Binocular Astronomy on a Budget in 2023

Buying, using and maintaining binoculars without breaking the bank.

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Topics

- Buying Binoculars.
  - Why budget? What do I mean by budget? Compromises.
  - Specifications and features – what does it all mean?
  - Testing at the Shop.
- Using Binoculars.
  - Resources for finding interesting objects.
  - Planning with simulated planetarium views and charts.
  - Tips for enjoying binoculars.
- Maintaining Binoculars.
  - Basic Care and Cleaning.
  - Aligning the optics on both barrels to eliminate double images. (aka “Dirty Collimating”)

At the end of the slides you will find many more references – books, web sites, and a more in depth review of each of my binoculars and bonus slides from 2012 I won’t cover tonight.

Disclaimers

- Presentation includes my own opinions.
  - You may disagree. Others say buy the best you can afford.
  - We have amazing expertise in this club. Do consider other opinions.
  - **But if you spot factual errors please tell me!**
- I do not own expensive binoculars.
- My eyesight is not fantastic.
  - I'm still legal to drive without glasses as of this year.
  - But I may not see as big a difference as someone with better eyesight.
  - Stigmatism means I probably use averted vision more than others.
  - I do not wear glasses when using binoculars.
- Focus is Astronomy. Terrestrial viewing has different requirements.
- Simulated Views On These Slides Are For Illustration. Not Exact Or Perfect.
  - Stellarium overlays deep sky images. Not what you'll see! I've tried to edit the screenshots to be a little more realistic.
- ******** NEVER look at the sun with binoculars! *********

Part 1 – Buying Binoculars

Why Binoculars?

- Compared to a telescope.
  - Easier to use than telescopes.
  - Wide viewer - The big picture top down view of the universe.
    - See entire objects and groups/constellations. All the Pleiades, whole Southern Cross.
    - See objects in the context of their surroundings.
  - Significantly cheaper than a decent telescope.
    - But not a replacement. Handheld binoculars are not the right tool at all for small or faint objects.
- Great for getting familiar with the sky.
  - Excellent tool when starting out as a stargazer.
  - See more stars, clusters and nebula than naked eye astronomy.
- Two Eyes = Richer more natural “3D” perspective than one.
- Portable - compact and light weight.
  - Compare to trying to fit a 10”-12” Dob in the car for family holiday.
  - Less back and neck strain.
- Almost no setup – quick 5-10 minute sessions possible.
- Versatile – can be used for other hobbies – birding, sports, plane/ship spotting, concerts, zoo.

  (Though lighter, smaller binoculars may be preferable for daytime viewing.)

Why Budget?

- For this talk budget means less than about $130 (up from $50-$100 in 2012, though <$100 and sometimes <$50 is still possible).
- It's 2023. Money's tighter than it use to be.
- If you mistreat or lose them or they are stolen they are easily replaced.
  - More likely to take them with you. Best binocs are ones you use.
- You might be able to afford a backup pair or two.
  - But don't keep them in the car on a hot day. Cheap plastic & glue.
- Variety. Can you afford or justify 3 pairs of $1000 binoculars?
- Give them to your children.
  - Would you rip apart $1000 binoculars?
    - To show your kids what's inside?
    - To align (dirty collimate) them yourself?
  - What about $100 binoculars?
- Inexpensive gift for friend or relative.
  - But don't buy a junk pair. It may put them off for life.

Will Any Cheap Pair Do?

- Short answer: NO!!!
  - Some only good for daytime viewing.
  - LOTS (the majority) are completely unusable.
    - Horrible colour tinges and fringing, lack of sharpness, too flexible to hold alignment, don't hold focus, "focus free", zoom mechanisms that break.
    - Children's toys, stage props, paperweights.
  - Really have to know what you're buying.
  - DO NOT expect the equivalent of $1000 views at <$100.
- If you already own a pair try them before buying more.
- Also expensive is no guarantee.
  - ****AT MOST**** you get what you pay for.

Budget Compromises

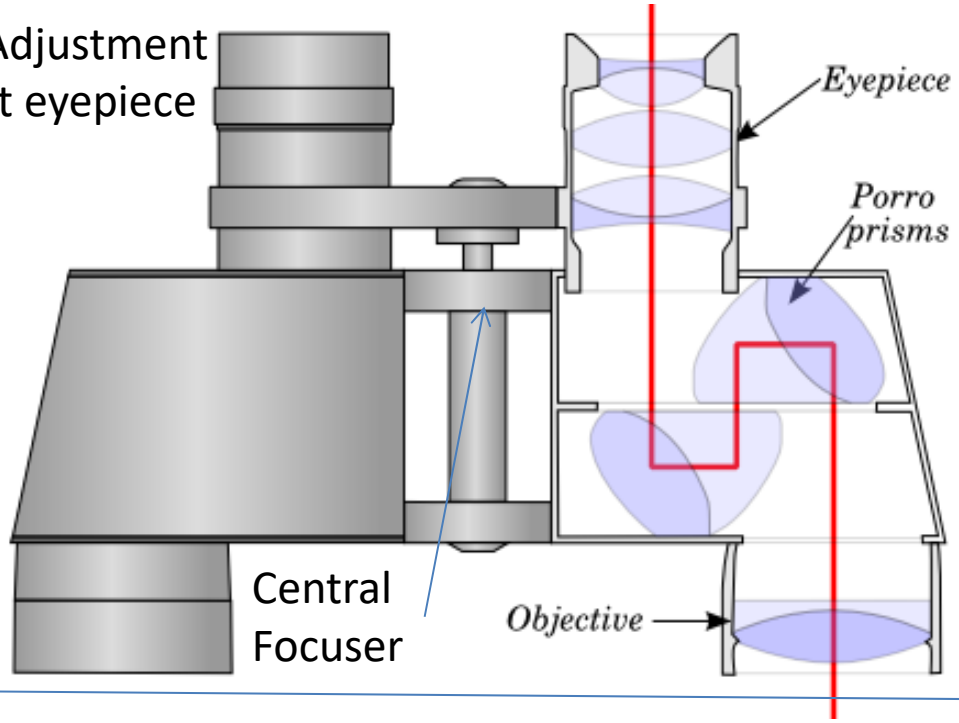
- Quality more expensive binoculars may give.
  - Slightly sharper views. (Significant for astronomy!)
  - Better contrast.
  - Better detail, especially in nebulas/clouds.
  - Less light loss - gather more light for the size.
  - Truer colour - Less chromatic aberration, colour cast.
  - Hold focus and collimation. No cheap flex.
  - Less sample variation. Better quality control.
  - Don’t fog up internally (Nitrogen filled, waterproof)
    - Internal focusing mechanism.
    - Some have individual focusing, not central.
  - Better build. Sturdier. May last longer.
  - Features like image stabilisation. MUCH more expensive.

Specifications - Overview

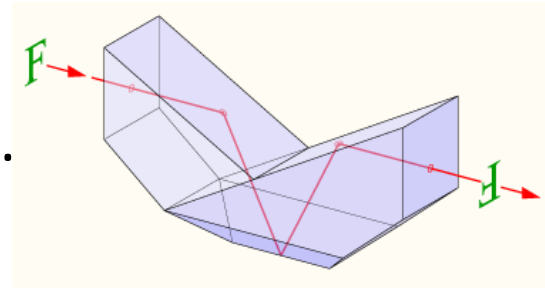
- Prism type.
- Magnification.
- Coatings.
- Field/Angle of view (true vs apparent).
- Exit pupil.
- Glass type (BAK-4 vs BK-7).
- Eye relief.
- Other features (rubber eyecups, tripod socket).

Specifications – Prism Type

- Porro prism.
  - Less compact width.
    “M shaped”.
  - More compact length.
  - Larger sizes available.
  - Cheaper.
  - Better for Astronomy.



- Roof prism.
  - Not as bright.
  - More compact width.
  - Less compact length.
  - Cost more for larger sizes than porro.



* Images from Wikipedia. See Thanks and Attribution slide for details.

Specifications – Magnification and Objective Lens Size

- Appropriate magnification and objective size .
  - Given as Magnification (times) X Objective Size (mm).
  - E.g. 7x50 means 7 times magnification, 50mm lenses.
- For Astronomy.
  - Magnification between 7 and 10.
    - <7 too wide. >10 can't hand hold steadily.
  - More magnification, harder to hold steady.
  - 50mm – 70mm for hand held. 50mm is the most common.
    - <50 gathers too little light. >70 too heavy, needs tripod.
  - 7x50 vs. 10x50 hotly debated.

Specifications - Coating

- Coating type.

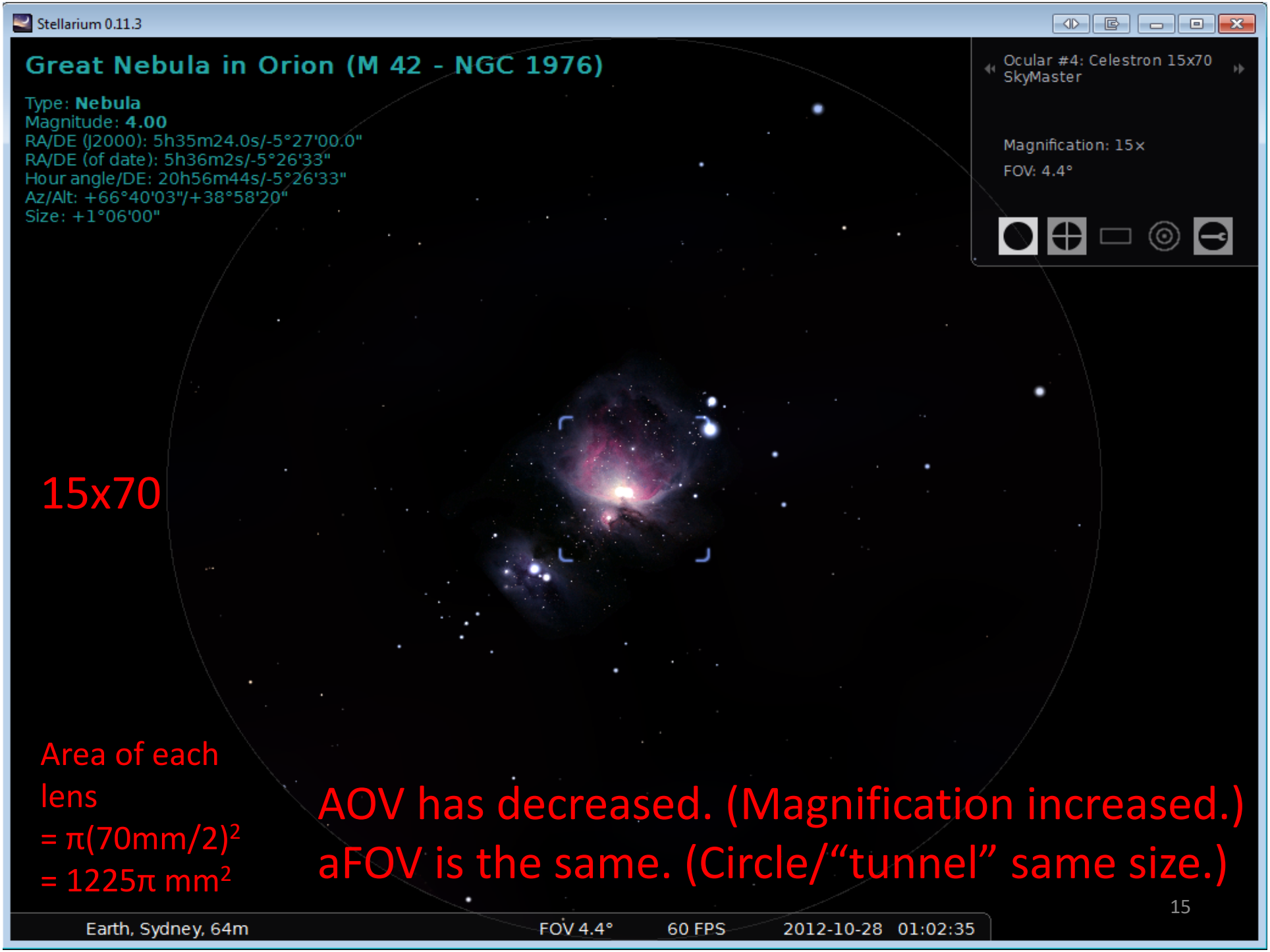
  Without coating, Internal reflections cause light loss , ghosting, other problems.

  - OK: Coated - Some surfaces not coated so reflect light – losses up to about 10% more light.
  - Better: Multi-coated (MC) - Multiple coatings to reduce light reflection.
  - Better: Fully-coated (FC) - Every surface coated.
  - Best: Fully Multi Coated (FMC) - Every surface multiple coatings.
- Coatings can be of varying quality.
  - Some binoculars marked FMC worse than ones marked as Coated.
  - Try to avoid horrible coloured “ruby” and orange coatings.
    - Used to mask bad optics that bend different colours by different amounts.
    - Cause false colour.
    - Can cut out certain colours. You’ll lose nebulousity in some objects.
    - Lighter coatings that are blue or indigo are preferred. Green in between.
    - Bad coatings cut out more light but even badcoatings can reduce colour fringing and increase contrast.

Specifications – Field and Angle Of View

- Angle of view – AOV (confusingly aka True Field of View - TFOV).
  - How much of the sky you can see.
  - Usually shown as width at a distance e.g. m@1000m or yards@1000ft. But also can be expressed as an angle.
  - Related to magnification, depends also on construction and configuration of optics.
- Apparent field of view – AFOV.
  - How wide the image looks to your eyes. Tunnel vision vs. fills your view.
  - **True Field = Apparent Field ÷ Magnification.**
  - "Wide Angle" binoculars usually have an apparent field of view of 60 degrees or more. Fill your view. Less tunnel vision.
  - Trade off against long eye relief. (Further from "light tunnel".)


Stellarium 0.11.3
Great Nebula in Orion (M 42 - NGC 1976)
Type: Nebula
Magnitude: 4.00
RA/DE (J2000): 5h35m24.0s/-5°27'00.0"
RA/DE (of date): 5h36m2s/-5°26'33"
Hour angle/DE: 21h04m55s/-5°26'33"
Az/Alt: +64°56'55"/+40°31'17"
Size: +1°06'00"
Ocular #6: 7x50Binocs
Magnification: 7×
FOV: 8°
7x50
Area of each lens collecting light is πr²
= π(50mm/2)²
= 625π mm²
*Unrealistic colour and brightness.
Earth, Sydney, 64m
FOV 8°
20.9 FPS
2012-10-28 01:10:44


Stellarium 0.11.3
Great Nebula in Orion (M 42 - NGC 1976)
Type: Nebula
Magnitude: 4.00
RA/DE (J2000): 5h35m24.0s/-5°27'00.0"
RA/DE (of date): 5h36m2s/-5°26'33"
Hour angle/DE: 20h56m44s/-5°26'33"
Az/Alt: +66°40'03"/+38°58'20"
Size: +1°06'00"
Ocular #4: Celestron 15x70 SkyMaster
Magnification: 15x
FOV: 4.4°
15x70
Area of each lens
= π(70mm/2)²
= 1225π mm²
AOV has decreased. (Magnification increased.)
aFOV is the same. (Circle/"tunnel" same size.)
Earth, Sydney, 64m
FOV 4.4°
60 FPS
2012-10-28 01:02:35

Stellarium 0.11.3

Great Nebula in Orion (M 42 - NGC 1976)

Type: **Nebula**
Magnitude: **4.00**
RA/DE (J2000): 5h35m24.0s/-5°27'00.0"
RA/DE (of date): 5h36m2s/-5°26'33"
Hour angle/DE: 20h36m33s/-5°26'33"
Az/Alt: +70°37'51"/+35°04'14"
Size: +1°06'00"

Ocular #0: Ocular 0
Ocular FL: 40 mm
Ocular aFOV: 43°

Telescope #0: C1400
Magnification: 79.7×
FOV: 0.5391°

Telescope

80x

Narrow Apparent Field of View. (aFOV) Smaller circle Tunnel vision.

Narrow AOV. More magnified.

*Unrealistic colour and brightness.

Earth, Sydney, 64m FOV 1.25° 57.8 FPS 2012-10-28 00:42:27

Stellarium 0.11.3

Great Nebula in Orion (M 42 - NGC 1976)

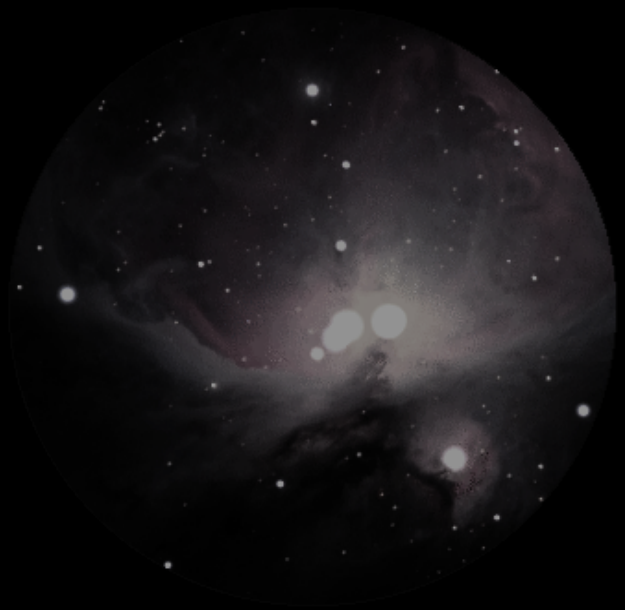
Type: **Nebula**
Magnitude: **4.00**
RA/DE (J2000): 5h35m24.0s/-5°27'00.0"
RA/DE (of date): 5h36m2s/-5°26'33"
Hour angle/DE: 20h33m55s/-5°26'33"
Az/Alt: +71°07'19"/+34°33'16"
Size: +1°06'00"

Telescope

80x

Ocular #0: Ocular 0
Ocular FL: 40 mm
Ocular aFOV: 43°

Telescope #0: C1400
Magnification: 79.7×
FOV: 0.5391°



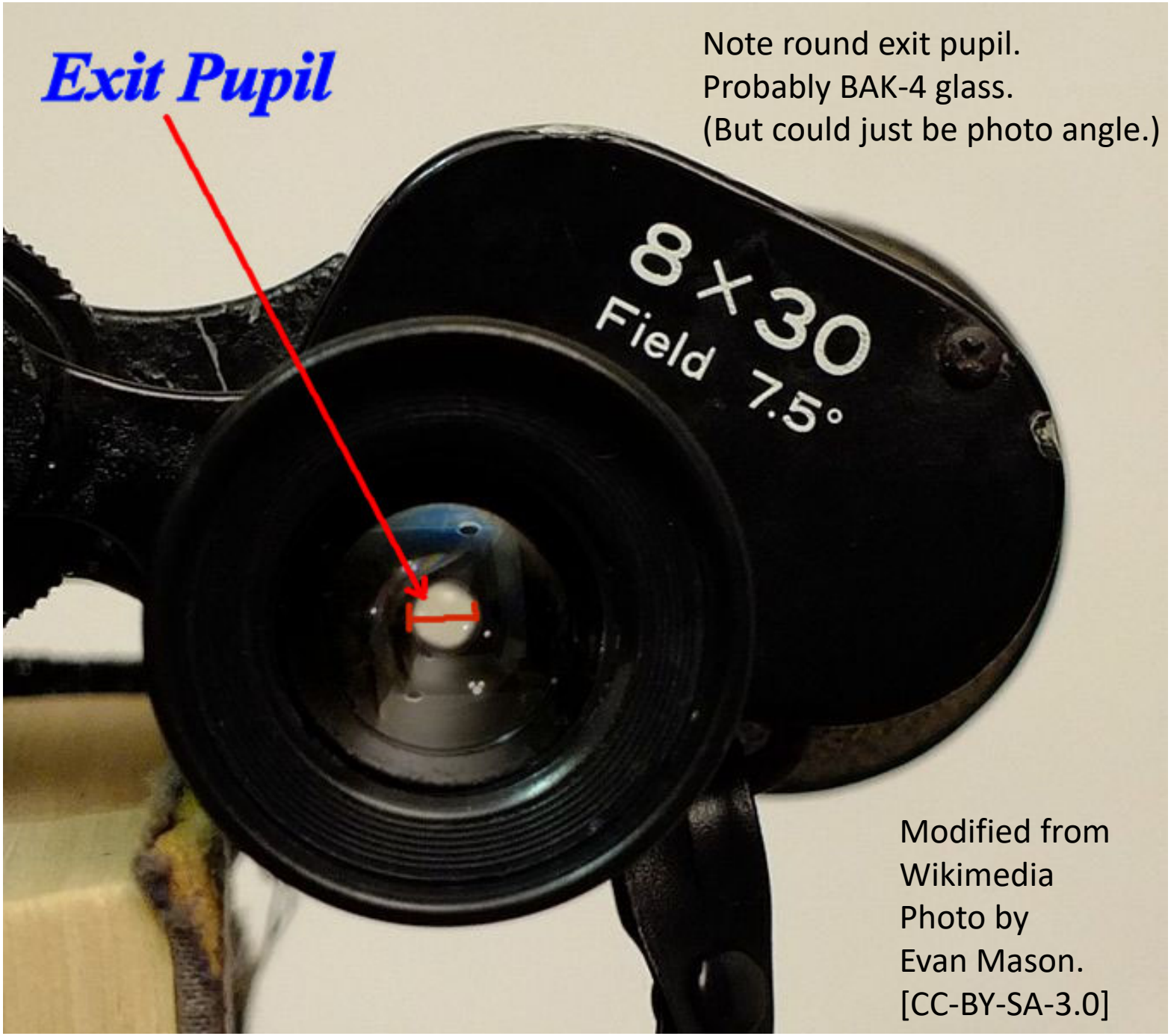
Last slides bright to show field of view but colours weren't very realistic

Earth, Sydney, 64m FOV 1.25° 59.7 FPS 2012-10-28 00:39:50


Stellarium 0.11.3
Great Nebula in Orion (M 42 - NGC 1976)
Type: Nebula
Magnitude: 4.00
RA/DE (J2000): 5h35m24.0s/-5°27'00.0"
RA/DE (of date): 5h36m2s/-5°26'33"
Hour angle/DE: 20h54m20s/-5°26'33"
Az/Alt: +67°09'34"/+38°30'47"
Size: +1°06'00"
Ocular #4: Celestron 15x70 SkyMaster
Magnification: 15x
FOV: 4.4°
15x70
More realistic view.
Earth, Sydney, 64m
FOV 4.4°
59.6 FPS
2012-10-28 01:00:11

Specifications - Exit Pupil

- Exit pupil.
  - How big the circle of light that hits your eye is. Usually in millimeters.
  - Larger magnification means smaller exit pupil.
  - On goal is to match the opening of your eye's dark adapted pupil to maximize light. As a general rule:
    - Younger viewers -> Pupils dilate more -> 7x ideal.
    - Older viewers -> Pupils dilate less -> 10x ideal.
    - Matching exit pupil with greater magnification of 10x gives illusion of improved contrast.

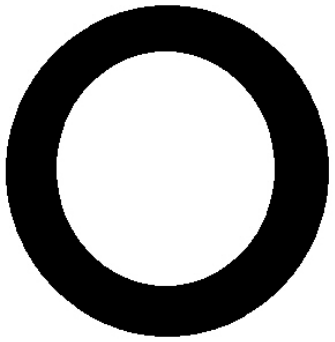


Note round exit pupil.
Probably BAK-4 glass.
(But could just be photo angle.)

Modified from Wikimedia Photo by Evan Mason. [CC-BY-SA-3.0]

Specifications – Glass Type

- Glass type.
  - BAK-4 = Barium Crown.
    - More expensive. I've never seen cheap BAK-4.
    - Round exit pupil.
    - Less light loss.
    - But more colour fringing.
    - Higher refractive index. Bends light more.
  - BK-7 = Borosilicate Flint.
    - Diamond exit pupil.
    - More light loss at edges.
    - All cheap binocs I've seen use BK-7 glass.
- BAK4 designation can be ambiguous.
  https://stargazerslounge.com/topic/135299-when-bak4-is-not-bak4-glass-types-for-binocular-prisms/
  "The Chinese designation "BaK4" is an entirely different glass to the Schott BaK4 -- BaK stands for ***Ba**ritleich**k**ron (Barium Crown)*; the Chinese BaK4 is actually Schott PSK3, which is not a Barium Crown at all: it is a phosphate crown. PSK3 is much cheaper to make than BaK4; it also has a lower refractive index."



Specifications – Glass Type – BK-7

- Surprisingly difficult to photograph. Right light required behind binocs. They need a clean, but not as filthy as they look here in bright sunlight.
- Avoid damage. Never get carried away over-cleaning optics. If you have a have specialized need make sure you have the right tools.

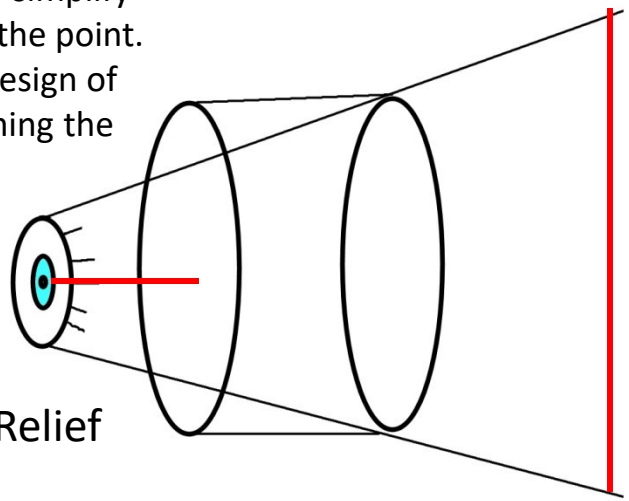
Specifications – Glass Type – BK-7

Specifications - Eye Relief

- Eye relief is how far from your eye you can hold binoculars and see the whole image.
- The longer the eye relief, the less the apparent field of view.
  - You can either have wide angle or long eye relief, not both.
  - The further your eye is, the less the eyepiece fills your eye.
- Viewing beyond eye relief distance also gives tunnel vision.
  - You miss out on the edges.
- No choice if you view with glasses. You need long eye relief.
  - 16mm and up recommended.
  - Harder but not impossible to find in cheap binoculars.

Specifications - Eye Relief vs FOV

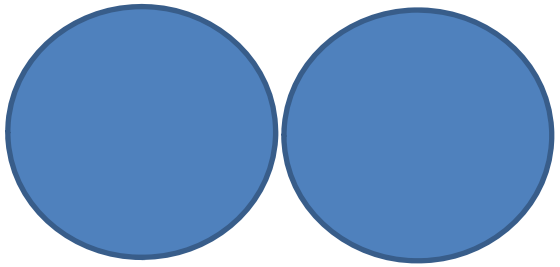
These diagrams over-simplify things a bit to make the point. We're ignoring the design of the optics and assuming the Same kind of glass.



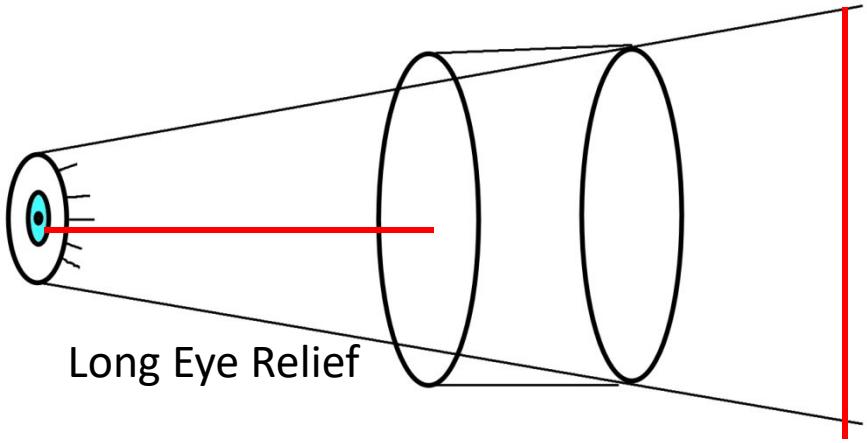
Short Eye Relief

Wide Angle

Expansive views. Goes past the edges of your central vision and fill some of your peripheral vision. This gives a "feeling of being in the scene" or "like a space walk".



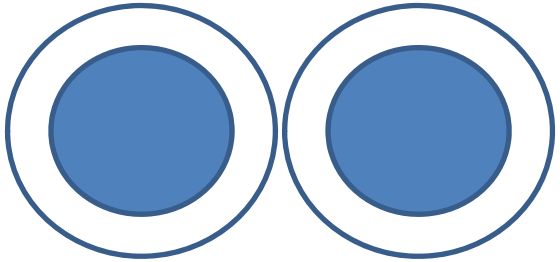
Binocular Eyepiece



Long Eye Relief

Narrower Angle

Like looking into a tunnel.
Wider better views if your eyesight Is Correctable enough just by adjusting focus without wearing eyeglasses.



Other Features

- Wrist or Neck Straps, Cleaning Cloth. (often included).
- Tripod Mount Screw.
  - Highly desirable.
  - Attaches to camera tripods, and specialized tripod mounts.
- Waterproofing.
- Gas (nitrogen) filled.
- Zoom. (Avoid!!!)
- Image Stabilization.
- Camera/Digital Binoculars. (Rare, expensive, often bad).
- Night Vision. (Not suitable for astronomy).

Where Not To Compromise

- NO zoom binoculars. (e.g. 7-21x50)
  - Not as bright.
  - Zoom mechanism linking both sides means one eyepiece may zoom more than the other. Linkage breaks easily. Usually cost more.
  - Difficult to find any good reviews of these for astronomy.
- NO “No focus” and “Focus free”
  - Not suitable for Astronomy.
  - Permanently focused on the hyper-focal distance.
  - Everything else has “acceptable sharpness”. Most things a little fuzzy. “Focus free” is an ironically accurate description.
- NO highly reflective mirror-like coatings on the front objective lens.
  - Usually used to cover up horrible colour fringing and cut out most of the light.
- DO NOT buy high powered binocs to use hand held!
  - Anything over 10x is difficult. Over 12x will be frustrating.
  - You won’t see more detail, due to hand shake,

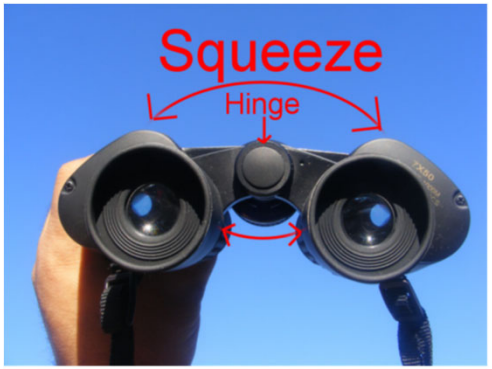
Cloudynights review. “Binocular Resolution Handheld versus Mounted“
https://www.cloudynights.com/item.php?item_id=1410
“a 10x50 or a 12x50 binocular for handheld use will show you everything or nearly everything that you would be able to see with a higher powered binocular.”

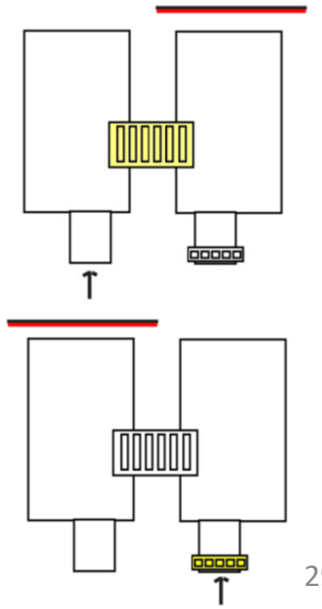
Specifications Not Always True

- Unfortunately manufacturers and retailers do post incorrect specifications.
- I own cheap binoculars.
  - With mismarked magnification and field of view.
  - Specifications can change without the model number changing.
  - Often specifications not given at all on cheaper binoculars.
- Beware of counterfeit branding, even on cheaper models.
- Judge Reviews Critically.
  - Watch out for fake reviews.
  - Focus on the negative reviews. Are they reasonable complaints and can you live with the problems?
- Use specifications as a guide only.
- No perfect binoculars. You will have to make some compromises, especially on a budget.

Testing - Basic Use – Setup and Focus

1. Aim at the same object from the same distance for the whole process.
   - Something with sharp lines or writing 30 to 100 meters away is ideal.
   - At night a planet, the moon or a star works.
2. Set the interpupillary distance – the distance between your eyes - by folding the barrels closer or pulling them apart at the hinge or hinges.
   - When adjusted properly you can cover the objective (large front) lens for each eye in turn and you should still see the object through the center of each eyepiece without needing to move.
3. Cover right objective (large front) lens and focus side left side with the center focus wheel.
4. Cover left objective (large front) lens and focus the right side with the the diopter dial on the right eyepiece (small back) lens.





Testing - Basic Use - Tips

5. Both eyes are now set to the same focus. From now on only use the center wheel to focus at different distances. No need to touch the diopter.
6. For the most steady views possible rest your elbows on something steady if available, or on your torso if not.
7. To view a subject quickly without hunting, look at the subject with just your eyes and then pull the binoculars up in front of your eyes.

This Cornel Lab bird watching video demonstrates set up and use nicely. However I would not rely on marking the diopter on budget binoculars and would set up focus at least once per session. https://www.youtube.com/watch?v=pkPzl-VPmo4

Testing At The Shop - Build

- Test the copy you are actually buying. Much variation between copies especially for cheaper binoculars
- No loose parts (inside and out) – lenses, focus controls.
- No internal dust, chips, paint flecks, smudges, oil/fluid.
- Easy precise focus – how easy is it to dial in the focus exactly on the object you're looking at?
- Hold focus - Push against eyepiece gently then a little more firmly. Does focus change? You don't want to refocus constantly.
- Collimated (both sides aligned) and hold collimation. No double images! Double images cause eyestrain and headaches.
  - Throw one eyepiece out of focus to make double image obvious . Your brain has more trouble merging misaligned images if one is out of focus.
  - No significant flex or play, otherwise they won't hold collimation. Gentle pressure only!!! Don't break them.
  - Round exit pupils. No cats eyes. (Diamond OK for BK-7.)

Testing At the Shop - Collimation

Correctly Collimated.
No effort forming one image.

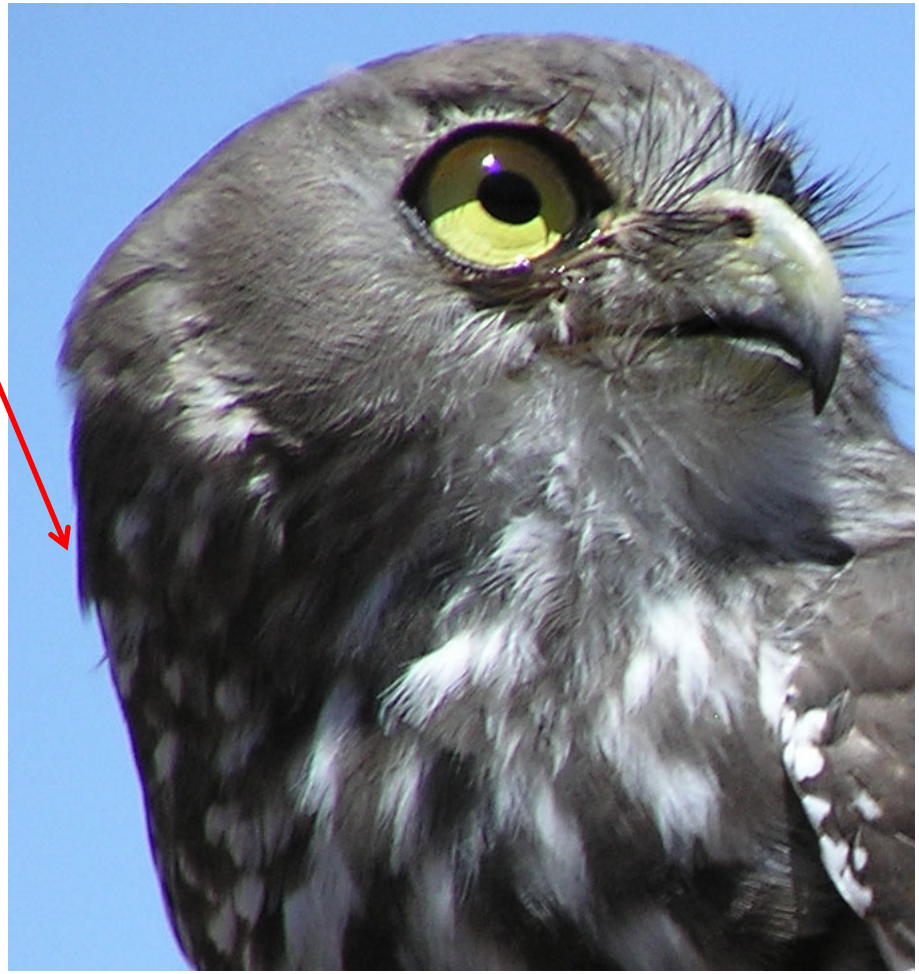
Uncollimated.
Double Image.

Testing At The Shop - Clarity

- Bright, clear and sharp on both sides with no defects.
  - Learn to focus both lenses correctly.
    - Central focuser with right eye covered or closed.
    - Then diopter (right side eyepiece) with left eye covered or closed.
  - Text makes a good target to test sharpness.
  - Test sharpness at the edges as well as the center.
- Correct colour.
  - Minimal or no chromatic aberration (CA)/colour halos.
    - Easier to see with high contrast e.g. dark object on light background.
    - In a shop look for signs, telegraph poles and street lights, brightly lit or brightly backlit objects.
    - CA halos can be purple, red, green or blue. Due to filters used to cover up cheap prisms and lenses that split colours.
  - No colour tinge. Objects in real colours. Also due to filters.
- Apparent field of view and eye relief.
  - Do the binoculars fill your field of view?

Colour Casts and Fringing

Purple halo. Chromatic aberration (CA) aka colour fringing. Notice that it's only happening on the side of the bird that is in shadow. i.e. where there is a high contrast (difference in brightness) between sky and subject. No surprise that it happens when viewing bright stars against a dark sky.



Colour casts can vary in how obvious they are depending on light and what you are looking at. Look for pure white object to judge. Look with at it without binoculars then with. Does the colour change?

Testing At The Shop - Comfort

- Comfortable to hold. Fit well in your hands.
- Neck strap length and comfort.
- Weight.
- Balance naturally and not too front heavy.
- Eye relief. Test with glasses on if you wear glasses!
  - Do they have folding eye cups for eyeglass wearers?
  - Consider whole family if you view with them.
- Test with and without glasses if you are just near or far sighted. Can you get away without using glasses?
- Interpupillary distance range. Distance between your eyes
  - Adjustable by bending tubes of binoculars closer or further apart.
  - Must be able to form 1 circle when looking through your binocs.

Testing At The Shop - Features

- Central focusing.
  - 1 main focuser, plus a diopter adjustment.
  - Once you set your diopter adjustment you won't need to readjust for different distance. Just adjust main focuser.
- Tripod adapter socket.
    - Plastic tripod adapters cost about $6-$15 on Ebay.
    - Mount binoculars to camera tripod
      (Or more expensive parallelogram mount.)
    - Accept large camera tripod $50-$100.
    - Detail won't be lost due to hand shake.
    - Lets you use larger magnification binoculars. (>10x)
    - At this price point most binoculars have horrible lens caps and tripod mount covers that won't stay on. (Acceptable compromise. Do your best not to lose them.)

Can’t Test At The Shop

- How bright they are for Astronomy?
  - But compare with others for daytime brightness.
- How much detail and nebulosity you will see.
  - Depends largely on coatings which act as filter.
- How moisture will affect them. (”Fogging”)
- Internet reviews can be very useful.
  - If manufacturer hasn’t changed the specifications.

  …and the reviews are genuine.
  - Look for multiple reviews listing show stoppers: Easily broken, misaligned, bad image quality, don’t stay in focus.

Manufacturers And Retailers

- There are good unbranded binoculars out there but known brands are safest until you have some experience.
  - Budget astronomy specialists.
  - Astronomy specialists and camera manufacturers.
  - Luxury brands.
- Less likely to get ripped off a with reputable astronomy retailers.
  - If you can support a local supplier whose prices are reasonable and lets you test please do. They're a dying breed.
- See references for links to binoculars you can buy in 2023.

Part 2 – Using Binoculars (For Astronomy)

Planning Your Observations

- WSAAG Newsletter.
  - Excellent charts produced by our members by hand.
- Powerhouse Museum monthly sky guides. https://www.maas.museum/observations/category/monthly-sky-guides/
  - (Seems to have replaced Sydney Observatory sky guides which use to also include a podcast.)
- Phone apps (often have a Northern Hemisphere focus)
  - Star Walk Astronomical News
- Books
  - See more information section for recommendations.

Stellarium With Binoculars

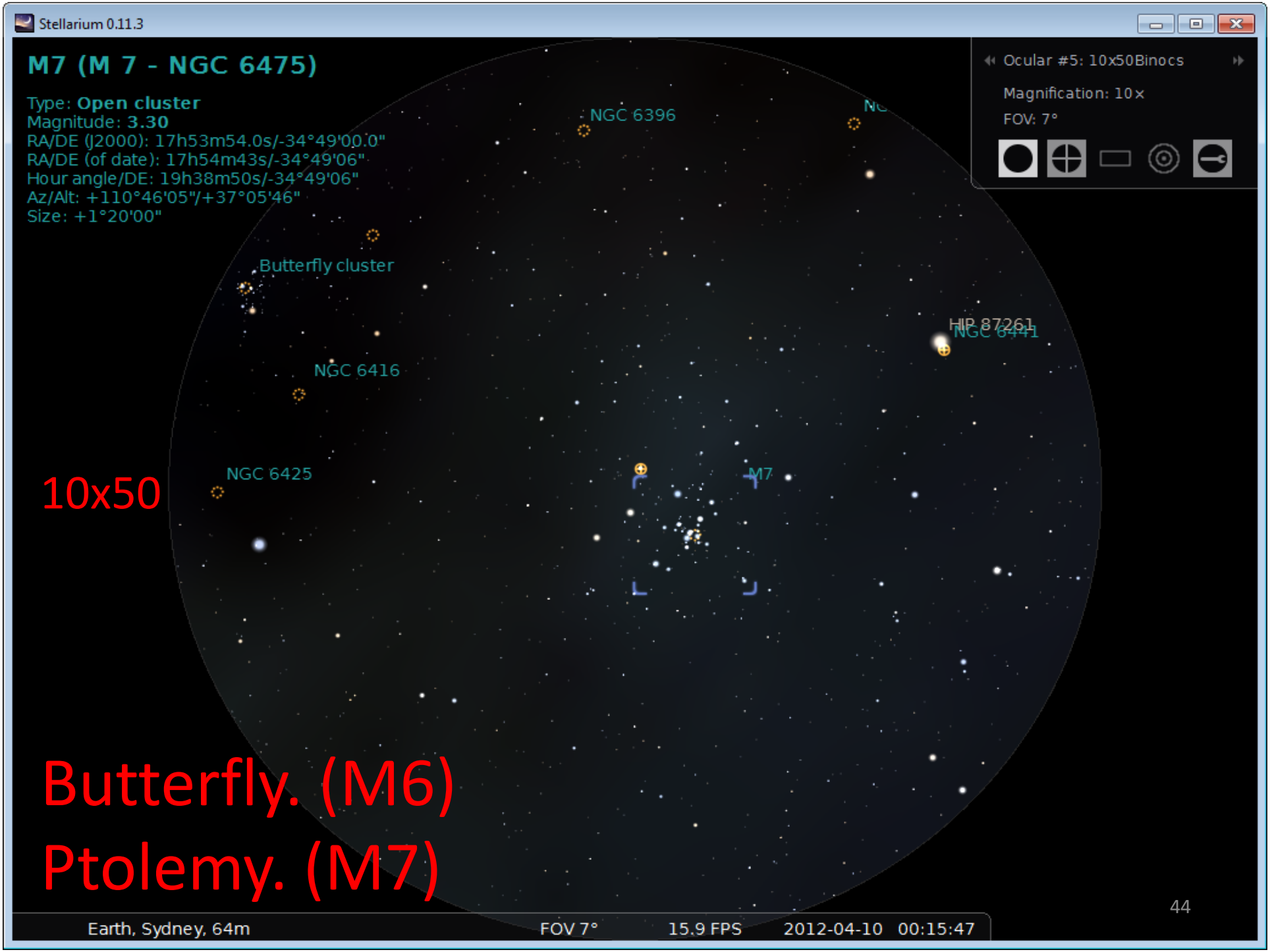
- Use Stellarium for quick planning, or on your mobile phone.
- For closer to realistic views.
  - Set up date, time and location correctly.
  - Set absolute scale to match limiting magnitude you expect.
  - On PC set up ‘Oculars’ plugin for your binoculars/telescopes.
  - Install the add-on catalogs for more stars.
- Use night mode if you take a laptop out.
- My bad habit – Duck in and out of house. Terrible for dark adaptation, but laptop not exposed to dew. Use night mode.
- Simulation is not perfect. Uses deep sky images nothing like what you can expect to see. I have edited some of the following pictures to be more realistic by reducing brightness and colour in the nebulae.
  - Sketches can be better, but I don’t sketch well.

Binocular Objects - Solar System

- Moon is a larger target than the planets.
- Comets.
- Artificial satellites.
- Planetary alignments.
- Planet against a particular constellation.
- Rest require too much magnification for binocs when viewing individual objects.
  - Venus, Mars, Jupiter as coloured discs.
  - Crescent shape for Venus – phases.
  - Jupiter's Galilean Moons. (Need good eyesight.)
  - If you want to try with binoculars, consider using a mount to steady them.

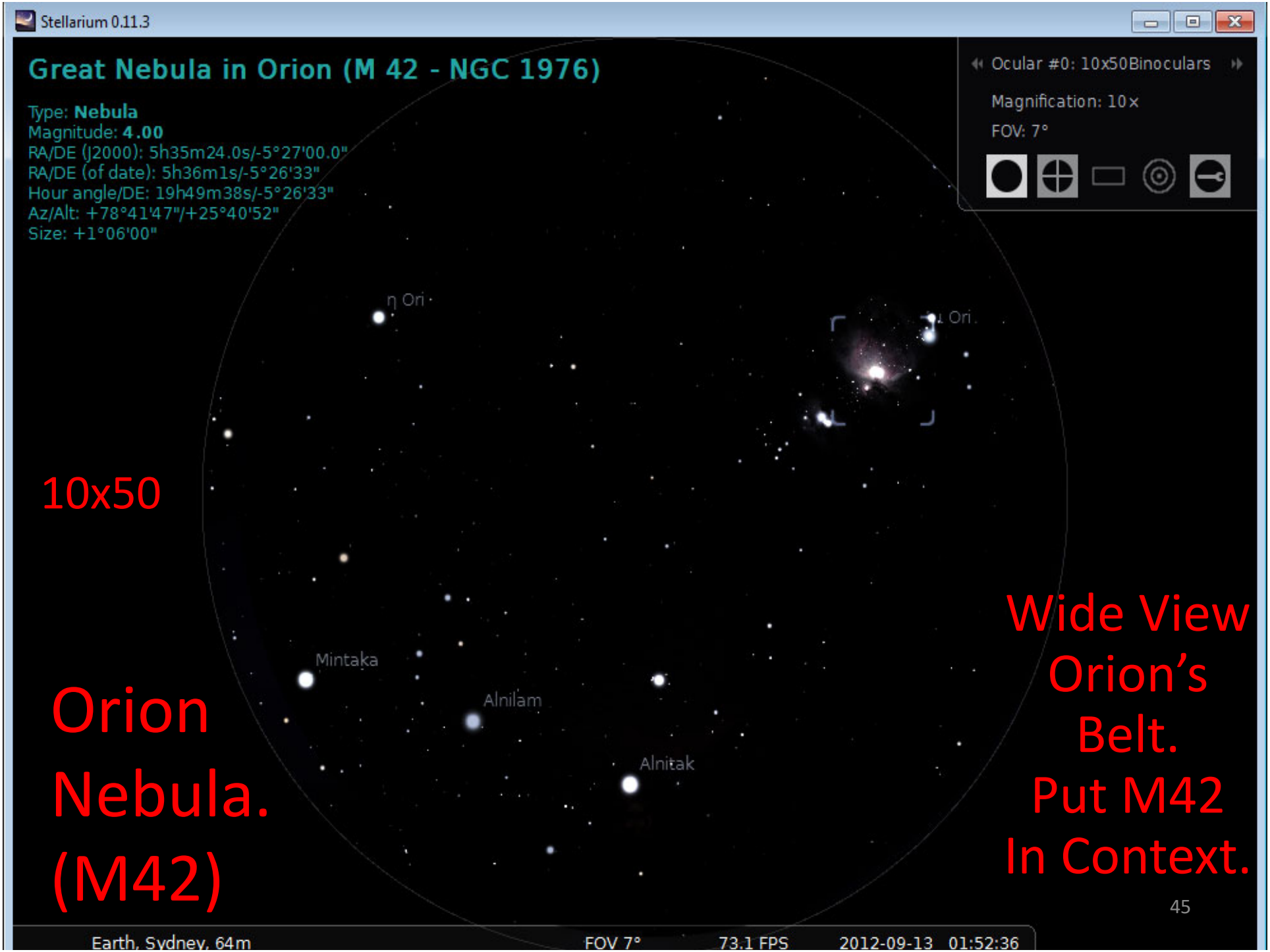
Extrasolar Binocular Objects

- Messier Objects,
  - M6 (Butterfly Cluster.)
  - M7 (Ptolemy's Cluster.)
  - M42 (The Great Orion Nebula.)
  - M45 (The Pleiades.)
- Crux and The Jewel Box.
- Theta Carinae (Southern Pleiades.)
- Eta Carinae.
- Omega Centauri.
- Magellanic Clouds.



Butterfly. (M6)

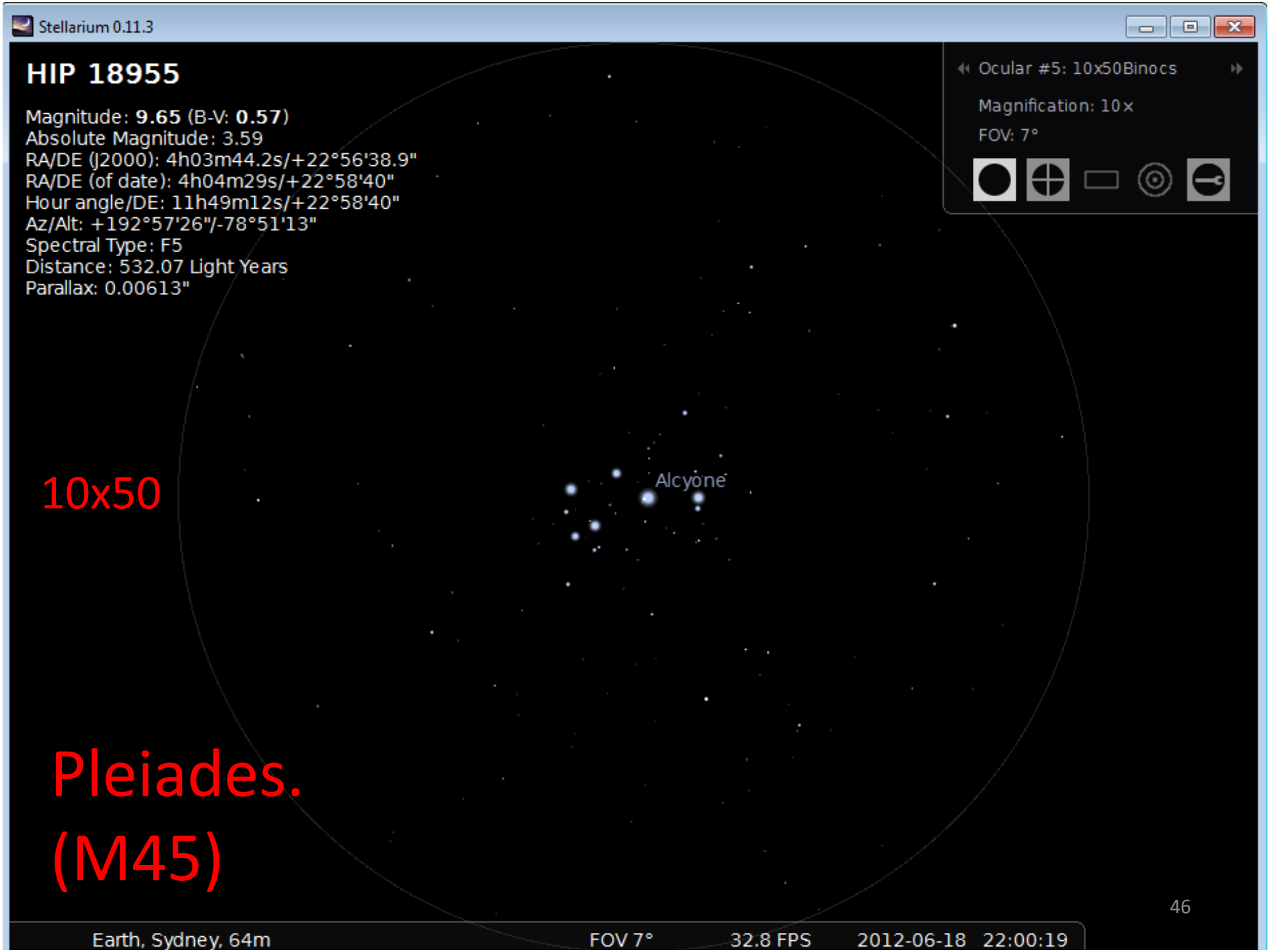
Ptolemy. (M7)



10x50

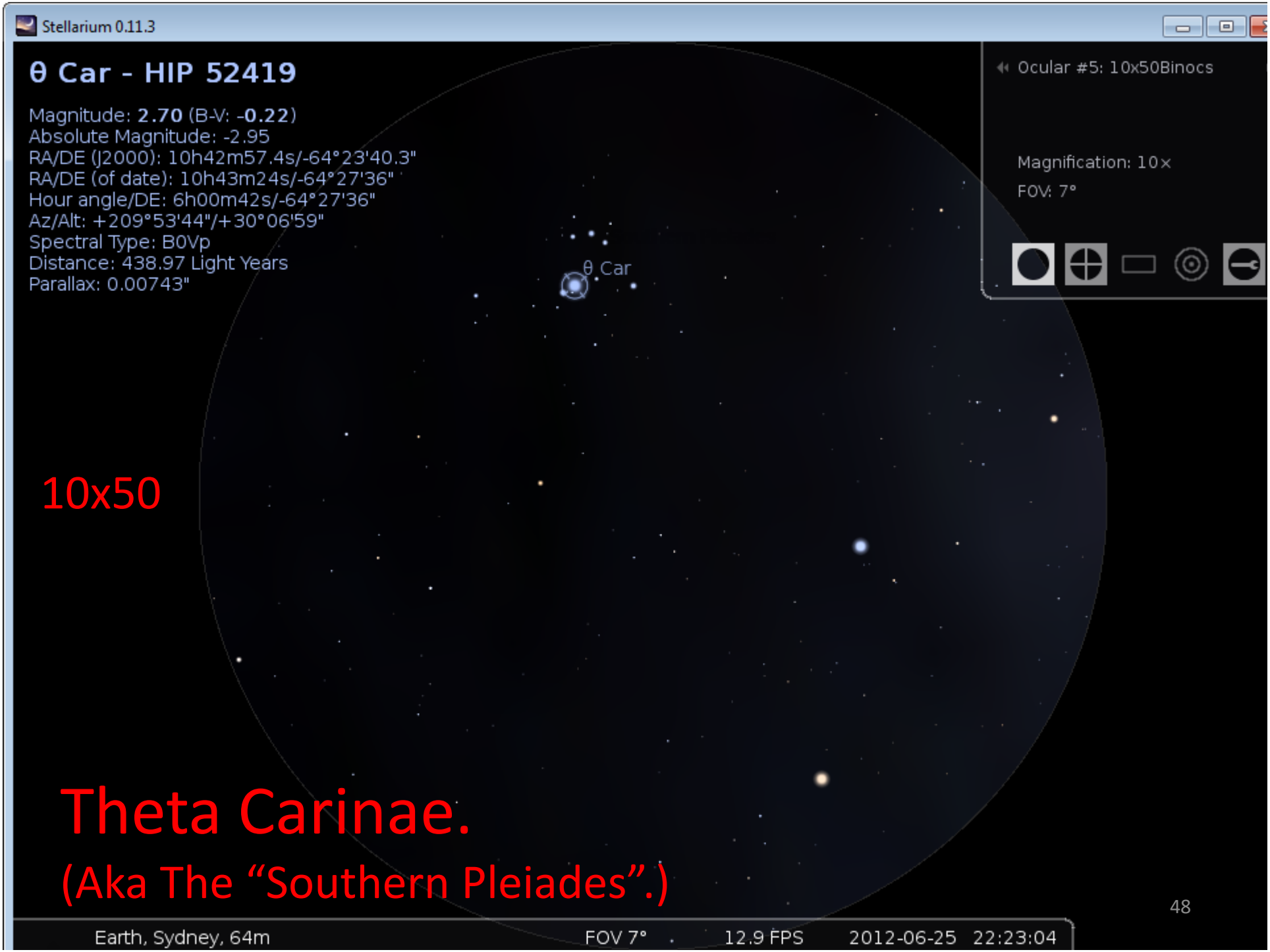
Orion Nebula. (M42)

Wide View Orion's Belt. Put M42 In Context.

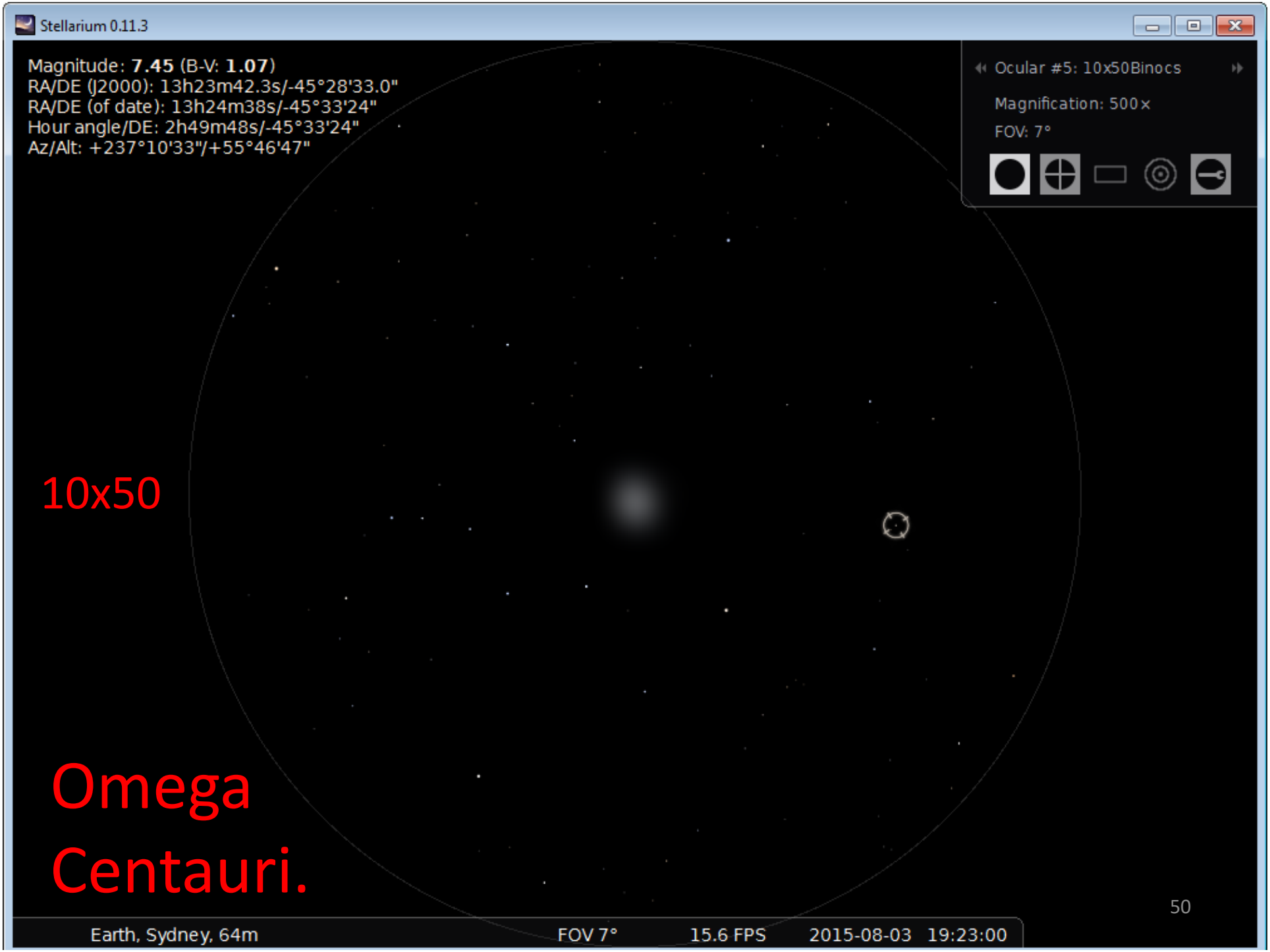

Stellarium 0.11.3
HIP 18955
Magnitude: 9.65 (B-V: 0.57)
Absolute Magnitude: 3.59
RA/DE (J2000): 4h03m44.2s/+22°56'38.9"
RA/DE (of date): 4h04m29s/+22°58'40"
Hour angle/DE: 11h49m12s/+22°58'40"
Az/Alt: +192°57'26"/-78°51'13"
Spectral Type: F5
Distance: 532.07 Light Years
Parallax: 0.00613"
Ocular #5: 10x50Binocs
Magnification: 10x
FOV: 7°
Alcyone
10x50
Pleiades.
(M45)
Earth, Sydney, 64m
FOV 7°
32.8 FPS
2012-06-18 22:00:19

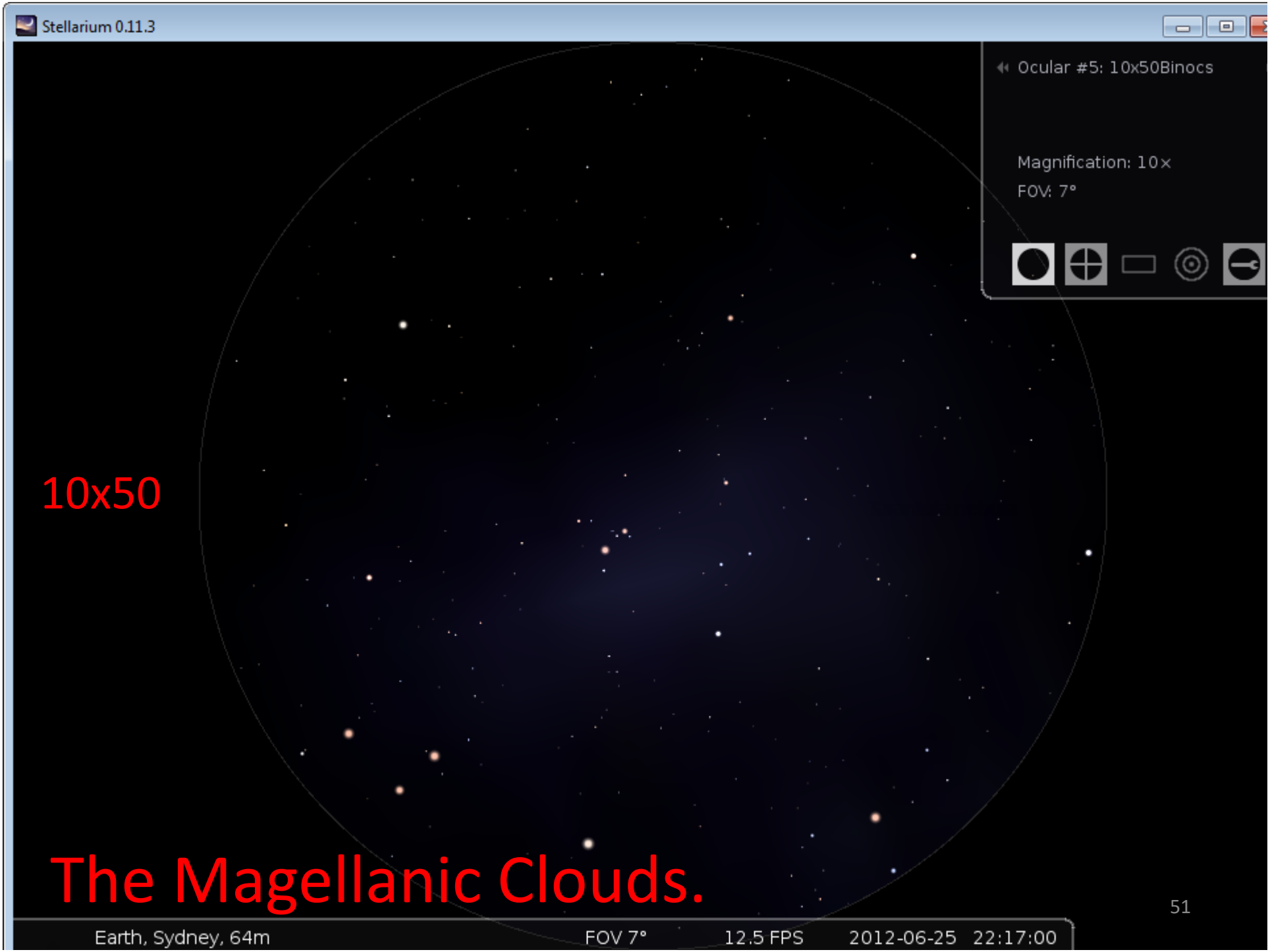
10x50

Crux And The Jewel Box.


Stellarium 0.11.3
θ Car - HIP 52419
Magnitude: 2.70 (B-V: -0.22)
Absolute Magnitude: -2.95
RA/DE (J2000): 10h42m57.4s/-64°23'40.3"
RA/DE (of date): 10h43m24s/-64°27'36"
Hour angle/DE: 6h00m42s/-64°27'36"
Az/Alt: +209°53'44"/+30°06'59"
Spectral Type: B0Vp
Distance: 438.97 Light Years
Parallax: 0.00743"
θ Car
Ocular #5: 10x50Binocs
Magnification: 10×
FOV: 7°
10x50
Theta Carinae.
(Aka The "Southern Pleiades".)
Earth, Sydney, 64m
FOV 7°
12.9 FPS
2012-06-25 22:23:04


Stellarium 0.11.3
η Car nebula (NGC 3372)
Type: Nebula
RA/DE (J2000): 10h43m48.0s/-59°52'00.0"
RA/DE (of date): 10h44m17s/-59°55'52"
Hour angle/DE: 1h26m25s/-59°55'52"
Az/Alt: +201°53'58"/+60°21'14"
Size: +2°00'00"
Ocular #5: 10x50Binocs
Magnification: 10×
FOV: 7°
10x50
Eta Carinae.
Earth, Sydney, 64m
FOV 7°
13.5 FPS
2012-04-02 23:20:41


Stellarium 0.11.3
Magnitude: 7.45 (B-V: 1.07)
RA/DE (J2000): 13h23m42.3s/-45°28'33.0"
RA/DE (of date): 13h24m38s/-45°33'24"
Hour angle/DE: 2h49m48s/-45°33'24"
Az/Alt: +237°10'33"/+55°46'47"
Ocular #5: 10x50Binocs
Magnification: 500x
FOV: 7°
10x50
Omega Centauri.
Earth, Sydney, 64m
FOV 7°
15.6 FPS
2015-08-03 19:23:00


Stellarium 0.11.3
Ocular #5: 10x50Binocs
Magnification: 10×
FOV: 7°
10x50
The Magellanic Clouds.
Earth, Sydney, 64m
FOV 7°
12.5 FPS
2012-06-25 22:17:00

Galaxies

- External Galaxies.
  - NGC 5128 - Centaurus A.
  - M87 - Virgo A.
  - NGC253 - Sculptor Galaxy. (Silver Coin/Dollar Galaxy.)
  - M31 - Andromeda Galaxy.
  - Northern Hemisphere.
    - M81 - Bode's Galaxy.
    - M82 - Cigar Galaxy.
  - Only 100 years since understood these are outside our galaxy! In 1923 Edwin Hubble found Cepheid stars in the Andromeda Galaxy which proved it was outside the Milky way.

Tips For Enjoying Binoculars

- Understand what you see, to enjoy what you see. Google every object you look at.
  - Don’t expect movie special effects, astronomy magazine or Hubble vision.
  - For jaw dropping views get away from light pollution.
- “Sweep” the skies at different times of the year. You’ll be amazed what catches your eye.
- Increase the objects you can see at any time of year. Observe early morning as well as night on different dates.
- A lot depends on seeing conditions. Take more than one look.
- The computer is your friend. Use Stellarium, Cartes Du Ceil and other star chart and sky simulation software before you go out.
- Enjoy and make the most of whatever instrument you have.
- Keep the binoculars handy for quick 5 minute sessions.
- The people you live with can be excellent observing companions.

Part 3 –
Maintaining Binoculars

Basic Care and Cleaning

Mostly obvious if you've owned anything optical – glasses, camera, telescope.
Optics.

- Keep fingers off glass.
- Dry brush first: Brush off dirt and dust first. Be careful not to rub in hard dirt that will scratch the lenses.
- Use a soft (optionally damp) microfiber cloth or tissue (no aloe!).
- Be careful with alcohol (Isopropyl and Methanol).
  - Some plastics, lens coatings and writing/markings will be eaten away.
- Soap/detergent and water is safer but can streak.
  - Non alcoholic eye glass cleaning fluid works well.

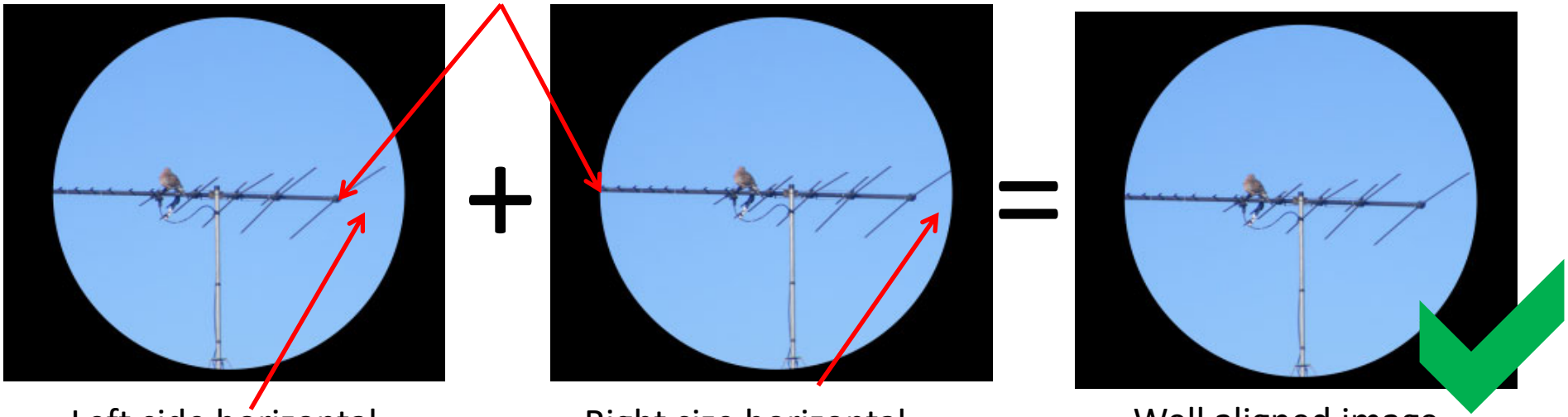
- Physical Care.
  - Avoid bumps and knocks.
  - Store in a case of some kind.
  - Use a strap to avoid dropping them, especially in the dark.
  - Keep away from sand, glitter, flour ("colour run" craze a few years ago).
  - Store in a cool, dry place with dessicate satchels.
    Avoid things coming apart in the heat or getting infested with mould.

How To Align (“Dirty Collimate”)

- Aligning both sides to look at the same thing. Not a true full collimation. You won’t be aligning lenses, just the prisms.
- Unaligned binoculars worthless. Professional fix not economical for <$130 binocs. **At your own risk**. But try before discarding. Nothing to lose!
- I found it easiest to adjust them while actually observing bright star at night.
- Alternately use a daytime target. Antenna or tower.
  - Make sure you’re not going to upset neighbours!
  - Can be easier to put binocs on a tripod, but be careful they don’t fall or get scratched if screwdriver slips. Use both hands.
- Other techniques including projecting the sun onto outline of eyepieces. Should line up. (But why expose your binocs to excessive heat?)
- Aim to have round exit pupils. Make note of what you change. If you end up with “cats eye” shaped exit pupils, undo changes and try aligning the other side. May need to change a little on each side.

Close one eye then the alternate to the other…

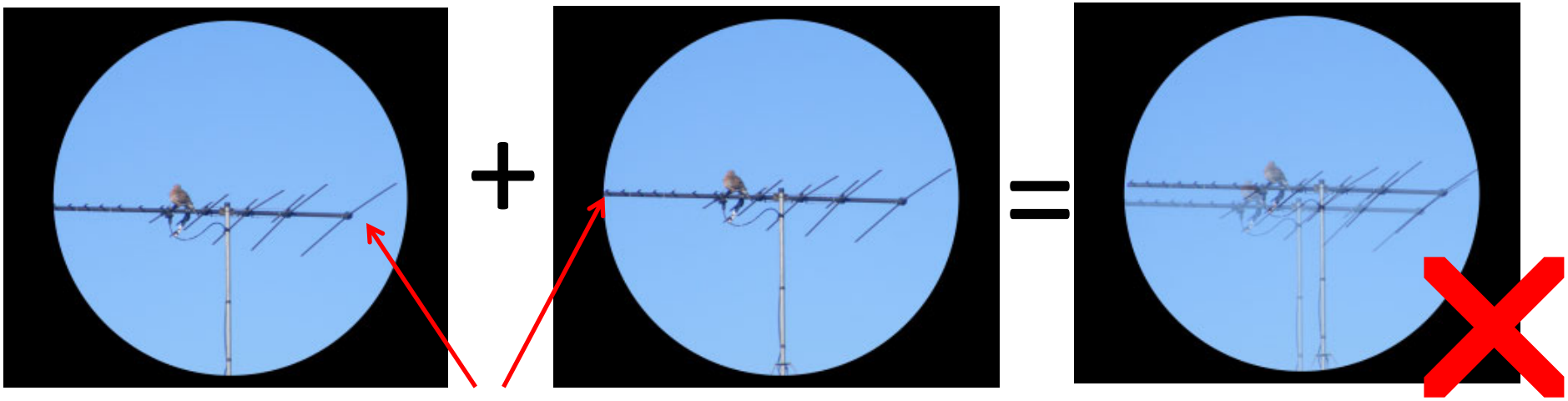
Vertical placement perfectly aligned. (Same height in eyepiece.)



Left side horizontal slightly left is OK.

Right size horizontal slightly right is OK.

Well aligned image.



Vertical placement not aligned. (Different height.)

Unaligned Double Image.

Left side too far right and/or right side too far left cause you to look at image cross eyed.

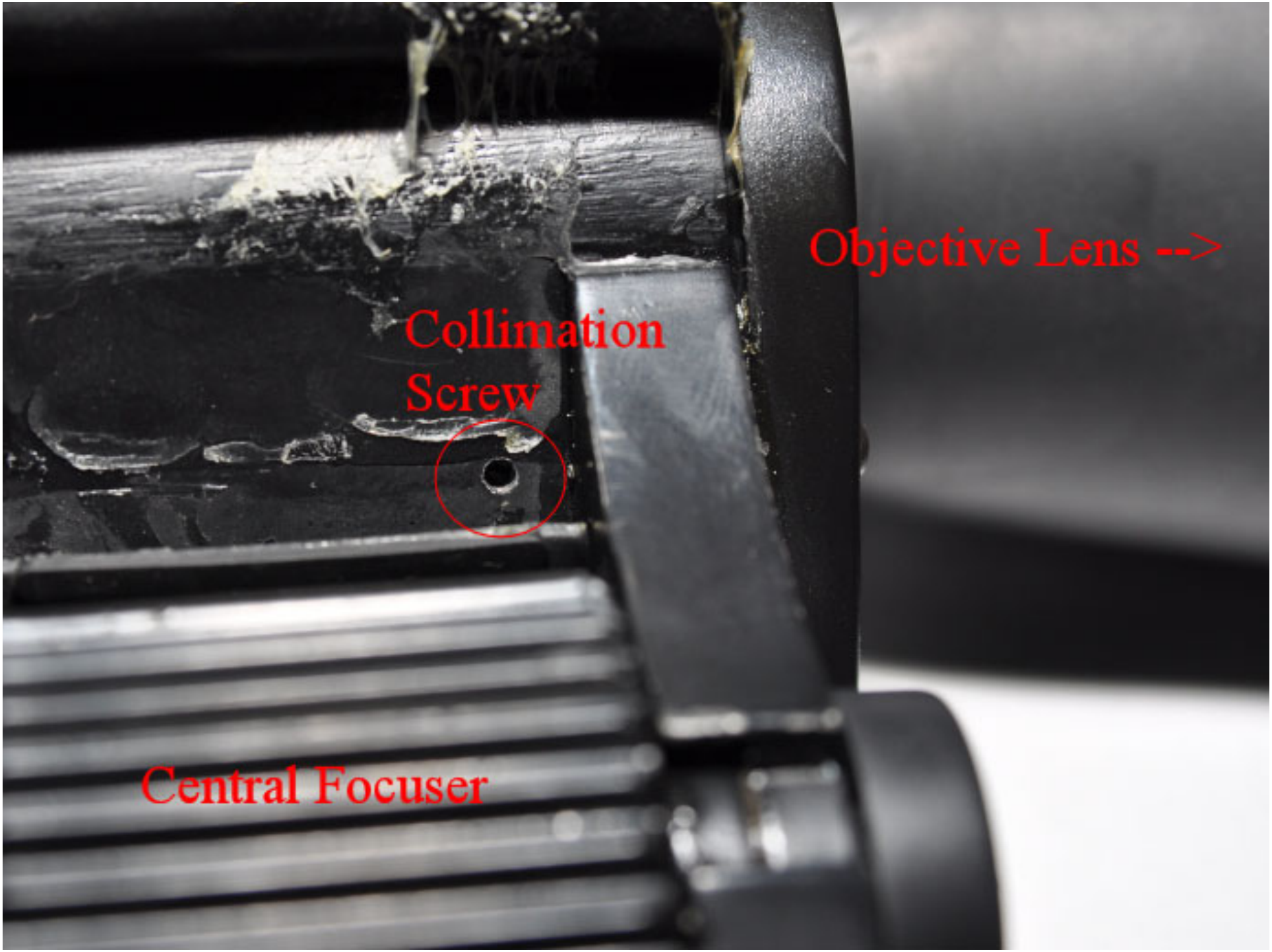
Prism Alignment Mechanics

- First make sure there is no flex, flop or play, or you're wasting your time.
- Locate collimation screws. The hardest part. May need to remove glue.
- Peel back rubber covering to reveal the screws.
- Need very small precision or jeweler's screwdriver.
  - On both pairs I've aligned the smallest flathead was what I needed.
- Make very small adjustments, especially if you aren't actually viewing while you turn the screw.
- On each side, one screw will move the image perpendicular to the other.
- Once you're happy with them re-glue. Don't use too much since you may need to align again later.


Collimation
Screws


Collimation
Screw


Collimation
Screw


Objective Lens -->
Collimation
Screw
Central Focuser

Thanks and Attribution

Thank You.

- WSAAG for allowing me to present.
- For feedback from members at the Ice In Space Forums, WSAAG, friends and family.
- For my wife and kids for their patience while I put this together.
- And thank you all for listening!

Wikipedia/Wikimedia Images.

- Antilived - https://commons.wikimedia.org/wiki/File:Binocularp.svg
  under CC BY-SA-3.0 - https://creativecommons.org/licenses/by-sa/3.0/deed.en
- Fred the Oyster - https://en.wikipedia.org/wiki/Binoculars#/media/File:Abbe-K%C3%B6nig_prism.svg
- under CCS BY-SA 4.0 https://creativecommons.org/licenses/by-sa/4.0/
- https://pxhere.com/en/photo/1381644
  - CC0 Public Domain
- Evan Mason - https://commons.wikimedia.org/wiki/File:Exit_Pupil.JPG
  - under CC-BY-SA-3.0

References and Further Reading

More Information – Binocular Guides

- Cloudy Nights Binocular Reports.
  https://www.cloudynights.com/category.php?category_id=90&pr=1
  Home / CN Reports / Binocular Reports
- Binoculars - A Basic Guide for Astronomy.
  – by Dennis Simmons. Excellent diagram of parts of a pair of binoculars. Great alternative explanations if you didn't understand anything here or just want a different (opposite) opinion. He recommends expensive binocs
  https://www.iceinspace.com.au/index.php?id=63,374,0,0,1,0
- Nikon Sports Optics Binocular Guide.
  https://imaging.nikon.com/sport-optics/best/
- Binocular Terms.
  https://www.bestbinocularsreviews.com/glossary-binoculars.php
- Best Binocular Reviews. (By brand, by use, guides.)
  https://www.bestbinocularsreviews.com
  https://www.bestbinocularsreviews.com/wide-angle-binoculars.php
- Zoom Binoculars VS Fixed Magnification Binoculars.
  https://www.optics-trade.eu/blog/zoom-binoculars-vs-fixed-magnification-binoculars/

More Information – Things To See

- ~~Sydney Observatory Monthly Sky Guides.~~
  ~~http://www.sydneyobservatory.com.au/category/astronomy/monthly-sky-guides/~~
- Powerhouse Museum Monthly Sky Guides. https://www.maas.museum/observations/category/monthly-sky-guides/
- The Astronomical League Binocular Programs.
  Southern Sky - https://www.astroleague.org/al/obsclubs/sskybino/ssbinoc1.html
  Messier - https://www.astroleague.org/al/obsclubs/binomess/binomess.html
  Double Star - https://www.astroleague.org/programs/BinoDS_Intro
  Deep Sky - https://www.astroleague.org/al/obsclubs/dsbinoc/dsbinoc.html
- Binocular Sketches.
  http://rodelaet.xtreemhost.com/binocular_astronomy.html
- Other Simulated Views. https://www.brighthub.com/science/space/articles/24224.aspx#
- Ice In Space Forums.
  https://www.iceinspace.com.au/forum/

More Information - Books

DISCLAIMER: These books have been recommended by others. I do not own them.

See amazon.com and other sites for reviews.

Beware focus on Northern Hemisphere objects. (Many northern objects are not visible here, and key Southern Hemisphere objects are missing.)

- Touring the Universe through Binoculars (A Complete Astronomer's Guidebook)
  Philip S. Harrington
  ISBN-10: 0471513377
  https://www.philharrington.net/sw8.htm
- Binocular Astronomy
  Craig Crossen
  ISBN-10: 0943396883
  1st Edition (According to one book review 2nd edition is not approved by author)
- Binocular Highlights
  Gary Seronik
  ISBN-10: 1931559430
  https://garyseronik.com/my-books/

More Information - Books

- Stargazing with Binoculars
  Robin Scagell, David Frydman
  ISBN-10: 1554078210
- Binocular Stargazing
  Mike D. Reynolds
  ISBN-10: 0811731367
- Patrick Moore's Exploring the Night Sky with Binoculars
  Patrick Moore
  ISBN-10: 0521793904
  (includes Southern hemisphere constellations)
- Heavens Above!
  A Binocular Guide to the Southern Skies
  Robert Bee
  ISBN-10: 1876409665

More Information – Other

- Collimating Binoculars
  https://www.cloudynights.com/item.php?item_id=416

  https://falakbeen.blogspot.com/2012/05/collimating-orion-worldview-10x50-wa.html

  https://binocularsky.com/binoc_collimating.php

  https://www.youtube.com/watch?v=WHtOJAgo-DM

- Dark Adaptation of Eyes By Age
  https://pubmed.ncbi.nlm.nih.gov/20506961/

Budget Binoculars Available in 2023

Branded

- Celestron 71198 Cometron 7x50 Binoculars.
  https://www.amazon.com.au/Celestron-71198-Cometron-Binoculars-Black/dp/B00DV6SI3Q

- Celestron UpClose G2 10x50 Porro Binoculars, Black (71256).
  https://www.amazon.com.au/Celestron-UpClose-10x50-Binocular-71256/dp/B006ZN4TZS

- TASCO Essentials Porro Binoculars with Carrying Case and Neck Strap.
  https://www.amazon.com.au/gp/product/B072MB2QHJ

Off Brand Binoculars

- Wuciray 10x50
  (Very cheap in April 2023.
  They look ok but I don't have personal experience these.)
  https://www.amazon.com.au/dp/B09C2345RF?psc=1&ref=ppx_yo2ov_dt_b_product_details

Note: I am not affiliated with any of the companies involved in making or selling these binoculars. These are not affiliate links and I get nothing for recommending them.

About Me - My Astronomy Background

- Lifelong fascination with Science and Astronomy.
- Member of WSAAG since 2009.
- Own a couple of Dobsonian telescopes, a couple of refractors, and too many binoculars.
- Did an astronomy masters degree “for fun” about two decades ago.
- Way too casual a stargazer. Go months without viewing sometimes. Others here have much more observing time to their name.
- Amateur photographer (who came to it through wanting to do astrophotography).
- Know something about optics but am by no means an expert.
- This talk is a revised version of a WSAAG talk I gave in July 2012.

Bonus Section – Old Binocular Reviews

I won't be going through these slides from my 2012 talk.

Reasons include:

- *Brevity.*
- *The binoculars discussed are no longer for sale new in 2023. Prices are what I paid more than 10 years ago.*
- *I haven't reviewed many binoculars that are for sale now and can't justify buying more just to test them. I'm happy with the ones I kept.*
- *This is all subjective and much more personal.*

I've left these in the slide decks for those who may be interested in what differences exist between budget binoculars.

List Of Binoculars

10x 50

1. Tasco Zip 10x50 Model 2023 (older version, no tripod mount). Selling for $70-$110 in Australia or about $35 in the US. I got an old unused pair cheap on Ebay.
2. Andrews Communications 10x50 WA - which look very similar to Saxon 10x50 BFWA marked as FC. $49 2012 price. Marked as 122m@1000m.
3. Dick Smith Digitor 10x50, marked as FMC. $40 (2012 price). Marked as 122m@1000m.
4. Binoculars marked and boxed as Bushnell 20x50 Powerview but which have a field of view I'd expect from 10x50. Marked as 69m@1000m but they fit the Southern Cross in so this is just plain incorrect. $30.

7x50

5. "Winner" branded 7x50 bought in about year 2000 for more money than they were worth from a Disposal store. $TOOMUCH. My first pair bought ~yr2000.
6. Unbranded 7x50 bought at Homeart around 2005 or 2006 marked as Coated. $25 at the time.

Other (Not Suited To Astronomy)

Tasco 12x30, Bushmaster 8x21, Bresser 6x21 (kids binocs).

Differences Summary

- Tried to compare side by side on the same night. But seeing varies moment to moment.
- Even at this price point there are differences in quality.
- Some have more precise focus. Tasco 10x50 and Digitor 10x50 very sharp compared to Bushnell 20x50.
- Some harder to focus than others. Andrews 10x50s difficult. Digitor 10x50 Easy. Tasco zip focus hard (touchy).
- Some hold focus better than others. Tasco 10x50 needs only gentle nudge on eyepieces and it's out of focus.
- Angle of view different. Digitor 10x50 don't quite fit Southern Cross in field. Tasco, Andrews and Bushnell do.
- Apparent field of view. Tasco, Andrews, Bushnell have wider AFOV than Digitor.

Differences Summary (Continued)

- Nebulosity looks different in each.
  - Digitor 10x50 shows little nebulosity on Eta Carinae at home - but better in darker skies (presumably due to ruby coating).
  - Tasco, and Andrews show Eta Carinae much better.
  - Surprisingly Digitor 10x50s show Omega Centauri slightly better than Tasco and Andrews.
  - The Digitor ruby coating is very much a filter.
- Protective eye cups fall off Bushnell and Digitor easily. Andrews 10x50 are tethered and can't fall off.
- No tripod adapter socket on Tasco 10x50. All the rest have one.
- Build quality varies. None are very sturdy but Andrews 10x50 and Tasco 10x50 are more solid that Digitor 10x50 and Bushnell.

Tasco Zip 10x50 Model 2023

- Possibly optically my best pair overall. 8-8.5/10.
- Do not hold focus well. Never lean into them or rest them on my head.
- No tripod adapter. Only usable hand held.
- Show nebulosity well in Eta Carinae and about equally well for Omega Centauri.

Andrews Communications 10x50 WA

- Optically not as happy with these as I thought I would be. About 8/10.
- Different but not significantly better than Digitors.
- Not the easiest to focus – hard to make fine adjustments. But do hold focus well.
- Other mechanics very good. Can't lose protective cups as they are attached to the body.
- But high contrast orange filters horrible. One more thing that can break.
- Show nebulosity well in Eta Carinae. Omega Centauri OK.

Dick Smith Digitor 10x50

- Sharpness very good - probably 8/10. Both copies I've owned.
- But ruby coating seems to cut out almost all of the nebulosity on Eta Carinae in light pollution. Better away from city. Improve contrast on Omega Centauri though.
- Bad colour cast/fringing. Especially in daylight/bright light. Even horrible ruby ovals due to sun glare in some conditions.
- Other pairs I've tested in store had more obvious colour cast. Sample variation may be higher than even other cheap pairs.
- Most magnification of any pair. Not quite able to fit in Southern Cross
- Surprised at how well these hold up. Really all you're missing compared to other pairs is true colour and nebulosity. Would buy these in a heartbeat if nothing else readily available.
- Build quality not brilliant. First pair lasted about 6 years before they broke. Screws started rusting after about 2-3 years. I'm fine with that for $40.
- Have been available for at least a decade.

Bushnell 20x50 Powerview

- Optically 7-7.5/10. Not the sharpest for nighttime viewing, but still quite usable.
- Build is not fantastic.
- Mismarked. No way are these 20x50. Magnification between 8x and 10x.
- Viewing in daylight mild colour tinge changes depending on where you point them in relation to the sun. Either side can become slightly cooler (more blue).
- Cheap. Happy to take these when there is more risk of them being lost or stolen.

Homeart Unbranded 7x50

- Optically very good. 7-8/10.
- Hold focus and collimation.
- Build quality OK.
- Absolute bargain at $25. Bought in Erina Fair Homeart around 2006. An unlikely find.

"Winner“ 7x50

- Optically good. 8/10.
- Overpaid. Very little difference between this pair and Homeart 7x50s.
- Old and showing their age. One side is loose and has play. But have lasted over a decade so far.

Various Small Roof Binocs

- 6x21 through to 12x30.
- Only good for brightest stars.
- Difficult to spot Omega Centauri at all from my back yard.
- Smaller apparent angle of view (tunnel vision).
- Okay for bird spotting, plane spotting during the day.
- Good for very young children who can't handle bulk of a bigger pair.
  - Learn to use binoculars.
- Even cheaper. About $12 (2012 price).