

Choosing and using telescopes

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Choosing and using telescopes

Types of telescope

- Refracting
- Reflecting
- Catadioptric

Uses

- A matter of scale

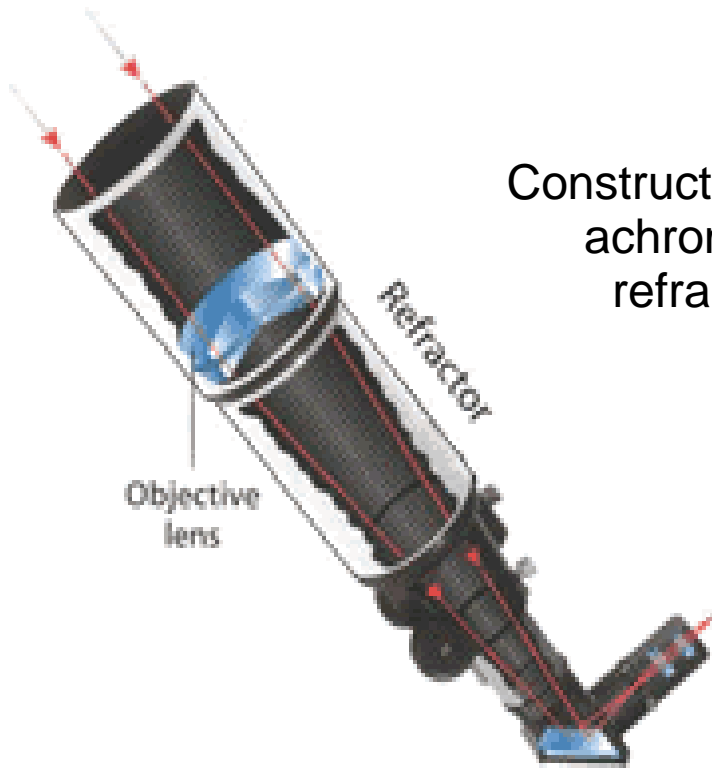
Prices

Mounts

Recommendations

Vendor list (last slide)

Refracting telescopes

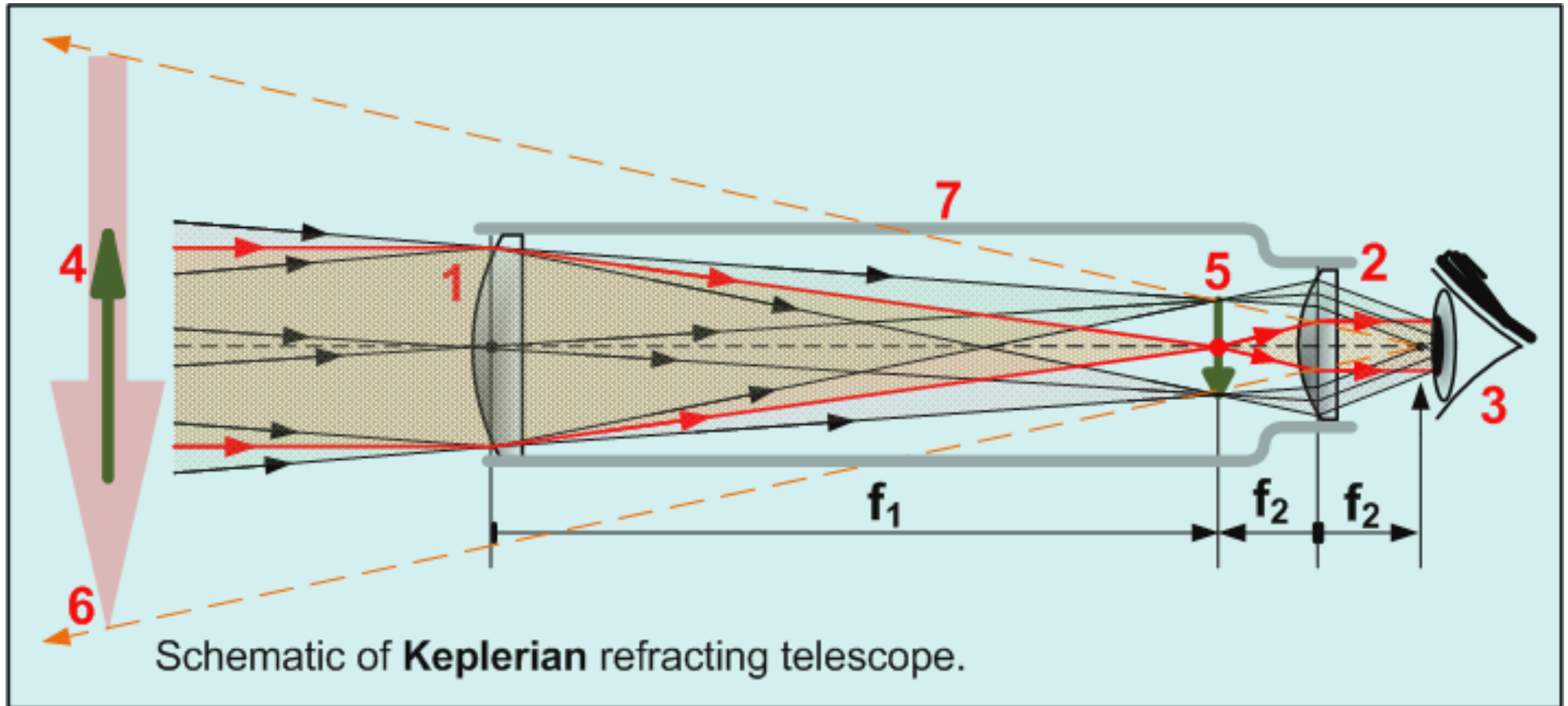


Construction of an
achromatic
refractor



A modern low f ratio apochromatic
(Meade 120 Apo)

Refracting telescope



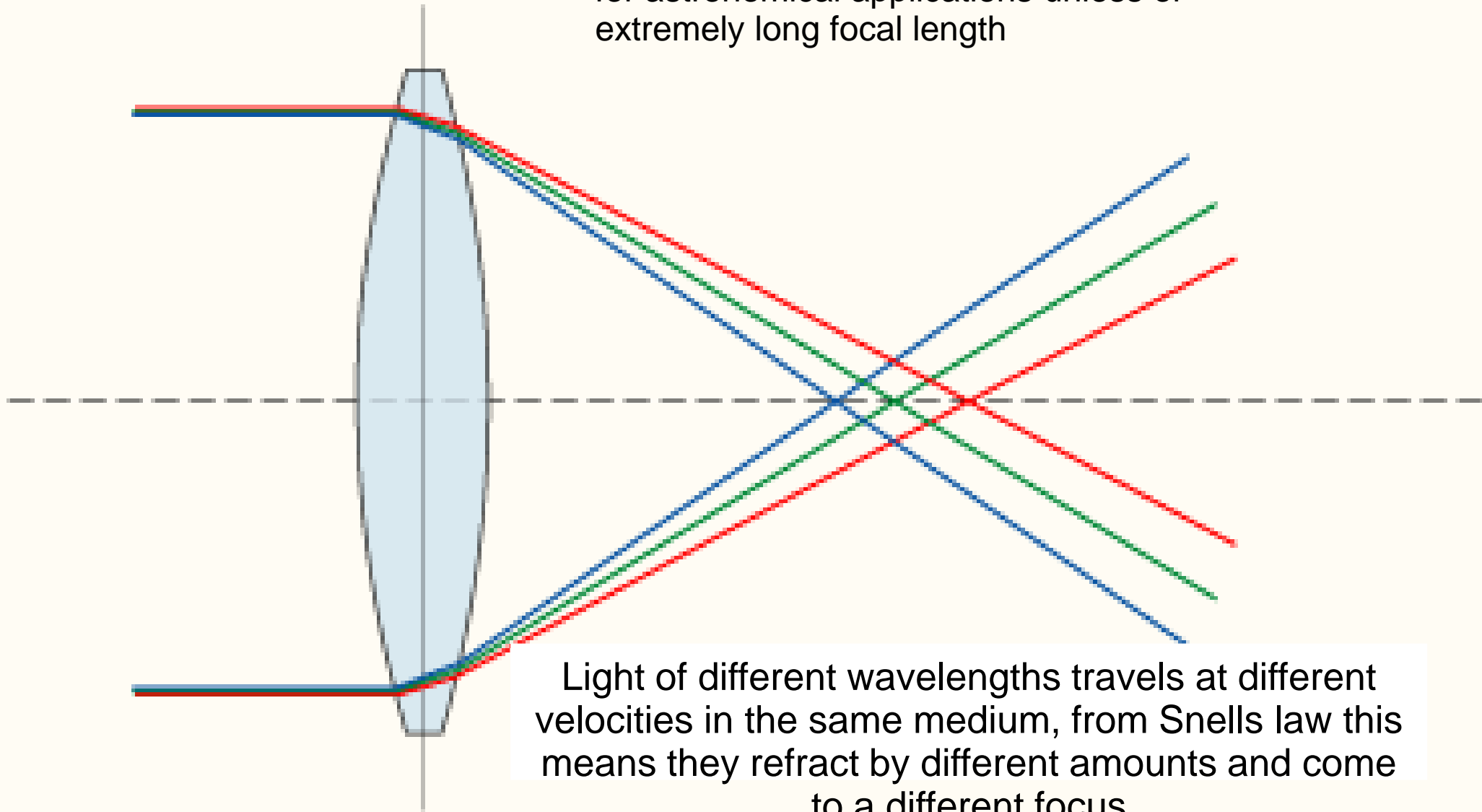
- 1 objective
- 2 eyepiece
- 3 eye
- 4 object
- 5 focal plane
- 6 virtual image

The magnification is the focal length of the objective (f_1) divided by the focal length of the eyepiece (f_2)

The f ratio is the focal length of the objective divided by the aperture

Chromatic aberration

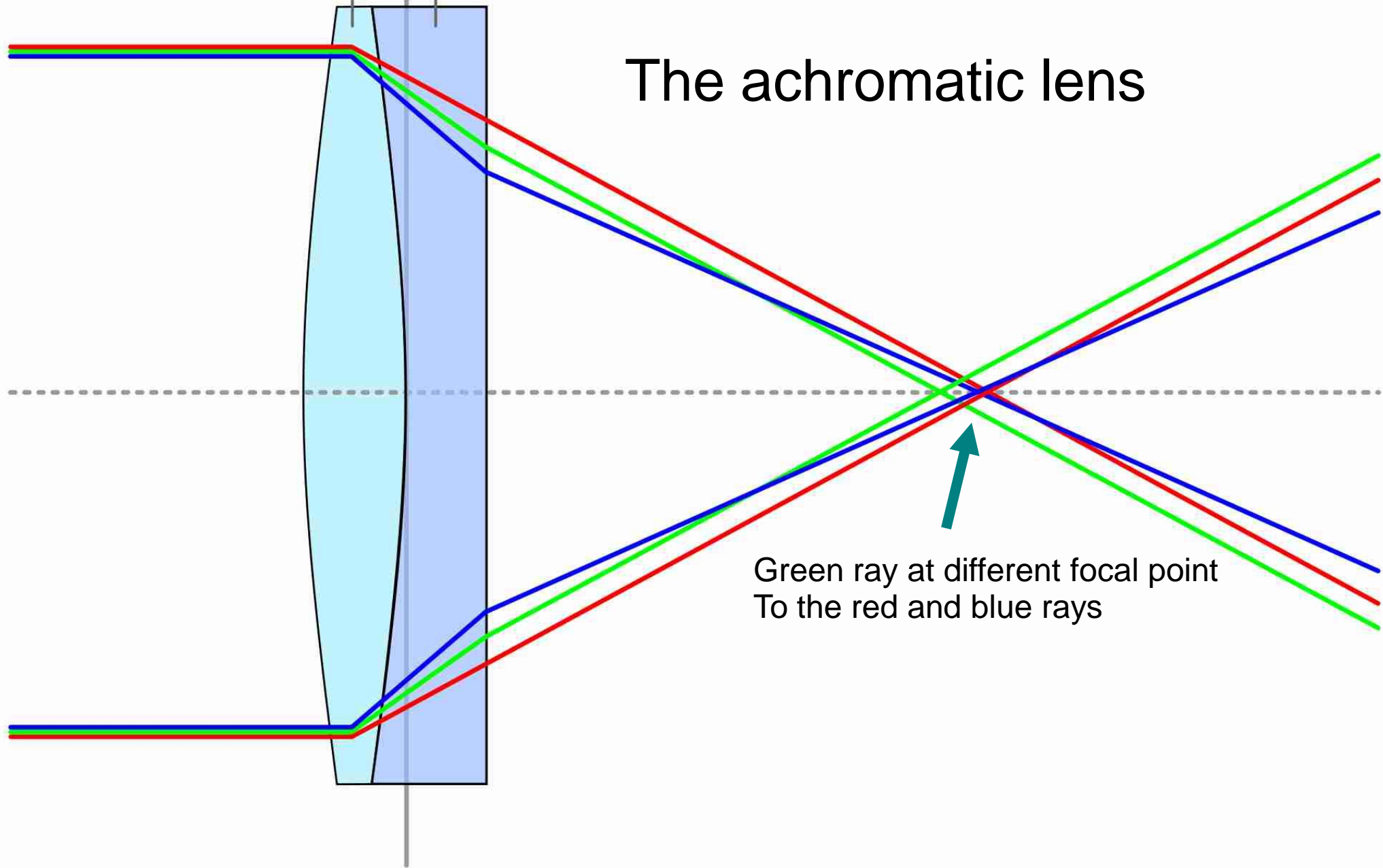
Single lens objectives are not really practical for astronomical applications unless of extremely long focal length



Crown

Flint

The achromatic lens



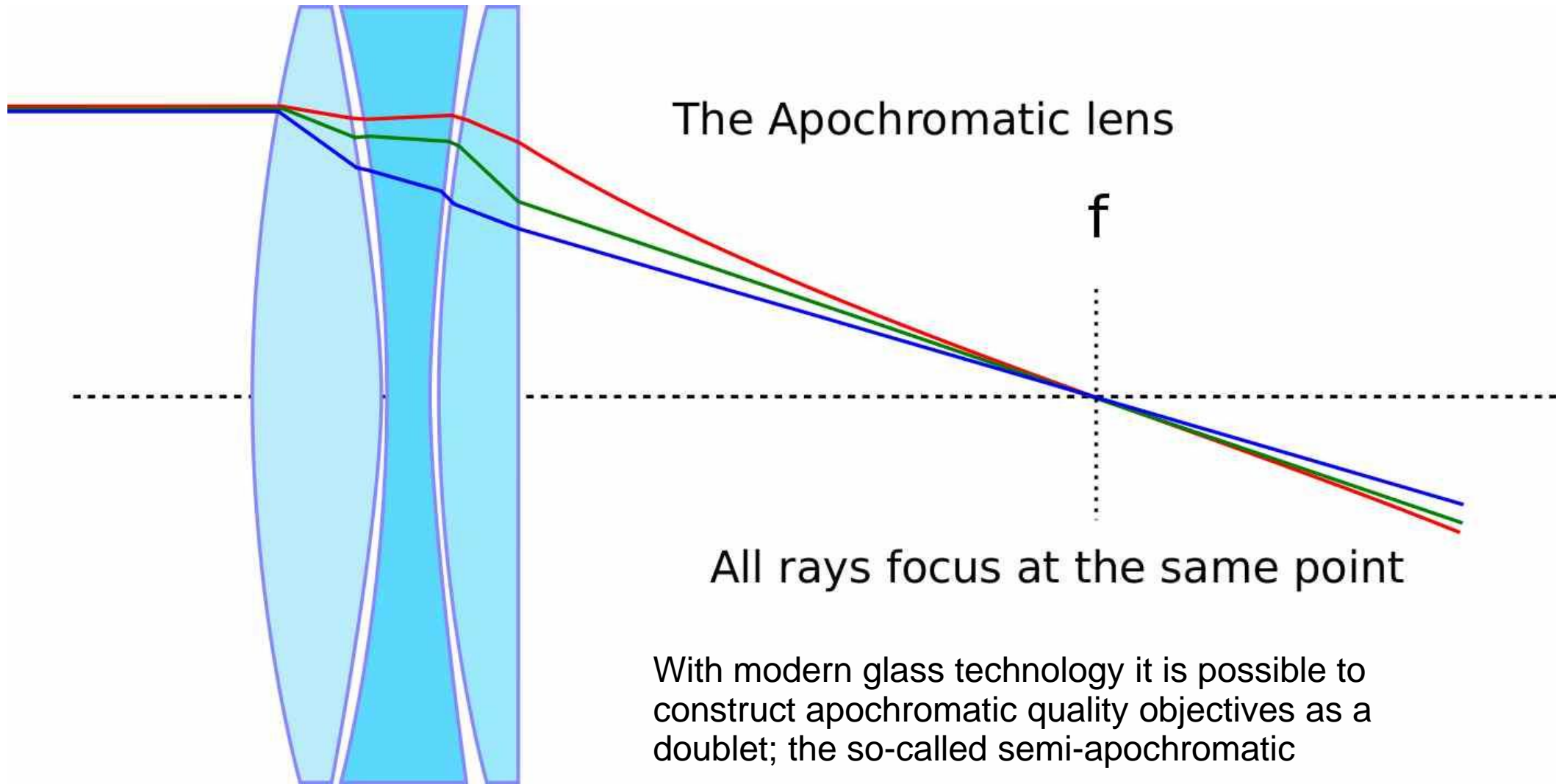
Uses specialist fluoro-crown
and flint glasses

The Apochromatic lens

f

All rays focus at the same point

With modern glass technology it is possible to
construct apochromatic quality objectives as a
doublet; the so-called semi-apochromatic



Reflecting telescopes

As mirrors reflect, not refract, they are intrinsically apochromatic

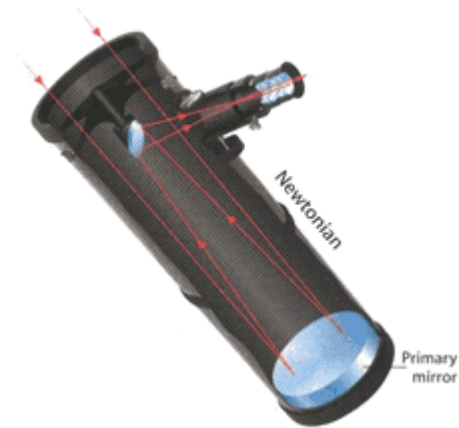
They do have their own defects however:

- Coma

- Spherical aberration

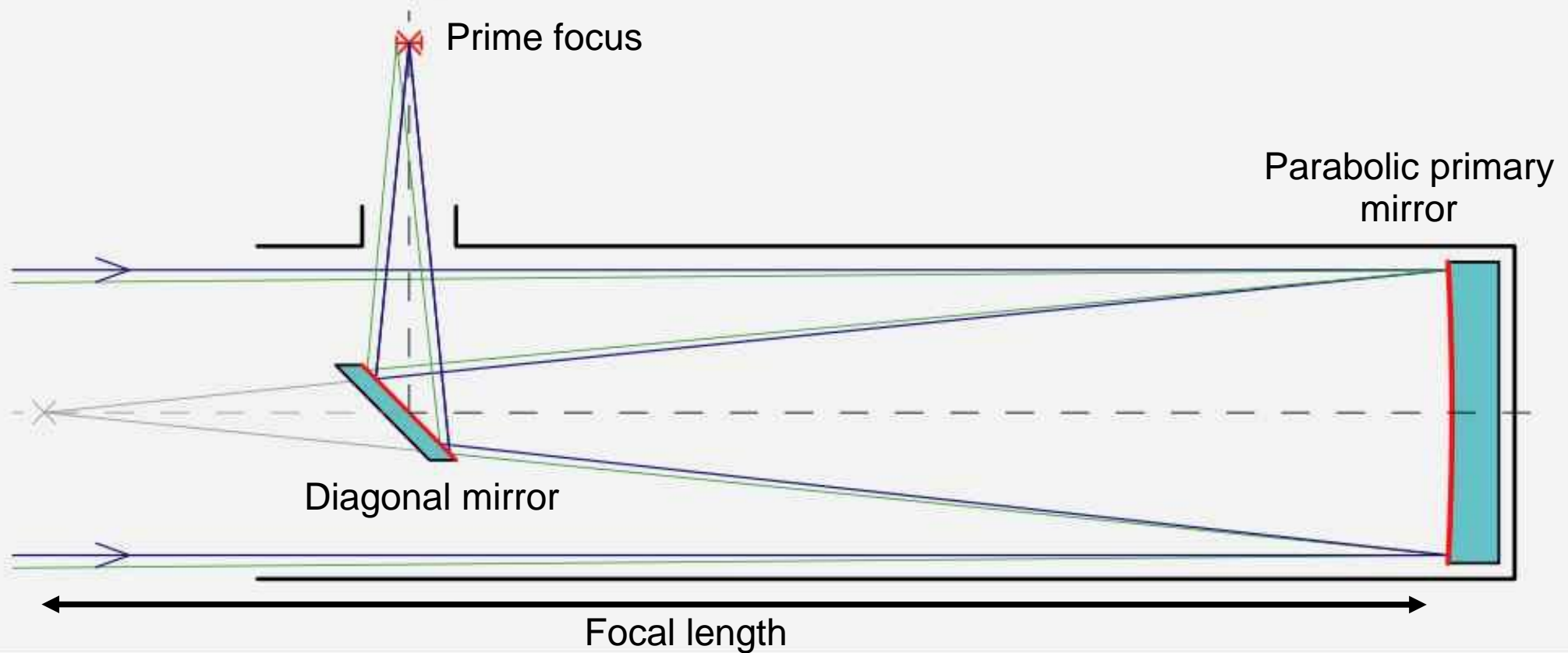
- Diffraction spikes

- Central obstruction



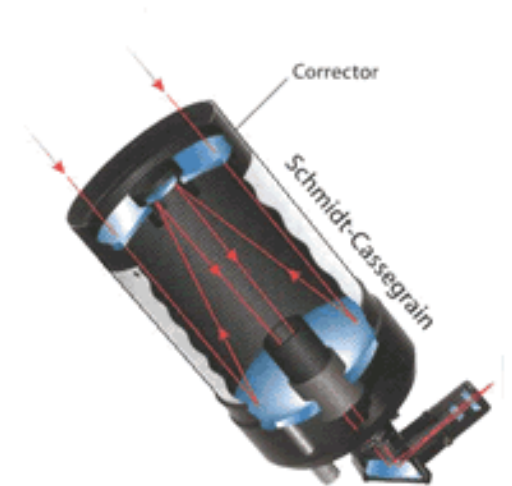
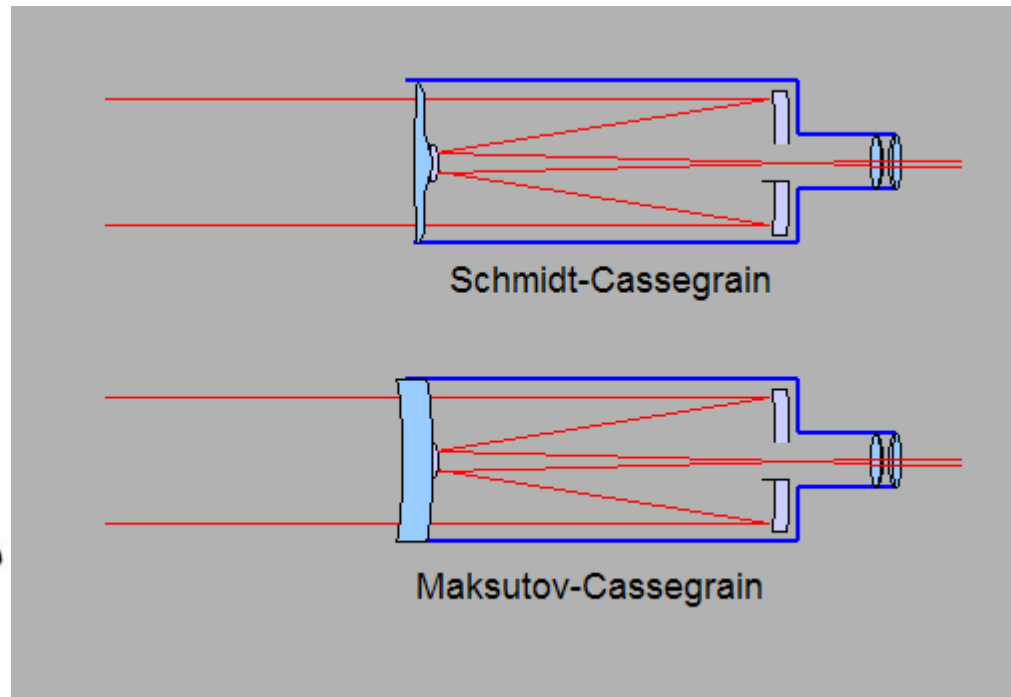
All these have been addressed and today all large telescopes are some kind of reflecting instrument

Reflecting telescope construction



The f ratio is the focal length divided by the diameter of the primary mirror
F10 is a relatively “slow” design, f4 is a “fast” design. Lower f ratios give wider fields of view but lower magnification, the image is brighter but they are more challenging to collimate and have worse coma. F4.7 to f8 is the usual range

Catadioptric designs



Both Schmidt and Maksutov designs are available as Cassegrain or Newtonian configurations



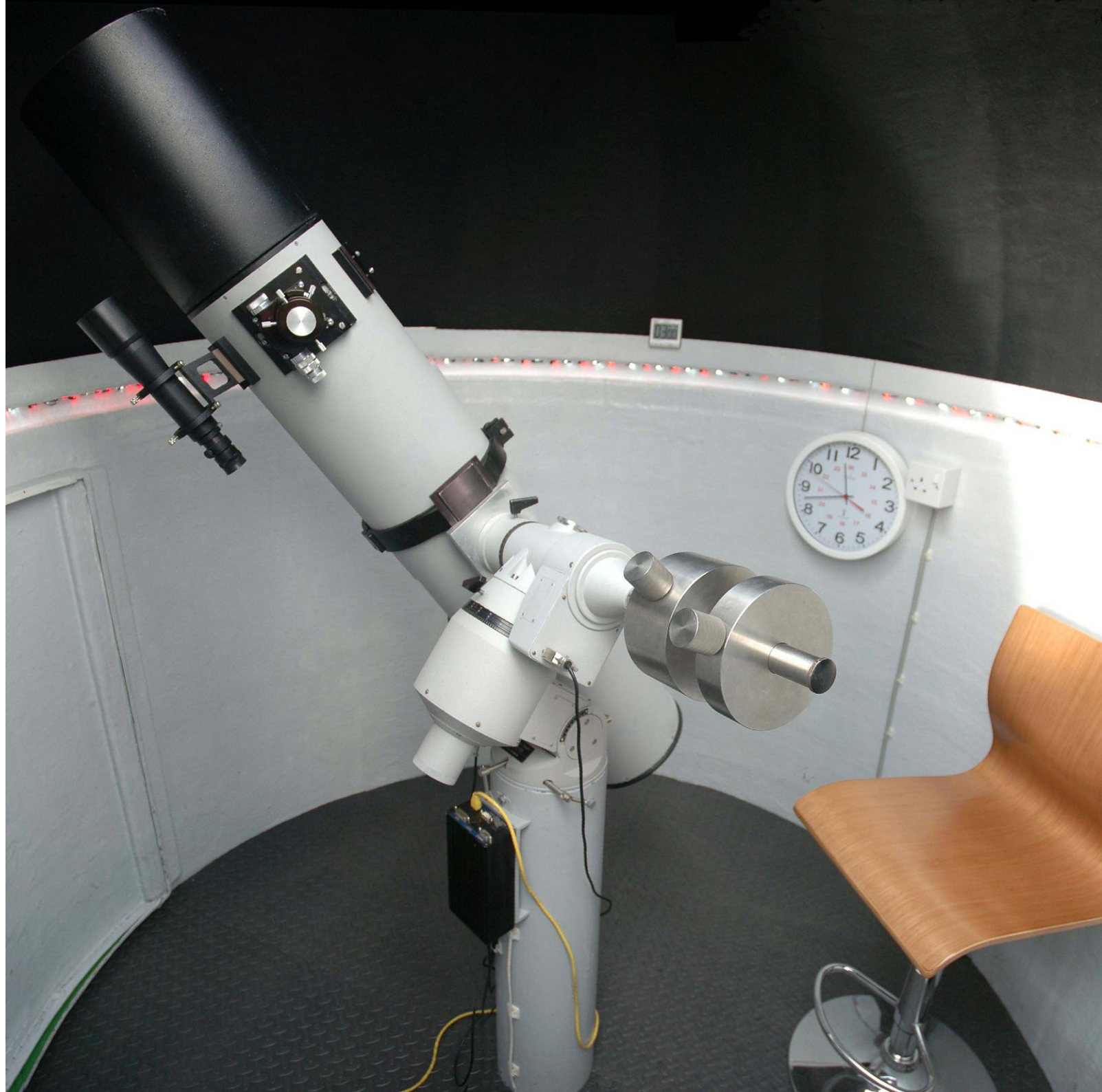
The Maksutov Newtonian



Maksutov Cassegrain

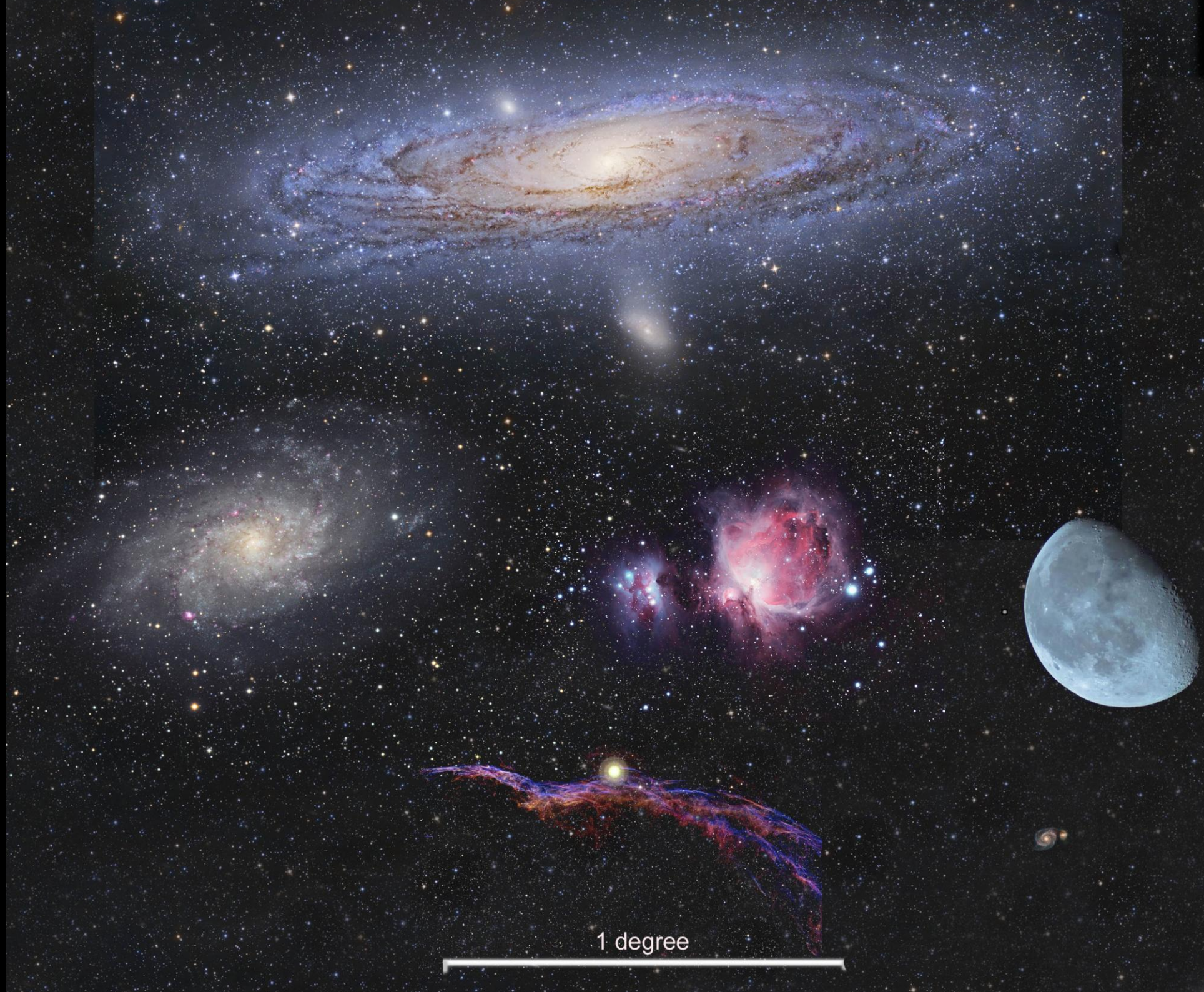
Intes micro MN86
Maksutov Newtonian

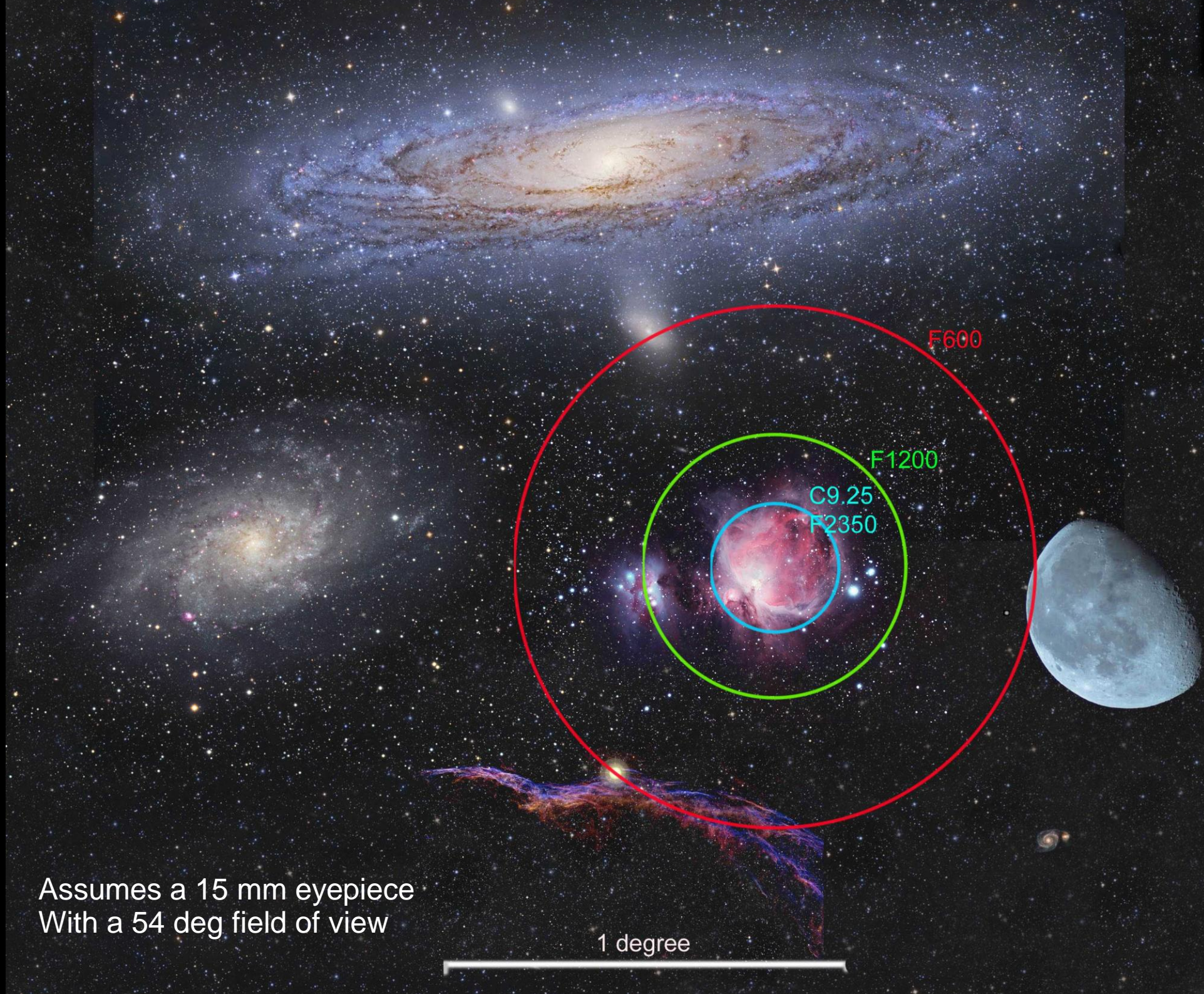
Alter D6 Equatorial
mount



Understanding field of view

The next 3 slides show the relative size of objects and the field of view when viewed through various telescopes. Notice that many objects are much bigger than the moon and require a short focal length, some especially planets can be tiny. This is why there are specialised instruments.





Assumes a 15 mm eyepiece
With a 54 deg field of view

1 degree



Shown to scale

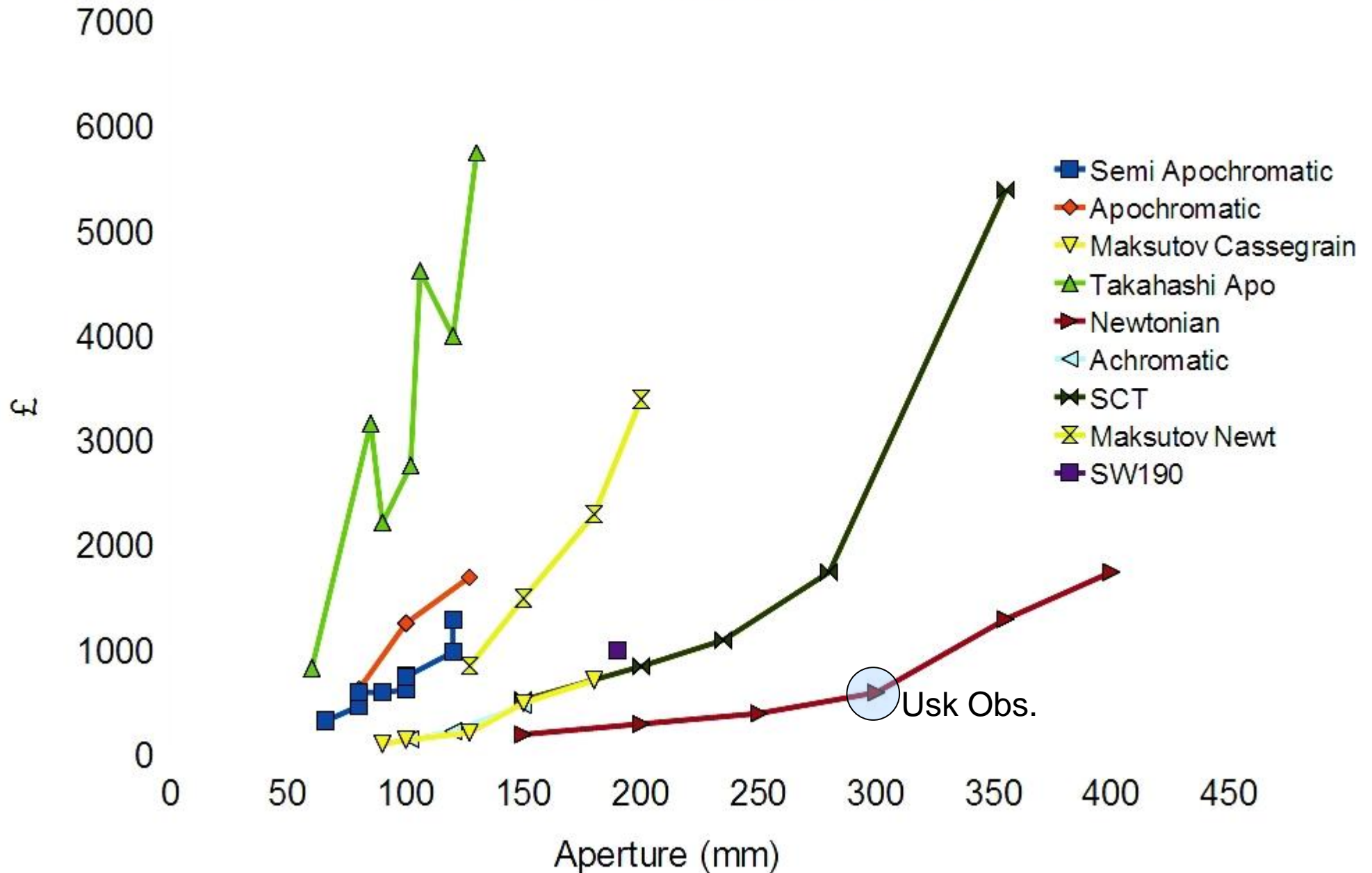
1 arc minute

Uses (visual)

Type	Planets	Moon	Deep Space	Terrestrial	Cost
Apochromatic	Excellent	Excellent	Good	Excellent	Highest
Achromatic	Good	Good	Good	Good	Medium
Maksutov	Excellent	Excellent	Good	OK	High
Schmidt	Very good	Very good	Good	poor	Medium
Newtonian	Good	Good	Excellent	poor	Lowest

Refractors score highly for high contrast requirements,
Apochromatics are fantastic astrographs but one scope will not
cover all requirements as different focal lengths needed
Catadioptrics are good all-rounders,
For low cost light buckets Newtonians are unbeatable
Other factors to consider include portability, type of mount
required, focal length, aperture

UK telescope prices, 2012



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Page: 1

MONSTER DOBSONIANS

Orion's Monster Dobsonians — the Orion 36", Orion 40", and Orion 50" Dobsonian telescopes — are for serious aperture fever infected enthusiasts only. Hand crafted, commercial telescopes of this size are only available from Orion. You'll be able to see deep sky objects others can only dream about — unless they have that key to Mt. Palomar.

Imagine what awaits you, pouring through the giant apertures when you "go deep" from a dark sky site: The Ring's central star is right there! NGC objects are mostly easy targets. Everything is more detailed. Anonymous galaxies from *Uranometria* are nearly always found.



Orion 36 Monster Dobsonian Telescope

Orion Monster Dobsonians - The Cure For Aperture Fever!

\$55,600.00



Orion 40 Monster Dobsonian Telescope

Orion Monster Dobsonians - The Cure For Aperture Fever!

\$80,000.00



Orion 50 Monster Dobsonian Telescope

Orion Monster Dobsonians - The Cure For Aperture Fever!

\$123,000.00

For those with a bad attack of aperture fever!

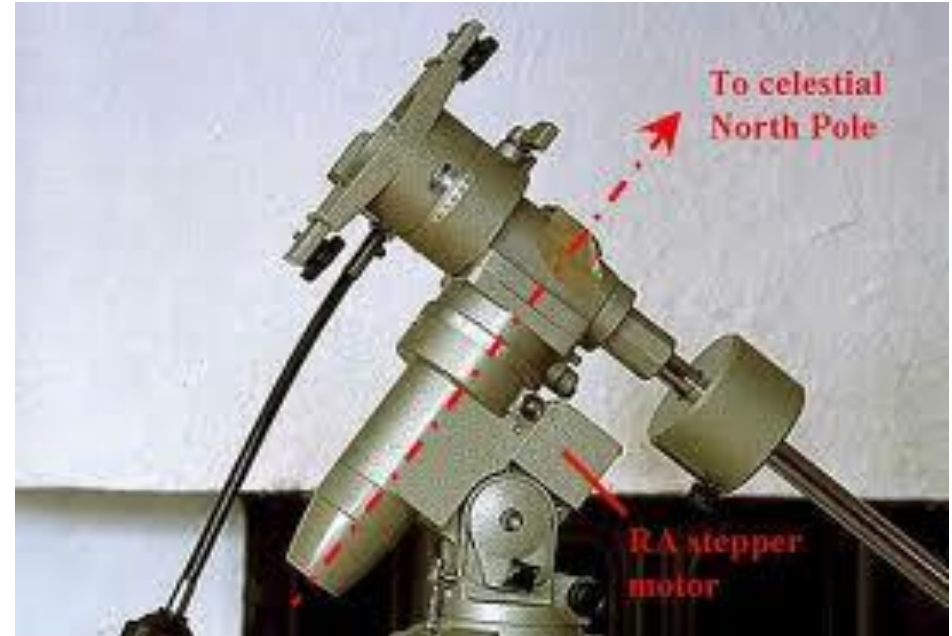
Mount types



Alt azimuth



Dobsonian



Equatorial



What should I buy?

Assumptions

- Beginning observing, little or no experience
- General observing, deep sky, planets *etc.etc.*
- On a budget and looking for value
- Reasonably portable (in a car)

The views expressed here are entirely personal, gained from experience and do not reflect any commercial interest. They are given for guidance and in good faith

£289

First choice



Skywatcher Skyliner 200PDobsonian

- + Quality optics
- + Good aperture (8")
- + Very easy to use
- + F5.9 – little adjustment
- + Portable
- No “goto”

A serious telescope that is huge fun bit
and at an excellent price

2nd choice(s) (Smaller and lighter goto)

£298



Skywatcher Explorer 130P
(Newtonian reflector)

Skywatcher Synscan
+Excellent “goto” for price
+Both quality scopes
+Maksutov £81 more, but more compact
-Mount a bit lightweight
-Takes about 15 mins to setup and align

£379



Skymax 127
(Maksutov Cassegrain)

Note both Skywatcher and Celestron entry level instruments are made in the same factory and are virtually the same – but Skywatcher is a bit cheaper

Buying second hand?

All Newtonians from Skywatcher, Meade, Celestron, Orion, Vixen etc. all good and reliable, not much to go wrong either, Dobs can be a steal. Avoid any other makes i.e. Seben, Jessops in my view they are generally junk

With Schmitt Cassegrains can get “lemons” – particularly pre 2000 – get advice

Cheap refractors (<£150 new) are always junk, expect to pay >£500 for a new 80mm APO

Buying mounts? – get some advice, some great bargains but can be problems

What else do I need?

You will need a range of eyepieces of different focal length, for a dob, 30mm, 15 mm, 10mm, and 6 mm is a good range

A 2x Barlow can be used to reduce the need for lots of eyepieces.

No need to start with expensive eyepieces good starter eyepieces can be bought for around £30 each. Look for Plossl, wide angle and orthoscopic.

All famous makers eyepieces are OK – Skywatcher, Celestron, Meade etc. also GSO and Revelation are good.

What else do I need

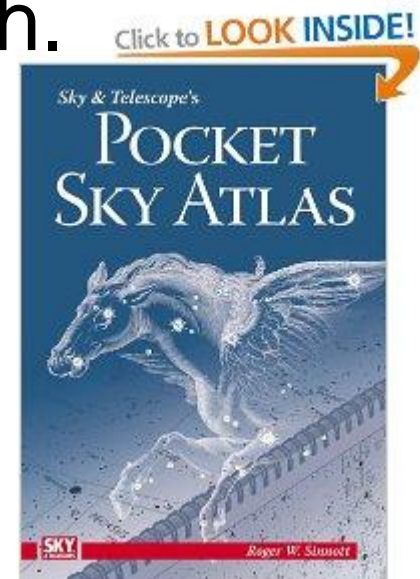
Filters you can get later – ask for advice from experienced members.

You will want to get a collimation device before long, these can be purchased for about £30 or even made for nothing. Forget laser collimators – more trouble than they are worth.

A decent star atlas, I use this one

Sky & Telescope's Pocket Sky Atlas [Spiral-bound]

Roger W Sinnott

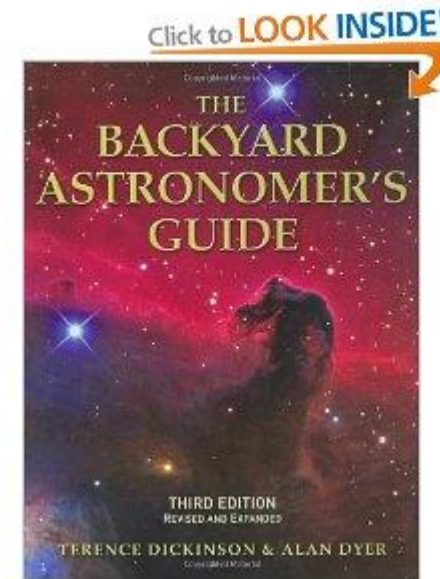


Some other great books to help you

Full of excellent advice for practical observing, highly recommended £24

The Backyard Astronomer's Guide

Terence Dickinson



Never be lost for something to look for – an excellent guide – get the spiral bound version £20

Turn left at Orion, Guy Consolmagno



And finally

The best way to learn the sky is by exploring – it is much easier than you think

Start with easy objects, The Pleiades, the double cluster, M13, Albireo, M42, the ring nebula, M31

Learn how the telescope works and how to find stuff

Don't start at the hard end – i.e. comets, faint galaxies

You will also learn how to “see”

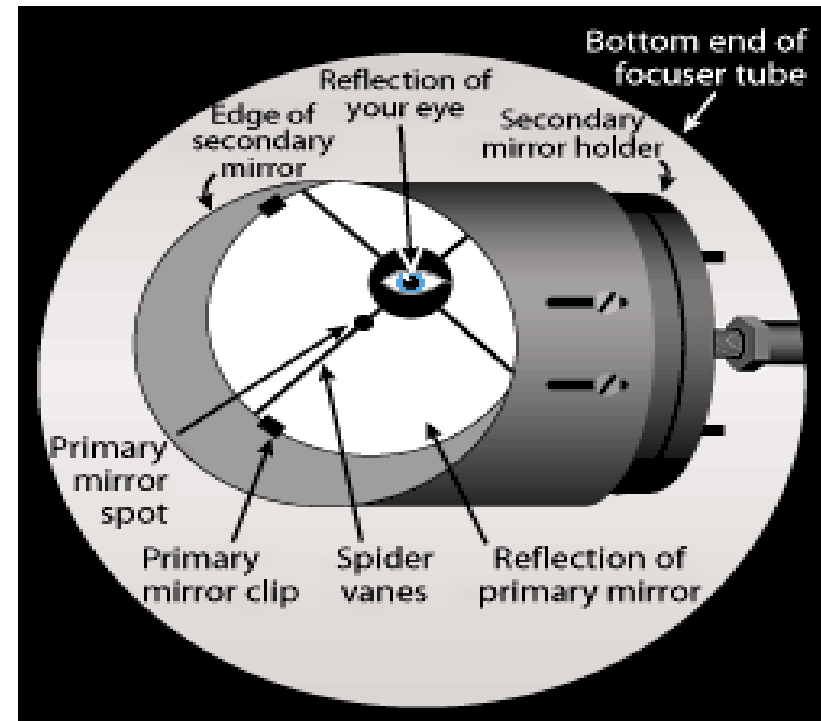
Plan your session based on conditions; i.e. if the moon is up look at that not nebulae

Be very wary of equipment reviews in magazines!

Get out and do it!

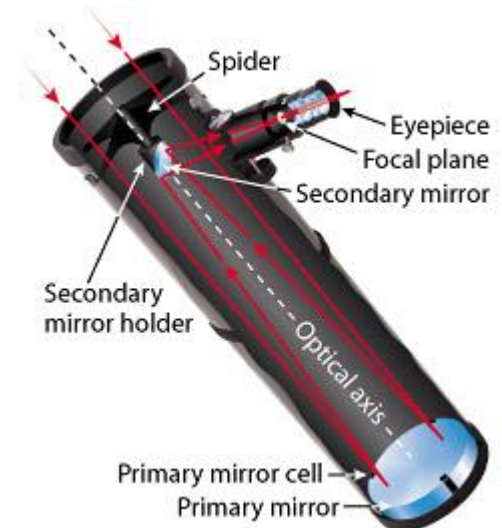
Collimating a Newtonian telescope

Newtonian reflector



The parabolic mirror has a sweet spot, or optic axis, it is critical that this optic axis passes through the dead centre of the eyepiece.

A telescope that is out of collimation has a very poor image

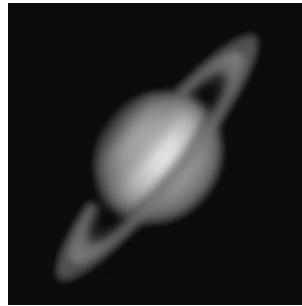
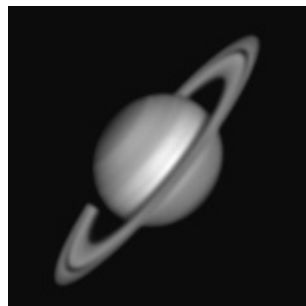


Collimation facts

The size of the sweet spot is proportional to cube of the f ratio, for an f10 it is 22 mm wide, for an f4.7 it is 2mm wide!

Larger reflectors tend to lose collimation more easily especially if transported or bumped

All reflectors and catadioptrics (with the possible exception of the Maksutov meniscus design) require collimation from time to time

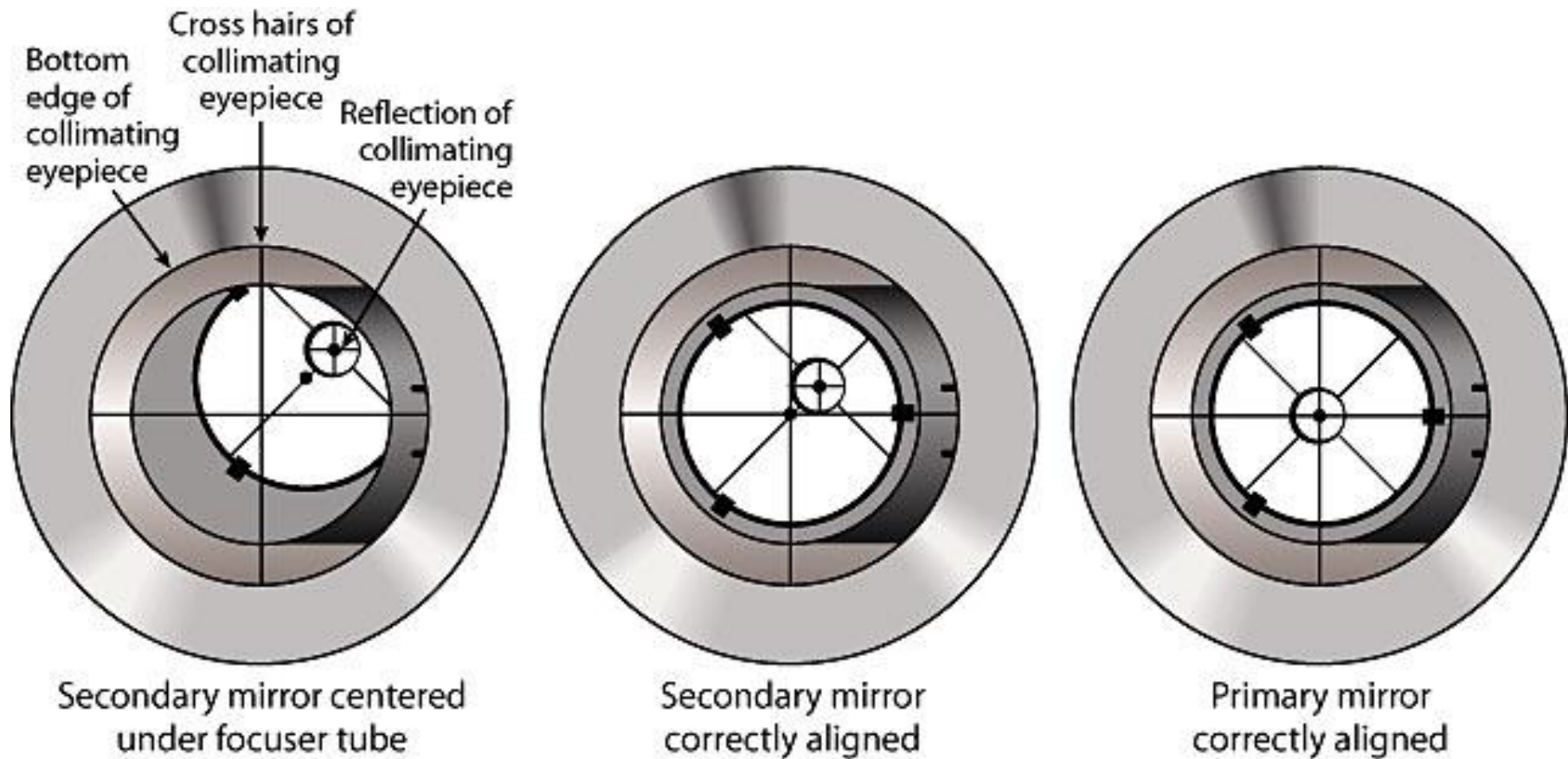


The collimation

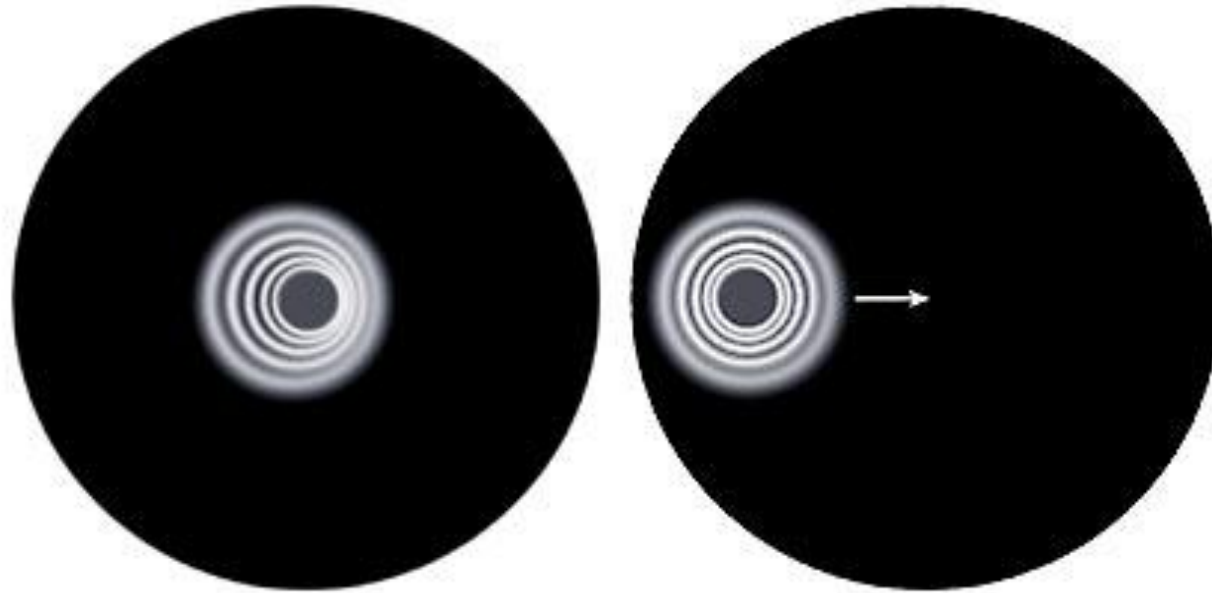
1. Centre the secondary mirror to be in the centre of the draw tube
2. Adjust the tilt of the secondary mirror to aim the focuser's axis at the centre of the primary mirror
3. Tilt the main primary mirror to centre its optic axis in the draw tube.

Steps 1 and 2 only usually need to be carried out when first setting up the instrument. Step 3 is the critical one, this should be checked frequently.

Collimating a Newtonian reflector



Star testing



For trimming the collimation use an out of focus star. Move the star until the shadow of the secondary mirror is central, finally adjust the mirror adjustment screws to bring the star back to the centre of the field

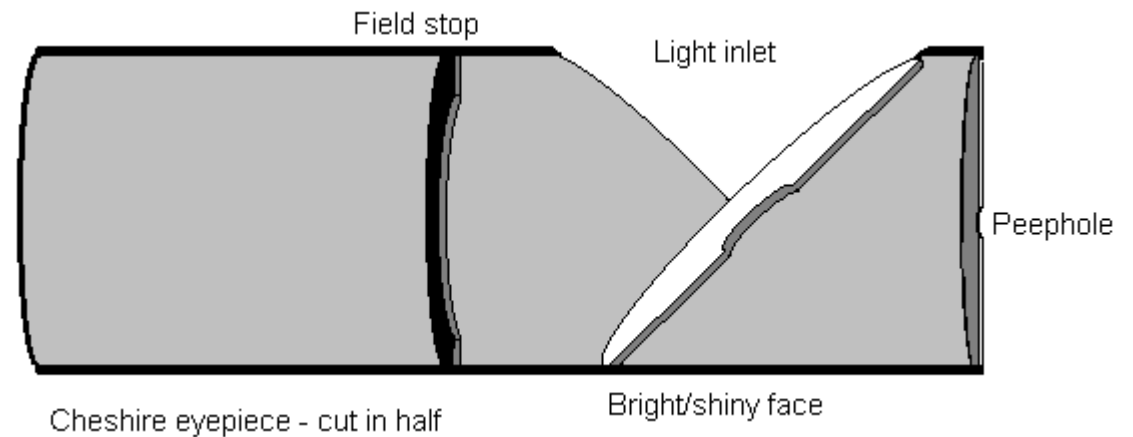
Collimating aides

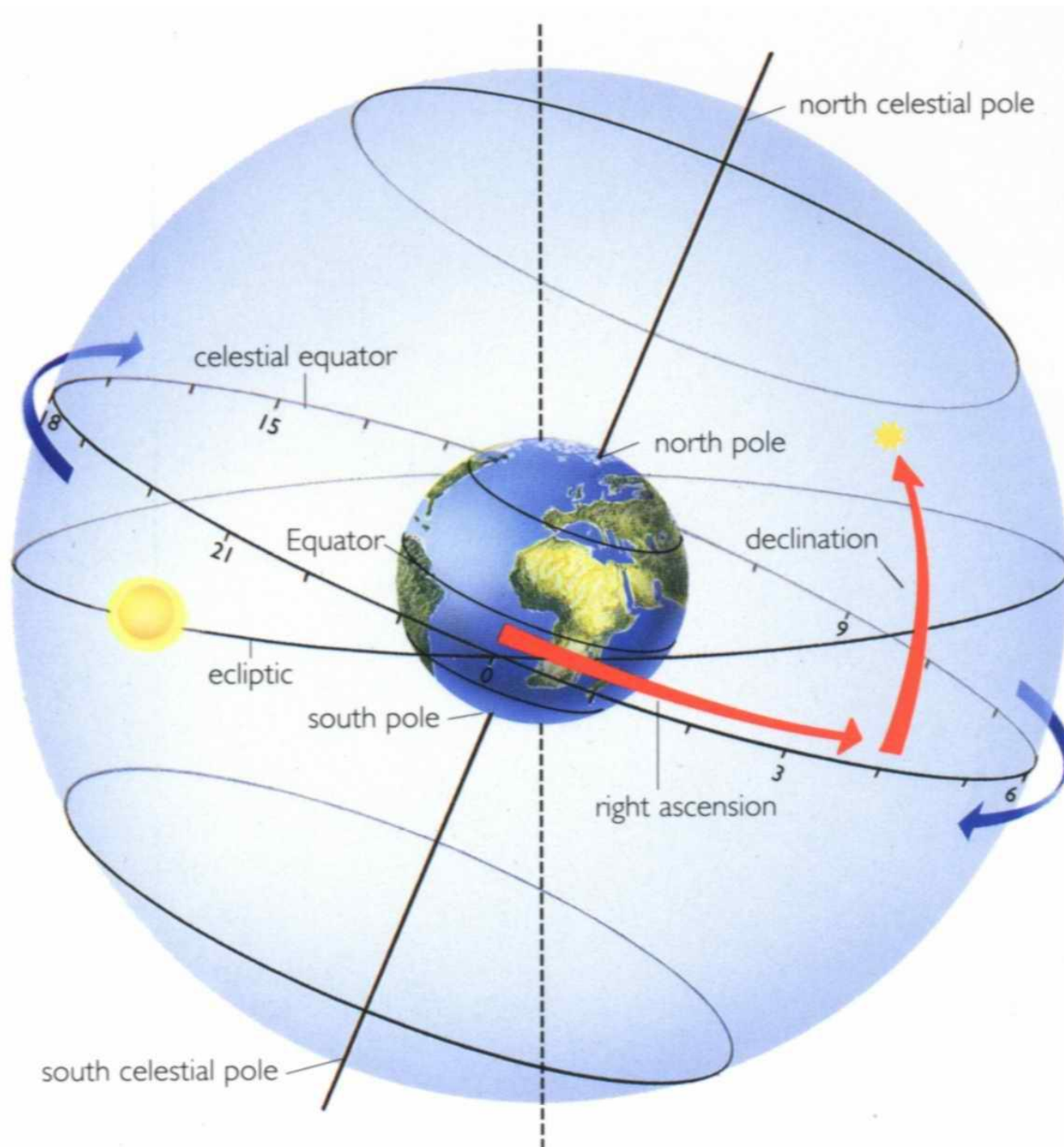
The collimating cap - use an old film canister with a hole or the drawtube cap

Cheshire eyepiece

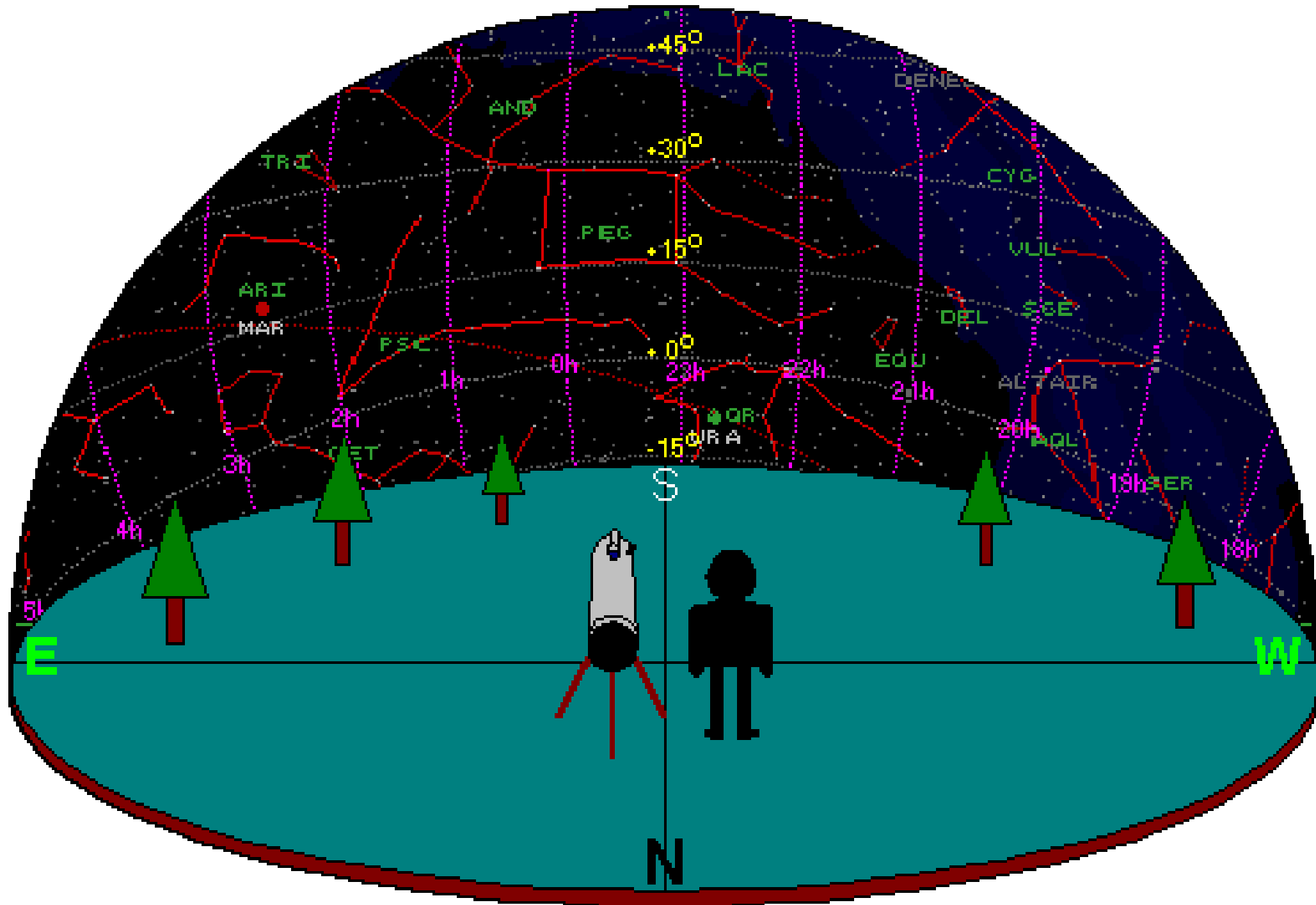


Laser collimator





Zenith



Lines of Right Ascension

Suppliers

There are loads of good vendors, these are just some I have bought from and trust

- <http://www.firstlightoptics.com/>
- <http://www.rothervalleyoptics.co.uk/>
- <http://www.telescopehouse.com>
- <http://www.widescreen-centre.co.uk/>
- <http://www.scsastro.co.uk>
- <http://www.green-witch.com/>