Wellington Astronomical Society May 2017 Volume 47 Issue 4
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The next WAS meeting will be held on Wednesday 3rd of May 2017 at 7:30 pm at Carter Observatory, Upland Rd, Kelburn, Wellington

The analemma, dials, and digits: some unusual combinations, or Clocks of the Really Long Now

Duncan Hall

As part of his talk, Duncan will demonstrate:

- The main aspects of the natural phenomena that power sundials
- Various types of solar-powered timepieces, and
- A digital clock with a display that uses shadows cast by a mini-gnomon

Duncan Hall is a founding member of WAS.

Having previously attended the Wellington RASNZ meetings, he signed up as a member of WAS when it was formed in 1974 (he thinks). At various times Duncan has been WAS President, Vice-President, Observatory Director, Council member, and ordinary member. He is currently a Trustee of the Gifford Observatory Trust. He was a co-Director of the Gifford Observatory in 1974 and 1975 while at Wellington College. Duncan's had a long-term interest in solar-powered, low-powered, and no-powered timepieces.

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 2016-2017

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

It appears that quite a few members from last year have not yet renewed their subscriptions. If this is an oversight, can you please remedy it as soon as possible.

WAS COUNCIL MEMBERS AND CONTACTS

Council Members

The following members were elected to Council at the Nov 2016 AGM

President: Antony Gomez
president@was.org.nz / 021_253_4979

Vice President: Duncan Hall
vice-president@was.org.nz

Secretary/Telescope custodian: Chris Monigatti
secretary@was.org.nz / 021_890_222

Treasurer: John Homes

Newsletter Editor: Gerard Coyle
editor@was.org.nz

Membership Secretary: Janine Bidmead
membership@was.org.nz

Website : Peter Woods
webmaster@was.org.nz

Council

Andrew Fuller

Edward Wilcock

Frank Andrews

Janine Bidmead

Murray Forbes

Peter Woods

Sarah Taylor

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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. The WAS Astrophotography Group https://www.facebook.com/groups/1684738758511214/ is for those interested in astrophotography. It serves as a place to notify others of astrophotography gatherings at short notice and to display images captured by members.

Wellington Astronomical Society May 2017 Events

WAS May Meeting

Our talk this month will; be given byu Duncan Hall, and is titled "The analemma, dials, and digits: some unusual combinations, or Clocks of the Really Long Now." The analemma is the plot of how the sun's position in the sky changes throughout the year when viewed from the same point on the earth's surface.

As part of his talk, Duncan will demonstrate:

- The main aspects of the natural phenomena that power sundials
- Various types of solar-powered timepieces, and
- A digital clock with a display that uses shadows cast by a mini-gnomon

Date: Wednesday 3rd May

Time: 7:30pm,

Venue: Space Place at Carter Observatory

Space & Science Festival @Night

Evening event focused on Astronomy with the Wellington Astronomical Society, Bioluminescent Bug Art with Dr Siouxsie Wiles, Science Talks and fun with Physics. Plus a chance to meet special guests from NASA!

A full programme is available at S & S Festival Evening programme
Tickets are required for this event S & S Festival Shop

Date: Saturday 6th May (backup Saturday evening 13th May)

Time: 6:00 to 10:00pm,

Venue: Onslow College, Burma Road, Johnsonville

STEMM Discovery Day

This annual event, which runs from 6th – 21st May, celebrates Science, Technology, Engineering, Mathematics and Manufacturing. On the Discovery Day, get hands-on with fun activities and fascinating science experiments.

Programmable robots called BeeBots, build your own model Earth, and experience a chemical reaction in your mouth. WAS will be participating with solar scopes to observe the Sun. See here for more details.

Date: Sunday 7th May

Time: 11:00am to 3:00pm,

Venue: Pelorus Trust Sports House, 93 Hutt Park Rd, Lower Hutt

Space & Science Festival @Day

Daytime event focused on Flying Machines, Maths Craft, Engineering with Robots & Electronics, Coding, Science Talks and fun with Physics, Chemistry & Biological sciences. Plus chance to meet special guests from NASA! WAS is a part of this event and we will be observing the Sun with solar scopes.
A full programme is available at S & S Festival Day programme
Tickets are required for this event S & S Festival Shop

Date: Saturday 13th May

Time: 12:00 to 4:00pm,

Venue: Onslow College, Burma Road, Johnsonville

Space & Science Festival - The Art of Night with Mark Gee

Late night event focused on Astrophotography with award winning local Astrophotographer Mark Gee. Register for event on Facebook here .

Date: Saturday 20th May

Time: 7:00pm, till late

Venue: Red Rocks Reserve, Wellington (weather dependent).

WAS Astrophotography Group

Location and updates will be posted on the WAS Astrophotography Group Facebook page closer to the time.

We will aim for a darker location this time to try out our new skills. If the skies are cloudy we will meet indoors and learn more about processing image data. For further details or cancellations contact Edward 021_08304802 or Chris 021_ 890222.

Date: Saturday 27th May

Time: 7:00pm

Venue: See WAS Astrophotography Group Facebook page.

WAS Observing Evenings

No official Society Observing Evening this month due to our participation in the Space & Science Festival., but do come along on Fridays to the WAS Tawa Observatory and see the many wonderful objects, star clusters, galaxies, dying stars and nebulae around and near the Southern Cross, the spectacular globular cluster 47 Tucanae and the Tarantula Nebula in the Large Magellanic Cloud (LMC). Jupiter is visible while Saturn rises around 8pm. Learn how to use the telescope and how to find these objects in the night sky.

Date: Every Friday in May (weather permitting)

Time: 7:00pm,

Venue: Tawa College

WAS April Meeting Talks "Introducing the WAS Research Group" by Roland Idaczyk and "Variable Stars" by Aline Homes

In a change to our usual format, we had not one but two speakers at out April meeting.

First was Roland Idaczyk, who gave a brief overview of the WAS Research Group.

The main purpose of the WAS Research Group iis to provide a forum for WAS members to share their enthusiasms for research. At the moment, its main three areas of interest are occultations, variable stars and exoplanets, but it is looking to expand into such areas as CCD spectrometry and sky surveys.

Roland then covered the requirements to join the group, and the advantages of belonging to it. Basically, there are no prerequisites except having a keen interest in astronomy and being willing to devote the time and effort. The advantages of being part of the group are support, mentoring from more experienced members and advice on suitable subjects to pursue. He also drew attention to the fact that the group works with professional astronomical organisations, and that members past contributions to research have been noted in their inclusion as authors for peer-reviewed literature.

Aline Homes then spoke about variable stars, one of the WAS Research Group main interests.

Aline began by explaining variability in a star is defined as significant and measurable changes in the star's brightness, and as such, all stars are variable to some degree. She then went on to say that variable star systems can be divided into two main types: pulsating and binary.

Pulsating systems vary their brightness due to actual changes in the size of the star. As the size increases, the star grows brighter, as it decreases, the star grows dimmer. There are a wide variety of types, most well-known of such is the Cepheid Variables, whose period of variability is directly linked to the range in brightness variation.

In binary systems, the variation in brightness is not related specifically to the star itself, but to the way it interacts with any companions. Most stars are actually part of a binary system, and it in some cases, the stars that make up the system interact with one another to affect the brightness. There are two main types of such systems, eclipsing and accreting.

In an eclipsing system, the stars orbit around each other so that when viewed from the earth, they pass behind or in front of one another. This causes the brightness of the system to vary in a regular manner.

In an accreting system, material from one of the stars is stripped off by the others pull of gravity to become part of the other star. This affect the brightness of both stars, usually in an irregular manner. The most widely known example of these are Type 1a Supernovae, where the accretion finally causes one of the stars to explode.

Apart from finding out the reasons for their variability, one of the main reasons for studying variable stars is their use in measuring the size of the universe. Both types of system contain examples whose variability is directly linked to their absolute magnitude, and therefore can be used to accurately estimate their distance from the earth.

Aline concluded her talk pointing out the advantages of observing variable stars for the amateur astronomer. Useful measurements can be made without requiring sophisticated equipment, in some cases purely visual observations are more than sufficient. Also, there are simply too many variable systems to be covered by professional astronomy. It is therefore a field where amateurs can make significant contributions on the same level as the professional astronomer, without incurring significant costs.

WAS Observatory Re-establishment at Tawa College

In the early 1990s, two WAS stalwarts the late Tony Dodson and Jack O'Kane established a dark-sky observatory for WAS on a farm in Pauatahanui. The dome was second hand from Tawa. Whilst the site was dark, there were no facilities leading over time to few users. The decision was made to shift the observatory to Tawa College, where hopefully greater usage will offset the poorer sky quality.

John Talbot liberating the dome at Pauatahanui.

Delivery at Tawa onto the student-made piles

Gordon and Paul finalizing
the concrete pad for the pier

Thanks to Gordon, Chris, Paul and several students, the scope is now in place and once accurately collimated and aligned should be very useful. We hope to repaint the dome and maybe even carpet the floor! WAS members will be able to use the scope on WAS Saturday observing evenings, or on the regular school Friday evenings.

Gordon, Paul and Chris installing the WAS 12" Meade LX200 GPS

NOAA's Joint Polar Satellite System (JPSS) to monitor Earth as never before

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!

Ball and Raytheon technicians integrate the VIIRS Optical and Electrical Modules onto the JPSS-1 spacecraft in 2015. The spacecraft will be ready for launch later this year. Image Credit: Ball Aerospace & Technologies Corp.

Later this year, an ambitious new Earth-monitoring satellite will launch into a polar orbit around our planet. The new satellite—called JPSS-1—is a collaboration between NASA and NOAA. It is part of a mission called the Joint Polar Satellite System, or JPSS.

At a destination altitude of only 824 km, it will complete an orbit around Earth in just 101 minutes, collecting extraordinarily high-resolution imagery of our surface, oceans and atmosphere. It will obtain full-planet coverage every 12 hours using five separate, independent instruments. This approach enables near-continuous monitoring of a huge variety of weather and climate phenomena.

JPSS-1 will improve the prediction of severe weather events and will help advance early warning systems. It will also be indispensable for long-term climate monitoring, as it will track global rainfall, drought conditions and ocean properties.

The five independent instruments on board are the main assets of this mission:

- The Cross-track Infrared Sounder (CrIS) will detail the atmosphere's 3D structure, measuring water vapor and temperature in over 1,000 infrared spectral channels. It will enable accurate weather forecasting up to seven days in advance of any major weather events.
- The Advanced Technology Microwave Sounder (ATMS) adds 22 microwave channels to CrIS's measurements, improving temperature and moisture readings.
- Taking visible and infrared images of Earth's surface at 750 meter resolution, the Visible Infrared Imaging Radiometer Suite (VIIRS) instrument will enable monitoring of weather patterns, fires, sea temperatures, light pollution, and ocean color observations at unprecedented resolutions.
- The Ozone Mapping and Profiler Suite (OMPS) will measure how ozone concentration varies with altitude and in time over every location on Earth's surface. This can help us understand how UV light penetrates the various layers of Earth's atmosphere.
- The Clouds and the Earth's Radiant System (CERES) instrument will quantify the effect of clouds on Earth's energy balance, measuring solar reflectance and Earth's radiance. It will greatly reduce one of the largest sources of uncertainty in climate modeling.

The information from this satellite will be important for emergency responders, airline pilots, cargo ships, farmers and coastal residents, and many others. Long and short term weather monitoring will be greatly enhanced by JPSS-1 and the rest of the upcoming satellites in the JPSS system.

Ethan Siegel

Want to teach kids about exoplanets? Go to the NASA Space Place and see our video called, "Searching for other planets like ours": https://spaceplace.nasa.gov/exoplanet-snap/

Occultations for May 2017

Total Lunar Occultations

There are only two worthwhile lunar occultations during May:

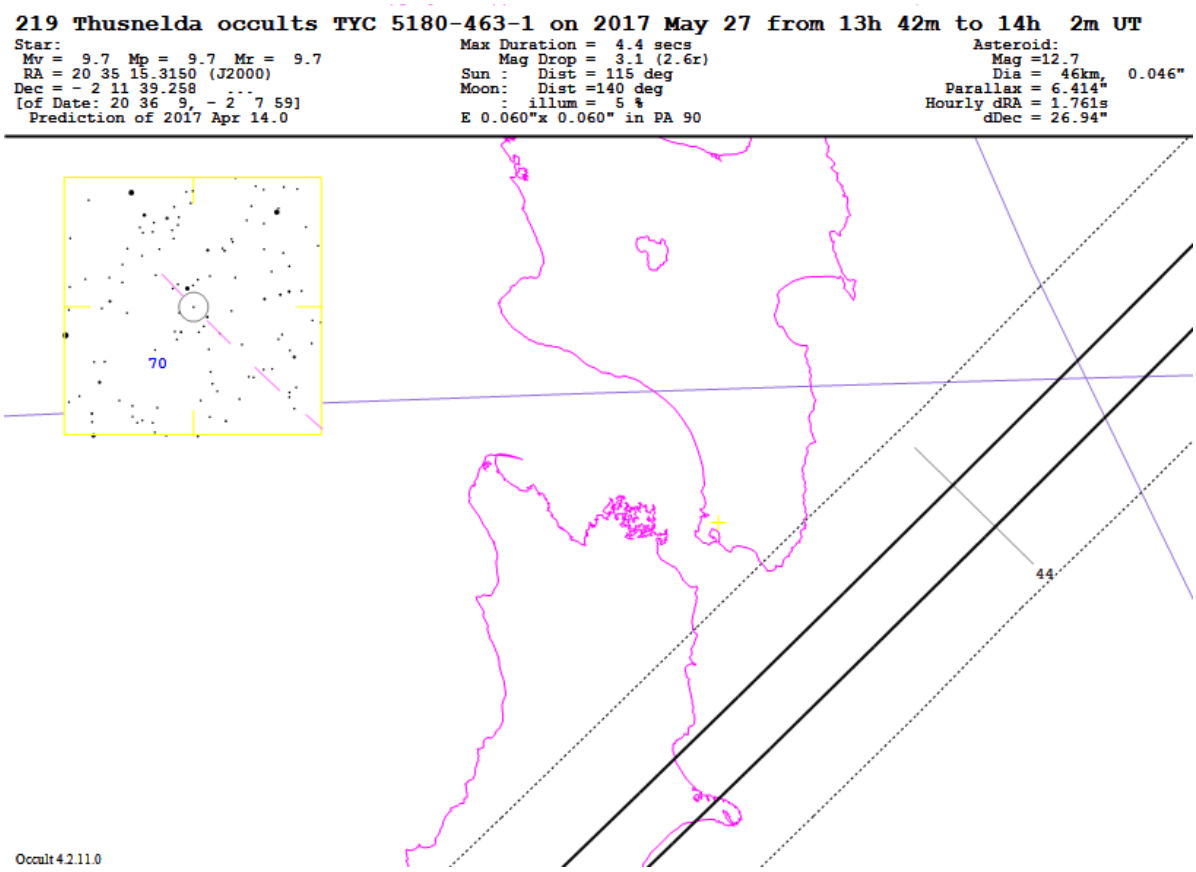
- The first event for the month is on Thursday 4 May, at 10:47pm. ZC1487 is a very bright star (magnitude 1.4) and is better known as Regulus. To avoid saturating your image of Regulus, you will need to either stop-down your telescope and/or use a shorter integration time if you have an integrating camera that has such settings. It is also a triple star system, but the drop in brightness when either the 'B' or 'D' components disappear some minutes before the primary 'A' component is too small to measure with a video camera adjusted to see the magnitude 1.4 'A' component.
- The next event is in the middle of the month, one Monday 15th May at 9:33pm. The moon is rising low (9°) in the east and is fairly bright (82% illumination) so will be tricky to see. The event is also a reappearance of the star, which I don't usually include. However it is a suspected triple system and so your observation may be the one that confirms this.

day			Time			P	Star		Sp	Mag	Mag		%	Elon	Sun	Moon	
y	m	d	h	m	s		No	D		v	r	V	ill		Alt	Alt	Az
17	May	04	10	47	18.9	D	1487	S	B7	1.4	1.4	s	63+	106		22	310
Triple: AB 1.4 8.2 176” 308.0, dT = -392sec :																	
AD 1.4 12.1 195” 274., dT = -418sec																	
17	May	15	09	33	21.9	R	2764	S	G5	6.4	5.9		82-	130		9	106
Triple: ** ? ? ? 208.2, dT = +5sec :																	
** 7.1 7.1 0.10” 90.0, dT = +0.19sec																	
2764 has been reported as non-instantaneous (OCc1561). Observations are highly desired																	

Minor Planet Occultations

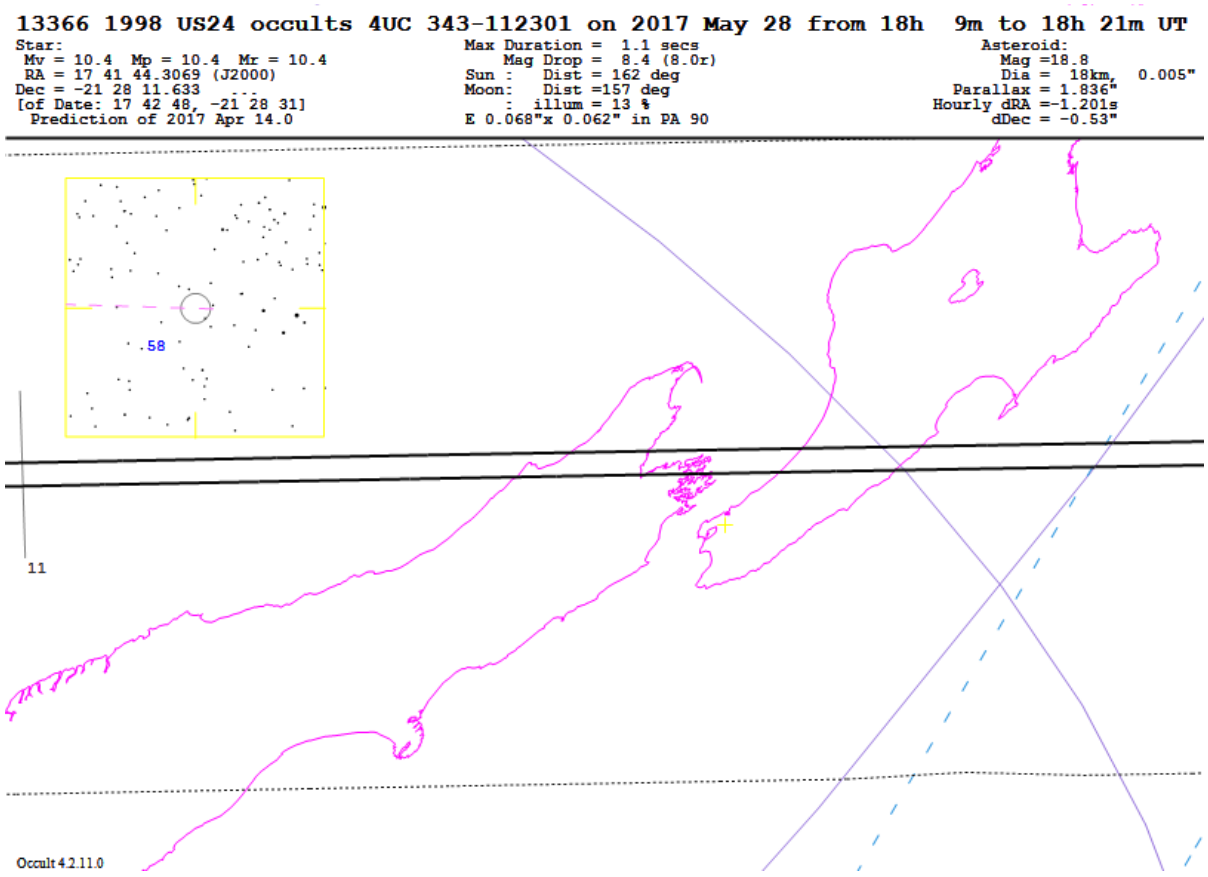
The first minor planet occultation for May is on Saturday 27th at 13h 43m 48s UT (1:43am Sunday morning). While not a particularly civilised hour, at least you can sleep in afterwards. While not a bright star (magnitude 9.6), Thusnelda (the minor planet) is faint enough that the star will seem to completely disappear for up to 4.4 seconds during the event. Further, the near-new moon (5% illumination) is well away from the star so it won’t cause any difficulties. The prediction shows the shadow travelling north-east across Christchurch and being well out to sea by the time it reaches Wellington’s latitude. However the uncertainty in the predictions means there is still a 3% probability that the centre of the shadow could actually cross Wellington – these are better odds than winning Lotto so I’d encourage all occultation observers to give it a go. All but one of the pre-point stars are magnitude 6, with the first (SAO 139890) at the beginning of the night and the last (SAO 144450) only 8 minutes before the occultation. Unfortunately the brightest pre-point star (magnitude 3.2) is near the middle of the night (11:30pm).

Point Time			Star	J2000 RA		Dec		Dec Offset	SAO
h	m	s	mag	h	m	o	‘	ArcMin	
13	36	01	6.7	20	27.5	-02	06	-5.3	144450
12	17	39	6.6	19	08.9	-02	17	7.5	143070
11	30	14	3.2	18	21.3	-02	54	45.4	
10	49	13	6.1	17	40.2	-02	09	1.6	141798
09	31	53	6.2	16	22.6	-02	05	-0.8	141129
09	05	13	6.8	15	55.9	-02	10	4.9	140842
07	31	32	6.8	14	22.0	-01	59	-4.0	139890


219 Thusnelda occults TYC 5180-463-1 on 2017 May 27 from 13h 42m to 14h 2m UT
Star:
Mv = 9.7 Mp = 9.7 Mr = 9.7
RA = 20 35 15.3150 (J2000)
Dec = - 2 11 39.258 ...
[of Date: 20 36 9, - 2 7 59]
Prediction of 2017 Apr 14.0
Max Duration = 4.4 secs
Mag Drop = 3.1 (2.6r)
Sun : Dist = 115 deg
Moon: Dist =140 deg
: illum = 5 %
E 0.060"x 0.060" in PA 90
Asteroid:
Mag =12.7
Dia = 46km, 0.046"
Parallax = 6.414"
Hourly dRA = 1.761s
dDec = 26.94"
70
44
Occult 4.2.11.0

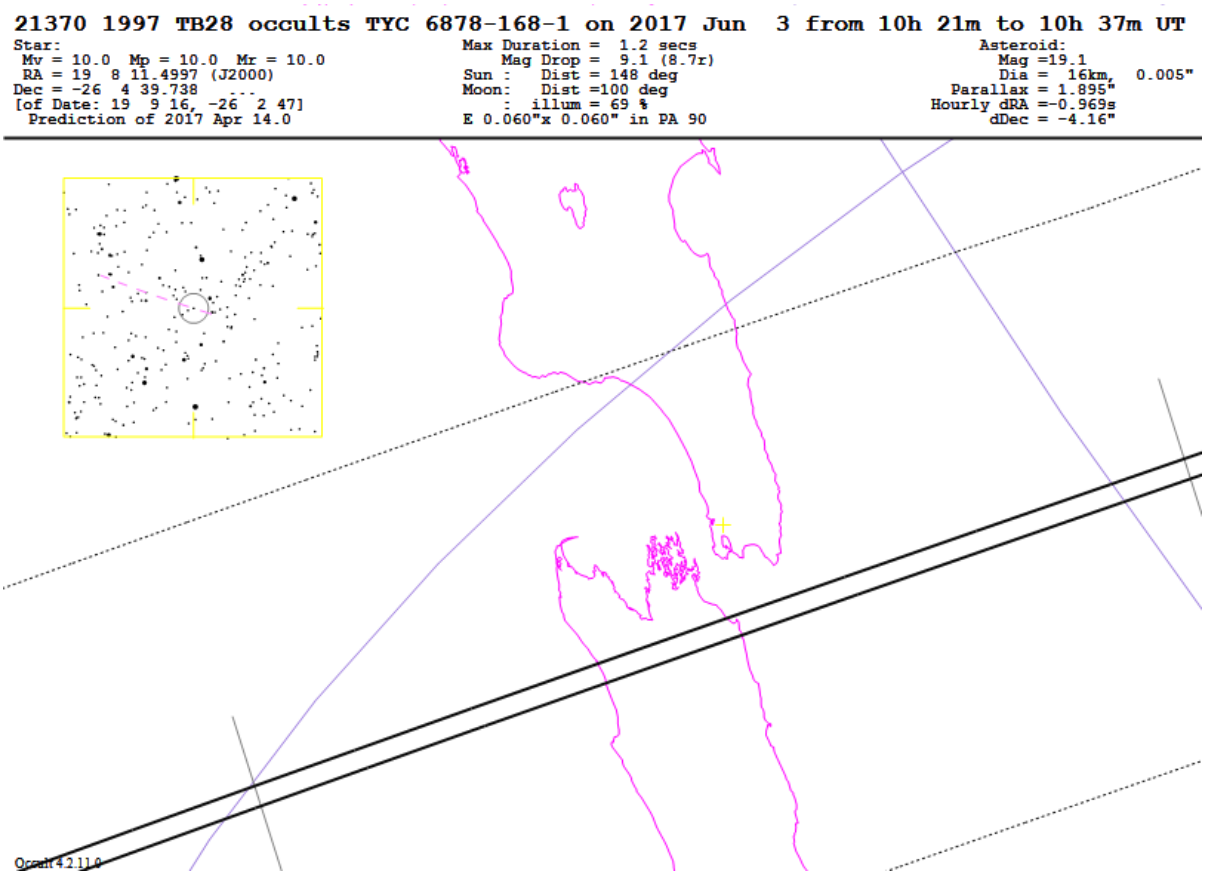
The next occultation is the following night, on Sunday 28th at 18h 10m 24s UT (6:40am Monday morning) – which you can hopefully squeeze in before going to work. This is still during astronomical twilight so there won't be any problems due to sun-rise. The moon is some distance away (157°) and not too bright (13% illuminated) so it won't be a problem. The star is quite faint (magnitude 10.4) and so you may need to need to use a longer integration time (if you have such a model of camera), but this also has to be balanced against the need for short integrations due to the brief duration (at most 1.1 seconds) of the occultation. Although the shadow is predicted to be north of Wellington, there is still a 3% chance that we could see the event. There is a long list below of pre-point stars. Arguably the most useful of these is one of the bright stars (SAO 184450) as its Declination is only 1.5 arc-minutes away from the target star and you only need to stop the telescope's tracking ~70 minutes before the event.

Point Time	Star	J2000 RA	J2000 Dec	Dec Offset	SAO
h m s	mag	h m	o '	ArcMin	
17 53 24	5.8	17 24.7	-21 26	-1.3	185367
17 34 57	6.3	17 06.2	-21 34	6.6	185024
17 24 20	6.6	16 55.5	-21 34	7.1	184804
17 00 59	4.5	16 32.1	-21 28	1.5	184450
16 45 51	6.6	16 17.0	-21 18	-7.9	184285
16 42 34	6.7	16 13.7	-21 24	-2.1	184240
16 35 42	3.9	16 06.8	-20 40	-45.7	184123
15 26 32	5.7	14 57.5	-21 25	0.4	
15 16 19	6.1	14 47.2	-21 19	-4.8	182873
10 03 03	6.7	09 33.3	-21 24	-0.4	177647
08 46 50	6.6	08 16.9	-21 19	-6.1	175497
08 07 01	6.7	07 37.0	-21 24	-2.6	174123
07 35 12	6.7	07 05.1	-21 27	0.0	172922



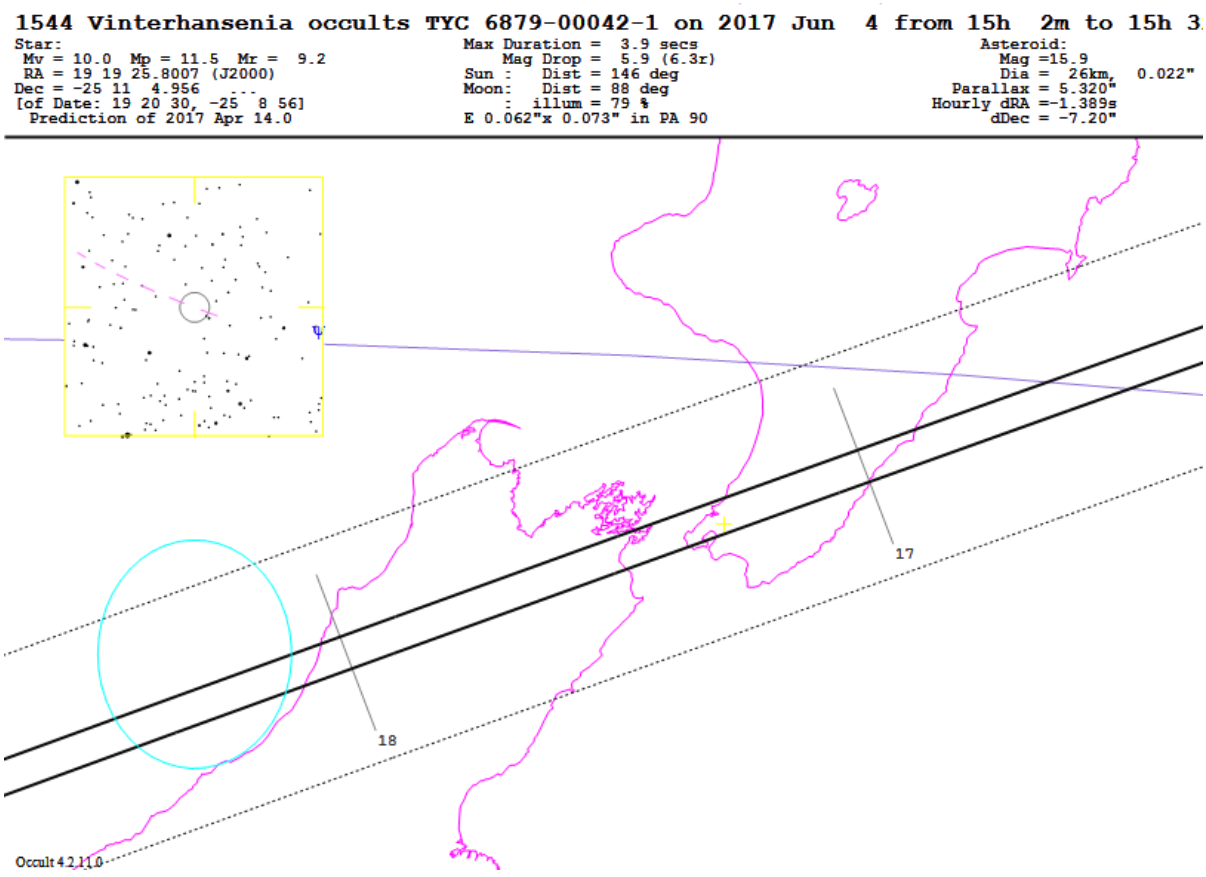
The remaining occultations are all in June but have been included here as they occur before our June WAS meeting. The first of these is on Saturday 3rd June at 10h 35m 30s UT, i.e. a fairly civilised time of 10:35pm. The minor planet is considerably fainter than the star, and so the star will seem to completely disappear during the occultation. The event is at most 1.2 seconds long so again you may need to balance increasing your camera's integration time to increase the signal verses having a fast time resolution. The moon is fairly bright now (69% illumination) but fortunately is some (angular) distance (100°) away from the star. The shadow's track is predicted to travel south of Blenheim but there is still a small chance (3%) that it could actually travel across Wellington. There are a surprising number of bright pre-point stars for this event, with, arguably, the best being SAO 183987 at the beginning of the night as it is only 6.8 arc-minutes different in Declination from the target star.

Point Time	Star	J2000 RA	J2000 Dec	Dec Offset	SAO
h m s	mag	h m	o '	ArcMin	
10 22 37	2.1	18 55.3	-26 18	13.5	187448
10 13 02	3.2	18 45.7	-26 59	55.3	187239
09 55 23	2.8	18 28.0	-25 25	-38.4	186841
07 57 09	1.1	16 29.4	-26 26	25.2	184415
07 48 56	2.9	16 21.2	-25 36	-25.0	184336
07 26 40	2.9	15 58.9	-26 07	6.8	183987



If you can only observe one occultation in the next month, make it this one as the shadow is predicted to travel across Wellington. It takes place on Sunday 4th June at 15h 17m 18s UT (3:17am Monday). As the minor planet Vinterhansenia is quite small (it is estimated to have a 26 km diameter), the duration of the occultation will be short (at most 3.9 seconds). The occulted star is faint (magnitude 10.0) so I'd recommend using one of the pre-point stars listed below to point your telescope to the right position in the sky. The moon is slightly brighter than the previous night (at 79% illumination) but still a reasonable angular distance away (88°) from the star.

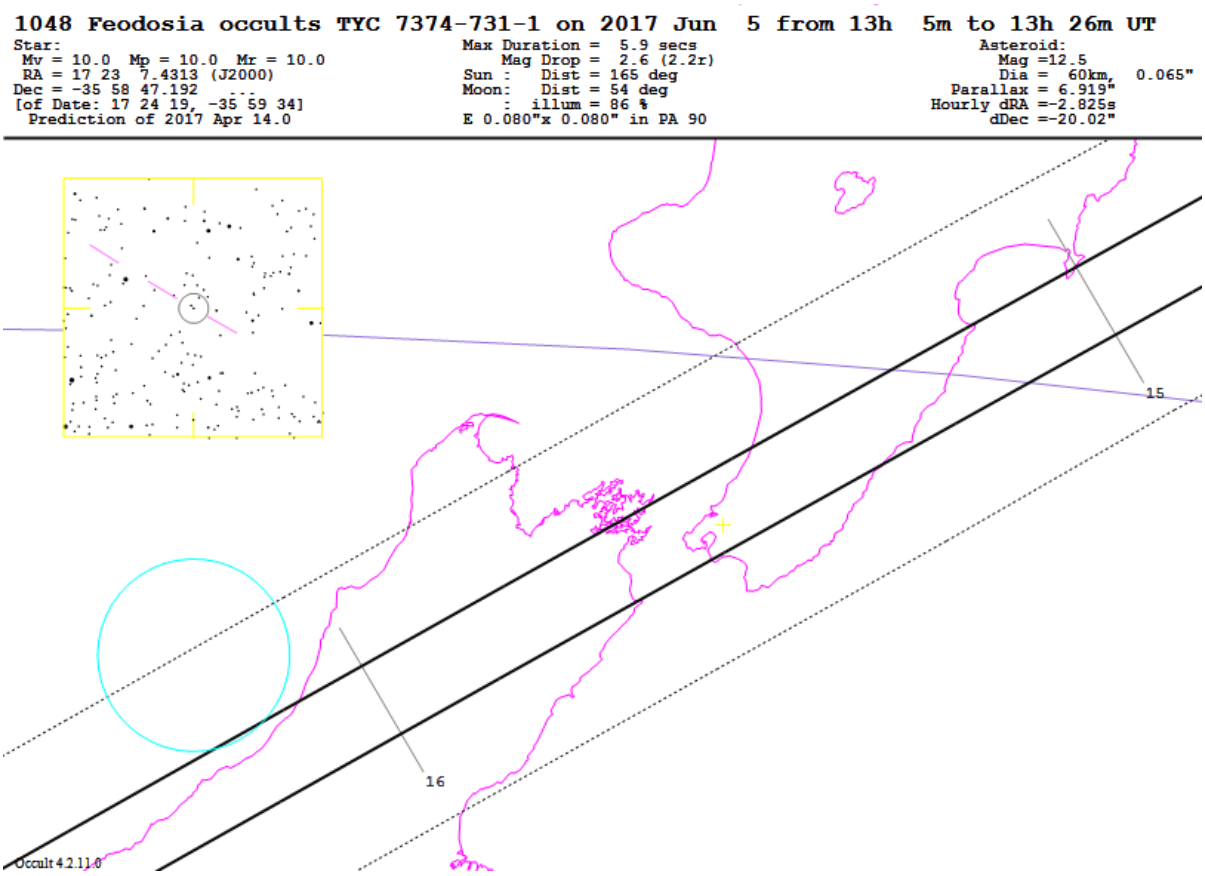
Point Time	Star	J2000 RA	J2000 Dec	Dec Offset	SAO
h m s	mag	h m	o '	ArcMin	
15 13 25	4.9	19 15.5	-25 15	4.4	187882
14 26 00	2.8	18 28.0	-25 25	15.5	186841
13 20 12	3.3	17 22.0	-25 00	-8.2	185320
12 58 13	5.9	17 00.0	-25 06	-2.1	184892
12 28 32	4.8	16 30.2	-25 07	0.0	184429
12 19 33	2.9	16 21.2	-25 36	28.9	184336
11 02 36	3.3	15 04.1	-25 17	11.9	183139
10 41 48	5.7	14 43.2	-25 00	-4.8	182795
09 58 40	5.8	14 00.0	-25 01	-3.4	
09 57 11	5.2	13 58.5	-24 58	-5.7	182134



Just to spoil us, here is another occultation whose shadow travels across Wellington, the Kapiti Coast, Wairarapa, Picton and Blenheim. This takes place on Monday 5th June at 13h 15m 30s (1:15am Tuesday). The conditions are similar to the previous night's event, except the moon is nearly full (86% illuminated) and getting a bit closer (54°) to the star.

If the weather cooperates for the beginning of June, I hope to hear about a whole lot of positive occultations at out June WAS Research Group meeting!

Point			J2000			Dec	
Time			Star	RA		Dec	Offset	SAO
h	m	s	mag	h	m	o '	ArcMin	
13	15	30	10.0	17	23.1	-35 59	star	
13	15	01	6.4	17	22.6	-35 55	-4.1	208741
12	53	03	6.0	17	00.6	-35 56	-2.2	208293
11	14	27	3.6	15	21.8	-36 16	19.7	206552
09	59	28	2.1	14	06.7	-36 22	27.4	
09	13	27	2.8	13	20.6	-36 43	48.5	
08	59	47	5.6	13	06.9	-35 52	-2.4	204132
07	40	07	6.2	11	47.1	-35 54	0.5	202805
06	57	58	5.4	11	04.9	-35 48	-5.8	202067



Murray Forbes

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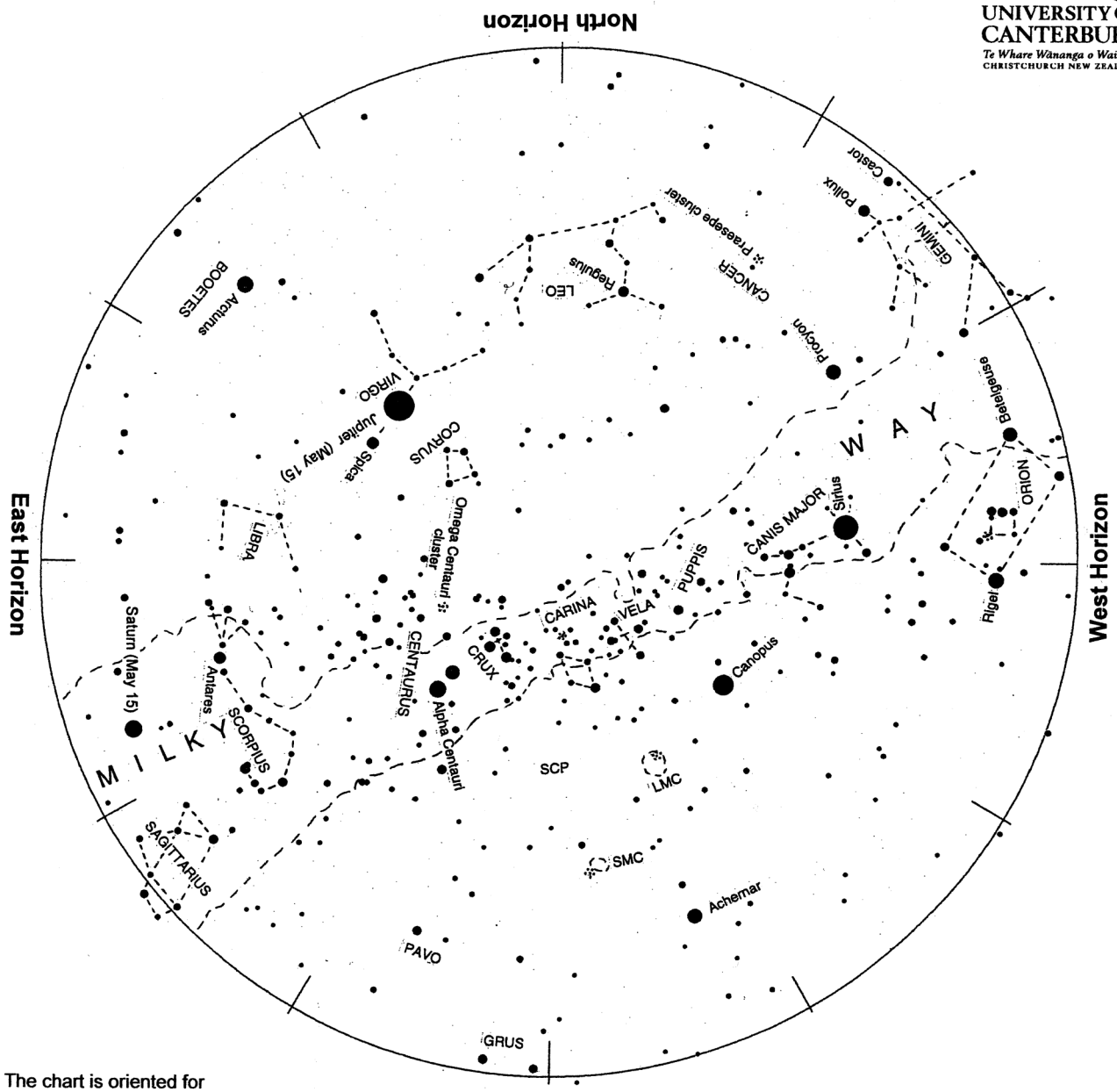

The chart is oriented for
April 15 at 10 p.m. NZST
May 1 at 9 p.m. "
May 15 at 8 p.m. "
June 1 at 7 p.m. "

Evening sky in May 2017

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 westward shift each night as we orbit the sun.

Two bright planets are in the evening sky. Golden Jupiter appears in the northeast soon after sunset, the brightest 'star' in the sky. Saturn is low in the southeast below orange Antares. Sirius, the brightest true star, is midway down the western sky. Directly below it is Orion with bright stars Rigel and Betelgeuse, and 'The Pot'. Canopus is southwest of overhead. Below Jupiter is orange Arcturus, often twinkling red and green. Crux, the Southern Cross, and the Pointers, Alpha and Beta Centauri, are southeast of the zenith.

Chart produced by Guide 8 software; www.projectpluto.com. Labels and text added by Alan Gilmore, Mt John Observatory of the University of Canterbury. www.canterbury.ac.nz

The Night Sky in May

Two bright planets and the brightest stars share the evening sky this May. Soon after sunset golden Jupiter appears in the northeast. Beside Jupiter is Spica, the brightest star in Virgo. Below Jupiter, near the horizon, is orange Arcturus, the brightest star in the northern sky. As the sky darkens Sirius, the brightest of all the stars, appears midway down the northwest sky. Canopus, second brightest, is southwest of overhead. Midway up the southeast sky are 'The Pointers', Beta and Alpha Centauri. Well below them is the hook-shaped pattern of Scorpius with orange Antares marking the Scorpion's body. Below Antares, and brighter, is Saturn, rising in the southeast.

Below Sirius are bluish Rigel and reddish Betelgeuse, the brightest stars in Orion. Between them is a line of three stars, Orion's belt. To southern hemisphere star watchers, the line of three makes the bottom of 'The Pot', now tipped on its side. Sirius, 'the Dog Star', marks the head of Canis Major the big dog, now head down tail up in the west.

Crux, the Southern Cross, is southeast of the zenith, to the right of 'The Pointers'. Alpha Centauri, the brighter Pointer, is the closest naked-eye star, 4.3 light years* away. Beta Centauri, like most of the stars in Crux, is a blue-giant star hundreds of light years away. Canopus is also very luminous and distant: 13 000 times brighter than the sun and 300 light years away.

Antares is a red-giant star like Betelgeuse: around 20 times the mass of the sun but wider than Earth's orbit. It is 600 light years away and 19 000 times brighter than the sun. Arcturus is the brightest red star in the sky but, at 37 light years, is much closer than Antares. It is about 120 times brighter than the sun. When low in the sky Arcturus often twinkles red and green as the air breaks up its orange light.

The Milky Way is brightest in the southeast toward Scorpius and Sagittarius. In a dark sky it can be traced up the sky past the Pointers and Crux, fading toward Sirius. 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, 30 000 light years away, is in Sagittarius. The nearby outer edge is by Orion where the Milky Way is faintest. A scan along the Milky Way with binoculars shows many clusters of stars and some glowing gas clouds, particularly in the Carina region and in Scorpius.

The Clouds of Magellan, LMC and SMC, are midway down the southern sky, easily seen by eye on a dark moonless night. They are small galaxies. The Large Magellanic Cloud is 160 000 light years away and is about 5% the mass of our Milky Way galaxy. The Small Cloud is around 200 000 light years away and 3% the mass of our galaxy. That's still many billions of stars in each.

At the beginning of May Jupiter sets due west around 5 a.m., reducing to around 3 a.m. by month's end. Jupiter is 700 million km away. It is always worth a look in a telescope. Its four big moons look like faint stars near the planet. One or two can be seen in binoculars if you can hold them steadily enough. All four are easily seen in any telescope magnifying 20x or more. The Moon will be near Jupiter on the 7th and 8th. Saturn is a great sight in any telescope with its rings near maximum tilt. It is 1,370 million km away. Titan, its biggest moon, orbits four ring diameters from the planet. Three or four smaller moons can be seen in larger telescopes closer to Saturn. The Moon will be near Saturn on the 13th.

Brilliant Venus (not shown on the chart) appears in the eastern morning sky, rising before 4 a.m. So around 4 a.m., for at least the first half of the month, Venus is rising in the east as Jupiter sets in the west. Venus is 67 million km away at the beginning of the month. It appears as a crescent in a telescope. The Moon is near Venus on the 23rd. About 90 minutes before sunrise Mercury rises in the empty sky below and right of Venus. Mercury looks like a medium brightness star at the beginning of May but brightens steadily through the month.

*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.

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