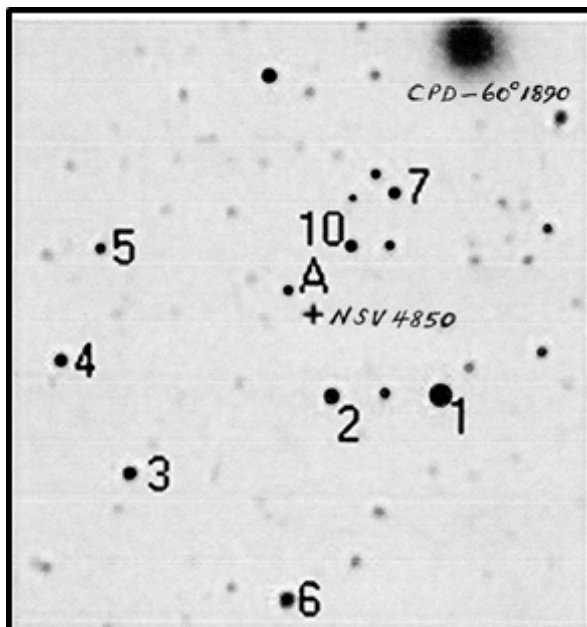


Figure 4. Field of NSV 4850, an extract from the Harvard Bruce 24-in. plate, a11160, exp 60min taken on 1915-04-20. Stars 1,2,7 and 10 are surmised to be part of Innes' 5-star group, with A the 5th star, close to his published position.

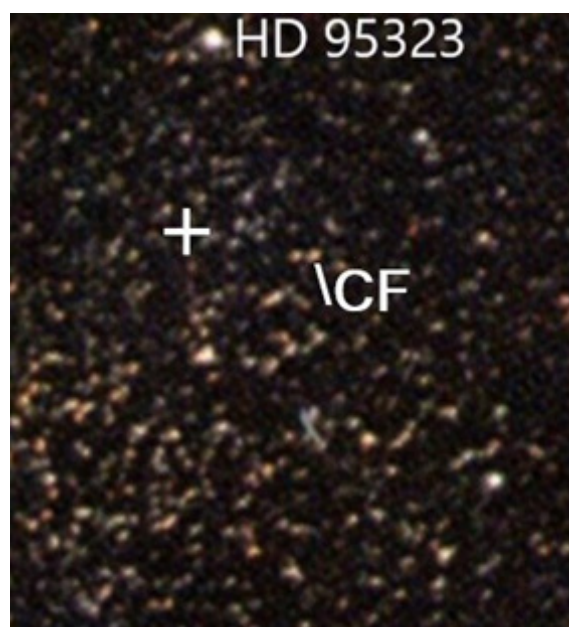


Figure 5. NSV 5045 field (its position marked by cross). CF Car is identified and its 13mag companion, a plausible match to description of NSV 5045. V plate. N is at top.

It is not excluded that stars 3 (12.91B), 4 (13.08B) or 5 (13.94B) could be part of the Innes group, but these stars are more distant. In either case star A is centrally located and is the likely candidate; it fits Innes' narrative, with the variable being fainter than the others, and within his plate limit. The claim for variability is based on a single bright observation. A lightcurve from ASAS-3 suggests constant light. A = NSV 4850. Variability doubtful.

NSV 5045

Position (1875) : 10h54.3m -59°36' (J2000) 105923.7-601612 Range 12-13p

Observations (Innes): 1893 May 10 13p

1910 May 7 12.5

1911 Apr 18 12

1914 Apr 27 12

1914 July 13 12

1915 Apr 17 13

1915 May 5 12

Remark (Innes) : "One of a pair, other =13mag."

Discussion

Taking Innes' magnitude scale at face value, and with no reason to dispute it, his variable is relatively

bright and consistently recorded at 12th magnitude. An examination of photos shows no such star at the stated position, nor any matching stars within $r = 1.5'$. It is almost certain Innes has given us a poor position - the field is crowded and can be confusing.

CF Car. Worssell (1919) blinked a series of plates and discovered a new variable a little to the west of Innes' star. Its position is (1875) 10h54.1m -59°36.5', range 11.8-13p. Now known as a Cepheid, designated CF Carinae. It has a range very similar to Innes' star, and is paired with a 13^{mag} star (19" east), much like Innes' star. **See Figure 5.** Photometry exists for the pair, below :

CF Car	V=12.027	B-V= 1.214	B = 13.241	29	APASS Mean values
Companion	V=12.524	B-V= 1.410	B = 13.934	29	APASS

Innes' star is known as NSV 5045, at a slightly different position. As the properties of the two are so very similar, yet unique in this vicinity, the obvious conclusion to be drawn is

NSV 5045 probably = CF Car.

Concluding remarks

I appreciate that identifications would, ideally, be made from reproductions of original photographs. These are not available, and after more than 100 years the possibility of such original material ever seeing the light of day again must be questioned. As a stopgap, I have made good use of Harvard plates of the same era, with similar limiting magnitude, to get a good sense of how the star fields would have appeared to the workers at Johannesburg Observatory. By giving Innes' remarks the highest possible weight the positions of NSV 4809 and 4820 can be pinpointed beyond doubt. The remaining stars NSV 4850 and 5045, and AR Car are also identified satisfactorily, but with a greater degree of uncertainty. This leads to some of my identifications being different to those currently accepted.

References.

- Anon. 1920 Astron. Nach. 211, 445
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DASCH Digital Access to a Sky Century at Harvard. <http://dasch.rc.fas.harvard.edu/>
Innes, R.T.A. 1915 Union Obs. Circ. 26, 202
SkyMapperDR1 2017 <http://skymapper.anu.edu.au/>
SuperCOSMOS Sky Survey <http://www-wfau.roe.ac.uk/ss/pixel.htm>
VSX database <http://www.aavso.org/vsx>
Worssell, W.M. 1919 Union Obs. Circ. 46, 17

A funny thing happened on the way to the observatory the other night – *Mark Blackford*

markgblackford@outlook.com;

The evening of August 12th, 2018 was promising to be clear so I headed out to my observatory about 6:15pm to open the roof and start cooling the CCD camera in preparation for a night of photometry. Low in the western sky I notice a brightish star shining through a small, strangely shaped cloud. I'm familiar enough with the night sky to know there shouldn't be any bright stars in that location so I turned my 80mm f6 refractor toward the object and captured a bunch of 3 second CCD images. Between exposures I had to manually re-centre the object as it was drifting quite rapidly to the east.

The bright "star" faded quite quickly; actually I was too busy trying to get images that I didn't notice it disappear. After some 30 minutes the cloud had moved closer to the zenith, expanding and fading considerably.

My images were quite poor, 3 sec exposures with a still-cooling CCD camera generally are, but I did manage to capture the central structure reasonably well.

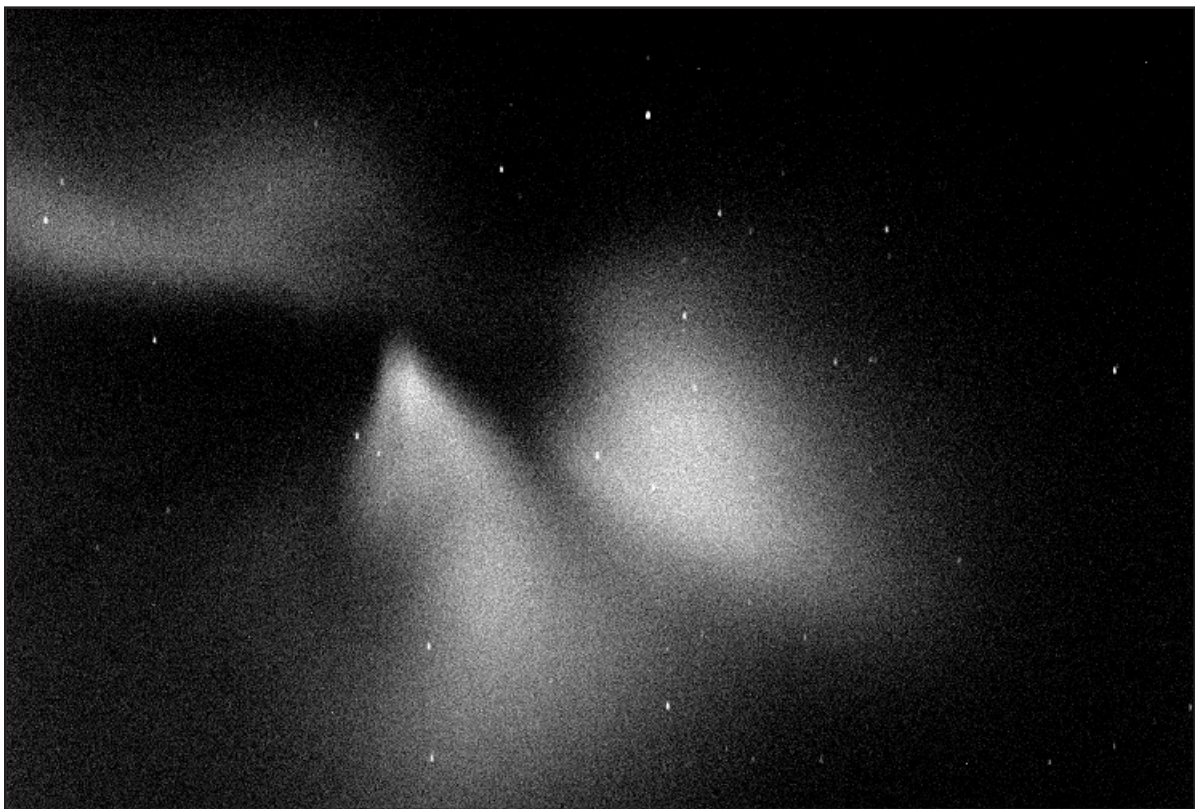


Figure1. *Central part of mystery cloud, field of view 1.8 x 1.2 degrees (12/08/2018 6:30:39 PM).*

I posted a message on the VSS Discussion Forum hoping that someone else had seen it or could offer suggestions as to what it might have been. Steve Flemming replied that I'd probably witnessed the after effects of the third stage burn of the rocket launching NASA's Parker Solar Probe, which had left Cape Canaveral about an hour before I recorded the image shown in Figure 1.

David Benn recalled seeing a similar sight some years previously from another (forgotten) rocket launch.

Peter Williams posted several images he captured from Heathcote in Sydney, some 500 km south of my location, and noted that it was a very impressive sight through 20x80mm binoculars.



Figure 2. Image by Peter Williams, Venus at right and Corvus top centre (12/08/2018 6:19:50 PM).

In 40+ years of astronomy I've witnessed a number of spectacular comets, fireballs, eclipses, and such, but this was probably my most unusual sighting. So remember, keep looking skyward, you never know what might catch your eye.

What prevents you from taking on a student project?

- Time?
- Effort?
- Equipment?
- Need of a mentor for yourself in this role?

And for teachers:

- Additional out of school time away from family?
- No subject experience?

My limited experience ($n=2$) suggests that these concerns are more perceived than real.

I've taken two high school students through three science fairs (Tessa Hiscox 2015/16; Joseph Chamberlain 2018) now. They each won major awards. Tessa's project, being the first astronomy project in literally years, created a bit of a quandary for the Manawatu Science and Technology Fair organisers as the prizes were slanted heavily towards agriculture and biology. That was changed for her second year and she won the major prizes in the event.

Time

This set the stage for Joseph's project this year and Joseph took the three top prizes being for physics, scientific aptitude and the overall premier prize.

What was my total commitment? I estimate somewhere between 8 and 10 hours in total spread over six months for each project.

What was the total commitment of the teachers of Tessa and Joseph? The time to enter their students into the Manawatu Science and Technology Fair. Seriously. That's it.

The Manawatu Science and Technology Fair requires students to be entered by a teacher. I am already known to the faculty at Freyberg High School and trusted in my capacity as an astronomy mentor. As such the teachers were happy to leave the organisation and delivery of an astronomy project to the Science Fair to their students, their respective parents, and myself.

Effort

Using Joseph's project reported on in this newsletter as an example, the best way to minimise effort on your part is to choose a project that fits within your existing programme of observations. Since 2015 I have largely been making observations for Pulkovo Observatory, St. Petersburg, Russia. Since late 2016 this work has focused on exoplanets.

An exoplanet project was put forward for Joseph when he approached me. The main reason being it fit within my current programme of observations and would contribute rather than divert my efforts.

Choice of project

This can be something requiring more time if the student is likely to benefit over more than one year, or otherwise needs to be comparatively short.

Joseph's exoplanet project has been aimed at the Manawatu Science and Technology Fair this year and next. He has expressed his interest in continuing especially after winning this year's event, and he genuinely wants an answer to the possible hypotheses. This means we will resume observations when transits can be captured of WASP-17b in the new year in anticipation of entering 2019's event.

If you need a shorter project, try a CV. If all you need are exoplanet transits where any will do, then

they are a good target because you can pretty much fill your calendar on any given week with potential transits.

Equipment

This should be what you already have, or have access to. Assuming you already have a programme of observations that you routinely undertake, then your hardest job is selling a project in that area to the student.

Commitment

Here I want to discuss commitment from a student and their parents/caregivers to the project. Both students I have taken on were given some minimum criteria to meet. I met with parents and the students and discussed their commitment.

In plain language the following is made clear:

- They are in charge of their learning. I am happy to answer questions but the effort has to be theirs not mine.
- A condition is that without assistance they can explain in plain English all the techniques from imaging, to data reduction, to data analysis – and most importantly their own project. I will quiz them on those topics until, without coaching or assistance, they show they understand. The point I make is that it is vitally important that anyone they talk to, including Science Fair judges, is left with the impression that they really know their stuff.
- They must make the effort to travel. My observatory is 40km from Palmerston North – the town that both Tessa and Joseph are from – and it can't go to the student so they must be prepared to come to it.

A plan

Here with minimum redaction is what I sent to Joseph and his parents when he expressed interest in an exoplanet project:

“Hi Joseph,

We need to get you familiar with some concepts irrespective of where/when the project is finally presented. I will lend you a couple of books and a planisphere.

Your goals from said books will be:

- Understand celestial coordinates and how they are like latitude and longitude.
- Become familiar with the southern night sky.
- Understand how to use a planisphere disk to find constellations on the sky.

Read up about what photometry is from here [*AAVSO CCD Photometry handbook*]. Feel free to ask any questions or have me sit down and go through it with you.

Orientation

Make a journey one clear night to the observatory. The weather being fickle this is best done organising things so you can come out to the observatory on short notice.

Once you have some idea as to what photometry is and what might be involved we need to do a few hands on exercises – another trip to the observatory - (on variable stars) and get you to do the data reduction to obtain the light curves. Submission from these will be to the

AAVSO International Database.

When you have the hang of that (the SW makes it very simple really) we will need to look at capturing a transit of WASP-17b – all your effort. i.e. You will need to set everything up, script the observations, do the image preparation (flat field division, dark subtraction), basic quality checks and data reduction. This will require a journey to the observatory again. Once set up and running it can be left to its own devices.

Presentation.

I suggest it needs to do the following:

- Assume your audience knows nothing of photometry or astronomy.
- Briefly explain photometry and what it can tell you about the behaviour of a star or transiting planet.
- Explain what an exoplanet transit is including the ‘four contacts’.
- Explain the importance of transit timing variation (remember the slide I showed you of the model solar systems with planets moving one another around?)
- Introduce WASP-17b, its orbital period, mass and radius. And the apparent deviation from its calculated orbital period.
- Show the O-C (observed - calculated) graph for WASP-17b to illustrate the deviation.
- Show where your transit of WASP-17b is on the O-C graph and describe the trend away from calculated - i.e. is the trend simple linear or something else.

The director of Variable Stars South (VSS), Mark Blackford has already requested that you write up an article for publication in the VSS newsletter of your project. It makes sense to do that after the presentation (science fair, CREST, whatever).

Never fear to ask questions, the only silly question is one left unasked.

Don't be overwhelmed. You eat an elephant one bite at a time. *[no actual elephants were harmed in the execution of this project. ;-)]*

No doubt that template can be improved upon. It's open to critique and improvement.

Will all students cope with that? No. It is daunting. Reality is that what they have learned of astronomy from their teachers is not practical. Given that the requirements include finding their target and understanding celestial coordinates, being able to run the observatory and make the observations themselves – it really is necessary to start from the basics in my view.

My experience (again emphasising $n=2$) is that an enthusiastic, genuinely interested student will step up to the task and need a minimum of hand holding. I have been regaled with tales from both Tessa's and Joseph's parents of them being dragged out in freezing (literally) conditions to a park or rural location so that their enthusiastic offspring can make observations or learn the sky.

It is vitally important that you emphasise your openness to being asked questions repeatedly. Hence:

“Never fear to ask questions, the only silly question is one left unasked.” Above.

Patience

Virtuous as it is – is an absolute necessity. Be prepared to explain the same thing seven different ways until the proverbial penny drops.

Not unsurprisingly it took a few explanations of the practical side of imaging for science (flat fielding in particular), complete with drawings representing pixels as little wells until Joseph understood. Joseph's parents were also very interested and I visited them all one evening and we worked on this until everyone had that vital "Ah-ha!" moment.

Having said that, that was only a couple of hours of my time.

End result? Joseph gave a talk to the Massey University Physics and Astronomy Club and a lecturer in physics asked some very practical questions about how he captured the images and did the data reduction and unassisted, Joseph gave a very satisfactory answer.

The recognition both Tessa and Joseph have received in the Manawatu Science and Technology Fairs (2015/2016/2018 respectively) for knowing their respective subjects and understanding the science is for me the icing on the cake. If they could win one award, it would be the Science Fair award for best prospects of becoming a future scientist.

Communication

In reality, it has taken relatively little effort on my part to quick fire respond to student and parent questions.

Communication and encouraging communication is vital. I don't imagine that surprises anyone.

Need a hand?

As I am newly appointed to the VSS committee in some role (yet to be named) that means helping educators and VSS members with student projects such as those written about here, I am more than happy to be contacted directly.

I don't have all the answers. My own knowledge is limited and my practical experience small – but my students have been very successful.

Email me: Observatory@ngileah.co.nz

Let's see what we can do together.

The reward?

In both Tessa's and Joseph's cases, the best reward is getting a late night phone call from an excited student fresh from the Manawatu Science and Technology Fair awards ceremony and hearing that they have just cleaned up the major awards including the Fonterra Premier Prize for best entry.

At that moment you know it was all worthwhile.

The mystery of WASP-17b – the story of an exercise in mentoring – *Joseph Chamberlain*

About six months ago, after talking to a teacher at school I approached Carl Knight of the Palmerston North Astronomical Society to see if he had a science project I could be involved in. My long term goal is to apply for a scholarship through the Royal Society to go to Space Camp in America. I have for a long time had an interest in space, especially in rockets and the Apollo Moon missions between 1968 and 1972.

Carl was very welcoming and passionate about the subject of astronomy. He was at the time involved in a study of an exoplanet and he was feeding back the information to an astronomer at the Pulkovo Observatory in Russia. The subject of the study was an exoplanet called WASP-17b. WASP-17b was not following the predicted orbit around its star. Carl had started observing the transits and invited me to become involved in this project. At first I was confused about a lot of the concepts as most of the things being explained were very foreign to me.

I am a year 12 high school student with an interest in space. I build amateur experimental rockets at home with support from my dad, but doing the project opened my eyes to a completely different aspect of astronomy and space. I found myself going outside on a clear night and identifying the different aspects in the sky, taking photos and editing these so I could see Scorpius and other constellations, and using a planisphere so you can see what is in the sky on different nights.



Joseph with Carl's telescope at Carl's home

The project

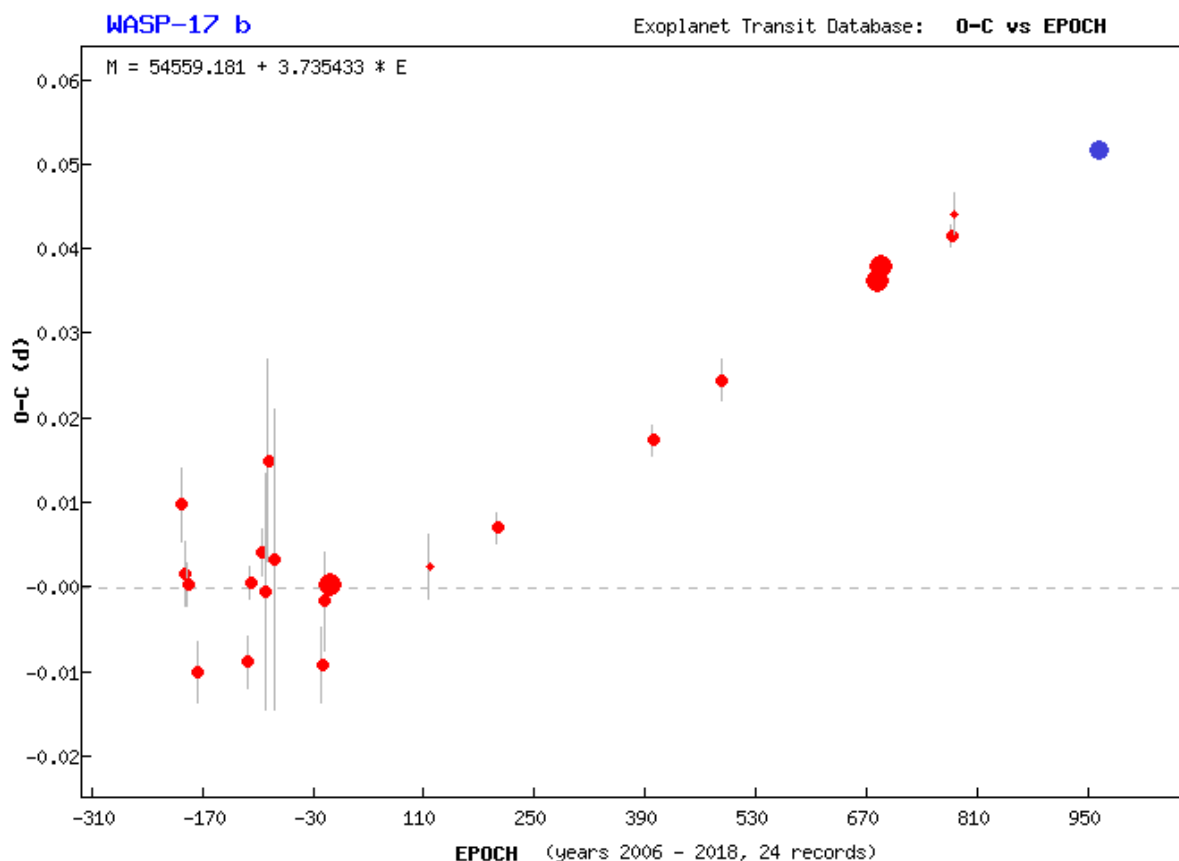
WASP-17b is one of many exoplanets that have been discovered. It is located in the Scorpius constellation, 1300 lightyears from Earth. It got its name from the exoplanet discovery project named the Wide Angle Search for Planets (WASP) and was the seventeenth such planet to be discovered by the group. It being the only planet discovered around its parent star it got the 'b' part of its name.

It is being studied because astronomers at the Pulkovo Observatory have noticed deviations in the pre-

dicted orbital period of WASP-17b and wanted to know why. The planet has a semi-major axis of 0.0515 AU (Astronomical Units). WASP-17b is 0.486 times the mass of Jupiter, and its radius is 1.991 times the radius of Jupiter. So it is almost twice as large, but half as dense, making the planet relatively thin in terms of density.

Although the orbital period of WASP-17b was initially measured as 3.73 days, my science project states that this may not be the case. The planet appears to be starting its transits later than expected. One possibility for this may be because the orbital period is simply wrong, but other, more exciting possibilities state that the planet may be being affected by another planet in the same system due to the 3-body problem. Or it may be exiting the planetary system altogether.

- Possibility one is that WASP-17b may be in a stable orbit around its parent star, and the calculated orbital period may simply be wrong. We will know if this is the case if the difference in expected transit time is linear, and is accumulating on itself. For example each time the transit starts five minutes later than expected).
- Possibility two is that WASP-17b may be exiting its planetary system altogether. This may be happening due to tidal forces or the gravitational influence of another body. We will know if this is the case if the difference in expected transit time is constantly increasing. For example the first time it is five minutes late, the next time it is fifteen minutes late, then thirty minutes, etc.
- Possibility three is that there may be another planet or large celestial body in the WASP-17 system that has not yet been discovered. This body may be exerting a gravitational force, slowing down and speeding up WASP-17b and therefore causing the orbital period to increase and decrease.



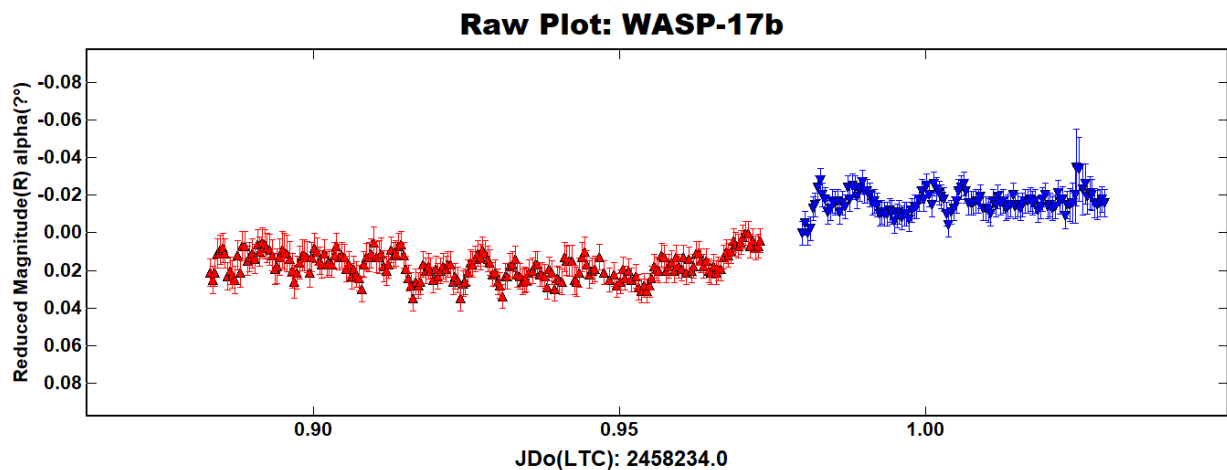
An Observed minus Calculated (O - C) graph for the time of transits of WASP-17b over a period of twelve years showing considerable departure from the initially measured period [Exoplanet Transit Database].

My hypothesis is that I think Possibility One is the most likely. To date there is currently insufficient data to prove my hypothesis right or wrong. I am going to continue with data collection to be able to make a suitable conclusion.

What it involved

The project involved learning and understanding all of the different aspects and terms, learning all the methods to do with photometry and actually going and doing some observations myself.

One of the times I was most confused was completing data reduction. At the time I learnt about data reduction I had not had a chance to be involved in setting up a transit due to the weather. So we interpreted some of the data that had already been gathered. Without the context of doing the first step at the observatory I had to just trust in the process and go with it. It was with some relief when I got out to the observatory that things started to make sense to me again. All the reading I had done was useful but the actual doing of the task is what I find is most beneficial to the learning and also to the meaning.



The light curve of a partial transit obtained by Joseph which he used to work out the 3rd and 4th contact points for his project. Inclement weather meant he missed the ingress to transit of the planet.

Of course doing the actual observing of the transit was the best part. Going out to an observatory in the cold of the evening, setting up the telescope (under Carl's direction), setting up the computer programme and hoping that the information that we gained would be usable.

I put all the information into a science fair in my local area for school students. I had to explain the information again and again to the judges as they went around all the projects. It was with some reluctance that I went along to the prize giving for the science fair thinking I had absolutely no chance at any type of prize. Well, I was really surprised to win two of the category prizes and then to my astonishment I won the top prize in the fair in the science category (Fonterra Premier Prize Science). What really excited me was an astronomy project winning the science fair.

Overall the project was a steep learning curve and not giving up was crucial to the initial success. What I have to do now is continue working on it as I want to see a conclusion to the study. I am very excited to see what the end result will be to explain the mystery of WASP-17b.

I could not have done any of this without having Carl as a mentor. He has the observatory at his home, he gave freely of his time and was very patient in his explanations.

T Sagittarii - what's hidden in the light curve – *Stan Walker*

astroman@xtra.co.nz (new address)

Abstract: T Sagittarii is an interesting Mira star with an F3IV companion. During the interval 2003 to 2011 Dale Mais, Giorgio di Scala and Arne Henden made CCD measures of this star in BVRI. The measures show interesting aspects of colour photometry and the contributions to the light of both stars has been separated to show the calculated light curve of the Mira itself which reveals a strong hump on the rising branch.

Introduction

In searching through Giorgio di Scala's BVRI measures of Miras to find stars with well defined humps I noticed that T Sagittarii had an unusual colour curve, but there were no comments about this as it is not readily apparent when the light curves through different filters are plotted. The phased light curve of all three datasets is shown in Figure 1.

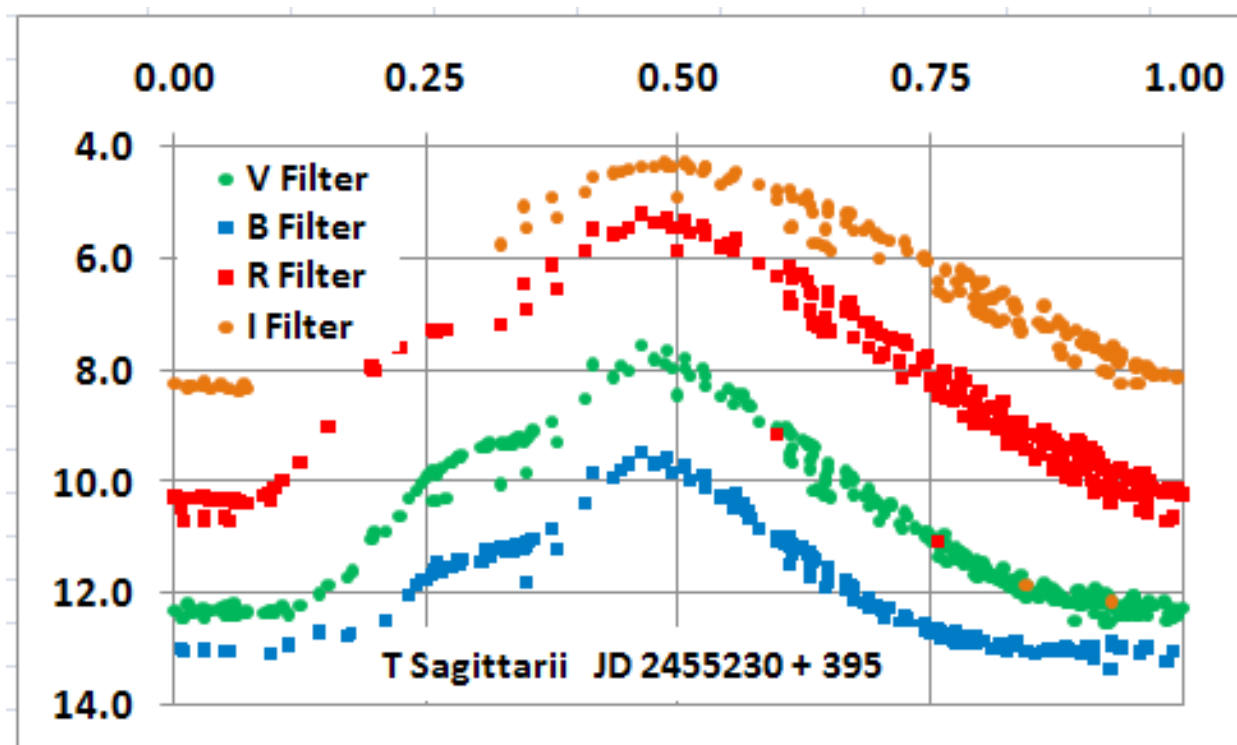


Figure 1. Measures of T Sagittarii folded to the light elements of minimum JD 2455230 + 395 during an interval of 2689 days.

The data comprises 116 BVRI measures by di Scala, 135 VRI measures by Mais and 42 BV measures from one of the BSM telescopes by Arne Henden. There are minor disparities as each observer used different comparison stars, but they have little overall effect on the results discussed below.

This seems a simple enough display with nothing unusual about it except for the scatter in the light curves which could be attributed to the differing amplitudes in each cycle. But to the analyst the flat minimum and the variable spacing between the B and V curves suggest that something might be unusual about this star. A quick check of the GCVS noted a variable period - all longer period Miras have these - and the presence of a companion of spectral class F3IV at 0.8" separation. The variable itself has a spectral class of S4,5,8e to S5,5,8e and at -13 degrees is quite a way from the galactic plane.

What the colours show

Colour photometry in astrophysics involves a comparison between different pairs of filters with V providing the apparent magnitude or brightness. So in Figure 2 the phased light curve is shown as V, B-V,

V-R and V-I. There are some offsets to produce a clearer diagram.

The three colour curves now have a rather unusual shape, tending to be out-of-phase with the V brightness curve. The inverted B-V curve is typical of a cool red star with a hot blue companion which affects the colours near minimum, as well as producing a flat minimum.

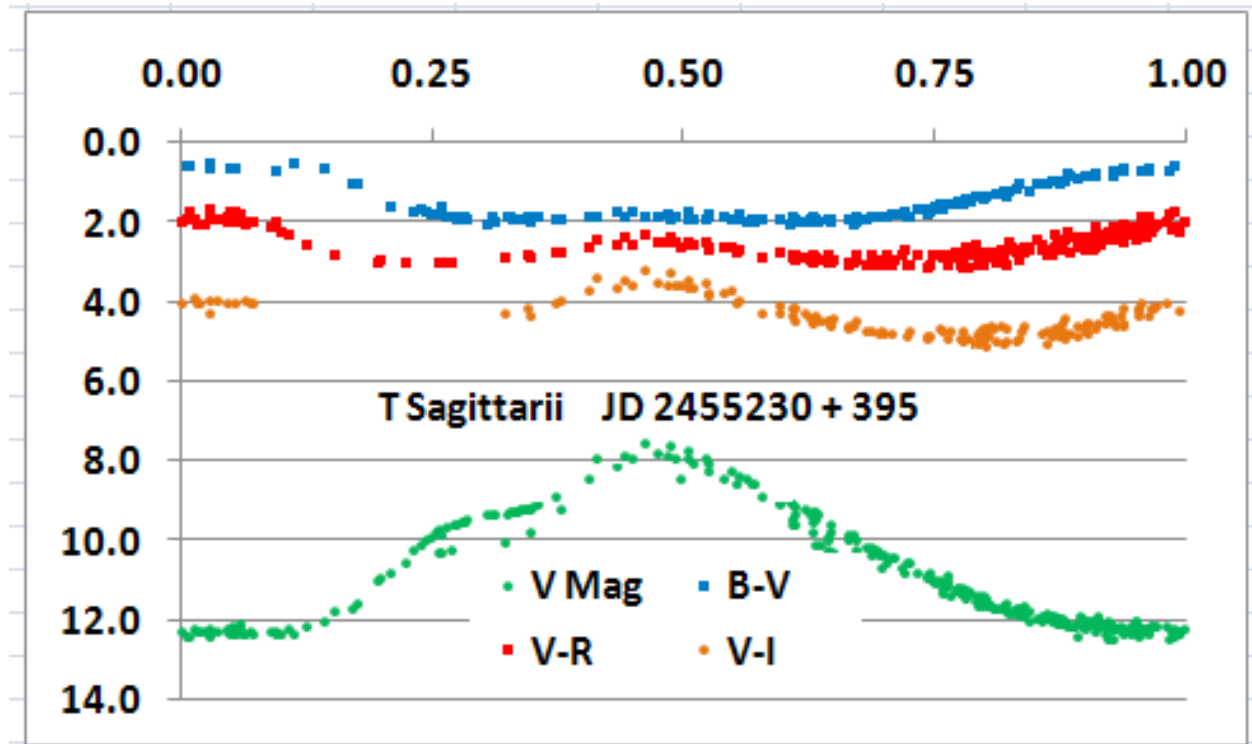


Figure 2. Measures of *T Sagittarii* folded to the same light elements but shown as *V*, *B-V*, *V-R* and *V-I*. *V-R* has been offset by 0.7 and 1.1 to match the data from two observers and to obtain a clearer picture without a colour overlap.

Separating out the Mira light curve

The three datasets provide a full light curve of *T Sagittarii* - but let's look at that of di Scala first. The method of getting rid of the companion star is described in detail but I imagine that software is readily available to do this - I just do not know where to look. Besides, it's more enjoyable to use your own ideas.

Allen's *Astrophysical Quantities* provides colours of $B-V = 0.38$, $V-R = 0.22$ and $V-I = 0.37$ for an F3V star but nothing for luminosity classes IV and III. After some trial and error Figure 3 was produced using values for the companion star of $V = 12.50$, $B = 13.07$, $R = 12.18$ and $I = 11.97$. ($B-V = 0.57$, $V-R = 0.32$, $V-I = 0.53$). There will be some reddening involved so these do not look unrealistic.

Why go to this trouble? Probably a third of all Mira stars have companions. These affect the light curves but only the brighter companions have been identified. The companion to *T Sagittarii* probably owes its being known to the fact that *Sagittarius* is the most heavily studied part of the sky and it received more attention than most Miras.

A more complete picture of all the measures is shown in Figure 4.

Another aspect is that only by using colour photometry and identifying $B-V$, $V-R$ and $V-I$ can we detect Miras which are unusual. There are several stars in di Scala's measures which are interesting, even if the light curves do not show binarity as clearly as this one. So I'm slowly working through these as well.

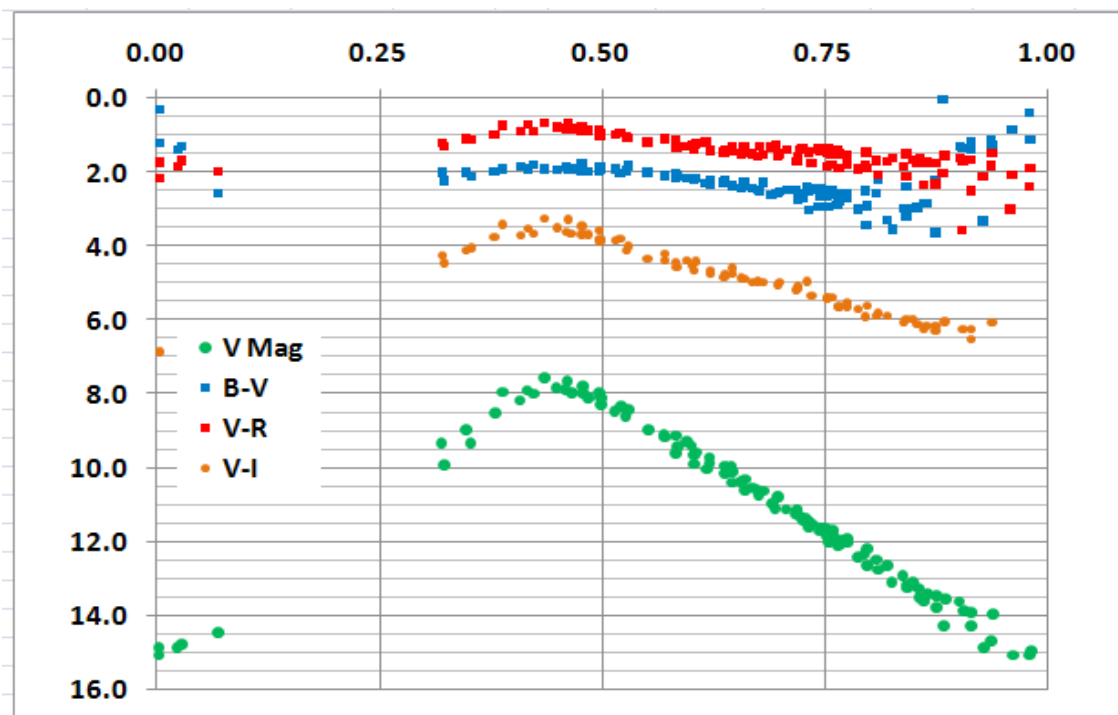


Figure 3. These are the measures by di Scala after the contribution of the F3IV star has been removed. They reveal much more realistic colours but there are some problems introduced by the measuring methods. In order not to saturate in R and I images were defocussed with the result that V became noisy at the fainter limits and B even noisier - the B-V colours within 0.15 phase of minimum are of little value. Due to the faintness of T Sagittarii at minimum the actual B-V value of the companion star is critical and only a very limited range of B-V colours are acceptable in the solution.

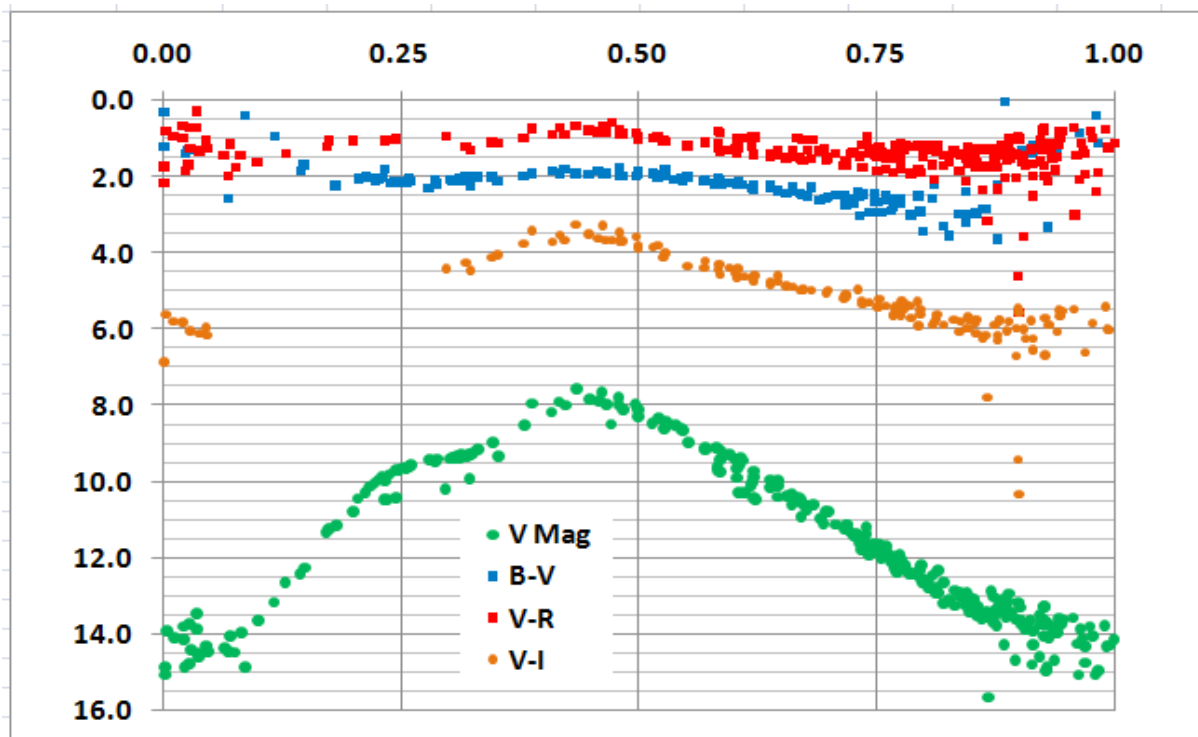


Figure 4. This graph uses the same ephemeris as Figure 1 and includes all the BVRI measures of the three observers. The comments about Figure 3 apply to a large extent here but Henden has resolved part of the colour spread problem by measuring only B and V, Mais by measuring V, R and I. On this scale the disparities in comparisons are noticeable near minimum.

The hump feature in Miras

Many of the longer period Miras - but certainly not all - show a pronounced hump on the rise to maximum. Two stars with period changes are interesting. One star, BH Crucis, was a dual maximum Mira in the 1970s but by 2000 had become a single maximum star with a hump on the rise. Its light curve is now similar to T Sagittarii but as it's a carbon star the amplitude is much less. Whether this hump is associated with period changes is not clear. In the case of R Hydrae, the period of which changed from 520 days about 1660 to 380 days by the 1960s - and may still be changing - there is sometimes a similar hump but measures are not adequate to examine this.

UBVRI photometry may reveal what causes this feature. Do the colours change along with the brightness or is something else involved? Two stars, S Orionis and R Telescopii, show a well-defined hump but the B-V, a temperature indicator, does not show the appropriate changes at the critical times. So there may be complex radius changes as well. T Sagittarii might help understand these changes so removing the effect of the hotter star might reveal something.

Conclusion

The Mira component at minimum is shown to reach as low as $V = 15.0$, giving it an overall amplitude of slightly over 7 magnitudes.

This analysis did not show any unusual temperature changes near the region of the hump on the rise. There is a slight suggestion of a decrease in B-V and hence temperature from phase 0.22 to phase 0.28 but this is so close to the noisy phases within 0.15 either side of minimum that it must be treated with caution,

Apart from this it was an interesting exercise in removing the effects of a companion star from a composite light curve. Several of these were measured at Auckland Observatory in the 1970s and 80s when computers were very slow and spreadsheet techniques not very good. So this might be an interesting area to explore. Several of the stars measured by di Scala also show anomalies in the light or colour curves and these will also be analysed to see if there is any evidence of a companion.

Any Mira with a C or S spectrum or combination of these is worth keeping an eye on. They are probably more highly evolved than those with normal M type spectra and perhaps more likely to show period or other changes.

Acknowledgements

The data has been extracted from the International Database managed by the AAVSO. The time spent by the three observers - two in the northern hemisphere and one in the south - has been substantial and their measures have provided this further insight into the T Sagittarii system.

Re-interpretation of the published O-C diagrams of the delta Scuti Star ZZ Microscopii, and further personal DSLR photometric observations – *Roy Axelsen*

reaxelsen@gmail.com

ZZ Microscopii is a high amplitude delta Scuti star with a principal period of approximately 1 hour 36 minutes and an amplitude of 0.4 magnitude in V. It is reported to have two pulsation frequencies, 14.896 c/d with a semi-amplitude of 147.3 mmag, and a second frequency 19.15 c/d with a much lower semi-amplitude of 14 mmag (Derekas et al, 2009), although Percy (1976), recalculating from the data of Leung (1968), had determined f2 to be 19.5 c/d. O-C diagrams have been published for data from 1960 to 2003 (Kim and Moon 2009) and, after the additional of personal observations, for data from 1960 to 2014 (Axelsen and Napier-Munn 2015).

Personal observations by photoelectric photometry (PEP) were taken in 2008 on 31 July, 9 August and 28 October 2008 and by DSLR photometry in 2014 on 19, 27 and 28 of July, and in 2018 on the four consecutive nights from 12 to 15 August. Times of maximum (TOMs) were calculated from four light curve peaks from PEP in 2008, from 13 light curve peaks in 2014 and from 11 peaks in 2018. The personal DSLR data from 2014 and 2018 were sufficient for Fourier analysis, using the software Period04, the results of which are listed in Table 1 together with data from the literature.

Derekas et al 2009		Axelsen 2014 Data		Axelsen 2018 Data	
Frequency (c/d)	Semi-amplitude (mag)	Frequency (c/d)	Semi-amplitude (mag)	Frequency (c/d)	Semi-amplitude (mag)
f1 14.896	0.147	f1 14.8853	0.164	f1 14.8920	0.175
f2 ¹ (Harmonic)	(Not listed)	f2 ² 29.7706	0.038	f2 ² 29.7725	0.045
f3 19.15	0.015	f3 22.2049	0.009	f3 ³ 44.6530	0.011

Table 1. Fourier analysis of ZZ Mic from the literature and personal data from 2014 and 2018 observations. The 2014 personal data has been published elsewhere (Axelsen and Napier-Munn 2015), but the 2018 data has not been published previously. Notes: 1. Presumably, the harmonic is 2xf1, but the authors do not state this. 2. Harmonic, 2xf1. 3. Harmonic, 3xf1.

All three datasets listed in Table 1 appear to be in agreement that the principal frequency f1 is approximately 14.89 c/d, corresponding to a period of about 1 hour 36 minutes. The second frequency is a Fourier harmonic, found to be 2xf1 in the 2014 and 2018 data. A third frequency is not consistently identified. It was found to be 19.15 c/d by Derekas et al (2009), 19.5 c/d by Percy (1976) and 22.20 c/d by Axelsen and Napier-Munn (2015). However, in the 2018 personal data, the 3rd frequency was found to be another harmonic, 3xf1. In view of these inconsistencies, the issue of a second independent pulsation frequency must be regarded as unresolved.

O-C diagrams

An O-C diagram published by Kim and Moon (2009) (Figure 1) showed data from 1960 to 2003. The authors fitted a second order polynomial function, concave up, which indicated that the period of ZZ Mic was increasing at a slow constant rate, which those authors calculated to be:

$$dP/dt = 7.9 (\pm 15.0) \times 10^{-9} \text{ d yr}^{-1} \text{ or } dP/Pdt = 11.8 (\pm 22.1) \times 10^{-8} \text{ yr}^{-1}$$

However, the present author recalculated the rate of change of the period from Kim and Moon's data and obtained quite different values:

$$dP/dt = 1.67 (\pm 0.56) \times 10^{-9} \text{ yr}^{-1} \text{ or } dP/Pdt = 2.48 (\pm 0.84) \times 10^{-8} \text{ yr}^{-1}$$

The next O-C diagram was published by Axelsen and Napier-Munn (2015) and contained data from 1960 to 2014. The authors decided to fit a third order polynomial expression to the data, but the fit is not ideal (Figure 2). The configuration of the diagram and the shape of the fitted curve indicated that the period of the star had changed. However, when re-analysing the O-C data after obtaining observations

in 2018, the present author realized that the personal 2008 PEP data was best added to Kim and Moon's O-C diagram, and that a second order polynomial expression could be fitted which extended the parabola of Kim and Moon. When this is done, and the additional DSLR photometric data is added to the same diagram (Figure 3), it can be seen that the most likely interpretation is that the period of ZZ Mic has been increasing at a constant rate from 1960 to 2008 (the data across which the parabola – a second order polynomial expression – has been fitted), and that thereafter the period decreased.

The period of ZZ Mic is now clearly different from what it was leading up to 2008. Further monitoring of this star will be required to determine if the period is now stable, or if it is changing at a slow constant rate.

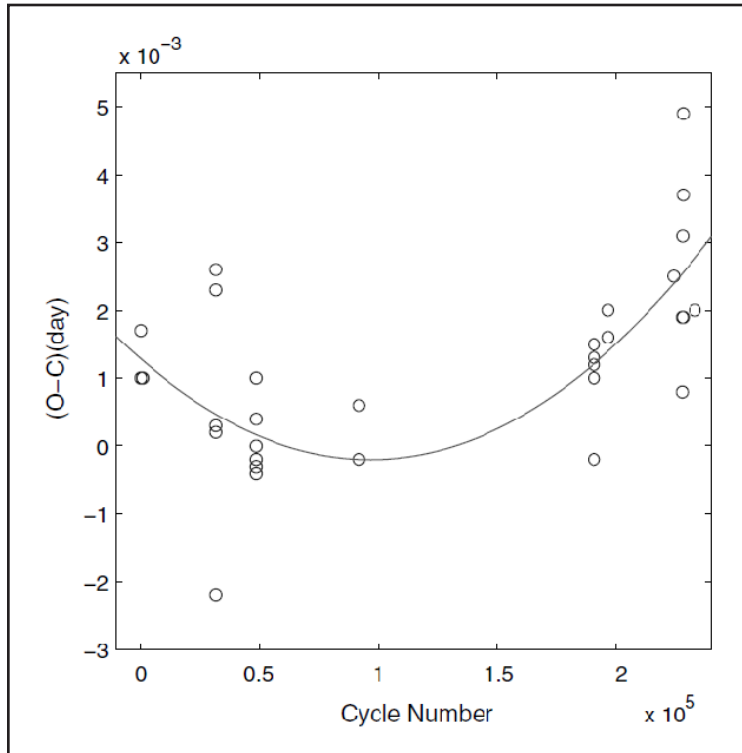


Figure 1. This O-C diagram of ZZ Mic was published as Figure 3 by Kim and Moon (2009). The fitted parabola – second order polynomial expression - which is concave up indicates that the period is slowly increasing at a constant rate.

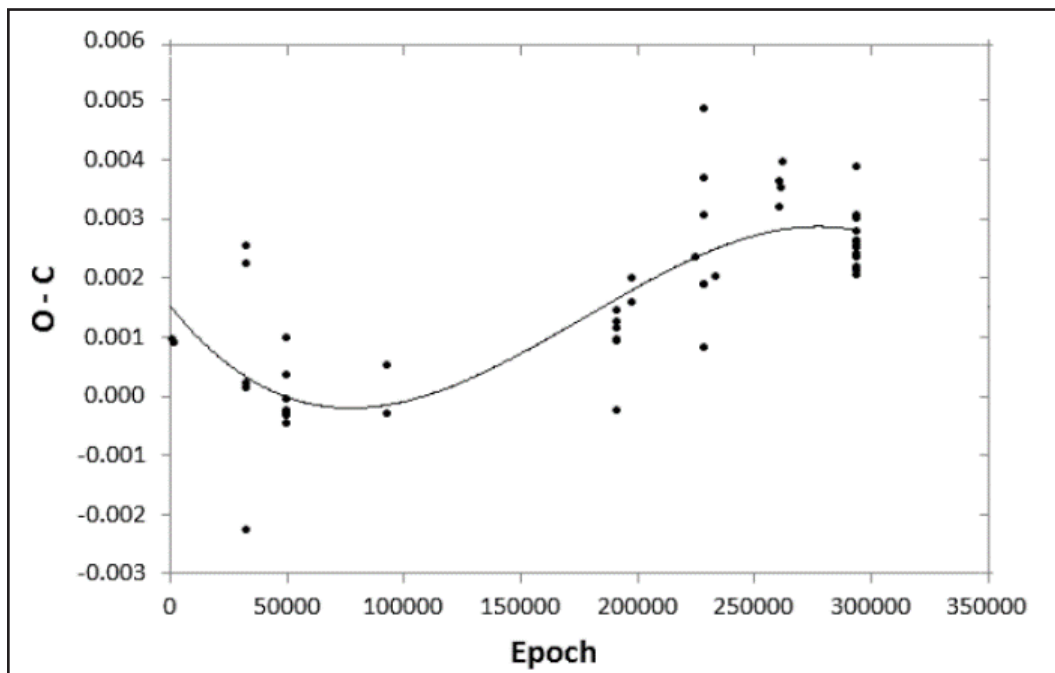


Figure 2. O-C diagram published as Figure 4 of Axelsen and Napier-Munn (2015). The authors PEP data of 2008 and DSLR photometric data from 2014 are the last two groups of O-C values at the right of the plot. A third order polynomial expression has been superimposed, but it is not an ideal fit.

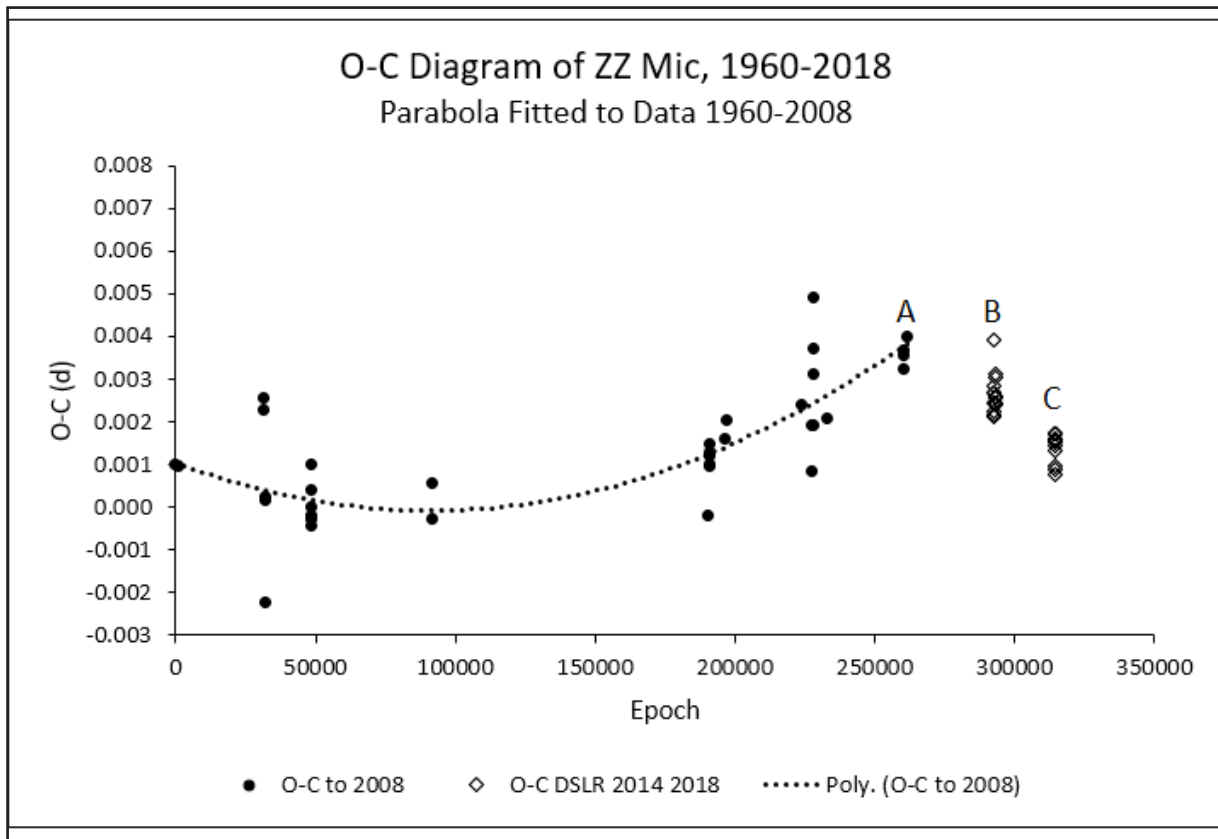


Figure. 3. *O-C diagram of ZZ Mic from 1960 to 2018. A parabola - second order polynomial expression - has been fitted to the data from 1960 to 2008, with the 2008 data (A) from the author's PEP. The last two groups of data to the right (B and C) are from the author's DSLR photometry in 2014 and 2018.*

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The LMC observing programme, part 2 – *Alan Plummer*

alan123604@live.com

The June newsletter included part 1 of a description of the LMC variable star programme observed from Linden. This month we complete the run-through of the Large Magellanic Cloud targets. In the six weeks between writing parts 1 & 2 the programme has developed a bit; a handful of faint red supergiants and one candidate Luminous Blue Variable (also called S Dor stars) have been added, and one new discovery, the classical nova ASAS-SN 18jj.

We'll start here in the Tarantula Nebula (NGC 2070) and then move south into the richest star fields around, then out and about a bit to mention some more distant targets. Mati Morel's LMC Visual Atlas 2000 (Morel 2000) is used to give the best idea possible of what it's like to observe these targets. Reproduced in Figure 1 below is Chart 18, centred roughly on NGC 2070, and the concentration of stellar associations and nebulas within the LMC bar proper—the lower half of the chart—is obvious. There is no greater concentration of NGC objects in all the sky. (The LMC is a very extended object, and Mati's Atlas comprises 27 of these charts, plus 30 deeper 'Selected Area' charts.)

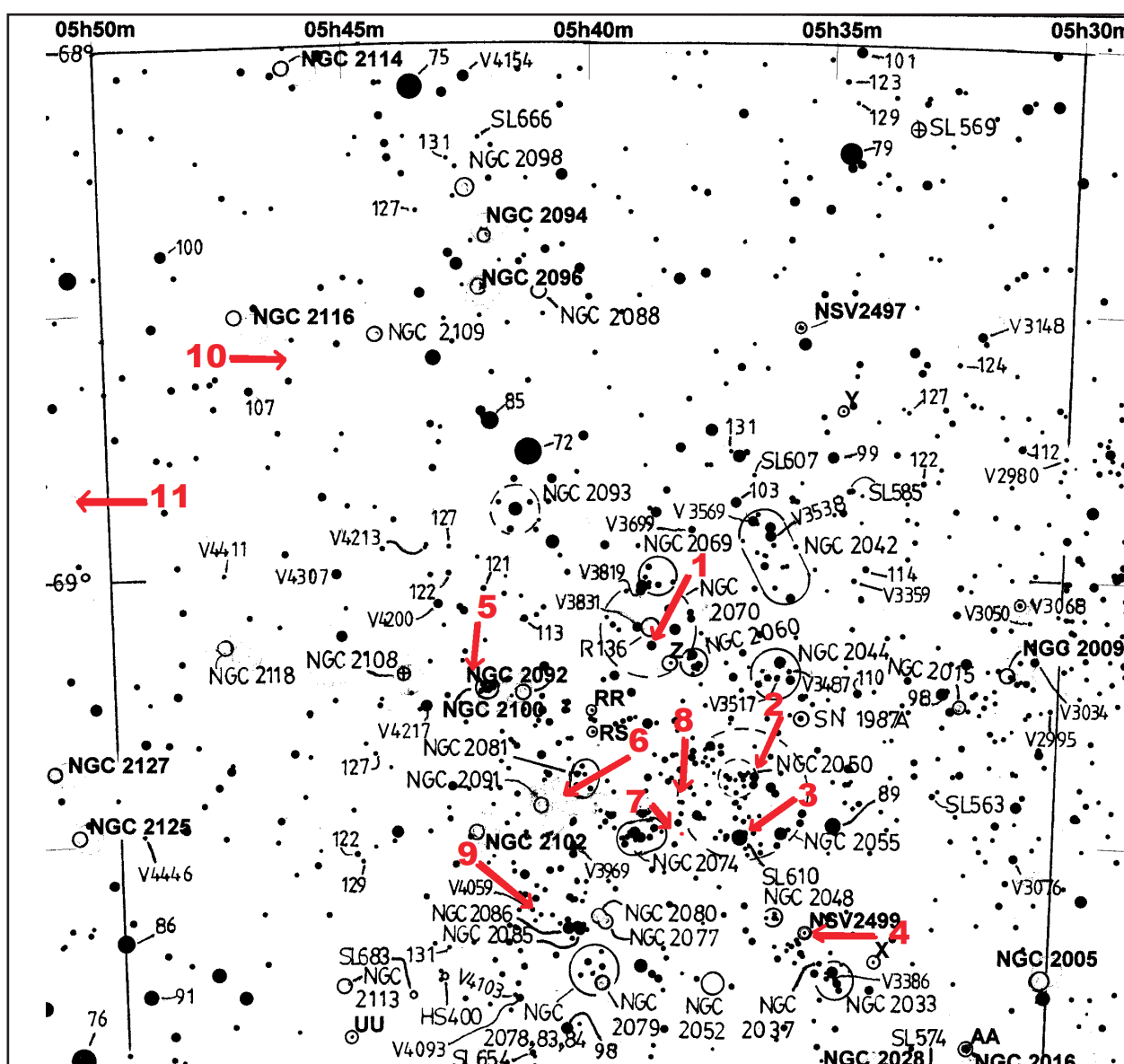
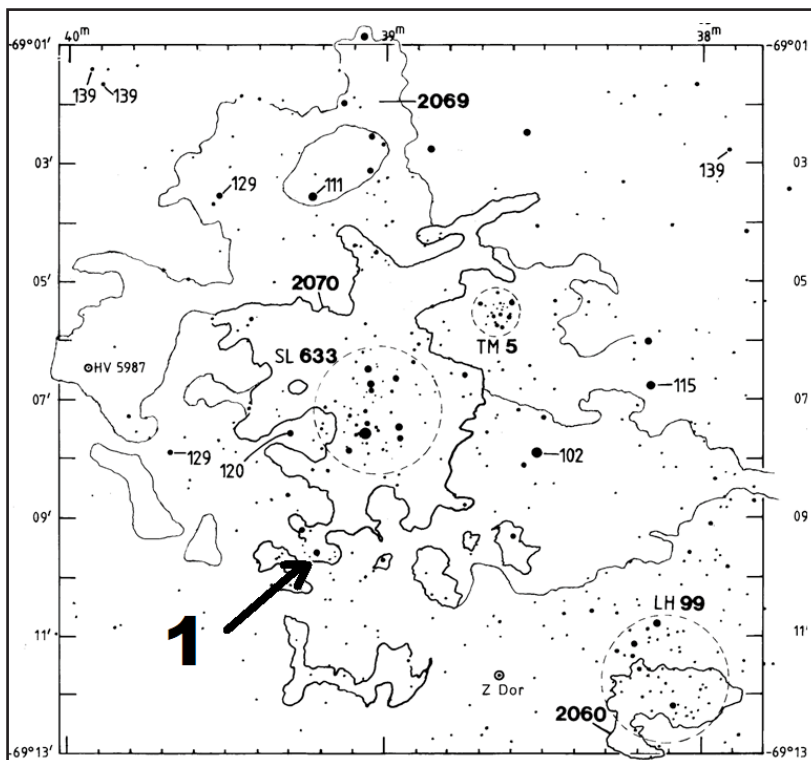


Figure 1. Chart 18 of Mati Morel's LMC Visual Atlas centered on the Tarantula nebula. (Morel 2000)

Put the finder on NGC 2070, and using the 40cm f4 Newtonian with a 9mm eyepiece giving 0.25° fov, enjoy the view for a minute before locating target no. 1, RMC 143. See Figure 2. A more recent addition to the list of Luminous Blue Variables, the star is plotted but not marked as variable. It's faint, at 12th



tively. Although bright, these are both hard to observe because the sequence stars lie some distance away in densely concentrated fields. These targets are both within the extended open cluster NGC 2055, with V3566 further inside NGC 2050, and V3600 further inside the Trapezium-like cluster SL 610. Two of the sequence stars are adjacent to the cluster/emission nebula complex NGC 2078, 2079, 2083, 2084, centre bottom in Figure 1, including LHA 120N 159, pictured in Figure 3. See also Figure 4, where ‘N159E’ is the eastern concentration of the wider nebula. (The filters and lack of fov and orientation particulars make it impossible to align the Hubble photograph with the chart.) Using the necessary 15mm 0.25° fov eyepiece, this is a spectacular field to get to know. Target no. 4, LMC V3436, presently 10.2 mag, needs a 25mm eyepiece with a 0.69° fov for the brighter sequence stars. V3600 is a confirmed and active LBV, while V3566 and V3436 are candidate objects.

Target 10 is BC Doradus, and 11 is YY Dor; two of the several cataclysmic variables I watch (I missed out a handful of old novas last month). BC Dor is a dwarf nova, and so intrinsically not an overly bright thing. In terms of absolute magnitude (Mv), how bright these things might be at 10 parsecs, a typical dwarf nova might be invisible in quiescence, and in outburst from barely visible to up equal to the brightest stars in the sky. By way of comparison, the Sun, with an Mv of 4.75, would be dimly visible from a dark sky. YY Dor is a recurrent nova that in outburst from 10pc might approach the full moon in brightness. It has had observed outbursts in 1937 and 2004. To complete the picture, from 10pc from here the red supergi-

Targets 2 and 3 in Figure 1 are LMC V3566 and LMC V3600, currently 11th and 10th mag respec-



ants might shine as bright as Jupiter or Venus, and the LBVs from that, up to as bright as the full moon. All my observations of BC Dor and YY Dor to date are negative.

There are several objects I observe that are located a long way off the chart in Figure 1, but I'll only mention one more here; the classical nova ASAS-SN 18jj. This was discovered by the All Sky Automated Survey on May 3rd, at 12th mag. Easy to find, it's only seven or eight arc minutes from $\pi 2$ Dor. Like YY Dor, at 10pc this one might approach the full moon in brightness. Fortunately it has exhibited a slow-ish decline, so there have been enough almost-clear nights at Linden to get a light curve. My last observation was 13.7 mag on the 14th of May, and so far I seem to be the only one following it.

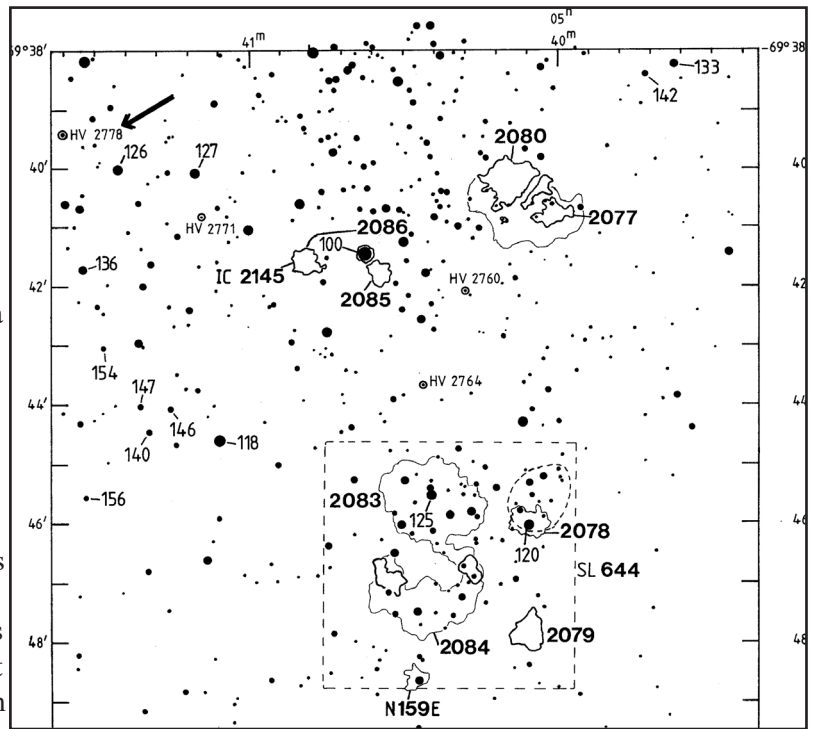


Figure 4. Chart 28 from 'Selected Areas' (Morel 2000)

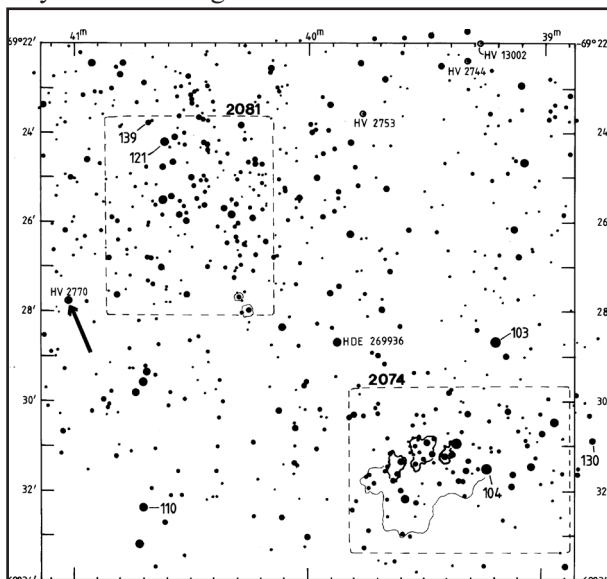


Figure 5. Chart 27 from 'Selected Areas' (Morel 2000)

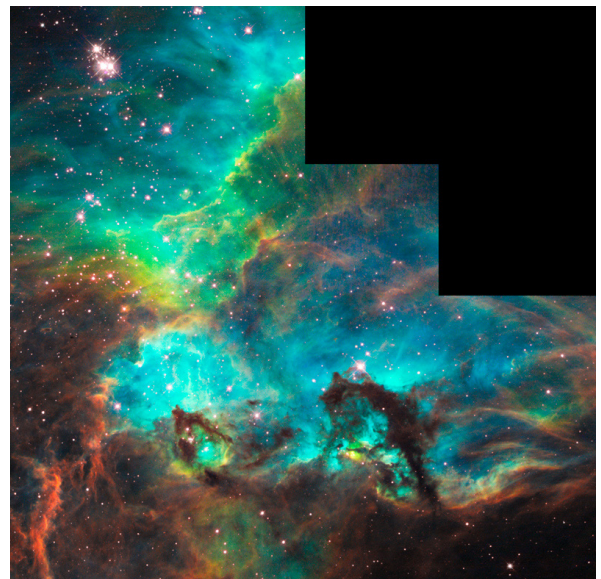


Figure 6. NGC 2074 [NASA](#), [ESA](#), and M. Livio ([STScI](#))

Target #	Name	RA(J2000)	Dec (J2000)	Field	Spectral type	Magnitude
1	RMC 143	05 38 51.62	-69 08 07.4,	SDOR	O9.5I-F8Ia	10.6-12.0V
2	LMC V3566	05 36 25.84	-69 22 55.9	ACYG:	B0.5Ia	10.85-11.0V
3	LMC V3600	05 36 43.69	-69 29 47.5	SDOR	Ofpe/WN9-AI	8.8-12.2
4	LMC V3436	05 35 16.63	-69 40 38.4	SDOR:	Be	10.25-10.7V
5	LMC V4171	05 42 35.35	-69 08 48.4	SRC	M1.5I	12.2-13.0V
6	HV 2770	05 40 36.93	-69 26 20.3	SRC	M3.5Ia	12.7-14.0V
7	LMC V3745	05 38 06.55	-69 28 45.4		K5Iab	13-13.6V
8	HV 2730	05 37 43.02	-69 25 00.1		M2.5Ia	2.2-13.6V
9	HV 2778	05 41 10.66	-69 38 04.4		M1Iab	11.9-13.5V
10	BC Dor	05 46 14.96	-68 35 23.7	UGSU		13.2-19.7V
11	YY Dor	05 56 42.38	-68 54 34.3	NR		10.8p-19.5V

Publication watch

As part of her studies for an M Phil degree **Margaret Streamer** has recently published a paper on her work in MNRAS.

Streamer, Margaret; Ireland, Michael J; Murphy, Simon J; Bento, Joao. *A window into δ Sct stellar interiors: understanding the eclipsing binary system TT Hor.* Monthly Notices of the Royal Astronomical Society, Volume 480, Issue 1, 11 October 2018, Pages 1372–1383, <https://doi.org/10.1093/mnras/sty1881>

Abstract

The semi-detached eclipsing binary system, TT Hor, has a δ Sct primary component (accretor) accreting mass from the secondary star (donor). We fit an eclipsing binary model from V, B and I photometry combined with spectroscopy using PHOEBE. Radial velocity variations of the center of mass of TT Hor AB over 2 years suggest the presence of a wide companion, consistent with a Kozai-Lidov resonance formation process for TT Hor AB. Evolutionary models computed with MESA give the initial mass of the donor as $\sim 1.6 M_{\odot}$ and that of the accretor as $\sim 1.3 M_{\odot}$. The initial binary orbit has a similar initial separation to the currently observed separation of $11.4 R_{\odot}$. Mass transfer commences at an age of 2.5 Gyr when the donor is a subgiant. We model the accretor as a tidally-locked, $2.2 \pm 0.2 M_{\odot}$ δ -Sct pulsator which has accreted $\sim 0.9 M_{\odot}$ of slightly He-enriched material (mean $\Delta Y < 0.01$) from the donor over the last 90 Myr. The best fit from all measured parameters and evolutionary state is for a system metallicity of $[M/H]$ is 0.15. A pulsation model of the primary gives a self-consistent set of modes. Our observed oscillation frequencies match to within 0.3% and the system parameters within uncertainties. However, we cannot claim that our identified modes are definitive, and suggest follow-up time-series spectroscopy at high resolution in order to verify our identified modes. With the higher SNR and continuous observations with TESS, more reliable mode identification due to frequency and amplitude changes during the eclipse is likely.

The Southern Eclipsing Binary project team have another publication of their recent work

Richards, Tom; Blackford, Mark; Butterworth, Neil; Crawford, Greg; Jenkins, Robert. *Southern eclipsing binary minima and light elements in 2017.* Open European Journal on Variable stars, Vol. 189, p. 1

Abstract

We present 101 minima estimates of 40 southern eclipsing binaries obtained in 2017 by members of the Southern Eclipsing Binary group of Variable Stars South using DSLR and CCD detectors. Where sufficient minima estimates of a target are obtained, we report the light elements derived from those minima, together with O-C comparisons with light elements in the literature.

The team looking at V454 Car has a new publication.

Butland, R. J.; Erdem, A.; Özkardes, B.; Blackford, M. G.; Sürgit, D.; Budding, E.; Demircan, O. *Absolute Parameters of Young Stars: V454 Carinae.* Monthly Notices of the Royal Astronomical Society, sty2543, <https://doi.org/10.1093/mnras>

Abstract

We present combined photometric and spectroscopic analyses of the multiple star V454 Car. High-resolution spectra of the system were taken at the University of Canterbury Mt. John Observatory in the years 2008-18. These have been processed using generic and purpose-built software. New DSLR photometry of the system has also been collected and similarly analysed. Absolute parameters for the three main stars confirm V454 Car's young and near-Main-Sequence nature. We find: $M1 = 4.6 \pm 0.4$, $M2 = 4.4 \pm 0.4$, $M3 = 4.5 \pm 0.5$, $R1 = 2.83 \pm 0.18$, $R2 = 2.74 \pm 0.16$, $R3 = 2.78 \pm 0.16$, ($\odot$); $T1 \sim 17500$, $T2 \sim 15500$, $T3 \sim 15000$ (K), age ~ 30 My, photometric distance ~ 500 (pc). The major component V454 Car A is the close binary iden-

tified by the HIPPARCOS satellite. This binary and component B appear to be in eccentric orbits about a common centre of gravity with a period of ~ 1900 d. Analysis of the radial velocity curves suggests that the mass of component B is greater than that of its visible member. Measured radial velocities of this visible star show irregularities with a timescale of about a week. The galactic location, proper motions and age of V454 Car support the runaway nature proposed by others, and the combined results are consistent with a dynamical ejection scenario from the Vela region of Gould's Belt relatively soon after the stars' formation.

Your editor, Phil Evans, has been named as a co-author in three recent exoplanet papers from the KELT group and the TESS group, published on the arXiv.

Labadie-Bartz, J *et al.* *KELT-22Ab: A Massive Hot Jupiter Transiting a Near Solar Twin.*
arXiv:1803.07559.

Abstract

We present the discovery of KELT-22Ab, a hot Jupiter from the KELT-South survey. KELT-22Ab transits the moderately bright ($V \sim 11.1$) Sun-like G2V star TYC 7518-468-1. The planet has an orbital period of $P = 1.3866529 \pm 0.0000027$ days, a radius of $R_p = 1.285^{+0.12}_{-0.071} R_J$, and a relatively large mass of $M_p = 3.47^{+0.15}_{-0.14} M_J$. The star has $R_* = 1.099^{+0.079}_{-0.046} R_\odot$, $M_* = 1.092^{+0.045}_{-0.041} M_\odot$, $T_{\text{eff}} = 5767^{+50}_{-49}$ K, $\log g_* = 4.393^{+0.039}_{-0.060}$ (cgs), and $[m/H] = +0.259^{+0.085}_{-0.083}$, and thus, other than its slightly super-solar metallicity, appears to be a near solar twin. Surprisingly, KELT-22A exhibits kinematics and a Galactic orbit that are somewhat atypical for thin disk stars. Nevertheless, the star is rotating quite rapidly for its estimated age, shows evidence of chromospheric activity, and is somewhat metal rich. Imaging reveals a slightly fainter companion to KELT-22A that is likely bound, with a projected separation of 6 arcsec (~ 1400 AU). In addition to the orbital motion caused by the transiting planet, we detect a possible linear trend in the radial velocity of KELT-22A suggesting the presence of another relatively nearby body that is perhaps non-stellar. KELT-22Ab is highly irradiated (as a consequence of the small semi-major axis of $a/R_* = 4.97$), and is mildly inflated. At such small separations, tidal forces become significant. The configuration of this system is optimal for measuring the rate of tidal dissipation within the host star. Our models predict that, due to tidal forces, the semi-major axis of KELT-22Ab is decreasing rapidly, and is thus predicted to spiral into the star within the next Gyr.

Collins, Karen A., *et al.* *The KELT Follow-Up Network and Transit False Positive Catalog: Pre-vetted False Positives for TESS.* arXiv:1804.01623.

Abstract

The Kilodegree Extremely Little Telescope (KELT) project has been conducting a photometric survey for transiting planets orbiting bright stars for over ten years. The KELT images have a pixel scale of $\sim 23''/\text{pixel}$ – very similar to that of NASA's Transiting Exoplanet Survey Satellite (TESS) – as well as a large point spread function, and the KELT reduction pipeline uses a weighted photometric aperture with radius $3'$. At this angular scale, multiple stars are typically blended in the photometric apertures. In order to identify false positives and confirm transiting exoplanets, we have assembled a follow-up network (KELT-FUN) to conduct imaging with higher spatial resolution, cadence, and photometric precision than the KELT telescopes, as well as spectroscopic observations of the candidate host stars. The KELT-FUN team has followed-up over 1,600 planet candidates since 2011, resulting in more than 20 planet discoveries. Excluding ~ 450 false alarms of non-astrophysical origin (i.e., instrumental noise or systematics), we present an all-sky catalog of the 1,128 bright stars ($6 < V < 10$) that show transit-like features in the KELT light curves, but which were subsequently determined to be astrophysical false positives (FPs) after photometric and/or spectroscopic follow-up observations. The KELT-FUN team continues to pursue KELT and other planet candidates and will eventually follow up certain classes of TESS candidates. The KELT FP catalog will help minimize the duplication of follow-up observations by current and future transit surveys such as TESS.

Vanderspek, Roland *et al.* *TESS Discovery of an ultra-short-period planet around the nearby M dwarf LHS 3844.* arXiv:1809.07242.

Abstract

Data from the newly-commissioned Transiting Exoplanet Survey Satellite (TESS) has revealed a “hot Earth” around LHS 3844, an M dwarf located 15 pc away. The planet has a radius of $1.32 \pm 0.02 R_{\oplus}$ and orbits the star every 11 hours. Although the existence of an atmosphere around such a strongly irradiated planet is questionable, the star is bright enough ($I=11.9$, $K=9.1$) for this possibility to be investigated with transit and occultation spectroscopy. The star’s brightness and the planet’s short period will also facilitate the measurement of the planet’s mass through Doppler spectroscopy

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.

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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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