Wellington Astronomical Society November 2016 Volume 46 Issue 10
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The next WAS meeting will be held on Wednesday 2nd of November 2016 at 7:30 pm at Carter Observatory, Upland Rd, Kelburn, Wellington

Wellington Astronomical Society Annual General Meeting

The Wellington Astronomical Society Annual General Meeting will be held on Wednesday 2 November, at Space Place at Carter Observatory, beginning at 7:30pm.

The agenda is as follows:

- President's Annual Report
- Treasurer's Report
- Syd Cretney Subcommittee Presentation
- Election of Officers for the next year
- Changes to the Constitution
- Other Business

Note that you need to be a **financial member** to vote so please renew your subscription if you haven't already done so.

Inside this issue:

2016 — 2017 SUBSCRIPTIONS DUE

The new subscription year began in September, so WAS looks forward to receiving your subscription renewal.

Renewal forms can be found on the website, but a summary follows:

Subscription for Newsletter by Email 2015-2016

Adult/Waged:	$ 50.00
Student/Unwaged:	$ 30.00
Family:	$ 70.00

Payment methods:

Cheque - make out to Wellington Astronomical Society Inc, and mail to PO Box 3181, Wellington 6140

Direct Deposit or Internet Banking - use Acc No: 03-0502-0508656-00, please include reference so WAS knows who is making the payment

Cash - please bring exact amount to meeting

WAS COUNCIL MEMBERS AND CONTACTS

Council Members

The following members were elected to Council at the Nov 2015 AGM

President: Antony Gomez

Vice President: Duncan Hall

Secretary/Telescope custodian: Chris Monigatti

Treasurer: John Homes

Website (joint): John Homes & John Talbot

Councilors

Frank Andrews

Janine Bidmead

Peter Graham

Aline Homes

Murray Forbes

James Smith

Peter Woods

Newsletter Editor: editor@was.org.nz

Postal Address: Wellington Astronomical Society, PO Box 3181, Wellington 6140, New Zealand

WAS ON FACEBOOK

Our Facebook page "Wellington Astronomical Society" is now operational. You can search for it on Facebook or click on this link https://www.facebook.com/WellingtonAstronomicalSociety/.

If you are a Facebook user, please use the page to receive up-to-date notifications of our Society's events and news. This is the easiest way to keep informed as to what is going on in the Society, as well as keeping up with astronomical news.

Remember you will need to interact occasionally with the page by liking or commenting on postings, or indicating whether you are coming to an event. Otherwise Facebook will, after a time, stop sending you new postings. So keep visiting the page as there are a number of Society events coming up in the next few months.

We also have Facebook group "WAS – Wellington Astronomical Society" https://www.facebook.com/groups/96304353012/ which is open for anyone to join by request. The public group is open for discussion or postings on astronomical news.

VOLUME 46 ISSUE 10

President's Annual Report

This has been my first term as President. It has been a good year and I have enjoyed the time. One objective we set at our first Council meeting last December was to raise the public profile of the Society and to increase our membership. I am confident we are achieving this objective through our public outreach events.

Our public outreach is making a difference as we have had some new and younger people come to the Society meetings and become members. We have held numerous telescope evenings at various schools in the Wellington region as well as holding regular monthly astronomy club meetings at 2 Hutt Valley schools. We co-host the bi-monthly Astronomy Night at the Lower Hutt War Memorial Library. During April's Global Astronomy month we were involved in 9 public events which included the Global Star Party and Sun Day held at Anderson Park in the Botanical Gardens. June was a busy month with many Matariki events held at a number of schools, Te Papa and the Matariki Dawn Viewing at Mt Victoria. Some of us were there at 4:30 in the morning setting up telescopes.

We also took part in the Wellington Engineering and Science Festival 2016 Lecture Series and more notably in the Space & Science Festival at Onslow College where over 3000 people attended. For a straight 9 hours we were inundated with queues at each of the 4 telescopes for solar viewing during the day and 4 telescopes for the evening observing the planets and the Moon. In hindsight we could have used more help to run shifts allowing those there to have a break. We have also had successful events at the Wellington waterfront with the 5 Planets and Observe the Sun & Moon Day. What these events show is that there is a strong yearning for the general public to take the opportunity to look through a telescope. Those of us involved in these public events will never grow tired of hearing the gasps of astonishment and awe from those seeing Saturn and its rings for the first time. All in all, including the monthly Society meetings and observing evenings, we were involved in nearly 70 events during the past 12 months.

Space and Science Festival—Onslow College

Social media plays an important role in today's world so we created a Facebook page Wellington Astronomical Society where all our events and latest astronomical news are posted. We also have 2 Facebook groups, WAS - Wellington Astronomical Society where members of the group can post articles and interact with each other, and the WAS Astrophotography Group which is for the recently formed astrophotography group. Having a Facebook page has allowed the public to take an interest in our activities and see our news postings. Some of these posts have been viewed by over 1000 people. The website has had improvements in that some of the pages are now mobile friendly. More work has to done on the website was.org.nz which we will continue to do in the coming year, improving its content and making it more dynamic so members can interact with it.

There has been a good turnout at our monthly Society meetings where we would have 30- 50 attending each meeting. These meetings are open to the public to attend and we have had some excellent presentations on varied topics as the list shows.

1. An Evening with Albert - Roland Idacyzk
2. Pictures from radio waves: how are images of astronomical radio sources constructed? - Duncan Hall
3. Astronomy and 3-D printing - Murray Forbes
4. Where are all the Aliens? An Introduction to the Fermi Paradox - Josh Gross
5. Is The Solar System Stable? - Dr Warwick Kissling
6. Revitalising Maori Astronomical Knowledge and Traditional Calendars - Dr Pauline Harris
7. Exoplanets: Facts and Fancies - Dr Ed Budding
8. Space Academy for Educators - Chris Monigatti
9. Imaging the Night Sky - Edward Wilcock and Jim McAloon
10. 4000 years in 40 minutes - Jay Èvett
11. Annual General Meeting

WAS Meeting

We have also had positive feedback about our new format at the monthly meetings. Each meeting now starts with a short presentation on the Night Sky pointing out some of the highlights during the coming month followed by the latest astronomy and Society news. The main presentation starts later closer to 8pm which unfortunately leaves slightly less time for socialising at the end of the meeting.

The meeting is preceded by 2 other meetings, the Research Group and now the newly formed Astrophotography Group. The Research Group mainly focuses on occultations and variable star observations and some of these results have been presented at national and international workshops and conferences. A number of members have expressed an interest in astrophotography so a new Astrophotography Group has formed with a couple expert members willing to show us the ropes.

The WAS observatory has now been re-sited at Tawa College. There are some minor issues that need resolving including the installation of a 12" telescope but we are hopeful that the observatory will be operational by the end of this year. The WAS Observing evenings are attended by a number of regulars but the plan is to encourage more members to come along by providing beginner courses on binocular and telescope observing as well as navigating the night sky.

The Society purchased a new 10" Dobsonian telescope which was partly funded by a public event we were asked to participate in with our telescopes. We would also like to purchase a 60mm Lunt solar scope for use at our public outreach events, taking it to schools and for the Astrophotography Group. At the moment the Society does not own a solar scope and has relied on borrowing from outside the Society. This is not tenable so there is an urgent need to purchase one as soon as we can. We need in the vicinity of $5000 for a solar scope and mount and will look for donations from members and apply for funding.

We are grateful to late Syd Cretney for his bequest to the Society to build an observatory for its members. Unlike the WAS Tawa observatory, the Syd Cretney Observatory will be a high end facility that could be used for research and astrophotography, and which will be remotely accessible through the internet. This means it can be operated from anywhere without anyone actually being present at the observatory. WAS has signed an agreement with the Gifford Observatory Trust to use the Gifford Observatory based at Wellington College to trial the technology and assess the demand for use. A small project team has been set up and they have been hard at work planning its development. A lot of effort was initially put in by a couple of Council members dealing with the lawyers acting for WAS and lawyers acting for the estate of Syd Cretney. This work resulted in the WAS proposal of collaborating with the Gifford Observatory Trust being accepted by Cretney estate. More details on the Syd Cretney Observatory project will be presented at the AGM.

WAS and the Wellington Museums Trust (WMT), which operates Space Place at Carter Observatory, have developed a good working relationship with each other. We have run joint events together such as the Matariki Dawn Viewing and the Beatrice Tinsley Lecture, and we plan to hold more regular events together in the future. The Society would also like to thank WMT for making Space Place freely available for its monthly meetings.

As President, I would like to thank

- the Council and especially our Secretary for their efforts in keeping the Society running smoothly,
- the editor and newsletter team for preparing the monthly newsletter,
- the social media team,
- the presenters at our monthly meetings,
- those that help out at the meetings with supper and putting away the chairs,
- the Cretney Bequest Committee for their efforts to date,
- and especially those Society members who have given up much of their time to help out with the public outreach events.

Lastly I would like to mention that late in September the Council met for a Strategic Planning meeting where we discussed the future directions of the Society as it approaches its 50th Jubilee in 2023. There are some exciting plans afoot which will be addressed at the AGM. I look forward to seeing as many of you there.

Antony Gomez

Annual Financial Statement

Wellington Astronomical Society Incorporated
Statement of Financial Performance CASH position as known at 30 August 2016
For Year ending 31-August-2016

INCOME:	Note#	2016	2015	2014	2013
Subscriptions Renewals in year	1	$2,050.00	$1,865.00	$2,395.00	$2,115.00
New Subscriptions	1	$325.00	$410.00	$290.00	$490.00
Interest		$120.61	$188.44	$183.96	$154.59
Donations		$110.00	$60.00	$1,110.00	$70.00
Grants		$-	$-	$-	$300.00
G Blow Legacy		$1,000.00	$-	$-	$-
Sold capital Items	2	$100.00	$-	$-	$300.00
Solar Viewers		$-	$-	$-	$140.00
Other	3	$400.00	$2,825.95	$-	$40.00
Total Income		**$4,105.61**	**$5,349.39**	**$3,978.96**	**$3,609.59**
EXPENDITURE:					
Affiliation Fees to RASNZ		$183.75	$127.50	$213.75	$146.25
Auditor		$100.00	$100.00	$-	$-
Bank Fees & Cheque book		$-	$-	$-	$-
Insurance		$410.55	$410.55	$410.55	$410.55
Post Office Box Hire	4	$-	$92.50	$185.00	$185.00
Newsletter Printing	5	$168.50	$129.00	$128.90	$224.11
Postage	6	$-	$-	$126.00	$30.80
Room Hire	7	$-	$-	$100.00	$-
Speakers		$314.50	$377.03	$50.00	$777.00
Cretney Bequest		$-	$2,825.95	$-	$-
Maintenance on Equipment		$-	$-	$-	$-
Solar Viewers		$-	$-	$-	$100.00
Moving Observatory		$172.50	$-	$-	$230.00
BHT Lecture		$187.00	$250.00	$-	$500.00
Web Site		$195.94	$195.94	$199.28	$199.28
Other Expenses		$128.73	$25.80	$50.00	
Capital Items		$825.00			
Total Expenditure		**$2,686.47**	**$4,534.27**	**$1,463.48**	**$2,802.99**
Cash Income less Expenditure		$1,419.14	$815.12	$2,515.48	$806.60
Accrual adjustments					
Reverse of previous years AP		$113.20	$107.00	$16.00	$-
Less current Accounts Payable	8	$150.00	-$113.20	-$107.00	-$16.00
Reverse of previous years Prepaid		-$239.49	-$310.30	-$293.44	$-
Plus Debtors/Prepayments		$-	$239.49	$310.30	$293.44
Less Depreciation	9	-$599.06	-$673.27	-$779.05	-$1,452.14
Income less Expenditure		**$1,668.79**	**$64.84**	**$1,762.29**	**($368.10)**

NOTES:

1. Includes $150.00 subscriptions paid in 2015-2016 year for 2016-2017 year.
2. Telescope mount not being used.
3. Payment from Te Papa for participation in event.
4. We now share a PO Box with RASNZ, and have yet to receive an account for our share of the costs.
5. We have been trying to reduce the number of printed newsletters, but there are still a few needed.
6. Postage still using stamps from previous year.
7. No room hire charges, due to arrangement with Wellington Museums Trust.
8. Subscriptions for 2016-2017 year per Note 1 above.
9. No depreciation included as yet for latest equipment purchase at end of this year.

Wellington Astronomical Society Incorporated
Statement of Financial Position **For Year ending 31 August 2016**

Current Assets	Note#	2016	2015	2014	2013
Bank Accounts		$16,699.17	$15,280.03	$14,451.71	$11,936.23
Prepayments		$-	$239.49	$310.30	$293.44
Total Current Assets		$16,699.17	$15,519.52	$14,762.01	$12,229.67
Property, Plant & Equipment from De	9	$5,910.48	$6,509.54	$7,182.81	$7,961.86
Total Assets		$22,609.65	$22,029.06	$21,944.82	$20,191.53
Liabilities					
Accounts Payable	10	$150.00	$113.20	$107.00	$16.00
Telescope Deposits	11				
Total Current Liabilities		$150.00	$113.20	$107.00	$16.00
Net Assets		**$22,459.65**	**$21,915.86**	**$21,837.82**	**$20,175.53**

Represented by Accumulated Funds o	Note#	2016	2015	2014	2013
Opening Balance 01-September		$21,999.92	$21,935.08	$20,172.79	$20,785.25
Income less Expenditure		$1,668.79	$64.84	$1,762.29	($612.46)
Total Members Funds		$23,668.71	$21,999.92	$21,935.08	$20,172.79

Bank Accounts		2016	2015	2014	2013
Cheque		$3,680.24	$7,448.33	$6,771.70	$4,407.75
Simple Saver		$13,018.93	$7,831.70	$7,680.01	$7,528.48
Total		$16,699.17	$15,280.03	$14,451.71	$11,936.23

Movement In Bank Accounts		Opening Bal	Deposits	Interest	Withdrawals	Closing Bal
Cheque		$7,448.33	$3,985.00	$33.38	$7,786.47	$3,680.24
Simple Saver		$7,831.70	$5,100.00	$87.23	$-	$13,018.93
Total		$15,280.03	$9,085.00	$120.61	$7,786.47	$16,699.17

Net bank change	$1,419.14	

Movement In Members Funds		2016	2015	2014	2013
Total Assets Opening		$21,999.92	$21,935.08	$20,172.79	$20,785.25
Cash, Income Less Expenditure		$1,419.14	$815.12	$2,515.48	$806.60
Assets Purchased		$825.00	$-	$-	$-
Assets sold					
Depreciation		-$599.06	-$673.27	-$779.05	-$1,452.14
Reverse of previous years AP		$113.20	$107.00	$16.00	$34.30
Less current Accounts Payable		$150.00	-$113.20	-$107.00	-$16.00
Reverse prev yr Accounts receivable/prepaic		-$239.49	-$310.30	-$293.44	-$278.66
Plus Accounts receivable/prepaid		$-	$239.49	$310.30	$293.44
Reverse previous years Telescope Deposits		$-	$-	$-	$-
Total Assets Closing		$23,668.71	$21,999.92	$21,935.08	$20,172.79

NOTES (continued):

8. Subscriptions for 2016-2017 year per Note 1 (see previous page)
9. No depreciation included as yet for latest equipment purchase at end of this year.
10. Subscriptions for 2016-2017 year per Note 1 (see previous page)
11. Telescopes are currently on loan to members only, and a deposit is not required.

Wellington Astronomical Society November 2016 Events

WAS Astrophotography Group

Come along to the South Coast of Wellington this Saturday night for a basic astrophotography workshop hosted by the Wellington Astronomical Society. We will cover the basic steps for setting up, camera settings, composition as well as tips on post-processing. This is the first outdoors Astrophotography event we have held so this event is to get people along. We will head out to more scenic locations with less light pollution in the future.

What to bring:

- A DSLR or mirrorless camera,
- A wide angle lens (preferebly),
- A tripod to fix the camera to
- And something warm knowing Wellington's wind!

While the moon will not be up on Saturday night making for better imaging of the night sky, the weather may not play along so any updates will be posted on here. Sunset will be after 8pm so it gives us an hour to setup and do some introductions to astrophotography.

Register you interest through the event on the WAS Facebook page.

For further details or cancellations contact Edward 021_08304802 or Chris 021_ 890222.

Date: Saturday 29th October

Time: 7:00pm

Venue: Te Raekaihau Point, South coast between Lyall Bay and Houghton Bay, Queens Drive. (see map)

WAS Annual General Meeting

Agenda

- President's Annual Report
- Treasurer's Report
- Syd Cretney Subcommittee Presentation
- Election of Officers for the next year
- Changes to the Constitution
- Other Business

Date: Wednesday 2nd November

Time: 7:30pm

Venue: Space Place, Carter Observatory

Note that you need to be a financial member to vote so please renew your subscription if you haven't already done so.

WAS Society Observing Evening

Come along and see the many wonderful objects, star clusters, galaxies, dying stars and nebulae as well as Venus, Mars, Saturn and the Moon. For beginners, help and training will be given in how to use telescopes. Telescopes will be available for use.

Date: Saturday 5th November

Time: 7:30pm

Venue: Tawa College

Astronomy Club Night

A short presentation and observing the night sky. Anyone is welcome to join in.

Date: Thursday 10th November

Time: 7:00pm

Venue: Hutt International Boys School

Astronomy Club Night

A short presentation and observing the night sky. Anyone is welcome to join in.

Date: Thursday 24th November

Time: 7:00pm

Venue: St Bernard's College, Lower Hutt

WAS Astrophotography Group

Time and location to be decided. More details will be available on the WAS Facebook page closer to the date.

Date: Saturday 26th November

Time: TBD

Venue: TBD

NZ Astrophotography Weekend 2016

The Horowhenua Astronomical Society is hosting the fourth New Zealand Astrophotography Weekend. Held in the lower North Island it is an annual event dedicated to astrophotography in a wonderful dark-sky location. It is open to everyone interested in astrophotography - from beginners to the advanced. Come along and share your knowledge, tips and experiences. All sorts of astrophotography can be undertaken - solar-system/nightscapes/deep-sky. The weekend shall consist of:

- **Practical astrophotography:** There's plenty of safe areas to set up their equipment and leave it in situ for the whole weekend.
- **Image Processing:** There is a huge room with long tables available which is perfect for people to set up computers to help each other process images. If you have one then please bring an external monitor to attach to your laptop as this is very useful.
- **Presentations:** There shall be talks on astrophotography related topics held in the large hall.
- **Bring-and-buy:** Feel free to bring along any equipment that you are no longer using and wish to sell.
- **Fish and chips dinner:** Saturday night. Please pay when you book.
- **Late-night movies:** Should the weather not be kind then movies can be shown on the big screen.

For more details see - http://www.horoastronomy.org.nz/upcoming-events/astrophotography-weekend

Date: Friday 25th – Sunday 27th November

Venue: Foxton Beach Bible Camp, Foxton Beach, Horowhenua.

Wellington Astronomical Society Research Group

Minor Planet Occultations

The "research" on Minor Planet Occultations done by Peter Graham, Gordon Hudson, Terry Butt & John Talbot & Roland Idaczyk was driven by the late Graham Blow's enthusiam for the subject.

The equipment needed for observing is non-trivial and observing is greatly enhanced by the use of a sensitive integrating video camera and accurate telescope pointing derived from a good go-to computer controlled mount.

Occult watcher has been a great boon to observers and there is a real feeling of team work generated by the software because you know who else is planning to observe the event across vast distances and it also indicates if there have been any successes within a few days.

Astronomy requires persistence to get results and there may be many failed attempts before a successful occultation is recorded. After that there is a considerable learning curves needed to master the analysis and reporting of the event to the director of the occultation group.

We would be interested in adding further observations to our activities - such as variable star observing and Double Star Lunar Occultations. There is also Timing of Jupiter Moons and some Saturn Moons and Grazing Occultations also there is Exoplanet searching.

To do this it would be helpful if the Research Group had a team effort to get new observers under taking Variable Star observing. This could be by a series of practical how-to discussions followed by a set plan to report back to the next meeting with results. Can our occultation setups be used for variable star work? What are the limiting factors? Would a simple DLSR piggy backed on the telescope be a good option?

Maybe more equipment can be brought along to the Research Group meetings to show members the sort of equipment we use these days and of course how to use the equipment. Is there equipment out there that could be loaned to members who don't have the gear but would like to participate in these timing events.

Gordon Hudson

Variable Stars

Variable star observing is easy, fun and requires little equipment to get started. All that is needed for visual observations is a sky atlas or planetarium software, some finder charts with comparison stars marked, and a pair of binoculars. Some very bright variables can even be followed without binoculars. If you find the idea of estimating how bright a star is daunting, we can show you a method that makes it easy. If you own a DSLR or similar camera and a telephoto lens you can take your observing further. We can show you how to use it for colour photometry without an observatory or a telescope. Visual observations and DSLR photometry are still quite acceptable for serious research so after a little practice you can start participating in research projects with very little outlay, and add extra gear as you go. Even if your main interest is astrophotography you can make a contribution. If you have a favourite area of sky or an object that you go back to time and again, keep an eye on your images. You could pick up an ephemeral event such as a flare, dwarf nova, nova or even a supernova. The thing to do is let somebody else know so that it can be followed up.

At a recent strategic planning meeting we discussed the possibility of starting a WAS project to observe one or more far southern variables suited for everybody. We are currently looking at a number of possible targets and we hope to announce them shortly. We'll discuss what to do and how to process your results as we go along. The main thing is to get started.

Aline Homes

Is Proxima Centauri's 'Earth-like' planet actually like Earth at all?

This article is provided by NASA Space Place.

With articles, activities, crafts, games, and lesson plans, NASA Space Place encourages everyone to get excited about science and technology.

Visit **spaceplace.nasa.gov** to explore space and Earth science!

Just 25 years ago, scientists didn't know if any stars—other than our own sun, of course—had planets orbiting around them. Yet they knew with certainty that gravity from massive planets caused the sun to move around our solar system's center of mass. Therefore, they reasoned that other stars would have periodic changes to their motions if they, too, had planets.

This change in motion first led to the detection of planets around pulsars in 1991, thanks to the change in pulsar timing it caused. Then, finally, in 1995 the first exoplanet around a normal star, 51 Pegasi b, was discovered via the "stellar wobble" of its parent star. Since that time, over 3000 exoplanets have been confirmed, most of which were first discovered by NASA's Kepler mission using the transit method. These transits only work if a solar system is fortuitously aligned to our perspective; nevertheless, we now know that planets—even rocky planets at the right distance for liquid water on their surface—are quite common in the Milky Way.

On August 24, 2016, scientists announced that the stellar wobble of Proxima Centauri, the closest star to our sun, indicated the existence of an exoplanet. At just 4.24 light years away, this planet orbits its red dwarf star in just 11 days, with a lower limit to its mass of just 1.3 Earths. If verified, this would bring the number of Earth-like planets found in their star's habitable zones up to 22, with 'Proxima b' being the closest one. Just based on what we've seen so far, if this planet is real and has 130 percent the mass of Earth, we can already infer the following:

- It receives 70 percent of the sunlight incident on Earth, giving it the right temperature for liquid water on its surface, assuming an Earth-like atmosphere.
- It should have a radius approximately 10 percent larger than our own planet's, assuming it is made of similar elements.
- It is plausible that the planet would be tidally locked to its star, implying a permanent 'light side' and a permanent 'dark side'.

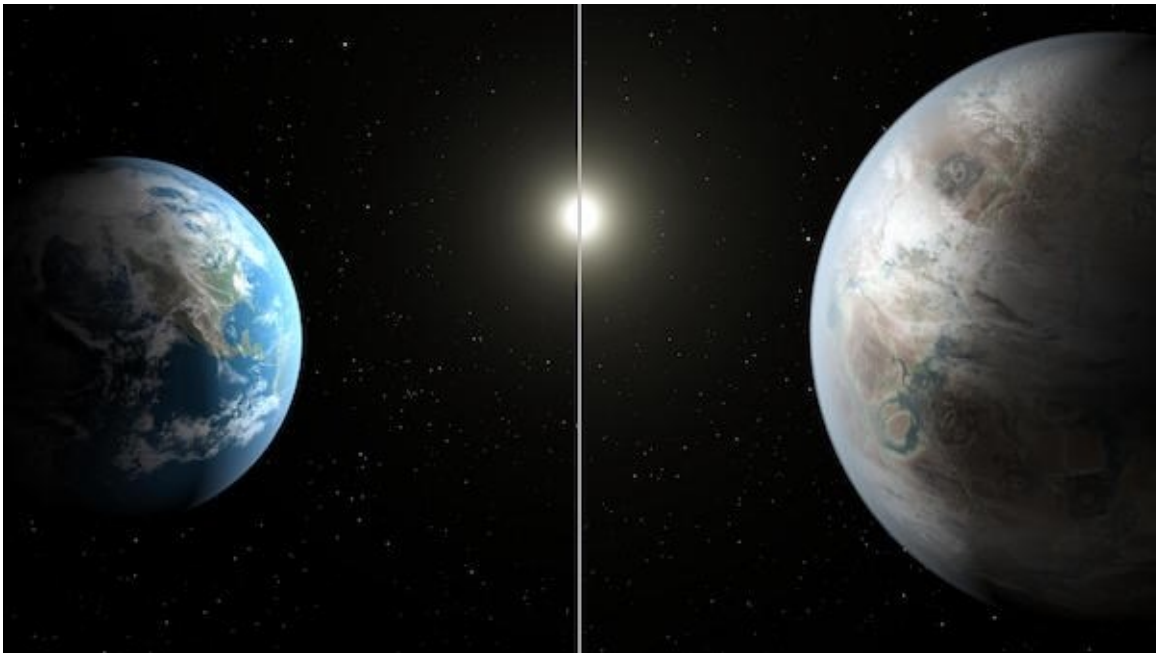
And if so, then seasons on this world are determined by the orbit's ellipticity, not by axial tilt.

Yet the unknowns are tremendous. Proxima Centauri emits considerably less ultraviolet light than a star like the sun; can life begin without that? Solar flares and winds are much greater around this world; have they stripped away the atmosphere entirely? Is the far side permanently frozen, or do winds allow possible life there? Is the near side baked and barren, leaving only the 'ring' at the edge potentially habitable?

Proxima b is a vastly different world from Earth, and could range anywhere from actually inhabited to completely unsuitable for any form of life. As 30m-class telescopes and the next generation of space observatories come online, we just may find out!

Looking to teach kids about exoplanet discovery? NASA Space Place explains stellar wobble and how this phenomenon can help scientists find exoplanets: http://spaceplace.nasa.gov/barycenter/en/.

Ethan Siegel



An artist's conception of the exoplanet Kepler-452b (R), a possible candidate for Earth 2.0, as compared with Earth (L). Image credit: NASA/ Ames/JPL-Caltech/T. Pyle.

Wellington Astronomical Society Christmas Party

Book this event into your calendar now before the Christmas rush!

Emailed Newsletter circulation method survey

I wrote the following for a newsletter a few months ago, and have received a grand total of two votes. That's an even worse turn-out that our local body elections – so could you please get your votes in to me before the November meeting;

> *Most of you will have 'received' this newsletter via email. More precisely, I will have emailed you a notice about where you go on our website to download the newsletter.*
>
> *We adopted this method of circulating the newsletter some years back, when few people had broadband so it took several minutes to download the file. With this procedure, you could choose when you wanted to do this download rather than have it forced upon you when you read your email. The downside was that the process of putting the newsletter on the website and then telling you about that added a day's delay in getting the newsletter into your hands.*
>
> *However now-a-days most (all?) people who have email use a broadband connection and the download only takes a few seconds. So the question is; do you want to continue with the current circulation method or would you prefer to have the newsletter emailed directly to you?*
>
> *Please let me know via email which method ('via website' or 'direct email') you prefer.*
>
> *Cheers,*
>
> *Murray Forbes*
>
> *murray_forbes@xtra.co.nz*

Colour Codes from the Stars, Part 3 Basic Equipment

This article introduces some basic principles and considerations regarding the choosing and using of equipment by field astronomers in exploring spectroscopy, initially at low spectral resolution. Please research for more details and for other viewpoints. To maximise text information here, please look up images and illustrations from the series articles or use the links shown or search the Internet.

1. Starlight through a grating creates a vivid, observable spectrum.
2. Image it, if desired.
3. Then explore with spectroscopy software.

With these 3 main steps, getting started is probably simpler tried out than explained. See in reality at the eyepiece. Later, concepts and techniques will assist in the fine-tuning.

See 'light' as a spectrum

Thread a transmission grating such as the SA100 to the bottom end of the eyepiece, as with a filter, i.e. in the converging cone of light. (Note the one-piece visual version of the Rainbow Optics is designed for mounting on top of the eyepiece). Firstly, view a bright star.

Caution: Do not touch the grating surface.

On either side of the star we will see brighter and fainter spectra that are off-centre and spread out sideways, or 'dispersed'. The pair closest to the target star are its '1st order' spectra, the next are '2nd order', and so on. The star is 'zero order'.

We shall observe and image the brighter of the 1st order pair, sometimes together with the zero order. The blazing design in a grating causes one to be brighter than the other.

This article addresses the slit-less, blazed, diffracted transmission grating. For a prism, there's no zero order -only one refracted spectrum with red nearest to the centre line.

What are we seeing? Beautiful colours arrayed out with violet nearest to the zero order, absorption lines (depending on the telescope used), directional changes with grating orientation, and the overlapping if several objects are in the same direction as grating dispersion. Do blue stars' spectra look that different from red stars'? What can be seen of the moon? How about Saturn or Jupiter with their moons? A cluster? A nebula? Any SN? A carbon star? A comet!? How faint is an object, to still be spectrally observable given a setup?

Image the spectrum

1. You can experiment with afocal imaging at the eyepiece, with a snapshot or a digital camera. Assess the quality of data obtained this way.

2. Put the grating in a DSLR camera nosepiece, or a CCD camera, and place the combination in the drawtube. Generally, focus at about the midpoint of the spectrum.

Experiment with imaging with tracking. If no tracking, have the spectrum lie perpendicularly to the direction of drift, so the spectrum height will spread crosswise.

3. If without a telescope, use the grating with a DSLR, with or without tracking -as in 2.

4. Experiments will show that aligning the spectrum with the pixel axis give better results.

5. In place of a still camera, an astronomical videocam can also be used.

6. A flip mirror, or alternative, allows convenient switching between visual and imaging. Example http://julianh72.blogspot.com.au/2016/09/methane-in-neptunes-atmosphere-from-my.html , with permission by Julian Hardy.

Process the image

Even without having taken an image yourself you can process any spectral image you can get hold of.

Without any grating or camera you can download some freeware or free-trial software and explore!

Forums have discussions on features and preferences: e.g. BASS, RSpec, Vspec, ISIS. As an illustrative introduction, below we shall use the free-trial RSpec that's easy to get started on.

Example stars (From the top-left File > Open Main Profile, or by two other means) access the reference library of spectral data files of various star types. Each profile graph shows on the right side screen as intensity (arbitrary scale) against wavelength in angstrom.

(Near the bottom right) the 'Synthesise' button will generate a band of synthesised spectrum in colour or monochrome, below the profile. Next, see what the 'Fill' button does.

Look at what first?
Is the red part or the blue more dominant, or the middle? Is it always more blue for bluish stars, more red for reddish stars, orangey for the sun type? What characterise star classes?

What basic 'features' are we looking for, in a profile graph?
What are the dips (absorption in the spectrum)? Are there spikes (emission in the spectrum)? Are they sharp or gradual? Explore the buttons above the graph and when overlaying lines of chemical elements or a profile of the same star type do they coincide?

Your star (From the bottom left menu) open a spectral image file that you have placed in the default 'Capture' folder. Play with cropping and rotating the image. Its profile graph appears on the right side screen, with the horizontal axis being pixel number.

To know what the wavelength values are, that the pixel numbers represent, we 'calibrate'.

Some basic methods for calibration, instrument response compensation, background subtraction, and intensity normalisation will be covered in the next article.

Further notes. What is being imaged?

The following will help in understanding about a) the adjustment of distance from the grating to the camera sensor, b) where the spectrum lies on the sensor pixels, c) considerations for which grating to buy, and d) what setup parameters affect data quality.

As seen in the eyepiece, the dispersed spectrum is deviated off-centre and spread out. By how much? The number of lines in a grating determines the deviation angles of the components of the spectrum. Too far off-centre and the spectrum, or the range of interest, will be off the field of view while more spread-out means the available pixels capture a smaller part of the spectrum and the image resolution can be higher -but not necessarily!

Here's a useful visualisation (or experiment or calculation). If a laser pen light: red, green, blue, in turn, is directed through a grating a distance y, e.g. 20 cm, away, to shine at point z on a wall, each additional colour spot lands a different distance away from z. Geometry or compass measurement will show respective deviation angles for each colour (wavelength).

A 100 lines/mm grating shows the angle for blue, green, red as 2, 3, 4 deg. respectively. For a 200 l/mm grating these are: 5, 6, 8 deg. For a 900 l/mm grating these are 22, 29, 36 deg

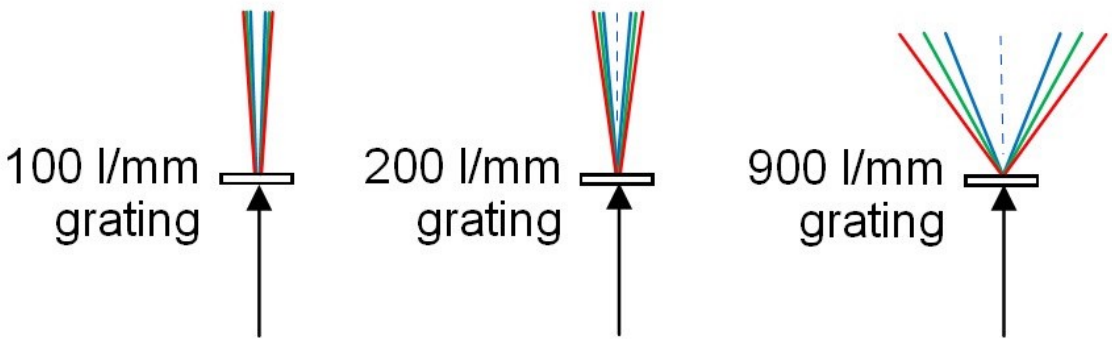


Figure 1. Grating dispersion, by Lesa Moore, ASNSW.

Relate these to a star with its colour components appearing off-centre and spreading out in your optical equipment.

Exploring further, a strip of cardboard bent as part of a circle in the path of the diffracted spectrum would show that the colour dots are closer together than their projections on the flat wall. This will relate later to nonlinearity when calibrating. Also see 'field curvature'.

This visualisation is useful in appreciating that in transmission-grating field use,

- Higher-number lines/mm directs the spectrum further away, sideway, from the centre line of the optical train.
- Higher-number lines/mm gives a longer strip of spectrum, so a smaller section falls on the pixels, possibly yielding a higher resolution. But the spectrum is also fainter!
- As the colour components are dispersed radially, their projections on a flat surface, such as the wall or an image sensor, stretch out non-linearly in 'plate scale' of angstrom/pixel, and also become relatively out-of-focus (field curvature).

Figure 2.

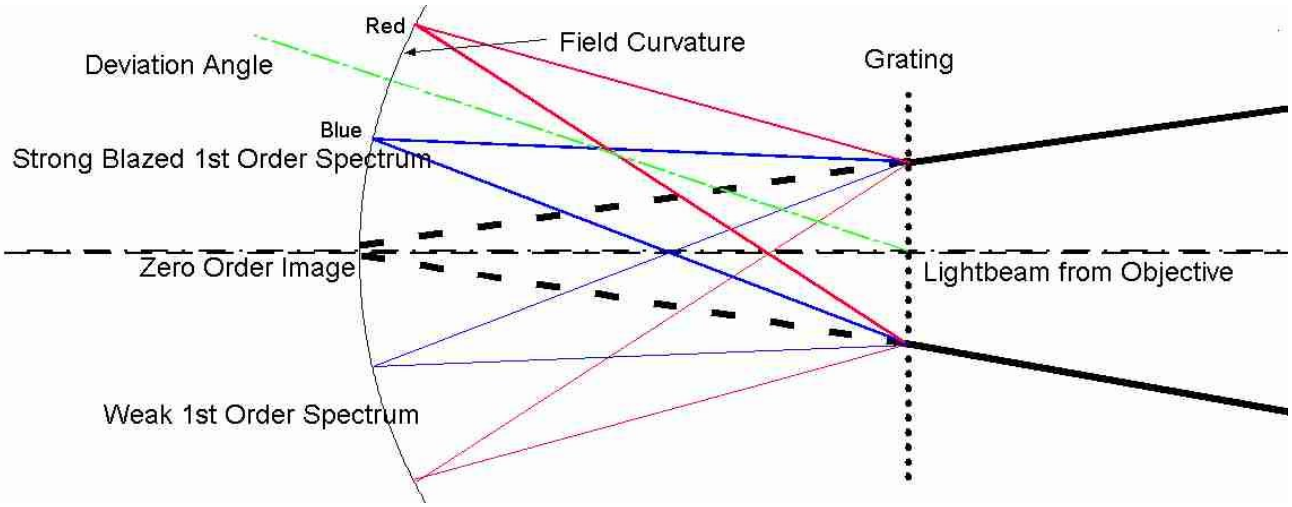


Figure 2. Deviation angle and field curvature. Resource [3] page 189, with permission

FAQs

- Colour or monochrome camera? In general, colour for visuals such as at group viewing, mono to achieve a higher image-resolution (then synthesise colours as required).
- DSLR or CCD or CMOS? To start with, use any existing camera then research well on sensor size, response curve, and other specifications. Suggest use a mono CCD to compare others with. Note the effect of the camera's IR filter.
- If there are many objects in the field of view, orientate the grating to avoid overlapping of spectra. Later, one might explore the slit spectrograph for individual or team use.
- If you cannot fit the zero order in the same frame as the spectrum, adjust the spacing between the grating and the sensor, or use a camera with a larger sensor, or just work with the spectrum and calibrate by other means.
- Note the relationship between the deviation angle, spectral spread, sensor size, and the grating-to-sensor distance. Sometimes a spacer is useful to set a desired distance. This relates also to filter wheel usage.
- Test this: Generally, spectra appear about 5th magnitude fainter than the target object.
- An added prism, in a 'grism', may be useful to redirect the spectrum towards the centre.

Medium- and High-Resolution Equipment. Research on these is recommended.

'Low-Res' Contributions to science: Scouting, surveys, campaigns. See later in the series.

Resources (See also Parts 1 & 2 lists)

[1] Christian Buil webpages www.astrosurf.com/buil/

[2] Spectroscopy workshop AAO, https://www.aao.gov.au/files/science/basics_of_spectroscopy_3_May_2016Creduced.pptx.pdf and https://youtu.be/kv8leQWyPwM

[3] Astronomical Spectroscopy for Amateurs, Ken M Harrison, Springer, 2011.

By Sky C Murphy and the Team at Southskyscience

A version of this article has been submitted to Astronomical Societies in Australia and New Zealand

Occultations for November

Lunar Occultations

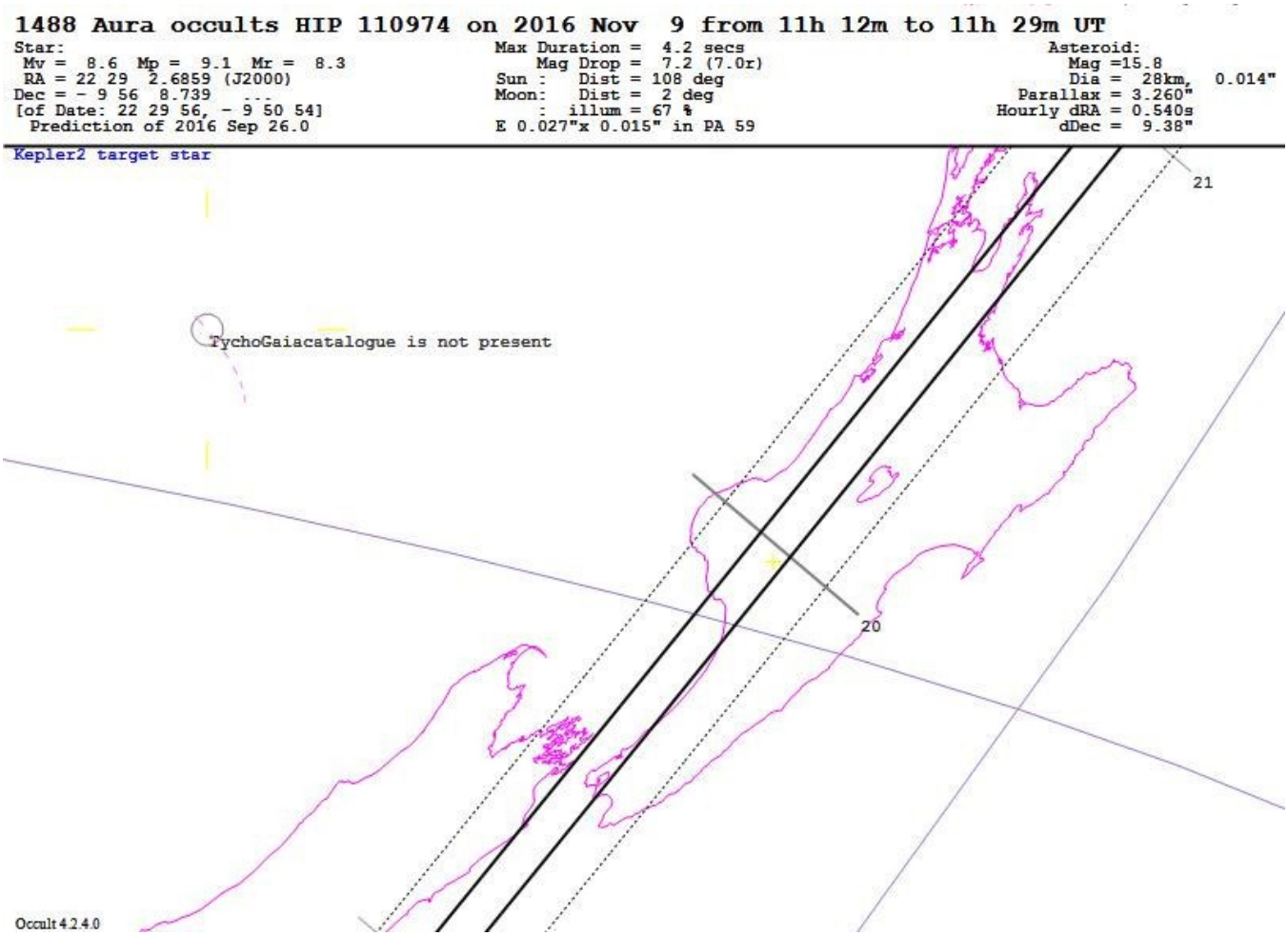
Events excluded: Outside 6.0h to 10.0h UT, Daytime, Bright-limb

y	m	day d	Time h	m	s	P	Star No	D	Sp	Mag v	Mag r	V	% ill	Elon	Sun Alt	Moon Alt	Az	
16	Nov	2	8	14	7.2	D	2365	c	F5	7.3			6+	28		8	256	double
16	Nov	3	7	53	38.7	d	160422		A2	8.9	8.8		11+	39	-9	21	265	
16	Nov	3	9	26	19.7	D	2495	S	A0	6.0*	5.9		11+	39		5	251	triple
16	Nov	4	8	11	15.9	d	161091		K1	8.6*	7.5		18+	50		27	269	
16	Nov	4	9	17	15.1	d	161134	k	B2	9.0*	8.8		18+	50		15	259	Kepler2
16	Nov	5	7	51	50.4	d	162040		K0	8.6	8.1		26+	61	-9	39	281	
16	Nov	5	8	16	33.3	D	162051	k	B9	8.0	8.0e		26+	61		35	276	Kepler2
16	Nov	6	8	46	13.0	D	2903	S	K3	7.7*	6.9		35+	73		38	281	triple
16	Nov	6	9	37	49.5	d	163087	d	K0	8.5	7.9		35+	73		28	272	double
16	Nov	7	8	47	53.7	d	163844	S	G5	8.8	8.3		45+	84		45	293	quadruple
16	Nov	7	9	34	39	m	163851		K0	7.4	6.9		45+	85		37	283	
16	Nov	8	9	21	21.5	d	164540		K1	8.1	7.5v		56+	96		46	299	
16	Nov	9	8	25	46.2	d	146122	k	G0	8.3	8.1		66+	109		55	337	Kepler2
16	Nov	9	9	19	52.2	d	3306	p	F0	7.8*	7.6		66+	109		50	318	Kepler2, double
16	Nov	9	9	20	12.9	d	X182873	p		8.6*	8.4		66+	109		50	318	Kepler2, double

Minor Planet occultations

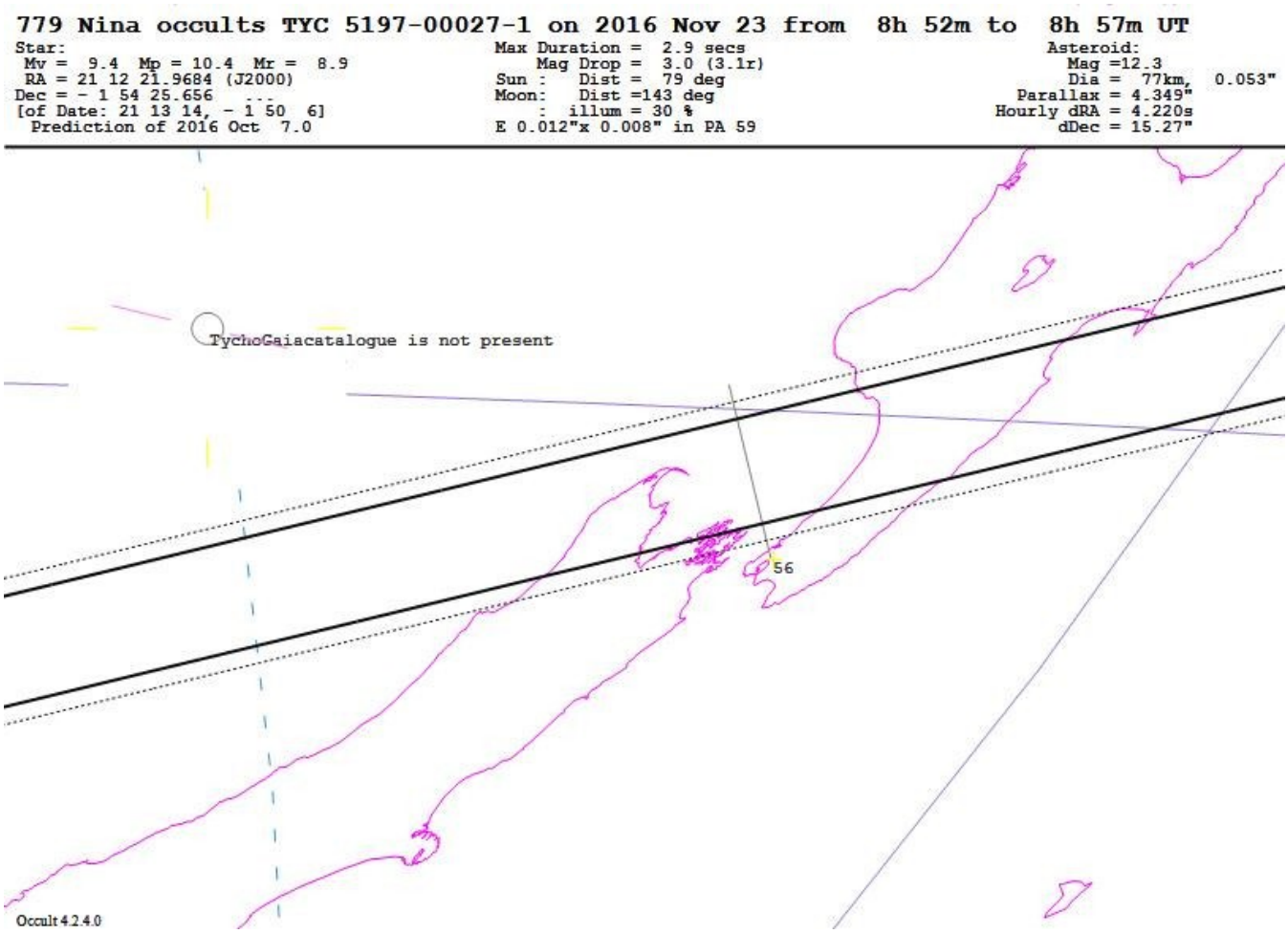
The following occultation already has four WAS members registered in OccultWatcher to attempt it. As the shadow is predicted to travel across Wellington on Wednesday 9th November at UT 11h 19m 30s, why don't we try for a few more observers? The star is reasonably bright (8.6 mag) and a good altitude above the horizon (32°). The moon is only 2° away so it may be a bit difficult to find the target star by star hopping. I'd suggest you use the following star to pre-point;

SAO144810, V=3.7, Sp=A1 V, RA=20h 47m 41s, Dec=-09° 29' 22", ΔDec=-25', UT=09h 38h 26s



There is also another occultation near the end of the month, on Wednesday 23rd November at 08h 56m 00s. Even though the prediction is for the shadow to travel north of Wellington, we still have four WAS members registered in OccultWatcher. The star is a bit fainter (9.4 mag) than the previous occultation but it takes place at a more civilised hour (just before 10pm NZDST). There is no moon visible that evening. There is one pre-point star that should be bright enough to see at the pre-point time (which is during twilight);

SAO144150, V=3.2, Sp=B9 III, RA=20h 11m 18s, Dec=-00° 49' 17", ΔDec=-64', UT=07h 55m 06s



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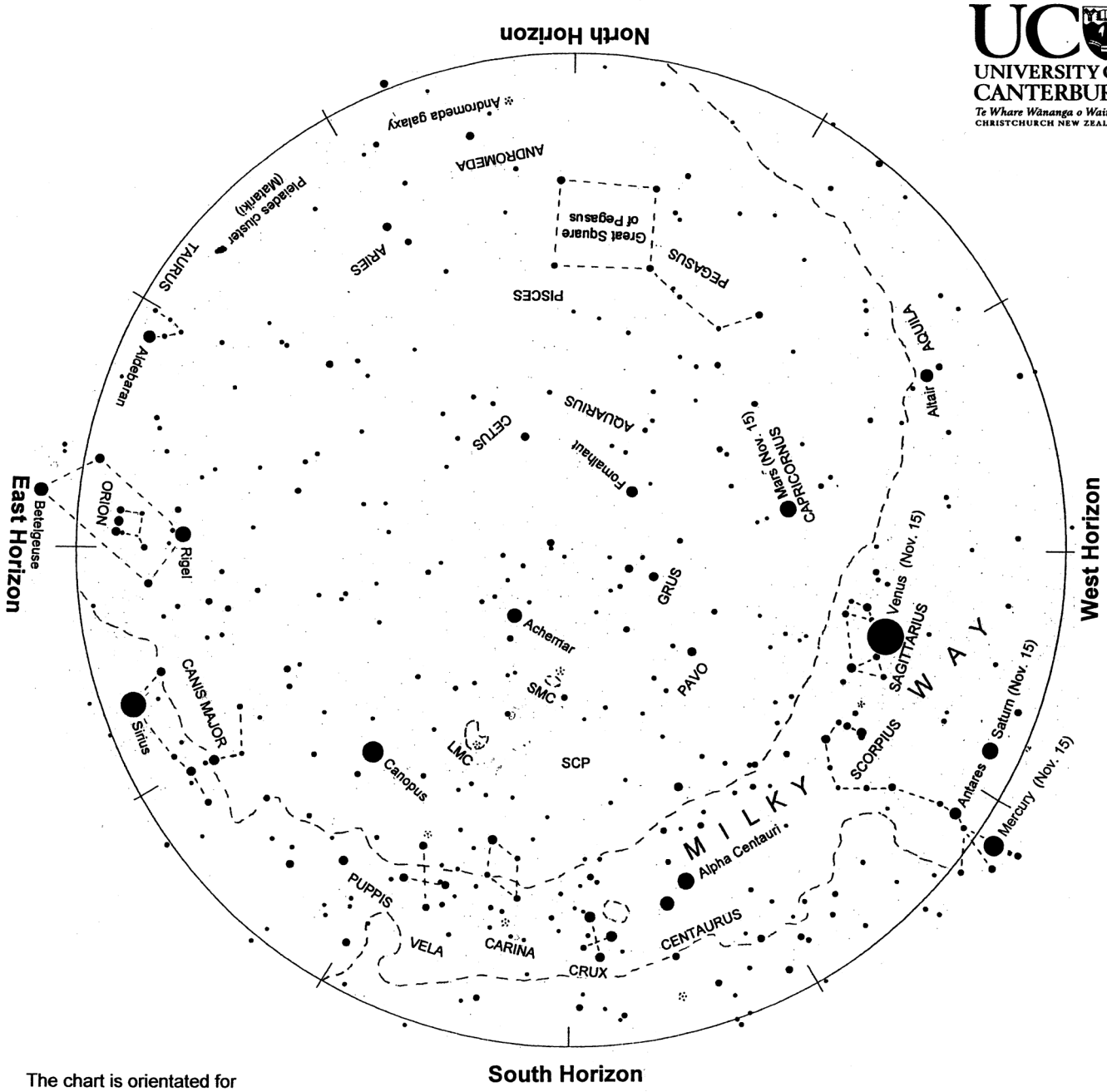

The chart is orientated for
Oct. 15 at midnight NZDT
Nov. 1 at 11 p.m. "
Nov. 15 at 10 p.m. "

Evening sky in November 2016

To use the chart, hold it up to the sky. Turn the chart so the direction you are looking is at the bottom of the chart. If you are looking to the south then have 'South horizon' at the lower edge. As the earth turns the sky appears to rotate clockwise around the south celestial pole (SCP on the chart). Stars rise in the east and set in the west, just like the sun. The sky makes a small extra clockwise rotation each night as we orbit the sun.

Brilliant Venus is the 'evening star', setting after 11 pm. Above it is orange Mars and below it creamy Saturn with orange Antares to Saturn's left. Late in the month Mercury moves up the evening sky passing between Saturn and Antares. Canopus is midway up the southeast sky. Sirius, the brightest true star, appears in the east. Left of Sirius is Orion containing 'The Pot'. Further left are Taurus and the Pleiades/Matariki star cluster. The Pointers and Crux, the Southern Cross, are low in the south. The Milky Way is wrapped around the horizon. The north sky is empty but for the Great Square of Pegasus with the Andromeda galaxy below and right of it.

Chart produced by Guide 8 software; www.projectpluto.com. Labels and text added by Alan Gilmore, Mt John Observatory of the University of Canterbury, P.O. Box 56, Lake Tekapo 7945, New Zealand. www.canterbury.ac.nz

The Night Sky in November

Venus is the brilliant evening star, appearing in the western sky at sunset and setting in the southwest around 11:30. It is bright enough to cast shadows in dark locations. Just below Venus at the beginning of the month is Saturn with the orange star Antares to its left. Midway up the evening sky, well above Venus, is Mars. It is similar in brightness to Saturn and orange-coloured like Antares. Venus and Mars hold their elevations, night to night, while Saturn and the stars sink lower. The moon will be right of Venus and Saturn on the 3rd and by Mars on the 6th.

Later in the month Mercury appears below Saturn and moves up the twilight sky. Around the 21st Mercury passes between Saturn and Antares, making a line of similar brightness 'stars' on the dusk horizon.

The brightest true stars are in the eastern sky. Midway up the southeast sky is Canopus, the second brightest star. Sirius, the brightest star, rises in the later evening at the beginning of the month. By month's end it is in the sky at dusk, twinkling like a diamond as the air disperses its light.

Left of Sirius is the constellation of Orion, with 'The Pot' at its centre. Rigel, a bluish supergiant star, is directly above the line of three stars; Betelgeuse, a red-giant star, is straight below. Left again is orange Aldebaran. It is at one tip of a triangular group called the Hyades cluster. The Hyades and Aldebaran make the upside down face of Taurus the bull. Still further left is the Pleiades or Matariki star cluster, also called the Seven Sisters, Subaru and many other names. Six stars are visible to the eye; dozens are seen in binoculars. The cluster is 440 light years away and around 70 million years old.

Sirius is the brightest star both because it is relatively close, nine light years* away. Seen up close it would be 23 times brighter than the sun. By contrast, Canopus is 300 light years away and 13 000 times brighter than the sun.

The Milky Way is low in the sky, visible around the horizon from the northwest, through south into the eastern sky. The broadest, brightest part is in Sagittarius, to the right of the Scorpion's sting. The Milky Way is our edgewise view of the galaxy, the pancake of billions of stars of which the sun is just one. The thick hub of the galaxy is 30 000 light years away in the direction of Sagittarius.

Low in the south are the Pointers, Beta and Alpha Centauri, and Crux the Southern Cross. In some Maori star lore the bright southern Milky Way makes the canoe of Maui with Crux being the canoe's anchor hanging off the side. In this picture the Scorpion's tail can be the canoe's prow and the Clouds of Magellan are the sails. Alpha Centauri is the closest naked-eye star; 4.3 light years away.

The Clouds of Magellan, (LMC and SMC), high in the southern sky, are two small galaxies about 160 000 and 200 000 light years away, respectively. They are easily seen by eye on a dark moonless night. The larger Cloud is about 1/20th the mass of the Milky Way galaxy, the smaller Cloud 1/30th. That's still billions of stars in each. The globular star cluster 47 Tucanae looks like a slightly fuzzy star near the top-right edge of the SMC. It is 'only' 16 000 light years away and merely on the line of sight to the SMC. Globular clusters are spherical clouds of stars many billions of years old.

Very low in the north is the Andromeda Galaxy, easily seen in binoculars in a dark sky and faintly visible to the eye. It appears as a spindle of light. It is similar in shape to our galaxy but is a little bigger and nearly three million light years away.

Jupiter is in the dawn sky so not on the chart. It rises due east an hour before the sun at the beginning of the month and two hours before the sun at month's end. It is the brightest 'star' in the morning sky and shines with a steady golden light. A small telescope shows its disk and its four 'Galilean' moons.

*A light year (l.y.) is the distance that light travels in one year: nearly 10 million million km or 1013 km. Sunlight takes

eight minutes to get here; moonlight about one second. Sunlight reaches Neptune, the outermost major planet, in four hours. It takes four years to reach the nearest star, Alpha Centauri.

Notes by Alan Gilmore, University of Canterbury's Mt John Observatory, P.O. Box 56, Lake Tekapo 7945, New Zealand.

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