Nebulous News

Newsletter of the Latrobe Valley Astronomical Society Inc.

April - May 2024

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Chris Morley

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Chris Moy

Committee Members
Chris Stockdale
Tracey Matthies
Rim Zitkevicius
Mark Jarrod

Society Web Site http://LVAstro.org

MEETINGS

General meetings are held on the second Tuesday of every month other than January and December, at 7:30 pm., at the Education Centre, Wirilda or by Zoom, unless otherwise noted.

Next Meetings

Tue	**9**	**Apr**	**7:30 PM**	**Monthly Meeting, at Wirilda / Zoom** *European Southern Observatory*
Fri	**10**	**May**	**7:30 PM**	**Public Deep Sky Observing Night, at Wirilda**
Tue	**14**	**May**	**7:30 PM**	**Monthly Meeting, at ? Zoom** *Probably Guest Speaker, to be announced*
Tue	**11**	**Jun**	**7:30 PM**	**Monthly Meeting, at Wirilda / Zoom** *Favourite Gadget or Book Night / How I got into astronomy*

SUBSCRIPTIONS

Members are reminded that annual subscriptions fall due on July 1st. Any member who has not paid their subscription by 31st October will be deemed unfinancial.

Full Members	$25.00	Family Rate	$38.00		
Associate Members	$13.00	Student Members	$19.00	Junior Members	$13.00

Subscriptions are preferred by EFT to our pay ID, **ABN 23 996 630 085**

They may also be paid by cash at a meeting, or by cheque to

Latrobe Valley Astronomical Society, PO Box 459, Moe, Victoria, 3825.

Articles for the next edition are very welcome up to the 20th May 2024 – and will probably be accepted until the end of that month. Submissions are preferred in plain text, or .odf, .docx or .doc with minimal formatting, but most sane formats are acceptable. Photographs for the front cover are preferred in A4 portrait aspect, about 1K pixels high – or allow the editor to “fix”.

On the cover: *Windmill and Orion just after the Moon set at Stockmans Camp, Gippsland Star Party. D750, 15 secs, 14 mm f/2.8 lens @ f/4, ISO 5000. Chris Morley*

Society Notes From the President

Gippsland Star Party

The inaugural Gippsland Star Party was held at Stockmans Camp at Buchan South from 15-17 March 2024. Over seventy people, mainly from the Astronomical Societies of Victoria, Mornington Peninsula and Latrobe Valley, attended.

Telescopes were arranged in two lines down the observing field, with vehicles parked on the outside of the lines, making it easy for people to walk down the centre. Scopes ranged from smallish astro-imaging refractors to a 22” Dobsonian.

We were blessed with clear dark skies on both nights (once the Moon had set). Sky darkness was measured by Dave Rolfe to be ‘nearly Bortle 1’. Numerous people had astro-imaging rigs whilst others were immersed in visual observing.

The gathering was good for meeting new people with similar interests and chatting about all things astronomical. The star party was considered very successful, so there are plans already to return to Stockmans Camp again next year in March.

Above and below are two pictures taken by MPAS member Chris Kostokanellis, showing solar viewing and the Vela Supernova Remnant. No details are to hand of the Vela image, which was taken at the star party.

National Australian Convention of Amateur Astronomers (NACAA) 2024

The 31st NACAA was held in Parkes over Easter and hosted by the Central West Astronomical Society. This event was Take 2 for the Parkes local organising committee, with the 2020 edition being cancelled due to Covid.

The convention was filled with many presentations. Being in Parkes, which is famous for having the 'Dish' radio telescope nearby, it wasn't too surprising that there were a number of talks featuring radio astronomy and radio telescopes.

The keynote address was given by Anthony Wesley (who is famous for observing and recording Jupiter impacts) on New Horizons – Advances in Camera Technology for Amateur Astronomy. We heard about some exciting developments that will make cameras much more sensitive (to photons) and extend their response into the Near Infrared.

Other presentations covered such diverse topics as Solar System Stability, Double Star Observing with an old telescope, Nova Hunting Insights, Eyepieces for the Great Melbourne Telescope, The Cranbourne Meteorite Fall, Serpentinization - the source of energy, catalysts and nutrients for life to emerge on Earth in the Hadean aeon,

Rethinking Home-made Dome Observatories, Determining the Eccentricity of Earth's Orbit, the Cosmic Microwave & Gravitational Wave Backgrounds; and a NZ perspective of the 1910 apparition of Halley's Comet. The last-mentioned talk, which was given by John Drummond from Gisborne, NZ, won the prize for the best presentation.

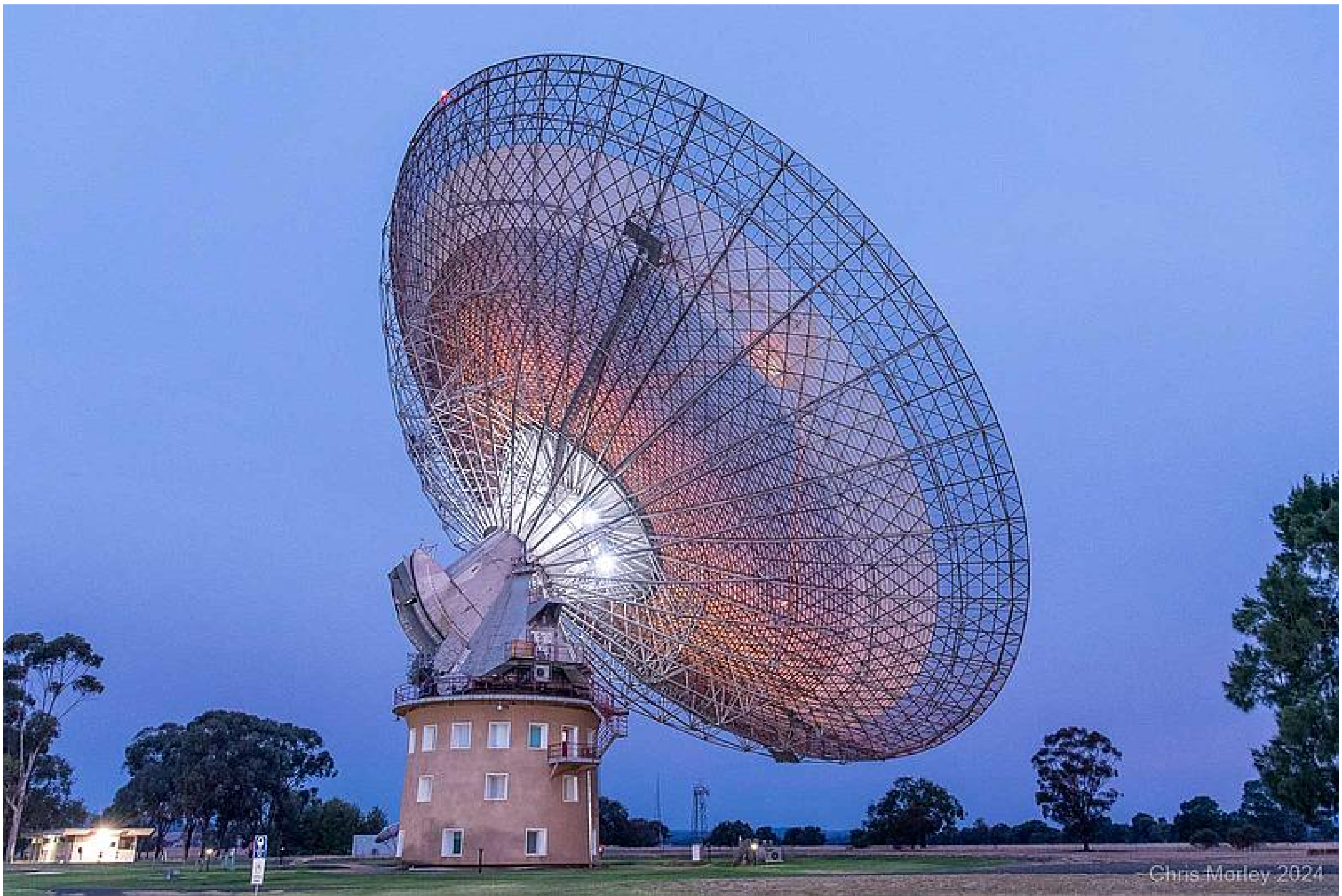
The John Perdrix Address was given by Col Bembrick on the topic of 'The Travels, Travails, and Triumphs of an Amateur Astronomer Through The Decades'.

John Sarkissian, a Parkes Radio Telescope stalwart, gave the after-dinner speech on Saturday night, outlining his time working at the Dish for nearly 30 years.

And then of course, there was the announcement awarding the Berenice and Arthur Page Medal for 2024 to our own Rod Stubbings for his prodigious work on variable stars. For more details, please refer to the separate article in this edition of Nebulous News.

The weekend finished with a BBQ at the Dish on Sunday evening, where a very pleasant time was spent chatting with others, inspecting a home-made radio interferometer, watching the Dish go about its pulsar timing array monitoring, and making new friends.

The next NACAA will be held in Tamworth at Easter, 2026



Calendar

Tue	**9**	**Apr**	**7:30 PM**	**Monthly Meeting, at Wirilda / Zoom** *European Southern Observatory*
Fri	**10**	**May**	**7:30 PM**	**Public Deep Sky Observing Night, at Wirilda** *(Suggestions for other locations welcome)*
Tue	**14**	**May**	**7:30 PM**	**Monthly Meeting, at ? Zoom** *Probably Guest Speaker, to be announced*
Tue	**4**	**Jun**	**7:30 PM**	**(Members) Observatory Visit, at Member's Observatory (TBC)**
Tue	**11**	**Jun**	**7:30 PM**	**Monthly Meeting, at Wirilda / Zoom** *Favourite Gadget or Book Night / How I got into astronomy*
Tue	**9**	**Jul**	**7:30 PM**	**Monthly Meeting, at Wirilda / Zoom** *Who Owns Space?*
Tue	**13**	**Aug**	**7:30 PM**	**Monthly Meeting, at Wirilda / Zoom** *AGM & Pulsar Timing Array (Gravitational Wave Background)*
Tue	**3**	**Sep**	**7:30 PM**	**Members Observing Night, at Wirilda**

Tue	**10**	**Sep**	**7:30 PM**	**Monthly Meeting, at Wirilda / Zoom** *Using a Dobsonian for Astrophotography*
Tue	**1**	**Oct**	**7:30 PM**	**Members Observing Night, at Wirilda**
Tue	**8**	**Oct**	**7:30 PM**	**Monthly Meeting, at Wirilda / Zoom** *Report on the TESS Science Conference*
Tue	**5**	**Nov**	**7:30 PM**	**Members Observing Night, at Wirilda**
Fri	**8**	**Nov**	**7:30 PM**	**Public Lunar & Planetary Night, at Morwell Town Common (?)**
Tue	**12**	**Nov**	**7:30 PM**	**Monthly Meeting, at Wirilda / Zoom** *Report on the Work of the JWST Space Telescope*
Fri	**6**	**Dec**	**6:30 PM**	**End of year Starbecue, at Wirilda barbecues** *BYO food, insect repellent, Telescopes*

Observing nights may be subject to change, and possibly even last-minute date changes to accommodate the weather, though the nights selected are around new moon, so they will probably not change by much. Suggestions for alternative locations are welcome, particularly for the public nights. The putative members' night on Tuesday 5 Nov has been left in for now, but may not have many takers if we have a Public L&P night the following Friday.

Rod Stubbings awarded medal Chris Morley

Long-time LVAS member Rod Stubbings was awarded the prestigious 2024 Berenice and Arthur Page Medal at NACAA in Parkes at Easter.

The medal is awarded every two years by the Astronomical Society of Australia. It recognises excellence in amateur astronomy in Australia and its territories, based on scientific contributions which have served to advance astronomy.

Rod is a world-renowned visual star observer, and has just clocked up 400,000 observations – a truly remarkable achievement.

On Rod’s website, he notes ‘The science of Astronomy is unique. A great deal of astronomical research depends on the work of highly skilled amateur astronomers who play a pivotal role in constantly monitoring variable stars.

‘I monitor variable stars for outbursts, particularly the cataclysmic (explosive) variable stars (CVs). Recorded observations are then sent to various variable star organisations, which include the American Association of Variable Star Observers (AAVSO), the research section of the Royal Astronomical Society of New Zealand, Variable Stars South (VSS), and the Variable Star Network (VSNET), a global professional-amateur network of researchers in variable stars.

Rod also recounts the evening a couple of months ago when he clocked up his 400,000th observation: ‘On February 10, 2024, I made my 400,000th visual variable star observation! This has taken 30 years and 9 months. This milestone was only previously achieved by Albert Jones and Hiroaki Narumi. I had to observe 148 stars to reach this total. I started at 9:00pm and got there by 11:11pm. I went inside for a break, and a cup of tea, then returned outside for more observing.

‘It was on the SU-UMa star VW Hyi, probably the most observed star in the southern skies. It was currently having a superoutburst. I have over 4000 observations of this star.

Rod was planning to be in attendance at Parkes for the National Australian Convention of

Amateur Astronomers (NACAA) but had to pull out at short notice. Rod’s award was accepted on his behalf by Peter Skilton (MPAS) who gave a glowing account of Rod’s dedication to variable star observing.

On behalf of LVAS, I also said a few words about Rod’s remarkable achievement and the method by which he covers so many stars, all from memory, each clear night. Rod not only knows where the many hundreds of stars that he observes are (to hand-point his 22” telescope), but he knows the magnitude of all the nearby reference stars for each variable star, thus enabling him to estimate the magnitude of the variable star. After he’s finished observing, he then enters into his database, all the results of the observing session, from memory!

Rod’s achievement has been covered in many media reports and interviews – Melbourne and local newspapers, ABC Melbourne and ABC Gippsland and WIN News to name a few.

Well done Rod! You and your work are a shining example of how amateurs can collaborate with professionals.

(There was a detailed article describing Rod's involvement with observations of X-Ray binary A0538-66 (= LMC V3434) in the last issue of Nebulous News - Ed)

Setting Up a Dobsonian

John Sunderland

Selected notes from the presentation at the March 2024 Meeting. The author apologises for the lack of diagrams, but most of this was done with practical demonstrations on the night. If you read this in conjunction with "LVAS 40cm Lightbridge", below, you will find some relevant pictures - and a bit of duplication - this article is intended to be "general", the succeeding on "specific".

A "Dobsonian" telescope is a Newtonian telescope on a particular style of alt-azimuth mounting. The mounting gives good utility for visual work using only multi-ply timber and simple hardware, so is quite cheap to make - most of your money goes into the optics - so "Dobs" are the cheapest way of getting a given aperture.

For visual work, “nothing beats square inches” and you can afford more of them with a Dob.

Accessories

So, you have bought a dob. What do you need to go with it ?

- Finder(s)
- Sky Map (omitted here)
- Collimator
- Eyepieces

Finding an object

Options:

- Finders & Map: See below
- “Push to” / Digital Setting Circles such as an “Argo Navis” are available, but are not covered here
- “Goto”: Usually rely on belt or wire drive as “servos” using feedback from the position sensors (as above).

"Optical Finders"

Most Dobs will come with some sort of finder, but you may need to add to or improve them.

My recommendation: BOTH of

- A “zero power” / “red dot” / telrad finder. Lets you get “within cooee” easily, and is all you need for things you can see “naked-eye”.
- A finder telescope
    - Preferably as close to ¼ of the aperture of the main telescope as you can mange.

200mm scopes typically come with 50mm finders, which is OK. 50mm is NOT big enough for a 40cm ‘scope ! The 80mm on our 40cm ‘scope is adequate.

- As wide a field as you can manage for the given aperture. A 50mm finder for a 200 mm scope should have at least a 5° field, but this gets harder with bigger finders.

Finder telescopes – mounting

The mounting for the finder needs to be robust, but easily adjustable.

The finder must be held in two sets of points. This can be done with:

- Two sets of rings (with adjustment points)
- One set of rings (with adjustment points) and something fixed, often an “O” ring.
- The further apart that the two points are axially, the better – they will be both more stable and easier to adjust.
- The system with one set of points and an O-ring works quite well so long as the O-ring is a snug fit both on the finder tube and on the carrier, and is far enough away from the adjustment points
- Three screws, or two screws and a spring ? The spring works well – so long as it is strong enough to hold the finder firmly against the adjustment screw.
- Angle of the adjustment screws ? Most rings have three points – two screws and a third screw or spring – space equally around the ring, ie, at 120°. Logical ? Well, yes, but it means adjusting in one direction also affects the other direction. If you have two adjustment screws at 90° and the third point or spring opposite them, the two screw adjustments are largely independent.

Aligning the Finder(s)

If your finder - any finder - is not aligned with the telescope, it is not particularly useful !

Best way to do this is in daylight using a terrestrial object, typically a tree, power pole or TV antenna. It needs to be a good distance away – 1km is in no way to far, but a few houses away would probably do. Something across your back yard will not.

Find a suitable object through the main ‘scope, and align the finder(s) to it (without moving the ‘scope). After you are happy, go back and check you have not moved the ‘scope! (it is in the nature of Dobs to be easy to move)

Why use a terrestrial object in daylight ?

- You aren’t wasting observing time
- It is easier to be sure you have both the main scope and finder on the same object
- Terrestrial objects don’t move ! (well, assuming you have chosen something sensible. Cows or trucks are not so good)

Collimation

ALL TELESCOPES NEED TO BE COLLIMATED

However, it must be admitted that Newtonians, especially Dobs, and especially especially the larger Dobs that collapse in some way for transport, need collimating more frequently.

There are a number of ways of collimating a Dob. The gold standard is using star-testing, not considered further here. By far the easiest way to get “pretty good” collimation is with a laser collimator. Advantages:

- You can do it in daylight, so you don’t waste observing time
- You don’t have to look through the eyepiece, so it is FAR easier single-handed
- It is simply easier and more intuitive

The problem with laser collimation ?

It really only collimates the centre of each mirror. This is fine if the mechanical centre of the mirror is the same as the optical centre, which, of course, it <u>should</u> be …..

Collimating with a Laser - Setting Up

The first time you do this, you should give yourself some time. After that, it becomes simpler

- Make sure your mirror has a centre “doughnut” and the secondary a centre dot.
- Make sure your laser collimator is itself collimated. This process only works if the laser beam is centred and parallel to the housing
  - Check the beam is centred – you an just use a ruler for this at the exit of the collimator. Take care not to look directly into the beam – they are not dangerously bright, but take care enyway.
  - Rotate the collimator in a housing and observe the beam on a target some distance away – think metres. If the beam moves as you rotate it, it is out of collimation. If your collimator is out, see if it has adjustment screws that you can use to collimate it.
  - This is a hint – either buy a relatively expensive collimator that should be pre-collimated, or make sure you buy one that has adjustments. Cheaper collimators do NOT necessarily come pre-collimated !

To rotate the collimator – typically they come as 1¼” barrels with a 2” adaptor. You an clamp the adaptor somehow and rotate the collimator in the adaptor. Alternatively, if you happen to have engineering V-blocks, they would work fine. I have also “chucked” one in my lathe (using a self-centring chuck) – turning it by hand!

Collimating with a laser – Collimating the Telescope

1. Mount the collimator in the eyepiece of your telescope, and check where the beam hits the secondary. You want it to be in the middle, (or offset centre if you secondary is offset). Hope that it is! If not, you can either displace the seconday, eg by moving the tensioning screws or nuts on the spider (messy) or you can shim the focuser to adjust its angle (also messy).

   If you are setting your ‘scope up for the first time, you should really try to ensure the focuser is square on then adjust the position of the secondary.
2. Adjust the angle of the secondary so that the beam hits the primary in the centre of the doughnut. (Then make sure the beam is STILL hitting centre of the secondary. If not, iterate). The nice thing about the laser collimator here is you do that looking down the tube of the ‘scope, so you are handy to the spider adjustments.
3. At the mirror end, adjust the angle of the mirror so the beam follows back on it self right back to the collimator. When it is close, it will appear on the collimator screen, which you can see from where you are adjusting the mirror.

   Your aim is to make it disappear into the hole that it comes out of.
4. If you are feeling brave: Rotate the collimator in the eyepiece and see if it still is OK. Iterate if not.
5. If you are still feeling brave, change the elevation of the ‘scope, and see if it maintains collimation!

If it doesn’t ?

1. If it is still pretty good, but you are feeling fanatical because there is great seeing and you want to look at Jupiter – or anything else that needs high mag – recollimate at the elevation of the object
2. If has moved a lot, time to think about how to stiffen the tube. This is most likely with a truss or collapsible tube dob.
   - Are the anchor points secure ?
   - If it is a sliding "collapsible tube" dob, can you add some trusses ? (Collapsible dobs miss the point of why proper dobs are made with truss tubes !)

Eyepieces - for fast telescopes

A full discussion of eyepieces is beyond the scope of this article, and there is not much difference between requirements for "Dobs" and any other fast 'scopes.

- Dobs are typically “fast” (short f-ratio), so the light cone coming into the eyepiece has relatively wide angles. You need a modern eyepiece type to cope with this. You don’t have to start at “Ethos”, but Plossels are your basic bottom line. Old styles like Kelners or Hygens won’t do it. But then you wouldn’t be using them anyway, would you?
- You may well need a “Barlow” style eyepiece to get higher magnification. Barlows had a bad rep a few decades ago, but good Barlows (especially three element ones) are quite usable, and “specialist” versions like “Power Mates” are good.
- Many better short focal lenght eyepieces are just a longer focal length eyepiece behind a built-in barlow, so you may as well buy one barlow rather than a separate one for each eyepiece! (This is a bit tongue in cheek - doubtless the eyepiece designers can do that little bit better with a custom barlow for the configuration. It depends on how fanatical you are)
- There are also specialist "coma correction" lenses specially designed for fast Newtonions to consider.

Magnification considerations

(This applies to any telescope, but the examples are canted towards Dobs)

Maximum Magnification:

Usually this is limited by seeing. For a top-notch 40cm Dob, it is worth having the capacity to go to anything up to 600X, but don’t expect to use it often ! For a 40cm f4.5, this means an eyepiece as short as 3mm, or more likely, 6mm with a 2x barlow, or even 15mm with a 5x barlow/ powermate.

Minimum Magnification

This is limited by your eyes. The light collected by the telescope has to be concentrated into a beam that fits into your eye. The exit beam width is simply the aperture of the telescope divided by the magnification. For most of us of “mature” age, it needs to be no more than 5mm.

For an f4.5 40cm dob, 400/5 = 80x => 1800 / 80 = 22.5mm, ie the longest eyepiece focal length.

- In general, max focal length = focal ratio * max eye pupil.

Note that this depends only on the f-ratio, not the aperture. For a 5 mm eye:

F-ratio	4.5	5	6	8	10	15
Max eye piece focal lenght (mm)	22.5	25	30	40	50	75

Barrel Size

Most eyepieces have the focus plane a little in front of the first element, so the barrel size has to be large enough to include the field of view at the focus plane. (If the first element is inside the focus plane, it needs to be wider)

Field of view = Eyepiece apparent field of view / magnification

So the max field of view = Eyepiece Apparent FoV / min magnification

The max. field size at the focal plane = focal length * tan(field of view)

Strictly it is 2 x fl * (tan or sin (1/2 field of view)) (depending on the shape of the focal plane), but the above formula is quite close enough a the small angles we are considering.

Calculating this out for various configurations, we get:

Note that we can get the same maximum field from both the f8 and f5 15cm (6") telescope, but if you want a rich field telescope, it is easier to get it with the f5, in terms of eyepiece focal length - 25mm not 40mm. Good 40mm eyepiecs with a large apparent field of view are harder to come by - and more expensive - than 25mm eyepieces.

Telescope		40cm f4.5	30cm f5	20cm f6	15cm f8	15cm f5
Minimum Mag.		80x	60x	40x	30x	30x
Focal Length FOV		1800	1500	1200	1200	750
EP FL		22.5	25	30	40	25
AFOV 50° (eg Plossel)	FOV	0.63°	0.83°	1.25°	1.67°	1.67°
	Field Size	20	22	26	35	22
AFOV 68° (eg Panoptic)	FOV	0.85°	1.13°	1.70°	2.27°	2.27°
	Field Size	27	30	36	47	30
AFOV 82° (eg Nagler)	FOV	1.0°	1.37°	2.05°	2.73°	2.73°
	Field Size	32	36	43	57	36

Focuser Size

So, if a 1.25" barrel eyepiece is OK, a 1.25" focuser is OK, right ?

Well - not necessarily. Consider a 30cm f/5 'scope.

The focus plane is going to be well inside the focuser, and the light cone from the mirror expands towards the mirror, with an angle around arctan(1/f), ie, 11°. This is not negligible!

The total size of the light cone at distance d from the focal plane is

Size of focal plane + d / focal ratio

A 30cm f/5 scope with a field of 30mm and the focus plane 60mm inside the focuser needs a width at the entrance to the focuser of 30 + 60/5 = 42mm.

So, while a 1.25" (barrel) eyepiece is OK (just), it needs a 2" focuser

For a focal plane 60mm inside the focuser, we can calculate:

The interesting points to note here are that a bigger telescope does not necessarily require a bigger focuser. Our 40cm could just about get away with a 1.25" focuser if we stuck to Plossels - which we don't ! - but the 2" focuser on it is quite OK. However, if we want maximum field of view, strictly you need bigger than 2" on a 20cm f/6 if you use a Nagler (or wider). Of course, you also need to consider the size of the secondary, but that is another story ....

Telescope		40cm f4.5	30cm f5	20cm f6	15cm f8	15cm f5
Minimum Mag.		80x	60x	40x	30x	30x
Focal Length		1800	1500	1200	1200	750
EP FL		22.5	25	30	40	25
AFOV 50° (eg Plossel)	FOV	0.63°	0.83°	1.25°	1.67°	1.67°
	Focuser Size	33	34	36	42	34
AFOV 68° (eg Panoptic)	FOV	0.85°	1.13°	1.70°	2.27°	2.27°
	Focuser Size	40	42	46	55	42
AFOV 82° (eg Nagler)	FOV	1.0°	1.37°	2.05°	2.73°	2.73°
	Focuser Size	46	48	53	65	48

LVAS 40cm Lightbridge

John Sunderland

Moving, Assembling and disassembling the LVAS 40cm Lightbridge

This guide was put to gether recently, so it seemed sensible to publish it in "Nebulous News"

Transporting

Space required:

Base: 820 mm diameter with 630mm clearance above most of it.

Mirror Tube: 600mm diameter x 570mm high. (Actually 500mm diameter with protruberances)

Sec. Cage: 600mm (as above) x 350mm high

I usually carry the mirror tube in one of the backseats, seat-belted in.

The secondary cage fits inside the base, but you need some packing in between

Hint: It does fit in a Forester, I think it fits in a Prius, it does NOT fit in a Corolla (!) (check model with Paul O)

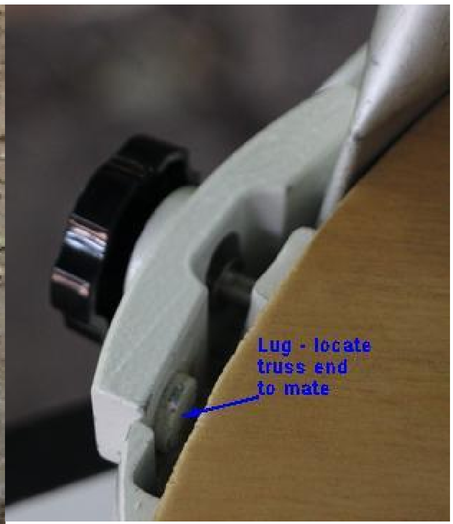
Moving (locally)

The lightbridge has "wheel-barrow" handles for moving short distances. They fit between cleats on the outside of the base, and captive screws hold them in place. Fit them with the wheels out (for stability), postion the screws into the holes, and tighten. This can move the whole assembled telescope short(ish) distances, but beware that the tube is not locked in the base, and can swing backwards and forwards. Either be dudicious in your movements, or, better, get someone to hold the tube. (there is a brake on the side of the tube, which "helps", but is by no means certain.)

Basic Assembly

If you have used them, remove the wheel-barrow handles. (They are a severe trip hazard!)

Lift the mirror tube into the base. Locate the metal seam, and orient that towards the cross brace of the base. (You may have done this before positioning with the wheel-barrow handles)



Undo the shock cord holding down the top cover, but do not remove the cover yet. It protects the mirror during assembly.

Install the trus tubes. The joined ends go "up", the free ends are set into the mirror tubelocks. Note the lugs that mate with the holes in the trusses. Do up the knobs enough to hold the trusses in place, but leave loose.

If you are going to use the black light shroud, put that on NOW, leaving it loose at the bottom of the trusses. It doesn't fit over the secondary cage !

Remove the top cover from the secondary cage (SC) - release the shock cord loops from the top, and lift off the top cover. Make sure the loops don't fly off, particularly if you are setting up in the dark. The SC lifts off from the bottom cover.

Next, fit the secondary cage. There are three attachment points around the rim of the SC, with threaded holes. Locate these first, so you understand what you are doing. The bolts (with black knobs) on the joiners of the trusses thread into these. Orient the SC so that the focuser is on the same side as the eyepiece rack on the bottom. Lift the SC into position. This is best a two (or even three) person job. Again, screw up the knobs so they are definitiely holding, but leave them a little loose. The next step requires some "wriggle room".

Now we have the main parts in place, it is safe to remove the cover from the mirror tube. This takes a little wriggling. The side with the cut-outs is lifted first. If you are using the light shroud, also reach into the mirror tube and remove the mirror cover. *(It is really annoying to get the shroud in place and then find the mirror cover still on ! Speaking from experience!)*

Tighten all the truss anchors, both on the base and the SC.

Finally, fit the light shroud (if you are using it). This is attached with velcro, top and bottom. In both cases (top and bottom) it fits over the truss knobs, and also over the finder holder at the top. Fit the top first, but in both cases, get the velcro loop over the knobs BEFORE getting enthusiastic about attaching the velcro, otherwise it is quite hard. At the bottom, the velcro stuck to the mirror tube has been installed at an angle, so that the shroud can be attached at a range of heights. Pull the bottom of the shroud down firmly so it is tight (longitudinally) as you attach it. If it is loose it will fall into the light path, obscuring some of that all-important light.

The light shroud should be used:

- When there is stray light around

- ALWAYS at public events, to reduce the possibility of something being dropped onto the mirror.

Realistically, this means pretty much always.

Finders

The telescope has two finders, the red dot finder supplied with the 'scope, and the 80mm refractor added by LVAS.

To mount the finders, move the telescope to horizontal. Once you mount the finders, the 'scope will be "nose heavy", and having it horizontal means it can't go any further. (It is more convenient anyway)

The red-dot finder lives in the eyepiece case, and is attached by a dovetail just under the main finder holder and above the focuser. Remove the "window" cover, and put back in the eyepiece case.

General word of warning - there are so many optics caps ! Always put them back in whichever case where you found them, so as not to get them mixed up!

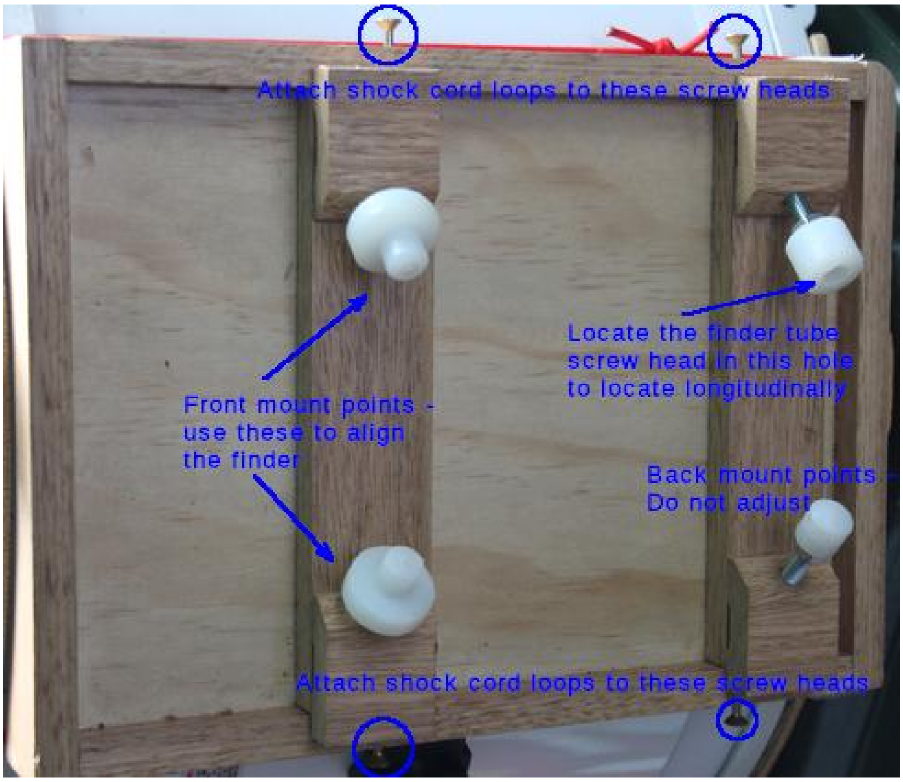
Notes:

- The battery is a CR ?? type, but should not need replacing I think the life time is about a decade at our rate of usage.

- There are allen key adjustments (up/down and across) to align the finder, but I have rarely had need to adjust them. You can do a fine adjustment if you are particular.

- The brightness control is usually set to "1". I think "7" is for alignment in full daylight. I don't know when you would use any of the others, perhaps they were intended for use in down town New York. Remember to turn back to "0" (off) when you pack up, otherwise my comments on battery life may not hold true.

The ***80mm finder*** is a standard Orion short-tube refractor, using the supplied eyepieces. We usually use the amici prism (the 45 degree "bend") to give an erect image and a slighty more comfortable head position. If you prefer to have a "telescope" view, leave it out and put the eyepiece



directly in the back of the refractor - but bear in mind the view though the main telescope will be reversed in the plane of the secodary, so you won't get an identical orientation anyway. The 25mm eyepiece has had cross hairs added. One day it may get them illuminated.

To mount the finder, consider first the secondary holder, and note the four mounting points on the diagram. The two back points are not adjusted, and one has a hole to take one of the screws of the refractor. This locates the refractor longitudinally, and also stops it rotating.

To mount the refractor, use two of the shock cord loops that hold the SC covers on. One is a little longer, that loops from one side and back again to the starting point. Either of the others reach from one side around the corresponding screw on the other side, and over to the other screw on the SAME side, ie, longitudinally. They are not secure if just looped from one screw to the opposite one.

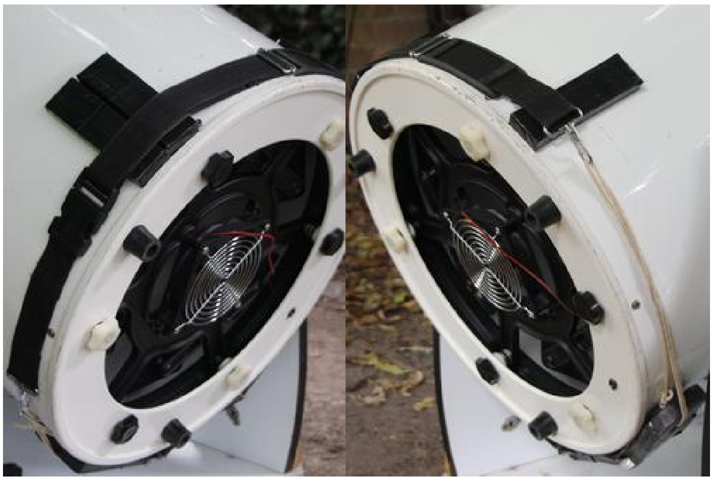
The two front points are used to align the refractor. (This is the same as any telescope - find a fixed object of some sort in the main telescope, and adjust the two front mount points until the cross hair is on the same object. The adjustment mount points are perhaps a little stiff, but it means they do not tneed locking. It is best to use a terestial object for this (it doesn't move!), but beware of two points:

- It needs to be a LONG way away, not just across a back yard.

- It means the telescope is aligned horizontally - the structure may flex a little when moved to a higher elevation, and loose alignment (slightly) but I have not noticed this to be a problem.

Balancing

The Lightbridge was tolerably balanced with only the red dot finder, it is very nose heavy with the the 80mm refractor and mounting added by LVAS. To fix this we need to add weights to the mirror end. As there is not enough solid fram-ing in the right place to allow the weights to be bolted on, a "dive belt" arrangement was used.



The easiest way to mount this is to start with the main weights on top of the tube. Do up the webbing clip, then slide the weights around the tube until they are opposite the finder holder. They need to be as close as possible to oppo-site the finder, but must clear the side wall of the base - only the belt or rope fits through. Note that while horizontal, only the longitudinal balance matters, but once the 'sope is lfted in elevation, the front-to-back balnace is impor-tant as well.

The main "belt" is not sufficient. There are another three small weights that are "tucked in" to the belt that finish off the balance (and add a degree of tightness so that the whole system is fairly rigid.)

(Note also the black adjustment knobs and white locking knobs (referred to below) for the primary mirror collimation)

Collimation

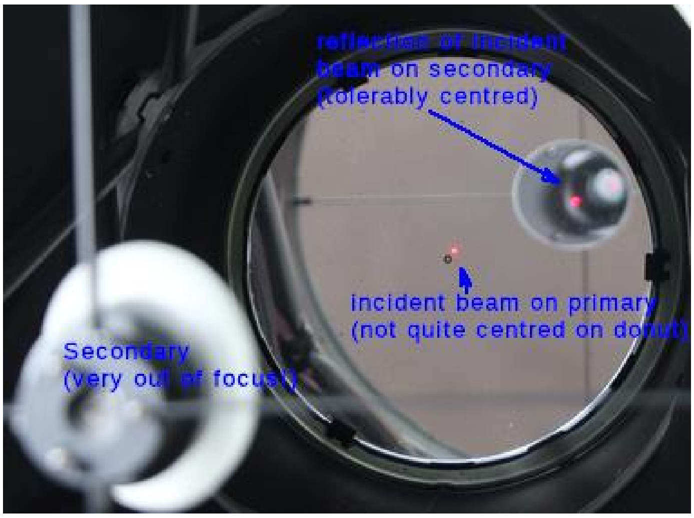
One drawback with truss-tube Dobsomians like the Lightbridge is that they really should be collimated each time they are assembled. The Lightbridge often goes back together "pretty well" - but not always!

There are various ways of collimating an instrument, but by far the quickest way of getting "pretty good" collimation is a laser collimator. There is one in the eyepiece case, under the "white flap".

Mount the collimator in the focuser "as if it was an eyepiece". Turn it on by moving the brightness control off zero. Mid way is probably good in daylight, lower at night.

Step 1: Check the beam directly from the laser collimator strikes the secondary close to mid centre. (Don't be misled by the beam reflected from the primary, we will fix that later)

Warning - this is difficult with the light shroud on !



If it is off centre, it is hard to do much "in the field". You either need to adjust the position (position as opposed to orientation) of the secondary, or shim the focuser (against the tube) until it points at the centre. Neither of these are straight forward. It should not be a problem, if it is, see one of the more experienced members.

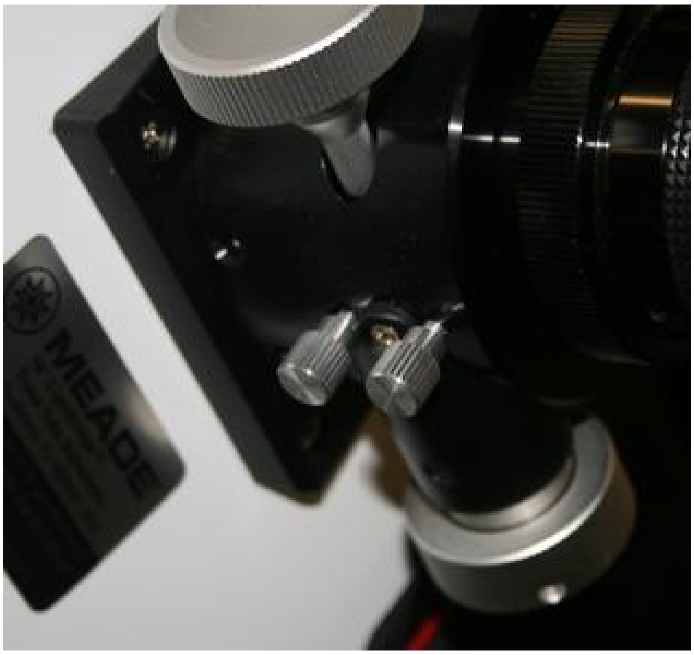
Step 2: Adjust the orientation of the secondary. Using the collimation tool, adjust the three screws in the secondary holder until the beam is centred on the "doughnut" on the primary. (A collimation tool in this context is the phillips-head screwdriver with the wrist strap - so you CAN'T drop the screwdriver onto the mirror.) The collimation tool is also in the eyepiece case, under the white flap.

Setp 3: Adjust the primary mirror. There are two sets of three screws on the back of the mirror cell. The WHITE ones are locking screw, the BLACK ones are adjustments.

Loosten off the white screws, and adjust the black screws until the laser beam is reflected back onto the collimator screen (the white bit at 45 degrees), then attempt to get it into the centre. (It will dissappear straight down the "hole"). One really great advantage of this is that you can see what you are doing FROM the screws!. Once adjusted, gently tighten the white screws. Due to the foolish arrangement of equally spacing the lock screws between the adjustment screws, tightening too much will flex the cell, and potentially distort the mirror, ruining its "figure".

Turn the collimator back off ("0"). Although not a high powered laser, still treat it with customary respect, ie, make sure it doesn't shine in anyone's eyes.

Eyepieces and focuser



The LVAS Lightbridge has the Meade 26mm eyepiece as supplied, a 19mm Televue Panoptic, and (new !) a 2.5x powermate. The 25mm is a 2" barrel, so you need to remove the 2" -> 1 1/4" reducer. The 19mm and powermate both use the reducer. (So the powermate is not usable with the 25mm)

Magnifications:

26mm: 70x

19mm: 95x

19mm + powermate = 7.6mm eq. : 238x

The focuser has two adjustment screws. If it it too stiff, or the focus does not work at all (too loose), these can be adjusted. Getting them right is simply trial and error. In theory it has a fine focus knob, but I have not had much success, and I can usually get good focus using the main knobs - perhaps more perserverence with the adjustments is needed.

Dissassembly

Dissassembly is the ***exact*** reverse of assembly:

1) Set the 'scope horizontal

2) Remove the blance weights

3) Remove the finders (and pack up amy eypieces still out)

4) unvelcro (and gather up) the light shroud. (So you can get into the mirror tube.)

5) Loosten off, but do not undo, the strut clamps (top and bottom)

6) Place the mirror cover (light plastic) on

7) "Wangle" the mirror tube cover (ply) on. (This can take a bit of doing, but perservere !)

8) Remove the secondary cage. Place on the bottom cover (locate the lugs in the cutouts - that's how you tell the bottom SC cover from the top, incidently). PLace the top cover on top, and secure with the shock cord loops. (Which you DIDN'T let fly off when you were removing the finder, did you ?)

9) Remove the light shroud

10) Remove the truss tubes

11) Secure the mirror tube cover with the shock cord loop around the mirror tube.

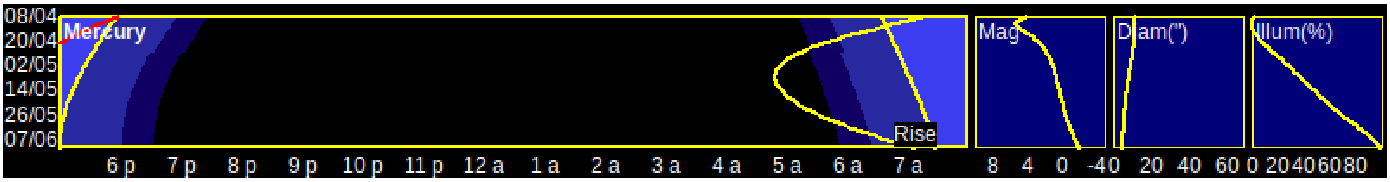
12) Pack the mirror tube and base into whatever means of transport available.

Sky Notes

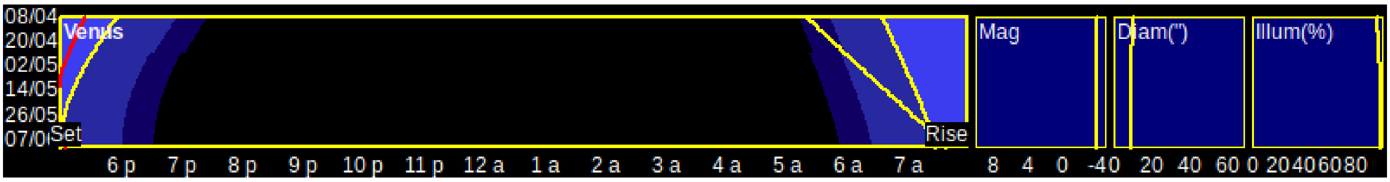
The Planets

Planet Graphs: Rise is in yellow, transit is in white, and set is red. The small graphs: Magnitude (+8 to -4), Diameter (0 – 60 arcsecs), and percentage illuminated (0 – 100). Times are AEDT.

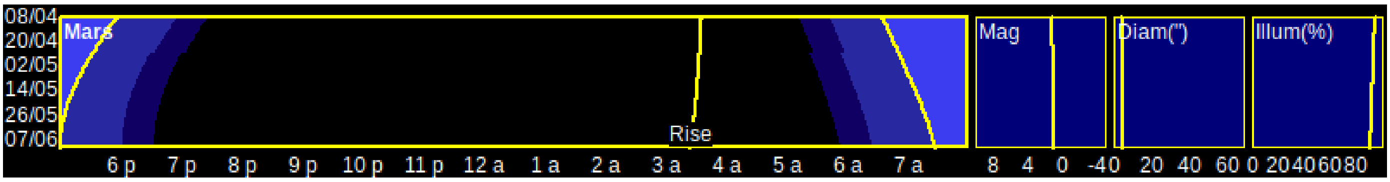
Mercury - Poor Evening object in March Superior Conjunction (E - S - M) 28th February



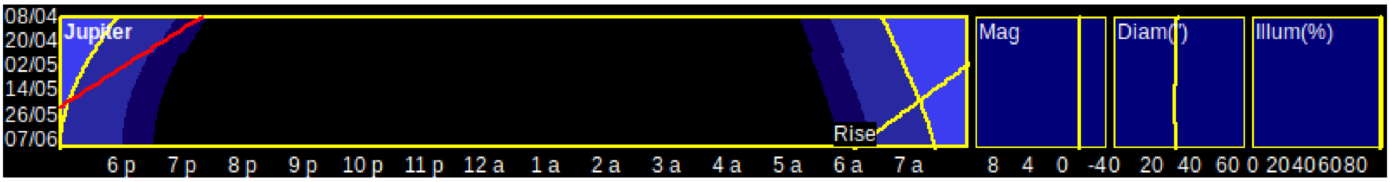
Venus - Morning object



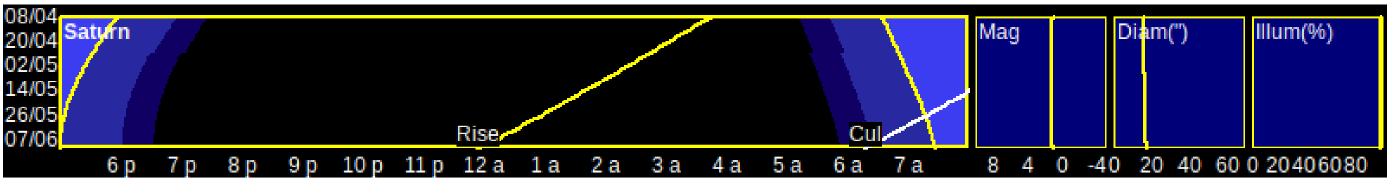
Mars - Morning Object



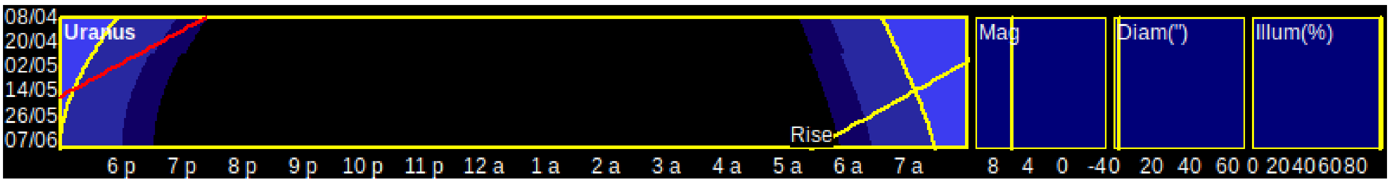
Jupiter - Evening object, but get your last views in !



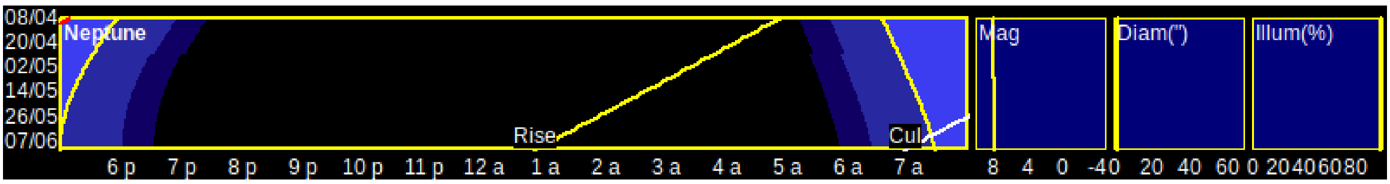
Saturn - Poor morning object by March Conjunction (E - S - S) 29th February



Uranus - Evening object, but get your last views in !



Neptune - Largely unobservable Conjunction (E - S - N) 17th March



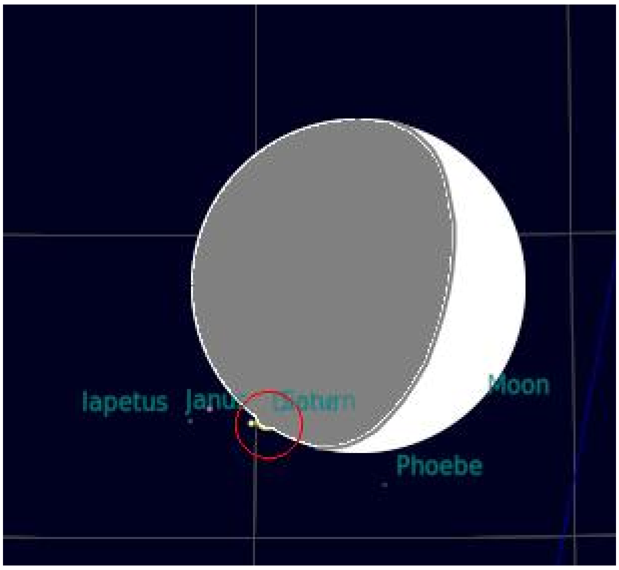
The Moon

Phase	April	May	June	Dark Evenings
3rd Quarter	2	1		2 - 11 April
Perigee	8	6	2	1 - 10 May
New	9	8	6	30 May - 8 June
1st Quarter	16	15	14	27 June - 8 July
Full	24	23	22	
3rd Quarter		31	29	

Perrigee

April has a "Super new moon", but by June Perigee has moved four days before new, so if you want to get that last bit of help with the eastern margin, it might be worth a try.

Conjunctions



Mars and Saturn are within 0.4° on the 11th April. For photographers, these are currently well matched in magnitude, making exposures easier!

On 29th and 30th April, Mars and Neptune will be within 0.5° - this may be the easiest way to find Neptune for some time !

Not a conjunction, but Mercury will have its best morning elongation for the year in early May. (There is also a good evening one coming up - next issue)

Also in early May, there is a daytime occultation of Saturn by the moon. This will be observable in Sydney and Hobart, but Melbourne will see only a close approach. Carte du Ciel predicts an occultation - or possibly a "graze" - for Churchill - see diagram - from about 0844 to 0912 (AEST). The chart is for 0858. Saturn disappears behind the dark limb, so photographers will be able to expose for Saturn (rather than the bright limb of the moon) but this may not be an issue in daylight (I have never tried !)

Minor Planets

No oppositions brighter than mag 12

Comets

12P/Pons-Brooks has been "putting on a show" in the northern hemisphere, and is reported as mag. 5.4, with a 6' coma. It is not visible currently in the southern hemisphere, but should become visible in late April.

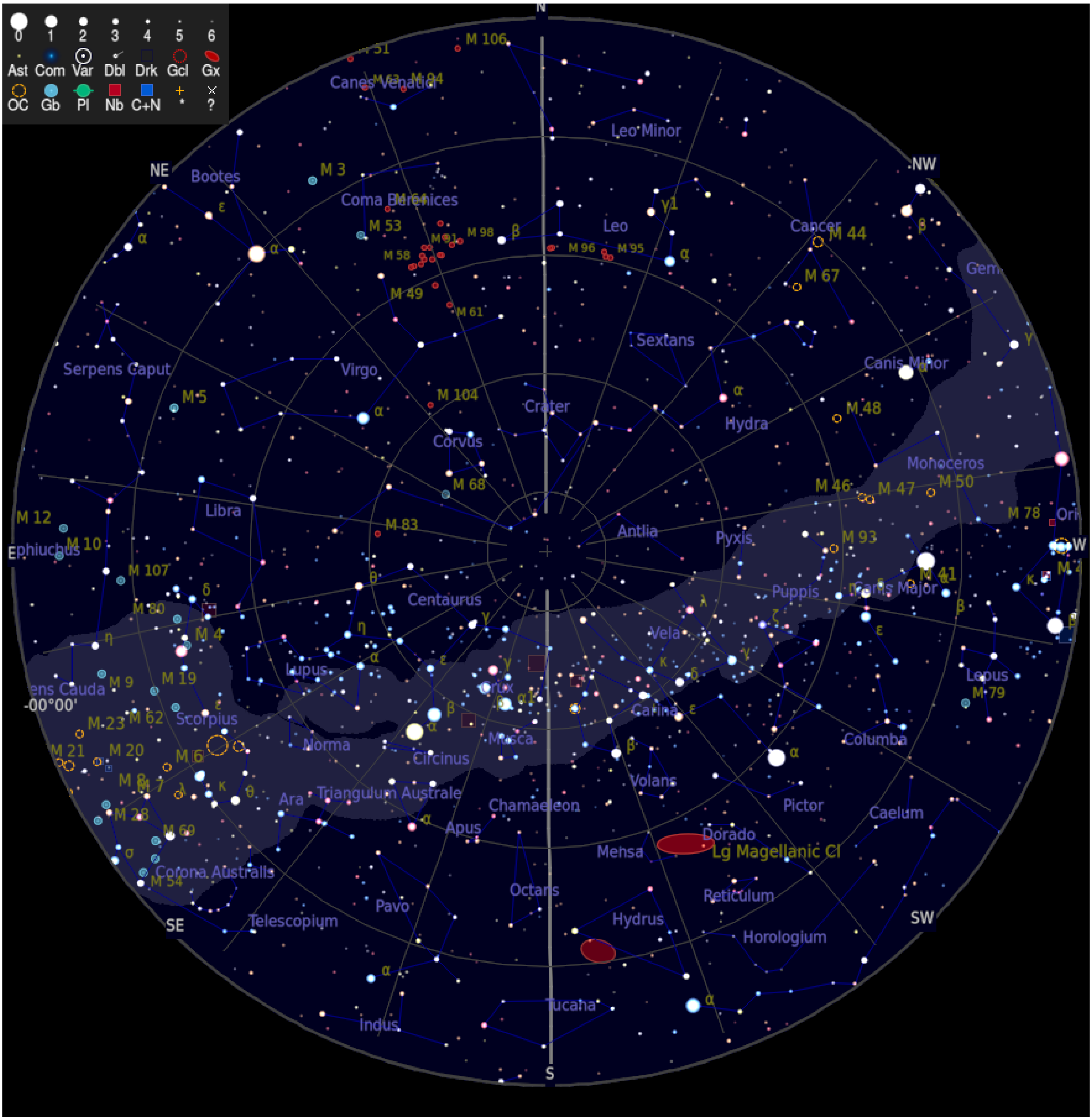
Coming Up (but don't hold your breath): **C/2023 A3 (Tsuchinshan-ATLAS)** has the potential to be a bright naked eye comet, and is currently around magnitude 12. It will reach perihelion on September 28, 2024.

Wot's Up

The whole sky chart above shows the sky at 9 pm on the first of Mary, and is generally representative of the evening sky for the next couple of months.

Autumn marks the "changing of the guard" from "summer" to "winter" constellations. Orion is just about set by now – get your last views early in the evenings over the next month. Canis Major follows, a little later. In the east, Scorpius is up, but you will need to stay up a bit later to get good views, and Sagittarius a bit later again.

The mid northern sky is dominated by Leo, and Virgo follows Leo, in the north-east, with Coma



The sky at the 1st March at 10pm AEDT, representative of the evening sky during February and March.

Berenices between and a little lower. We are looking out of our galaxy to the north, so we can see other galaxies without the "local clutter". The Virgo / Coma Berenices Galaxy group is around best, and Leo has some good galaxies as well. Also rising in the east is Sepens Cauda and Caput, either side of Ophiuchus, and Libra, a little higher.

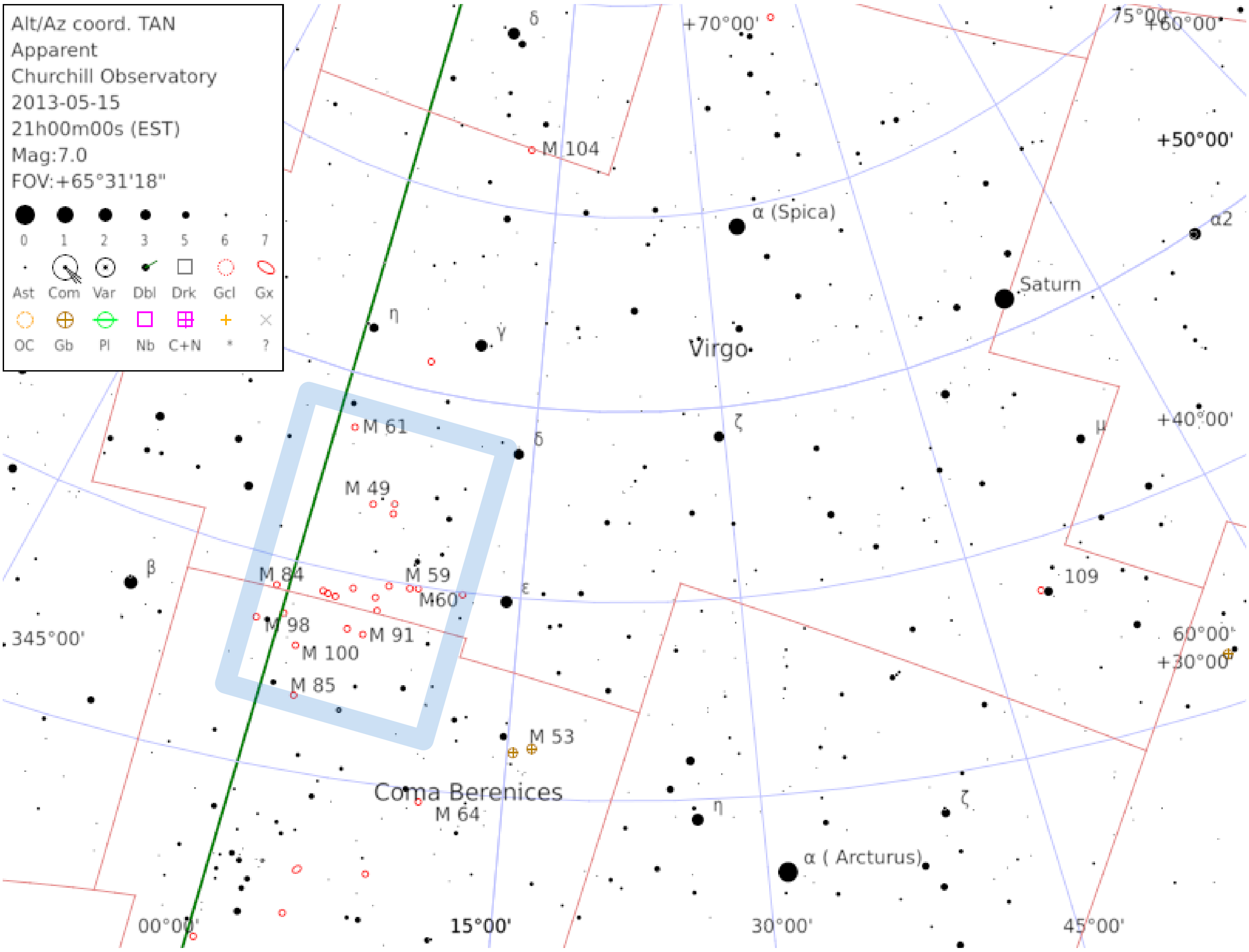
The "argo" constellations, Puppis, Vela and Carina, are all well placed in the higher west, and Crux is at its highest. Centaurus is well placed, a little east of south at 9 pm, optimum a little later in the evening. Best circumpolar constellations are Musca, Norma and Volans. The LMC is past it's prime, but still viewable, but you will need a good southern horizon for the SMC.

Virgo Cluster

The Virgo cluster is a galaxy cluster, with its centre about 53 M light years away, in the constellation Virgo, though the group spills across into Coma Berenices. The cluster forms the heart of the Virgo Supercluster, of which our Local Group of galaxies is an outlying member.

"Astrophyisically", galaxies are identified on a one-by-one basis, determining whether they are gravitationally bound to the group, but as this article is primarily observational, I am considering all galaxies in that general area of sky, whether they formally belong to the group or not.

The chart below shows most of Virgo and a bit of Coma Berenices. You can locate the area by finding α Virginis (Spica) and α Bootis (Arcturis) on the whole sky chart, then transferring to the Virgo chart. This chart is still in alt-azimuth projection, so is still the "right way up". The table below shows selected objects (there are over 1300 members in total!)



Virgo, showing the general location of the Virgo group.
The pale blue rectangle shows the area of the detialed map below

The chart on the next page shows the cluster in more detail. There is one globular cluster, NGC 4147/4153 in the lower left corner of the chart. (Apparently it was given two NGC numbers).

This chart is in equatorial projection, with an RA and Dec grid, but it is rotated 180° so north is still at the bottom. The dec grid is only two degrees, so a low magnification view should cover half of this. This means that many of the galaxies that appear in little groups, eg NGCs 4206 & 4216, and Ms 84, 86, and two unlabelled, should be visible within the one field.

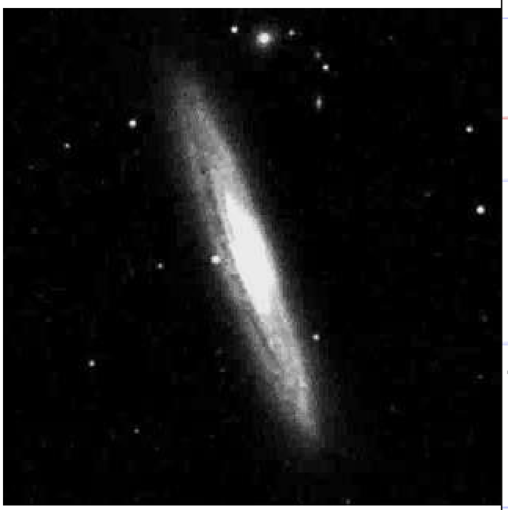
To star hop to objects in the group, first identify either Arcturus or Spica, as mentioned above, then work your way to ε Virgo, shown in Fig. 14, and then across to ρ Virgo, just above M59 & M60. This is labelled in Fig. 15. From there, identify the other stars in Fig. 15. Most finders should fit a good quarter of the group in their field of view at the one time.

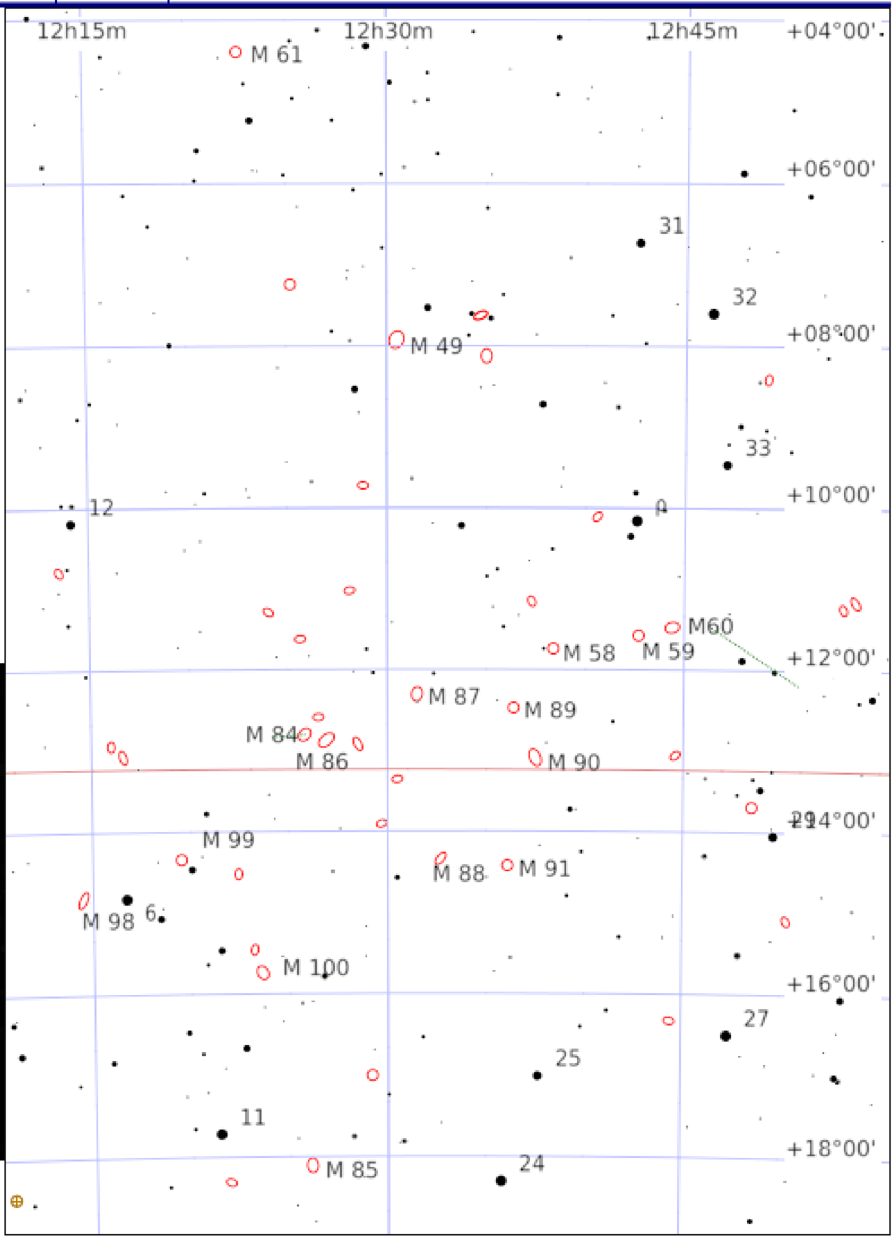
This area contains three of the galaxies from the "best of" list, NGC 4216, M60 and M85. As the list above is sorted in Surface Brightness order, it is not surprising that they are all near the top. (M104, covered April 2012, is also in Virgo, but not in the Virgo group.)

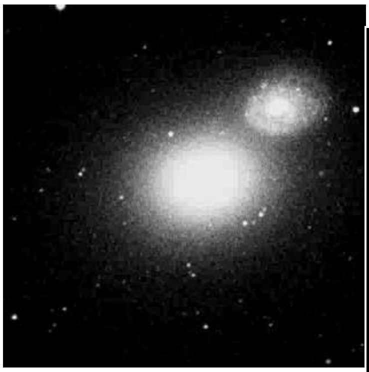
NGC	Mes.	Mag	S Br	Dimns	Class	Notes
Globular Clusters						
4147		10.3		4.0 x 4.0 '	VIc	
4153		10.3		4.1 x 4.1 '	VIc	equals NGC 4147; best possible ID
Galaxies						
4216		10	12.8	7.8 x 1.8 '	SBbc	edge on streak;two other in field
4621	59	9.6	12.9	5.3 x 4.0 '	E3O	smooth arms
4649	60	8.8	12.9	7.6 x 6.2 '	E1c	
4382	85	9.1	12.9	7.4 x 5.9 '	SaSO	
4374	84	9.1	13.0	6.7 x 6.0 '	E1O-a	centre of Virgo cluster
4486	87	8.6	13.0	8.7 x 6.6 '	E1p	
4501	88	9.6	13.0	6.8 x 3.7 '	Sbc	mult arm spiral
4579	58	9.7	13.1	6.0 x 4.8 '	SBb	fine compact spiral
4293		10.4	13.1	5.5 x 2.9 '	SBO	Spiral pattern dim;heavy dust lanes
4472	49	8.4	13.2	9.8 x 8.2 '	E4	
4406	86	8.9	13.2	9.8 x 6.3 '	E3b	comp superimposed @ 1.4'
4552	89	9.8	13.2	5.3 x 4.8 '	EO	
4254	99	9.9	13.2	5.3 x 4.6 '	Sca	3 branch spiral
4302		11.6	13.3	5.3 x 1.0 '	ScO	Nearly edge-on spiral w equatorial dust lane
4321	100	9.4	13.4	7.5 x 6.1 '	SBb	spiral-Rosse
4303	61	9.6	13.4	6.5 x 5.9 '	SBb	L face-on spiral
4569	90	9.5	13.4	9.9 x 4.4 '	SBa	diff bar with much dark matter
4548	91	10.1	13.4	5.2 x 4.2 '	SBb	F outer arms in spiral patten
4192	98	10.1	13.6	9.4 x 2.3 '	SBb	6 Comae Berenices is 30' east
4178		11.4	13.7	5.0 x 1.7 '	SBc	nearly edge on
4206		12.1	14.1	6.4 x 1.1 '	Sbc	

Three Gaxies are mentioned below - Each with a picture "something like" what you might be able to see your self (ie, as opposed to Hubble inamges).

NGC4216 is an almost edge on spiral galaxy, nearly 8 arc mins across. It is an “intermediate” spiral, ie between barred and un-barred, and probably of similar size to our own Milky Way. NGC 4206 is close, nearly as big (in apparent size) but not as bright. 'Deep' photos reveal other galaxies in the same field. It appears that NGC 4206 is not particularly closely bound to 4216, beyond lying in the same group (along with 1300 others!).

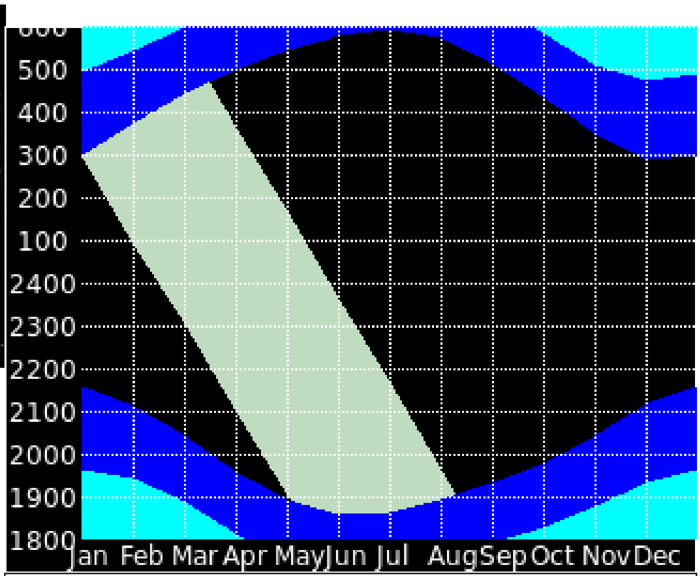






NGC 4649 (M60) is a giant elliptical galaxy, and appears to have a smaller spiral galaxy, NGC 4647, as a companion. However, if the spiral was really as close as it appears, the two would interact, and no signs of this appear in photos. It is likely, therefore, that it is an optical alignment only.

With a magnitude of 8.8, a surface brightness of 12.9, and just under 8 arc mins across, this fits well into the “bright and not too small” category aimed at for the “best of” list.



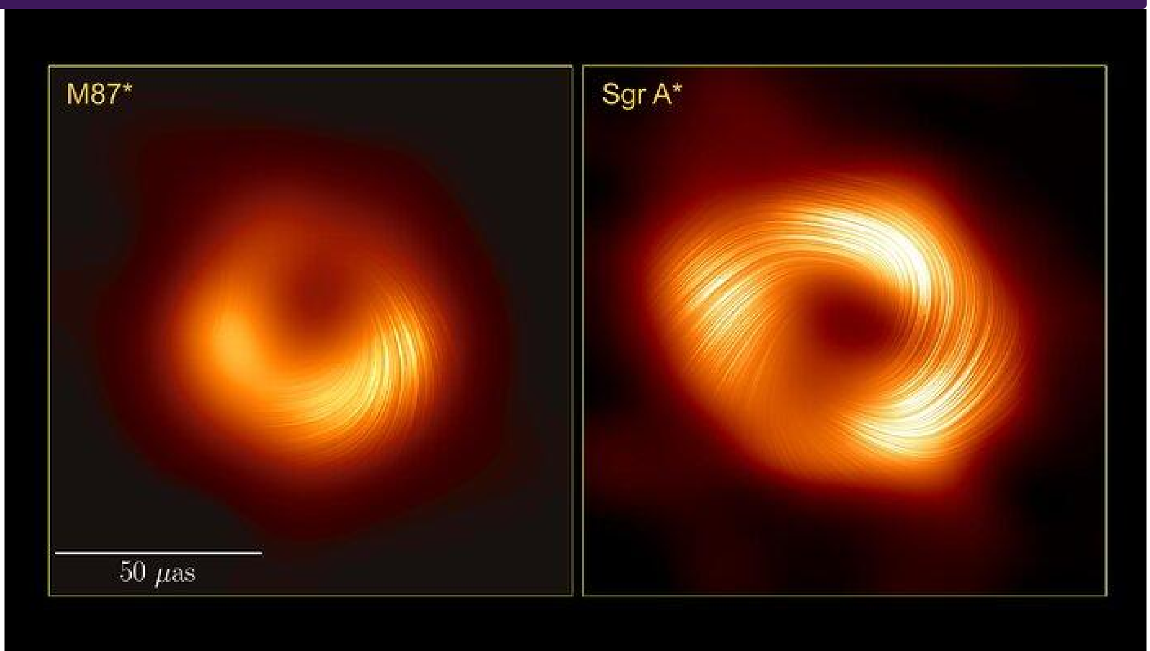
Visibility chart - Virgo Group. The green band shows the times the group is visible (vertical axis) for a given date (horizontal axis). The blue bands are twiglight and daylight.

NGC 4382 (M85) is a lenticular galaxy, between elliptical and spiral, with ill defined arms, of similar (apparent) size to the previous two. In fact, all three are just under 8 arc minutes across, have a surface brightness of 12.9, and vary in integrated magnitude due to their varying widths. 4649 is elliptical, nearly circular, and brightest, 4216 is a spiral nearly edge on, and dimmest, while 4382 is a lenticular galaxy, and in this case is closer to face on. It has a width, and hence integrated brightness, between the other two.

Snippets

ESO/NASA et al

A new image from the Event Horizon Telescope (EHT) collaboration has uncovered strong and organised magnetic fields spiraling from the edge of the supermassive black hole Sagittarius A* (Sgr A*). Seen in polarised light for the first time, this new view of the black hole at the heart of the Milky Way galaxy has revealed a magnetic field structure strikingly similar



Seen here in polarised light, this side-by-side image of the supermassive black holes M87 and Sagittarius A* indicates to scientists that these beasts have similar magnetic field structures.*

The scale shows the apparent size on the sky of these images, in units of micro-arcseconds. In context, the images of these black holes have an apparent size similar to that of a donut on the surface of the Moon. Note the similar apparent size, but also how much further M87 is from Sgr, making the M87 black hole event horizon far larger.*

to that of the black hole at the centre of the M87 galaxy, suggesting that strong magnetic fields may be common to all black holes. This similarity also hints toward a hidden jet in Sgr A*. The results were published today in The Astrophysical Journal Letters.

In 2022 scientists unveiled the first image of Sgr A* at press conferences around the world, including at the European Southern Observatory (ESO). While the Milky Way's supermassive black hole, which is roughly 27 000 light-years away from Earth, is more than a thousand times smaller and less massive than M87's, the first-ever black hole imaged, the observations revealed that the two look remarkably similar. This made scientists wonder whether the two shared common traits outside of their looks. To find out, the team decided to study Sgr A* in polarised light. Previous studies of light around the M87 black hole (M87*) revealed that the magnetic fields around it allowed the black hole to launch powerful jets of material back into the surrounding environment. Building on this work, the new images have revealed that the same may be true for Sgr A*.

“What we're seeing now is that there are strong, twisted, and organised magnetic fields near the black hole at the centre of the Milky Way galaxy,” said Sara Issaoun, NASA Hubble Fellowship Program Einstein Fellow at the Center for Astrophysics | Harvard & Smithsonian, US, and co-lead of the project. “Along with Sgr A* having a strikingly similar polarisation structure to that seen in the much larger and more powerful M87* black hole, we've learned that strong and ordered magnetic fields are critical to how black holes interact with the gas and matter around them.”

Light is an oscillating, or moving, electromagnetic wave that allows us to see objects. Sometimes, light oscillates in a preferred orientation, and we call it ‘polarised’. Although polarised light surrounds us, to human eyes it is indistinguishable from ‘normal’ light. In the plasma around these black holes, particles whirling around magnetic field lines impart a polarisation pattern perpendicular to the field. This allows astronomers to see in increasingly vivid detail what's happening in black hole regions and map their magnetic field lines.

“By imaging polarised light from hot glowing gas near black holes, we are directly inferring the structure and strength of the magnetic fields that thread the flow of gas and matter that the black hole feeds on and ejects,” said Harvard Black Hole Initiative Fellow and project co-lead Angelo Ricarte. “Polarised light teaches us a lot more about the astrophysics, the properties of the gas, and mechanisms that take place as a black hole feeds.”

But imaging black holes in polarised light isn't as easy as putting on a pair of polarised sunglasses, and this is particularly true of Sgr A*, which is changing so fast that it doesn't sit still for pictures. Imaging the supermassive black hole requires sophisticated tools above and beyond those previously used for capturing M87*, a much steadier target. EHT Project Scientist Geoffrey Bower from the Institute of Astronomy and Astrophysics, Academia Sinica, Taipei said, “Because Sgr A* moves around while we try to take its picture, it was difficult to construct even the unpolarised image,” adding that the first image was an average of multiple images owing to Sgr A*'s movement. “We were relieved that polarised imaging was even possible. Some models were far too scrambled and turbulent to construct a polarised image, but Nature was not so cruel.”

Mariafelicia De Laurentis, EHT Deputy Project Scientist and professor at the University of Naples Federico II, Italy, said, “With a sample of two black holes — with very different masses and very different host galaxies — it's important to determine what they agree and disagree on. Since both are pointing us toward strong magnetic fields, it suggests that this may be a universal and perhaps fundamental feature of these kinds of systems. One of the similarities between these two black holes might be a jet, but while we've imaged a very obvious one in M87*, we've yet to find one in Sgr A*.”

To observe Sgr A*, the collaboration linked eight telescopes around the world to create a virtual Earth-sized telescope, the EHT. The Atacama Large Millimeter/submillimeter Array (ALMA), in which ESO is a partner, and the ESO-hosted Atacama Pathfinder Experiment (APEX), both in northern Chile, were part of the network that made the observations, conducted in 2017.

"As the largest and most powerful of the telescopes in the EHT, ALMA played a key role in making this image possible,” says ESO's María Díaz Trigo, European ALMA Programme Scientist. “ALMA is now planning an ‘extreme makeover’, the Wideband Sensitivity Upgrade, which will make ALMA even more sensitive and keep it a fundamental player in future EHT observations of Sgr A* and other black holes."

The EHT has conducted several observations since 2017 and is scheduled to observe Sgr A* again in April 2024. Each year, the images improve as the EHT incorporates new telescopes, larger bandwidth, and new observing frequencies. Planned expansions for the next decade will enable high-fidelity movies of Sgr A*, may reveal a hidden jet, and could allow astronomers to observe similar polarisation features in other black holes. Meanwhile, extending the EHT into space would provide sharper images of black holes than ever before.

The EHT collaboration involves more than 300 researchers from Africa, Asia, Europe, and North and South America. The international collaboration is working to capture the most detailed black hole images ever obtained by creating a virtual Earth-sized telescope. Supported by considerable international investment, the EHT links existing telescopes using novel systems — creating a fundamentally new instrument with the highest angular resolving power that has yet been achieved.

The individual telescopes involved in the EHT in April 2017, when the observations were conducted, were: the Atacama Large Millimeter/submillimeter Array (ALMA), the Atacama Pathfinder EXperiment (APEX), the Institut de Radioastronomie Millimetrique (IRAM) 30-meter Telescope, the James Clerk Maxwell Telescope (JCMT), the Large Millimeter Telescope Alfonso Serrano (LMT), the Submillimeter Array (SMA), the UArizona Submillimeter Telescope (SMT), and the South Pole Telescope (SPT). Since then, the EHT has added the Greenland Telescope (GLT), the IRAM NOrthern Extended Millimeter Array (NOEMA) and the UArizona 12-meter Telescope on Kitt Peak to its network.

Brightest and fastest-growing: astronomers identify record-breaking quasar

The black holes powering quasars collect matter from their surroundings in a process so energetic that it emits vast amounts of light. So much so that quasars are some of the brightest objects in our sky, meaning even distant ones are visible from Earth. As a general rule, the most luminous quasars indicate the fastest-growing supermassive black holes.

“We have discovered the fastest-growing black hole known to date. It has a mass of 17 billion Suns, and eats just over a Sun per day. This makes it the most luminous object in the known Universe,” says Christian Wolf, an astronomer at the Australian National University (ANU) and lead author of the study published today in Nature Astronomy. The quasar, called J0529-4351, is so far away from Earth that its light took over 12 billion years to reach us.

The matter being pulled in toward this black hole, in the form of a disc, emits so much energy that J0529-4351 is over 500 trillion times more luminous than the Sun [1]. “All this light comes from a hot accretion disc that measures seven light-years in diameter — this must be the largest accretion disc in the Universe," says ANU PhD student and co-author Samuel Lai. Seven light-years is about 15 000 times the distance from the Sun to the orbit of Neptune.

And, remarkably, this record-breaking quasar was hiding in plain sight. “It is a surprise that it has remained unknown until today, when we already know about a million less impressive quasars. It has literally been staring us in the face until now,” says co-author Christopher Onken, an astronomer at ANU. He added that this object showed up in images from the ESO Schmidt Southern Sky Survey dating back to 1980, but it was not recognised as a quasar until decades later.

Finding quasars requires precise observational data from large areas of the sky. The resulting datasets are so large, researchers often use machine-learning models to analyse them and tell quasars apart from other celestial objects. However, these models are trained on existing data, which limits the potential candidates to objects similar to those already known. If a new quasar is more luminous than any other previously observed, the programme might reject it and classify it instead as a star not too distant from Earth.

An automated analysis of data from the European Space Agency’s Gaia satellite passed over J0529-4351 for being too bright to be a quasar, suggesting it to be a star instead. The researchers identified it as a distant quasar last year using observations from the ANU 2.3-metre telescope at the Siding Spring Observatory in Australia. Discovering that it was the most luminous quasar ever observed, however, required a larger telescope and measurements from a more precise instrument. The X-shooter spectrograph on ESO’s VLT in the Chilean Atacama Desert provided the crucial data.

The fastest-growing black hole ever observed will also be a perfect target for the GRAVITY+ upgrade on ESO's VLT Interferometer (VLTI), which is designed to accurately measure the mass of black holes, including those far away from Earth. Additionally, ESO's Extremely Large Telescope (ELT), a 39-metre telescope under construction in the Chilean Atacama Desert, will make identifying and characterising such elusive objects even more feasible.

Finding and studying distant supermassive black holes could shed light on some of the mysteries of the early Universe, including how they and their host galaxies formed and evolved. But that's not the only reason why Wolf searches for them. "Personally, I simply like the chase," he says. "For a few minutes a day, I get to feel like a child again, playing treasure hunt, and now I bring everything to the table that I have learned since."

Webb Probes an Extreme Starburst Galaxy *NASA*

Image - NASA, ESA, CSA, STScI, Alberto Bolatto (UMD)

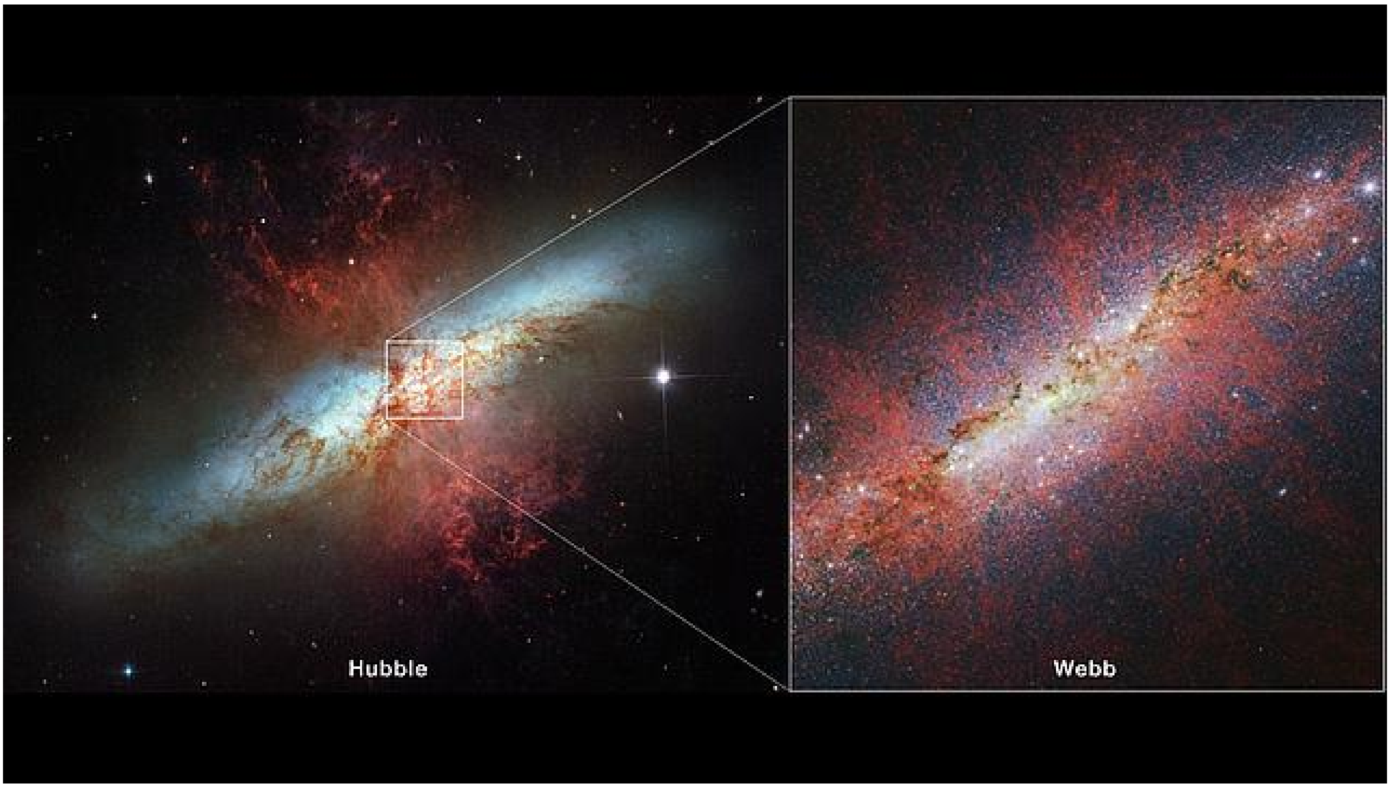
A team of astronomers has used NASA's James Webb Space Telescope to survey the starburst galaxy Messier 82 (M82). Located 12 million light-years away in the constellation Ursa Major, this galaxy is relatively compact in size but hosts a frenzy of star formation activity. For comparison, M82 is sprouting new stars 10 times faster than the Milky Way galaxy. The team directed Webb's NIRCam (Near-Infrared Camera) instrument toward the starburst galaxy's center, attaining a closer look at the physical conditions that foster the formation of new stars.

"M82 has garnered a variety of observations over the years because it can be considered as the prototypical starburst galaxy," said Bolatto, lead author of the study. "Both NASA's Spitzer and Hubble space telescopes have observed this target. With Webb's size and resolution, we can look at this star-forming galaxy and see all of this beautiful, new detail."

A Vibrant Community of Stars

Star formation continues to maintain a sense of mystery because it is shrouded by curtains of dust and gas, creating an obstacle in observing this process. Fortunately, Webb's ability to peer in the infrared is an asset in navigating these murky conditions. Additionally, these NIRCam images of the very center of the starburst were obtained using an instrument mode that prevented the very bright source from overwhelming the detector.

While dark brown tendrils of heavy dust are threaded throughout M82's glowing white core even in this infrared view, Webb's NIRCam has revealed a level of detail that has historically been obscured. Looking closer toward the center, small specks depicted in green denote concentrated



areas of iron, most of which are supernova remnants. Small patches that appear red signify regions where molecular hydrogen is being lit up by a nearby young star's radiation.

"This image shows the power of Webb," said Rebecca Levy. "Every single white dot in this image is either a star or a star cluster. We can start to distinguish all of these tiny point sources, which enables us to acquire an accurate count of all the star clusters in this galaxy."

Finding Structure in Lively Conditions

Looking at M82 in slightly longer infrared wavelengths, clumpy tendrils represented in red can be seen extending above and below the galaxy's plane. These gaseous streamers are a galactic wind rushing out from the core of the starburst.

One area of focus for this research team was understanding how this galactic wind, which is caused by the rapid rate of star formation and subsequent supernovae, is being launched and influencing its surrounding environment. By resolving a central section of M82, scientists could examine where the wind originates, and gain insight on how hot and cold components interact within the wind.

Webb's NIRCam instrument was well-suited to trace the structure of the galactic wind via emission from sooty chemical molecules known as polycyclic aromatic hydrocarbons (PAHs). PAHs can be considered as very small dust grains that survive in cooler temperatures but are destroyed in hot conditions.

Much to the team's surprise, Webb's view of the PAH emission highlights the galactic wind's fine structure – an aspect previously unknown. Depicted as red filaments, the emission extends away from the central region where the heart of star formation is located. Another unanticipated find was the similar structure between the PAH emission and that of hot, ionized gas.

"It was unexpected to see the PAH emission resemble ionized gas," said Bolatto. "PAHs are not supposed to live very long when exposed to such a strong radiation field, so perhaps they are being replenished all the time. It challenges our theories and shows us that further investigation is required."

Lighting a Path Forward

Webb's observations of M82 in near-infrared light spur further questions about star formation, some of which the team hopes to answer with additional data gathered with Webb, including that of another starburst galaxy. Two other papers from this team characterizing the stellar clusters and correlations among wind components of M82 are almost finalized.

In the near future, the team will have spectroscopic observations of M82 from Webb ready for their analysis, as well as complementary large-scale images of the galaxy and wind. Spectral data will help astronomers determine accurate ages for the star clusters and provide a sense of timing for how long each phase of star formation lasts in a starburst galaxy environment. On a broader scale, inspecting the activity in galaxies like M82 can deepen astronomers' understanding of the early universe.

"Webb's observation of M82, a target closer to us, is a reminder that the telescope excels at studying galaxies at all distances," said Bolatto. "In addition to looking at young, high-redshift galaxies, we can look at targets closer to home to gather insight into the processes that are happening here – events that also occurred in the early universe."

Hubble Finds that Aging Brown Dwarfs Grow Lonely

It takes two to tango, but in the case of brown dwarfs that were once paired as binary systems, that relationship doesn't last for very long, according to a recent survey from NASA's Hubble Space Telescope.

Brown dwarfs are interstellar objects generally more massive than Jupiter but less massive than the lowest-mass stars. They are born like stars – out of a cloud of gas and dust that collapses – but do not have enough mass to sustain the fusion of hydrogen like a normal star.

The team selected a sample of brown dwarfs previously identified by NASA's Wide-Field Infrared Survey Explorer. It sampled some of the coldest and lowest-mass old brown dwarfs in the solar neighborhood. These old brown dwarfs are so cool (a few hundred degrees warmer than Jupiter in most cases) that their atmospheres contain water vapor that condensed out.

To find the coolest companions, the team used two different near-infrared filters, one in which cold brown dwarfs are bright, and another covering specific wavelengths where they appear very faint due to water absorption in their atmospheres. Astronomers using Hubble confirm that companions are extremely rare around the lowest-mass and coldest brown dwarfs. Hubble can detect binaries as close to each other as a 300-million-mile separation – the approximate separation between our Sun and the asteroid belt. But they didn't find any binary pairs in a sample of brown dwarfs in the solar neighborhood. This implies that a binary pair of dwarfs is so weakly linked by gravity that they drift apart over a few hundred million years due to the pull of bypassing stars.

"Our survey confirms that widely separated companions are extremely rare among the lowest-mass and coldest isolated brown dwarfs, even though binary brown dwarfs are observed at younger ages. This suggests that such systems do not survive over time," said lead author Clémence Fontanive.

In a similar survey Fontanive conducted a couple of years ago, Hubble looked at extremely young brown dwarfs and some had binary companions, confirming that star-forming mechanisms do produce binary pairs among low-mass brown dwarfs. The lack of binary companions for older brown dwarfs suggests that some may have started out as binaries, but parted ways over time.

The new Hubble findings further support the theory that brown dwarfs are born the same way as stars, through the gravitational collapse of a cloud of molecular hydrogen. The difference being that they do not have enough mass to sustain nuclear fusion of hydrogen for generating energy, whereas stars do. More than half of the stars in our galaxy have a companion star that resulted from these formation processes, with more massive stars more commonly found in binary systems. "The motivation for the study was really to see how low in mass the trends seen among multiple stars systems hold up," said Fontanive.

"Our Hubble survey offers direct evidence that these binaries that we observe when they're young are unlikely to survive to old ages, they're likely going to get disrupted. When they're young, they're part of a molecular cloud, and then as they age the cloud disperses. As that happens, things start moving around and stars pass by each other. Because brown dwarfs are so light, the gravitational hold tying wide binary pairs is very weak, and bypassing stars can easily tear these binaries apart," said Fontanive.

Three-Year Study of Young Stars with NASA's Hubble Enters New Chapter

In the largest and one of the most ambitious Hubble Space Telescope programs ever executed, a team of scientists and engineers collected information on almost 500 stars over a three-year period. This effort offers new insights into the stars' formation, evolution, and impact on their surroundings. This comprehensive survey, called ULLYSES (Ultraviolet Legacy Library of Young Stars as Essential Standards), was completed in December 2023, and provides a rich spectroscopic dataset obtained in ultraviolet light that astronomers will be mining for decades to come. Because ultraviolet light can only be observed from space, Hubble is the only active telescope that can accomplish this research.

The ULLYSES team studied 220 stars, then combined those observations with information from the Hubble archive on 275 additional stars. The program also included data from some of the world's largest, most powerful ground-based telescopes and X-ray space telescopes. The ULLYSES dataset is made up of stellar spectra, which carry information about each star's temperature, chemical composition, and rotation.

One type of stars studied under ULLYSES is super-hot, massive, blue stars. They are a million times brighter than the Sun and glow fiercely in ultraviolet light that can easily be detected by Hubble. Their spectra include key diagnostics of the speed of their powerful winds. The winds drive galaxy evolution and seed galaxies with the elements needed for life. Those elements are cooked up inside the stars' nuclear fusion ovens and then injected into space as a star dies. ULLYSES targeted blue stars in nearby galaxies that are deficient in elements heavier than helium and hydrogen. This type of galaxy was common in the very early universe. "ULLYSES observations are a stepping stone to understanding those first stars and their winds in the universe, and how they impact the evolution of their young host galaxy," said Roman-Duval.

The other star category in the ULLYSES program is young stars less massive than our Sun. Though cooler and redder than our Sun, in their formative years they unleash a torrent of high-energy radiation, including blasts of ultraviolet light and X-rays. Because they are still growing, they are gathering material from their surrounding planet-forming disks of dust and gas. The Hubble spectra include key diagnostics of the process by which they acquire their mass, including how much energy this process releases into the surrounding planet-forming disk and nearby environment. The blistering ultraviolet light from young stars affects the evolution of these disks as they form planets, as well as the chances of habitability for newborn planets. The target stars are located in nearby star-forming regions in our Milky Way galaxy.

The ULLYSES concept was designed by a committee of experts with the goal of using Hubble to provide a legacy set of stellar observations. "ULLYSES was originally conceived as an observing program utilizing Hubble's sensitive spectrographs. However, the program was tremendously enhanced by community-led coordinated and ancillary observations with other ground- and space-based observatories," said Roman-Duval. "Such broad coverage allows astronomers to investigate the lives of stars in unprecedented detail and paint a more comprehensive picture of the properties of these stars and how they impact their environment."

To that end, STScI hosted a ULLYSES workshop March 11–14 to celebrate the beginning of a new era of research on young stars. The goal was to allow members of the astronomical community to collaborate on the data, so that they could gain momentum in the ongoing analyses, or kickstart new ideas for analysis. The workshop was one important step in exploiting this legacy spectral library to its fullest potential, fulfilling the promise of ULLYSES.

"I believe the ULLYSES project will be transformative, impacting overall astrophysics – from exoplanets, to the effects of massive stars on galaxy evolution, to understanding the earliest stages of the evolving universe," said Julia Roman-Duval. "Aside from the specific goals of the program, the stellar data can also be used in fields of astrophysics in ways we can’t yet imagine."