# Visit to Sark Astronomical Society

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# Technical Notes


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## SAstroS Observatory

SAstroS has an excellent observatory facility with a good location that benefits from the extremely dark skies of this internationally recognised site. Despite the relative remoteness however, there is amply access and both on mains power and broadband internet reach the observatory. The building itself is a 16’ x 10’ wooden shed with an apex roof that is on rollers and which can easily be pushed out over onto its adjacent supports to expose the telescopes within to the skies. The top 1 foot of each of the south, west and east faces of the observing area can then be folded down to give line of sight to the horizon in required, or kept up to help in protecting both the observers and the telescopes from the wind. Half of the floor area is in the form of a covered “warm room” where there is further storage and a work bench for laptops and star maps.

In the observing area, there is a central pier for the club’s primary instrument, a 10-inch Meade LX200 F/10 Schmidt-Cassegrain reflector. The pier is set into deep concrete and very stable, and there is a wooden floor with carpet tiles which aid in keeping the toes of the observers warm and comfy. The floor is engineered to have a gap around the pier and thus avoid transmitting vibrations to it as people walk about.

*(( However the gap was quite large and could be filled with padding to stop eyepieces and filters dropping into it.))*

The fork mount of the telescope on the pier was in the Alt-Azimuth configuration which is a perfectly sensible solution for such a telescope in normal condition – however there is currently a problem with the drive electronics for the ‘scope which refuses to power up at all, let alone drive the telescope’s motor, track, or carry out its “goto” functions.

Pier mounted forks were in AltAz mode, which is fine so long as the full goto and tracking of the electronically controlled drive is working and fully calibrated and aligned.

This meant that we had to resort to “the ancient arts” – star hopping and guess-work to find objects. Fortunately I grew up with such methods and so was able to do quite a grand tour for the assembled crowd on folk who wanted to have a show without too much trouble.

However, with the alt-azimuth configuration and no-computer controlled driven motors to follow an object across the sky this did rather make the

process of continual adjustment in both axes between each person's turn at the eyepiece rather tricky.

*(( A "wedge" to tilt the mount over into the polar mode would be a simple change that would vastly improve usability as, once an object is located, it could then be followed across the sky matching the earth's rotation with the "declination" axis locked, and just one movement of the right-ascension needed. This has the huge benefit that it is much harder to "lose" an object while adjusting, as you are on a one-dimensional path and can just swing back and forth along it until the object is relocated. Currently target loss with two degrees of freedom is very easy!))*

## Optics

The main scope optics are clean and in great shape. Continued efforts to keep it dry and protected will be worth maintaining. It is also well collimated and star images nice and round both in and outside focus. This is often a benefit of a permanently mounted setup, and portage can knock the optics out of alignment

The eyepiece diagonal tended to come loose and be wonky possibly as a result of some operators using it as a handle to swing the scope against the friction of partly clamped axes.

The main eyepiece used was a 40mm plossl which was favoured as it gave a wide field, with long dwell time for untracked objects enabling easier use with novice groups of observers. Also in the set were a 20mm a 9mm and 4mm.

The Focal Ratio of the main optical path is F/10, thus a prime focal length of 250mm x 10 =2500mm

This is quite a "long" and "slow" arrangement as it stands, with a naturally narrow field of view and naturally high image scale, with the light being spread out over a wider area it thus leads to fainter apparent images than a "fast" "short" system with a lower focal ratio and focal length. This is discussed below, starting from the perspective of usable ranges for image magnification.

### Current available Magnifications

With the eyepieces available the magnifications can be calculated by dividing the prime focal length (2500mm) by that of each eyepiece. The results are thus:-

| Eyepiece | Magnification | Comments |
|---|---|---|
| 40mm | 62.5 | Usable but slightly too high for a starting magnification perhaps. Around 40x as the base point would be better |
| 20mm | 125 | Good for planets on steady nights, or detailed views of the moon, splitting close double stars |
| 9mm | 278 | Pushing the boundary! See below |
| 4mm | 625 | Completely impractical |

The rule of thumb for maximum practical magnification of any given reflecting telescope is often stated as around 50x per inch of aperture. This can be somewhat a matter of opinion but I propose to adopt it.

For this telescope therefore the sensible upper limit is 10x50 = 250 times magnification.

As one can see, the 9mm eyepiece somewhat exceeds this, and the 4mm is completely out of any plausible range.

## Use of the Barlow (telenegative) lens

There was also a 2x Barlow lens available. These common and often useful additions to the optical train work to double the effective focal length of the prime optical train. For this system this would take it from an already long 2500mm to 5000mm, doubling the magnification effect when used with each of the available eyepieces as follows

| Eyepiece | Magnification | With Barlow x2 | Comments |
|---|---|---|---|
| 40mm | 62.5 | 135 | This equals the effect of the 20mm eyepiece, but will not live up to it in sharpness because more glass surfaces will have been used to achieve it. |
| 20mm | 125 | 250 | The maximum limit is 250 so this may work on really good steady nights for bright objects |
| 9mm | 278 | 556 | TOO MUCH |
| 4mm | 625 | 1250 | JUST ABSURD |

## Options to improve the magnification ladder

The current set of eyepieces and barlow are perhaps not the best choices due to the ratio of a factor of 2 that pervades them. I normally recommend create a "magnification ladder" that steps up in smaller scale factors, aiming for 1.4x at each step (This being close to the square root of 2). The finer grain choice that results gives a better chance of being able to get a good compromise between images size, field of view and surface brightness.

Given the current selection, there is an option to “in-fill” the present magnification ladder. I would recommend adding a 28mm eyepiece to the set. This fits neatly between the 40mm and 20mm in the ladder in that “x1.4” position between them, and with the Barlow this also fulfils the 14mm role, slotting in neatly between the 20mm and 9mm that are already present.

| Eyepiece | Magnification | Comments |
|---|---|---|
| 40mm | 62.5 | Deep sky and nebulae, but a little high as a starting magnification. Struggles with over-spill of images on a lot of things. |
| 28mm | 89 | Some nice 28mm wide-angle eyepieces in the standard 1.25” barrel fitting |
| 20mm | 125 | |
| 28mm with barlow | 178 | 178 is a nice high power for planets and doubles, or the moon, without going to far |
| 20mm with barlow | 250 | The upper limit |
| 9mm | 278 | Pushing the boundary |

## Minimum Magnification.

It will no-doubt surprise people that there is also a minimum magnification for a telescope, and that this too matters. The rule-of-thumb for this is 3.6x the aperture in inches.

For a 10 inch scope this is therefore 36x.

This is governed by the fact that for a fully dark adapted eye the pupil will be around 7mm wide. (Sadly this being something that older eyes tend to fail to match, which partly accounts for the advantage that younger people have seeing in the dark), and if too low a magnification is used, then the beam emerging from the telescope is wider than the eye can accept – and light is then lost. This is not necessarily an immediate catastrophe, but the system is not working at its best.

So, if we are to consider a lowest-available power, we should at least bear this in mind.

With the current lowest power from the 40mm eyepiece at 62.5x the system is configured for almost double its lowest power by this rule, and this suggests that perhaps consideration to arranging a lower power as a first step, wide-view should be looked into.

Sadly, eyepieces of longer than 40mm focal length are rare, expensive specialist items, and so this is not as simple as buying a lower power eyepiece of say 62mm with what would be a starting magnification of 40x.

(( You will see that I have recommended earlier in the first tabulation on magnification that a base of around 40x would be nice))

However all is not lost…

## The Focal reducer option

The Meade telescopes of this type can be fitted with a “focal reducer” lens which simply screws in at the base of the telescope before the eyepiece and diagonal.

This has the effect of reducing the prime optical train focal length. There are two versions of this available which drop the F10 focal ratio to F6.3 and F3.3 respectively.

This has the effect of reducing the magnification for each eyepiece, and combinations with barlow lenses. It increases field of view and therefore dwell-time of the target in the field before a correction to track the object is needed and brightens the image by concentrating the light better on the retina. (For photography it shortens exposure time requirements.)


Meade F6.3 focal reducer lens – available for around £110

With the F6.3 fitted, the prime focal length will be reduced to 1575mm and this will, in combination then with the proposed eyepiece ladder give a very much more practical set of magnification / field of view choices.

| Eyepiece | Magnification BASED ON F6.3 FR Focal Length 1575mm | Comments |
|---|---|---|
| 40mm | 39x | Perfect starting magnification and wide-field view for open clusters, Andromeda Galaxy and moon |
| 28mm | 56x | This is approx. the current base power of the system |
| 20mm | 79x | A good workhorse power for mid-range use |
| 28mm with barlow | 112x | Just right for Jupiter, Saturn and moon-surfing |
| 20mm with barlow | 157x | A good mid-to-high power for planets moon and double stars |
| 9mm | 175x | A nice high power for planets and the moon or close doubles |
| 4mm | 393x | Probably over the top, but not as crazy any more. If you want to hit the max mag of 250x then a 6.3mm eyepiece would be the one. But I doubt you'd ever use it. |

With a budget of around £200 one could probably achieve both obtaining the F6.3 Focal Reducer AND a 28mm eyepiece. If only half that is available, and only one can be done, then I think the Focal Reducer should take precedence as it will make most difference to drop the magnification of each of the eyepieces that are currently available and make them all more useful.

## Finder scope

The finder scope is good. Care in aligning it perfectly with the main optics is well worth the effort, and people need to be encouraged not to touch it and knock it out of alignment again.

It was possible to see a number of galaxies and nebulae in the finder due to the dark skies with good contrast, and for larger clusters people can be encouraged to look through it rather than the main scope.

## Laser finder method

As demonstrated it is often effective to have a coaxial laser pointer that can (a) show where the target is to those watching and (b) assist in star-hop target location, especially when the finder is at back breaking positions. I would recommend permanently mounting one and carefully aligning it with the rest of the optics.

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