Solar Eclipse 10th June

Beginners 19th MAY 2021

Steve Harris

The ideal thing to observe during the summer, when the nights are short, is the Sun.

Of course we must take great care in how we observe the Sun as it can be very dangerous if not done correctly.

With special events like a Solar Eclipse we must remember to be safe.

A telescope or binoculars must never be used to look directly at the Sun.

The instruments are designed to gather as much light as possible from faint objects and direct that light into our eyes.

However the Sun produces a lot of light and heat so directing this light and heat into the eye will cause permanent damage and blindness.

There are two ways to observe the Sun safely these are to use a special Solar Filter or to project an image of the Sun on to a screen.

If we do have a telescope or binoculars we can use a piece of white card as a screen and project the light from the Sun on to the card.

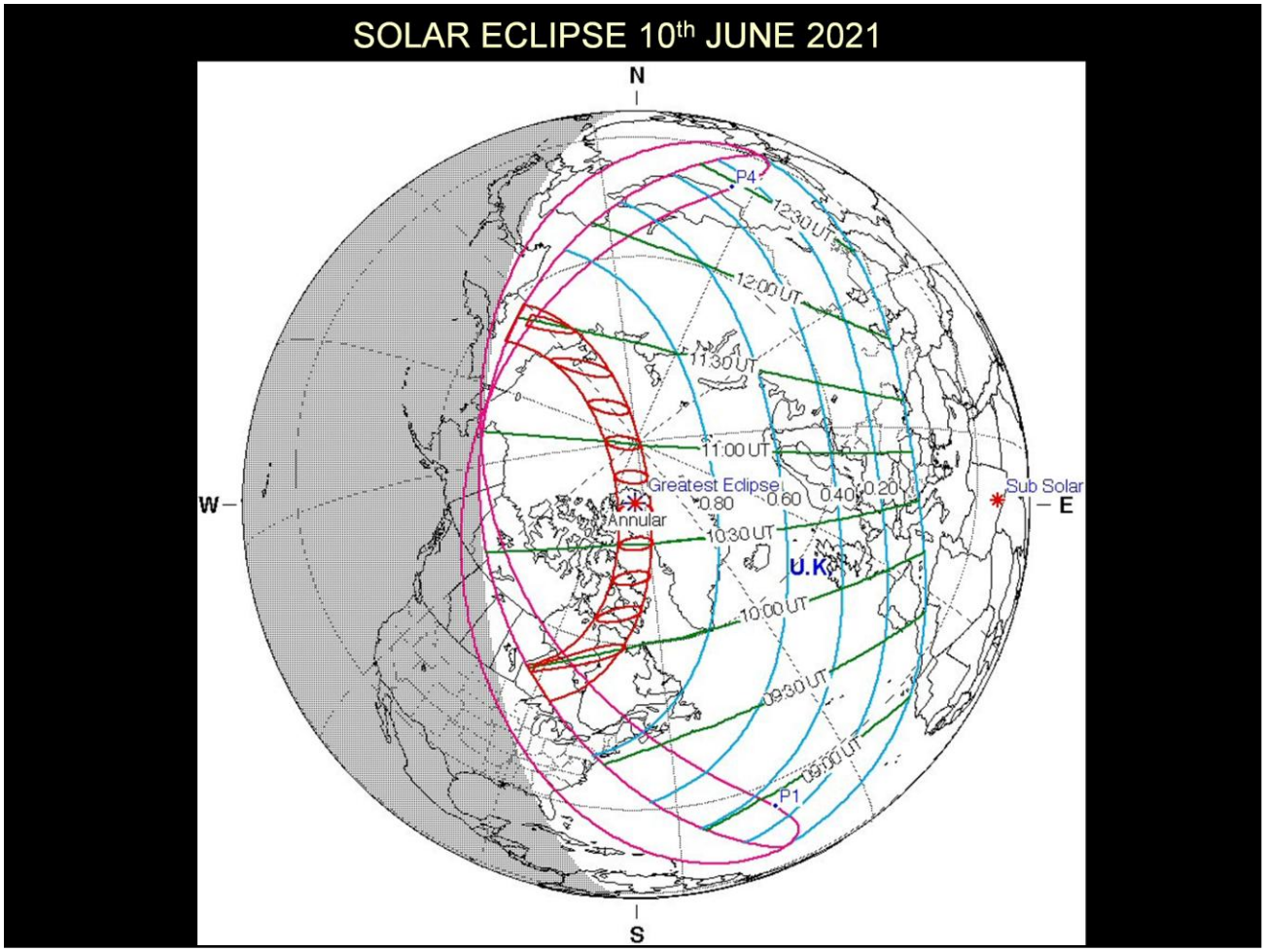
If binoculars are to be used be sure to cover one of the lenses with the dust cap.

Place the card in a suitable supported position so its flat surface is facing the Sun.

Hold the binoculars about 300mm above the card in the direction of the Sun.

Move the binoculars around until the projected image can be seen on the card.

The process can be improved by using an improvised stand to support the binoculars and screen.

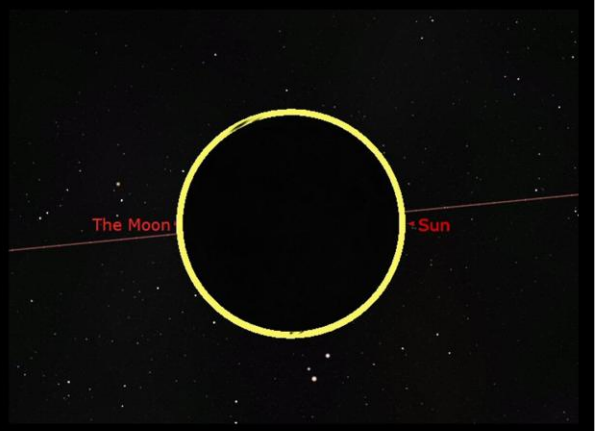


An annular solar eclipse will occur on 10th June 2021, when the Moon will pass between Earth and the Sun thereby partly obscuring the image of the Sun for a viewer on Earth. During the eclipse, the Moon's apparent diameter will be smaller than the Sun's, so it will block most of the Sun's light and cause the Sun to look like an annulus (ring). The annular eclipse will be visible from parts of North-Eastern Canada, Greenland, the Arctic Ocean (passing over the North Pole), and the Russian Far East, whilst the eclipse will appear partial from a region thousands of kilometres wide which includes northern and eastern North America, most of Europe and northern Asia.

The path of totality is show in red on the chart above. The Moon's eclipse will not completely cover the Sun because this will be an Annular Solar Eclipse. At the point of maximum cover the Sun will be 1890.4 arc-seconds in diameter but the Moon will only be 1773.6 arc-seconds in diameter so the Moon will not completely cover the Sun. At the centre of the eclipse shadow the edge of the Sun will be seen as a thin ring of bright light in the sky. This is called an Annular Eclipse. It is sometimes called the 'Ring of Fire'. This centre point of the eclipse will be in northern Canada and Greenland.

This eclipse will be an Annular Eclipse

Annular Eclipse 2019

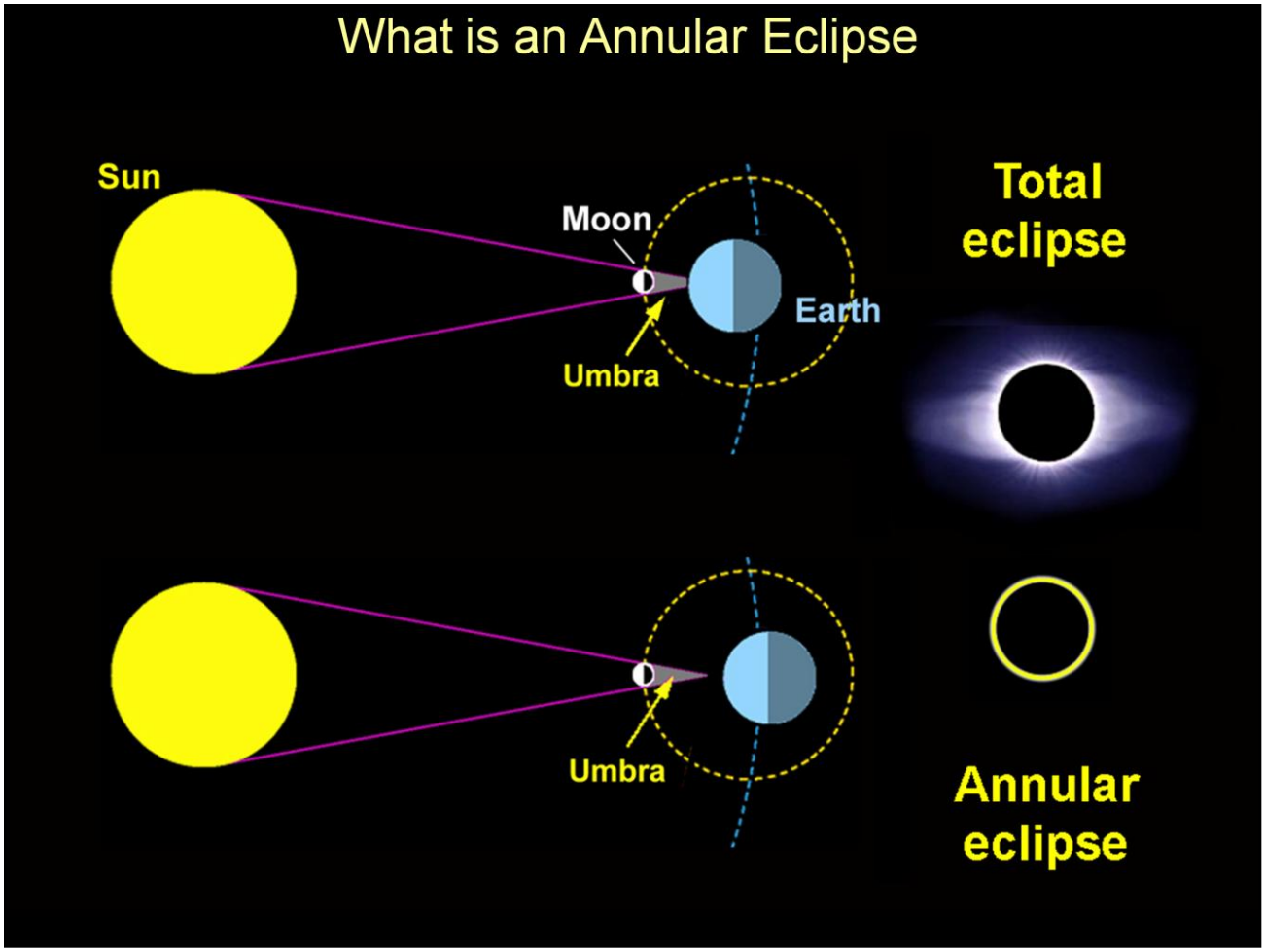


Annular Eclipse 2021
Starrynight simulation

An Annular Solar Eclipse occurs when the Moon appears smaller than the Sun.

Therefore we can see the bright outer edge of the Sun around the Moon that is sometimes called the ‘Ring of Fire’.

The sky does not become fully dark like a Total Solar Eclipse.



An Annular Solar Eclipse occurs when the Moon appears smaller than the Sun.

Through pure coincidence the Sun and Moon appear to be about the same size to us.

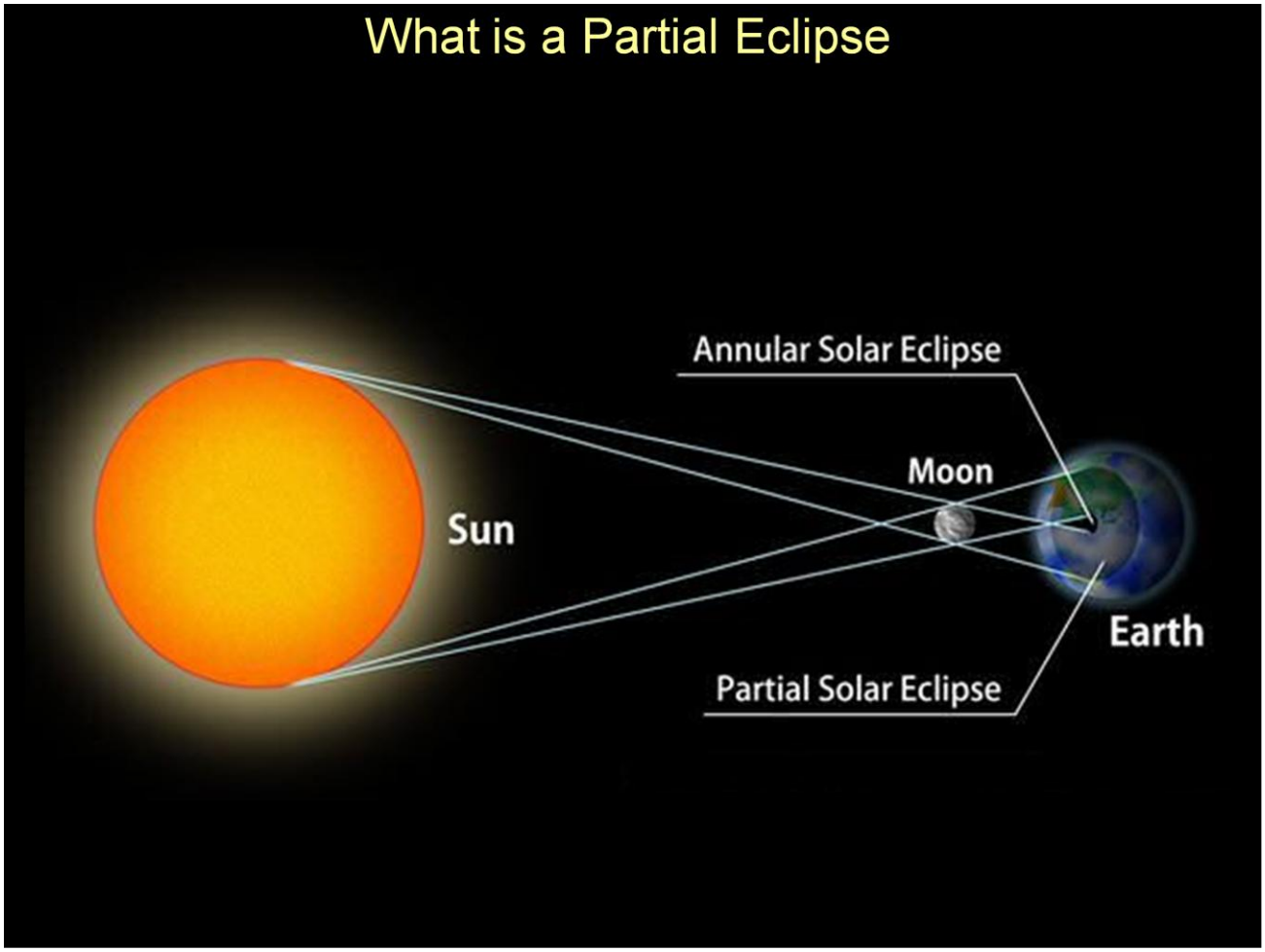
The orbit of Earth around the Sun and the Moon around are elliptical.

This means their radial distance changes as they move around their orbits.

When the Earth is at its closest to the Sun it appears bigger and when the Moon is at its furthest it appears smaller.

So when this occurs the Moon appears too small to completely cover the Sun in an eclipse.

Therefore we can see the bright outer edge of the Sun around the Moon.



Any Solar Eclipse will have two parts to the Shadow of the Moon falling on to Earth.

With a normal Total Solar Eclipse the Moon will completely cover the Sun.

As the Sun is much bigger than the Moon the rays that will be blocked by the Moon form a cone shape.

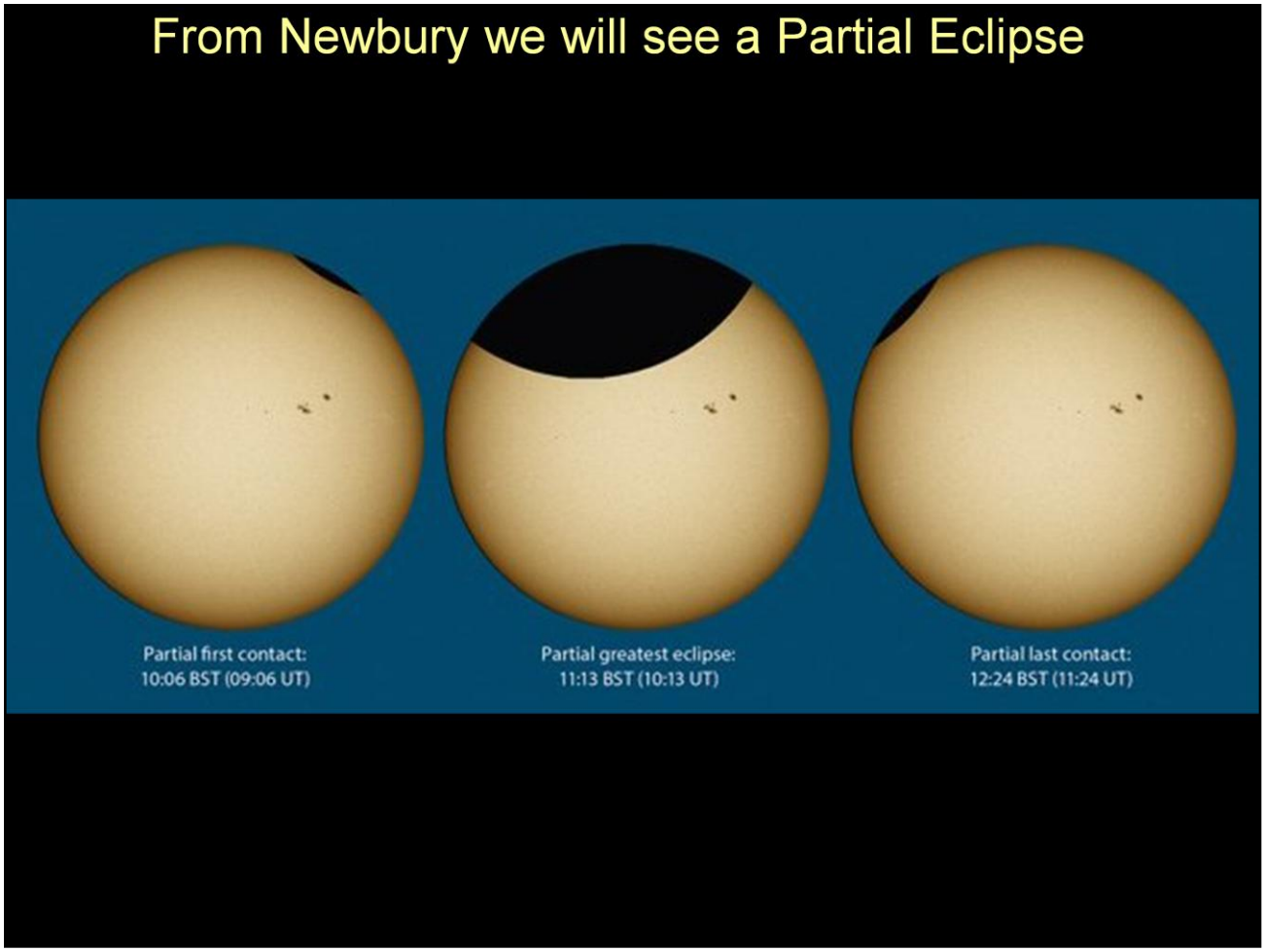
The relative distances of the Earth, the Moon and the Sun dictate how big the totality shadow will be.

The inner (totality) shadow is called the ‘Umbra’ and the outer (Partial) part of the shadow is called the ‘Penumbra’.

The size of the full Umbra shadow may be a few hundred metres in diameter or up to few hundred kilometres when the Moon appears bigger than the Sun.

However when the Sun appears bigger than the Moon the Penumbra does not ‘touch down’ on Earth.

So there will be no ‘Totality’ and the will be an ‘Annular Eclipse’.



The ‘Totality’ will occur at 10:41:51 UT (GMT) which will be 11:41:51 British Summer Time (BST).

Of course this Annular view will not be visible from the UK as we will only have a partial eclipse.

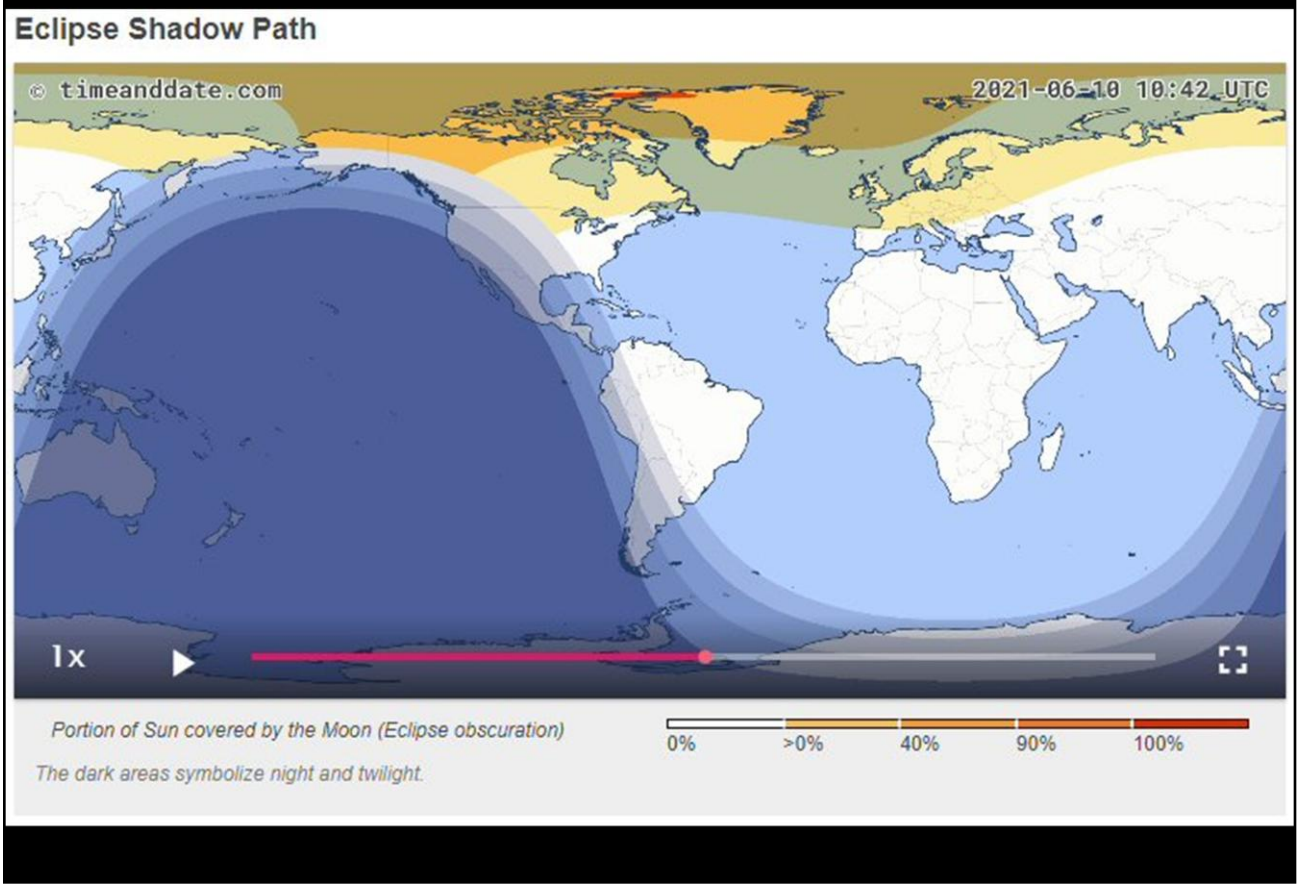
We in the south of England will see about 20% of the Sun obscured by the silhouette of the Moon.

The UK times are show on the diagram above but remember the time for our maximum cover will be 11:13 British Summer Time (BST).

A Total Solar Eclipse happens in a short period of between less than one minute or up to about five minutes for the longest.

The development of this Partial Eclipse will take nearly 2½ hours.

The path of the Eclipse



Most of the northern hemisphere will be able to see at least some of the Eclipse but very few people will see the Annular phase (Ring of Fire) because it will occur in a very remote place.

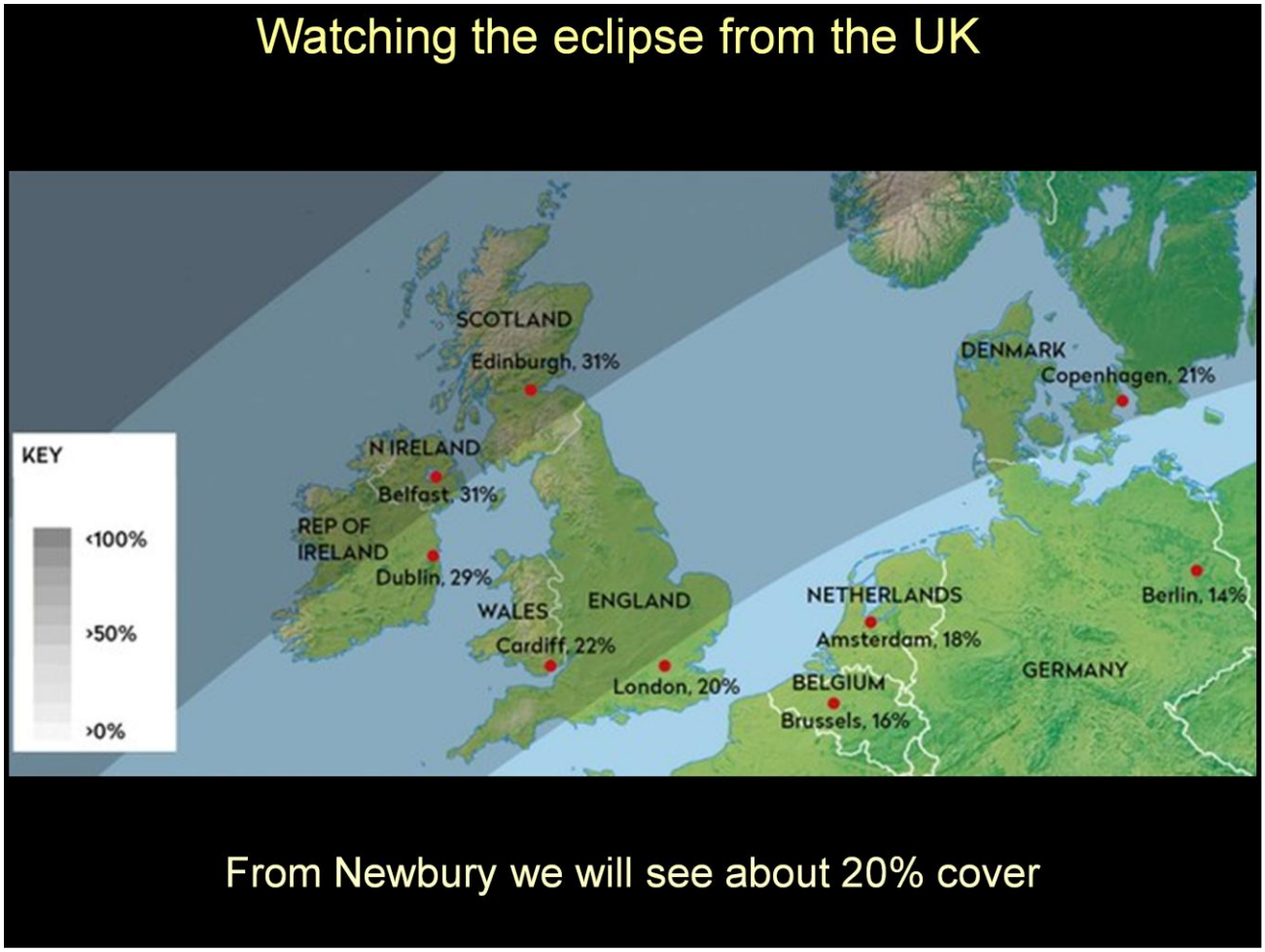
The blue area is night time and will see nothing because the Sun is not visible.

In the white areas it will be daylight but it will not be possible to see the eclipse.

We are in the yellow band where 0 to 40% cover will be seen and will be able to see 20%.

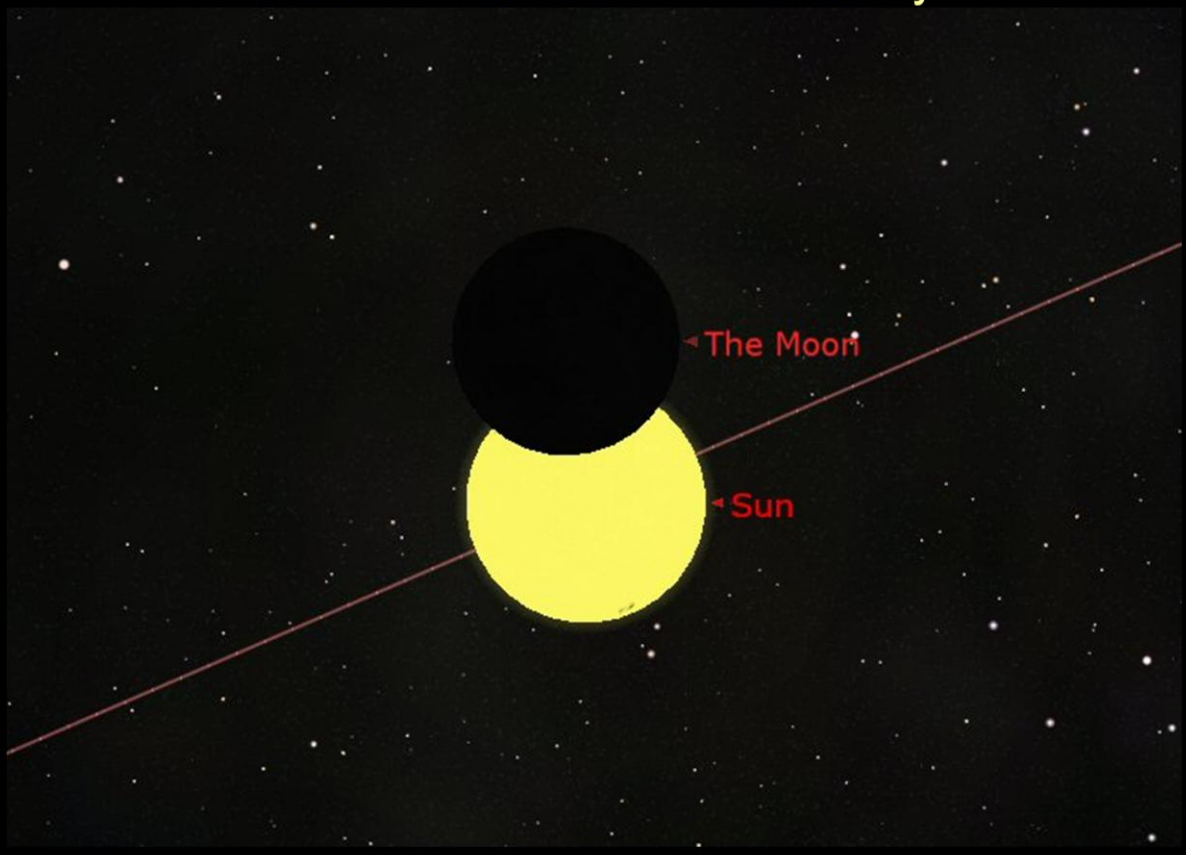
The orange areas will see 40% - 90% and from the red area the maximum Annual Eclipse will be visible.

The Annular Eclipse will only be visible from northern Canada and Greenland.



We will see about 20% of the Sun Covered by the Moon at 11:13 British Summer Time (BST)

What we will see from Newbury



Our view of the eclipse CGI from Starrynight

We must observe the Eclipse ‘Safely’

We must protect our eyes

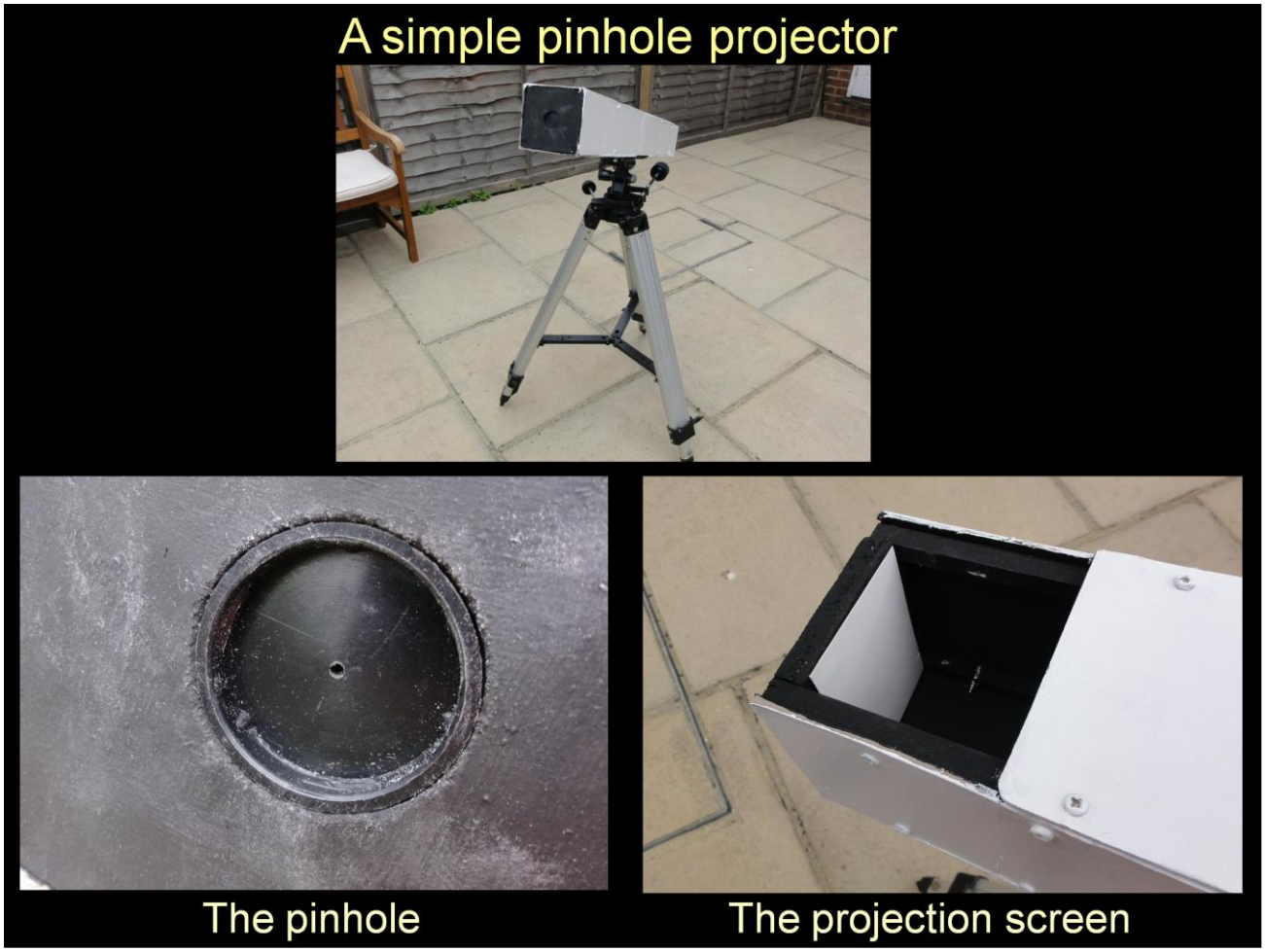
The most important thing is to make sure we observe this eclipse safely.

We must never stare at the Sun because it will damage our eyes.

The simplest way to do it is to use a pair of special Solar Viewing Spectacles.

Regular sunglasses must not be used to look at the Sun they do not stop enough sunlight and heat.

These special Solar Viewing Spectacles can be bought from astronomy shops.



We could also construct a simple ‘pin-hole’ projector to enable the eclipse to be seen safely. This requires a pinhole to allow sunlight to be projected on to a white screen. It is quite simple to construct a simple but effective instrument to do this. The pictures above show such an instrument made in 2019 to try out the idea. The simple wooden square tube was made from 10mm wooden sections and hardboard sheet.

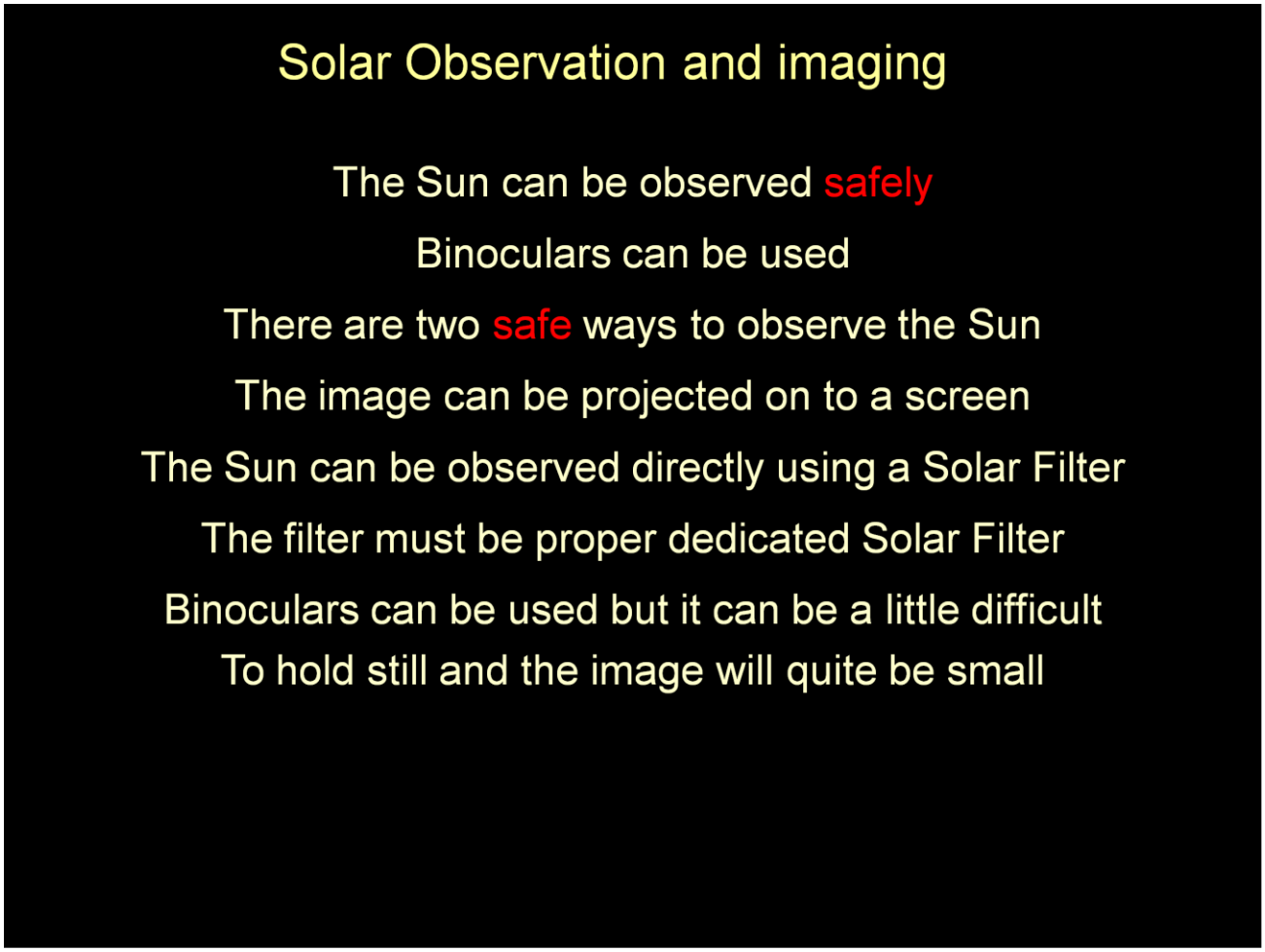
The tube was a metre long and 100mm square.

A plastic tube end had a 1.6mm hole drilled in the centre and was mounted in the end of the tube.

A viewing hole was left in the top of the tube so the image of the Sun could be seen projected on to a cardboard screen.

The whole assemble was then attached to a tripod.

It did work and the Sun could be seen however the image was a little small but quite good.



There are two ways to observe the Sun safely these are to use a special Solar Filter or to project an image of the Sun on to a screen.

If we do have a telescope or binoculars we can use a piece of white card as a screen and project the light from the Sun on to the card.

If binoculars are to be used be sure to cover one of the lenses with the dust cap.

Place the card in a suitable supported position so its flat surface is facing the Sun.

Hold the binoculars about 300mm above the card in the direction of the Sun.

Move the binoculars around until the projected image can be seen on the card.

The process can be improved by supporting the binoculars using an improvised stand and to support the screen.

Using binoculars to see the Eclipse

Binoculars must never be used to look directly at the Sun unless a special solar filter is fitted.

If binoculars are available they can be used but must have a special solar filter fitted over the large optic lenses.

These solar filters can be bought or be home made using special Milar plastic sheets of solar filter material.

The image of the Sun can also be projected on to a screen.

A chair or small set of steps can be used to support a cardboard screen behind the binocular to project the image on to.

The side of the binocular not being used must be covered.

To prevent damage to the binoculars a mask should be fitted to reduce the amount of heat entering the lens. This mask can be made out of cardboard with a 20 – 25mm hole to let the light through. It must be well secured over the lens.

Telescopes for Solar Observation and imaging

The Sun must be observed safely

Most telescopes can be adapted for solar observing

There are two safe ways to adapt a telescope

The image can be projected on to a screen

The Sun can be observed directly using a Solar Filter

The filter must be proper dedicated Solar Filter

There are two ways to observe the Sun safely using a telescope these are to use a special Solar Filter or to project an image of the Sun on to a screen.

If we do have a telescope we can use a piece of white card as a screen and project the light from the Sun on to the card.

Place the card in a suitable supported position so its flat surface is facing the Sun.

Position the telescope about 300mm away from the card in the direction of the Sun. The eyepiece may need to be rotated to achieve this.

Move the telescope until the projected image can be seen on the card.

The process can be improved by attaching and supporting the on the telescope.

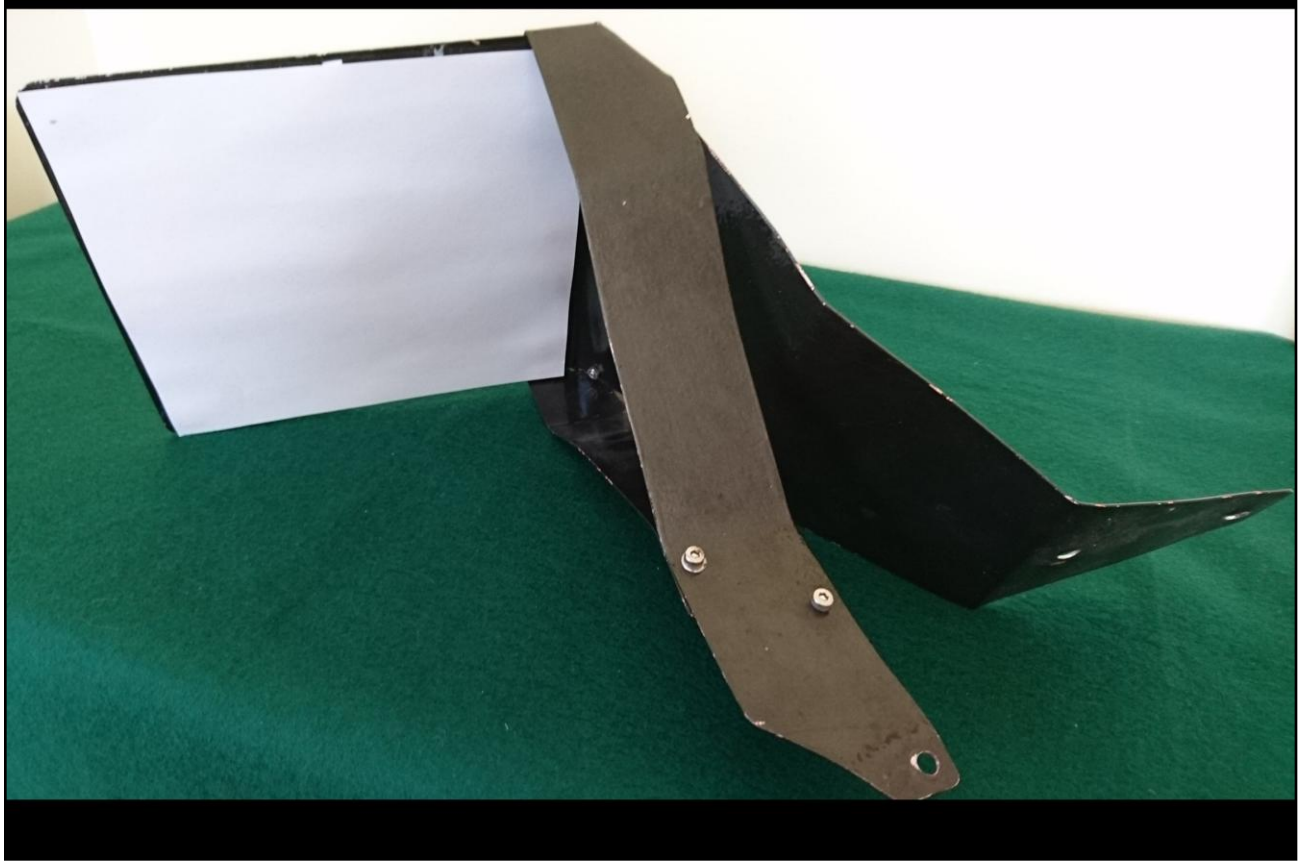
A small telescope can be adapted for Solar observing

Most telescopes can be adapted for observing the Sun ‘SAFELY’.

The image above shows a simple basic refracting telescope used and adapted by Steve Harris for Solar Observation.

The following slides show how both methods have been used on the same telescope.

The homemade projection screen



A simple rig can be assembled to support a screen and can be made from and piece of white card.

A ‘matt’ rather than ‘glossy’ card is better.

It is best if a simple rig is constructed to attach it to a telescope. Its design must be adapted to fit the telescope to be used.

The example telescope has two camera thread holes on the telescope mounting cradle and a smaller threaded hole for the focus lock screw.

Aluminium sheet was shaped to utilise these holes and to provide support for the screen.

It was shaped to allow the image of the Sun to be projected on to a screen from the eyepiece.

The picture above shows the homemade rig that was fitted to the refracting telescope.

Telescope with Projection Screen fitted

This projection screen support has been made using Aluminium sheet.

It has been made so that it also provides a sunshade to make it easier to see the projected image of the Sun.

Photographs can also be taken of the projected image on the screen.

The Dust Cap and light reducing removable cap

If there is too much light the Dust Cover can be fitted over the lens of the telescope and the small light reducing cap removed.

This will restrict the amount of light entering the telescope to reduce the glare on the screen and help protect the eyepiece from overheating damage.

The image above shows the telescope Dust Cap and the removable smaller central cap.

Telescope with light reducing cap removed

To reduce the amount of light entering the telescope the Dust Cap has been fitted and the light reducing cap has been removed to reduce the light and heat damaging the telescope.

Solar Observation and imaging

The second way the Sun can be observed safely

Is to use a special Solar Filter to reduce the light

The Sun can be observed directly using a Solar Filter

But the filter must be a proper dedicated Solar Filter

Any telescope can be converted for Solar observing

by fitting a special filter over the front of the telescope

Observing the Sun directly through the telescope will produce a much better view.

However a special Solar Filter must be fitted over the end of the telescope to vastly reduce the luminosity of the Sun.

A filter that fits over the front of the telescope must be used any filter that fits inside the telescope must be avoided at all cost.

My Skywatcher 102mm by 500mm *fl* telescope

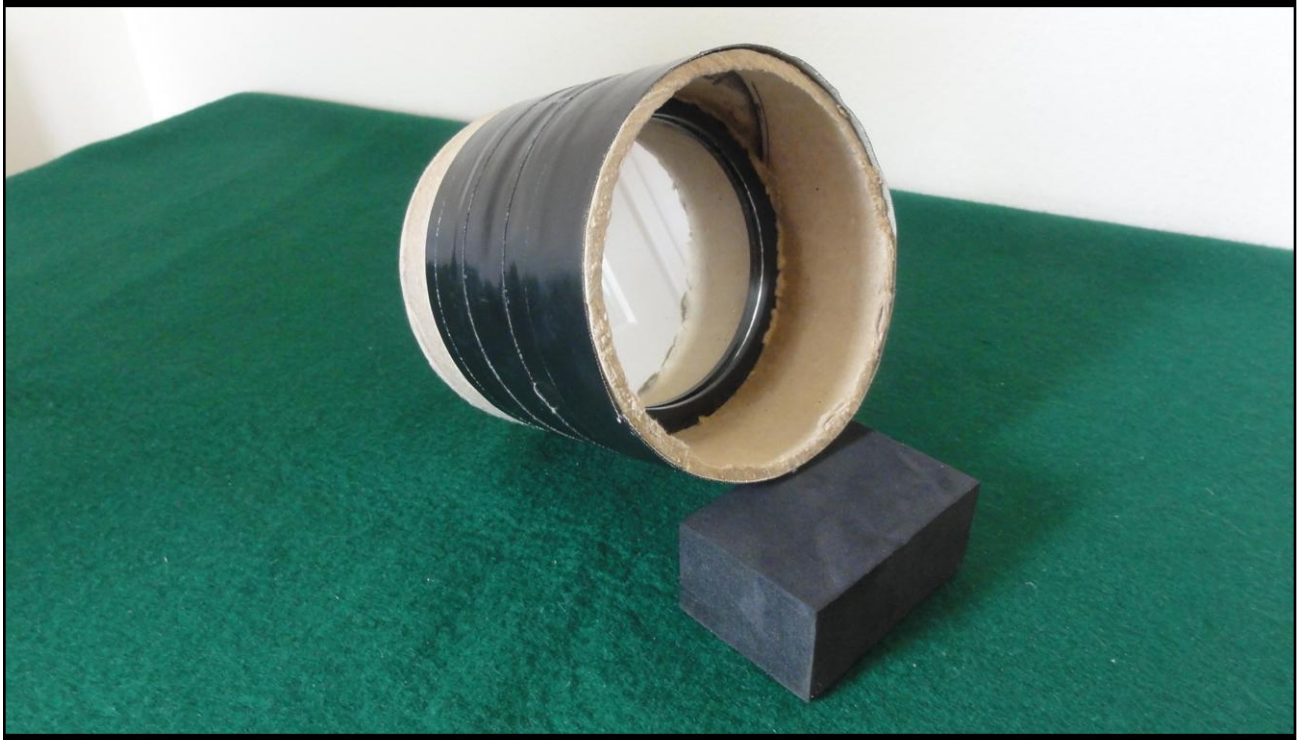
My Skywatcher adapted for Solar Observation

The image above shows the Skywatcher telescope with a solar filter fitted.

Some other changes to improve solar observation have also been incorporated.

These additions will now be explained in detail.

My Solar Filter



A Meade ETX90 glass filter in a cardboard tube

The Solar Filter shown above is the one used in the solar telescope shown above.

The glass solar filter is a special filter supplied by Meade for use with a Meade ETX90 telescope.

It is usually screwed into a special thread on the ETX90 but has been mounted into a cardboard tube to fit into the Dew Shield of the telescope use here.

There are three types of filter that can be used to observe the Sun.

1 A specially coated glass filter that fits over the open end of the telescope.

2 The glass filters are expensive so a special Milar (plastic) film filter can be manufactured or bought.

3 A very special red filter called a Hydrogen Alpha Filter (Hα) can be used but these are very expensive.

The Hydrogen Alpha Filter type filters will be discussed elsewhere n a separate presentation.

The Sun Finder fitted to the telescope

A special Solar Finder has been made and fitted to the telescope to help locate the Sun.

This is done by projecting the light of the Sun through a pinhole in the front (black) screen on to the white rear screen.

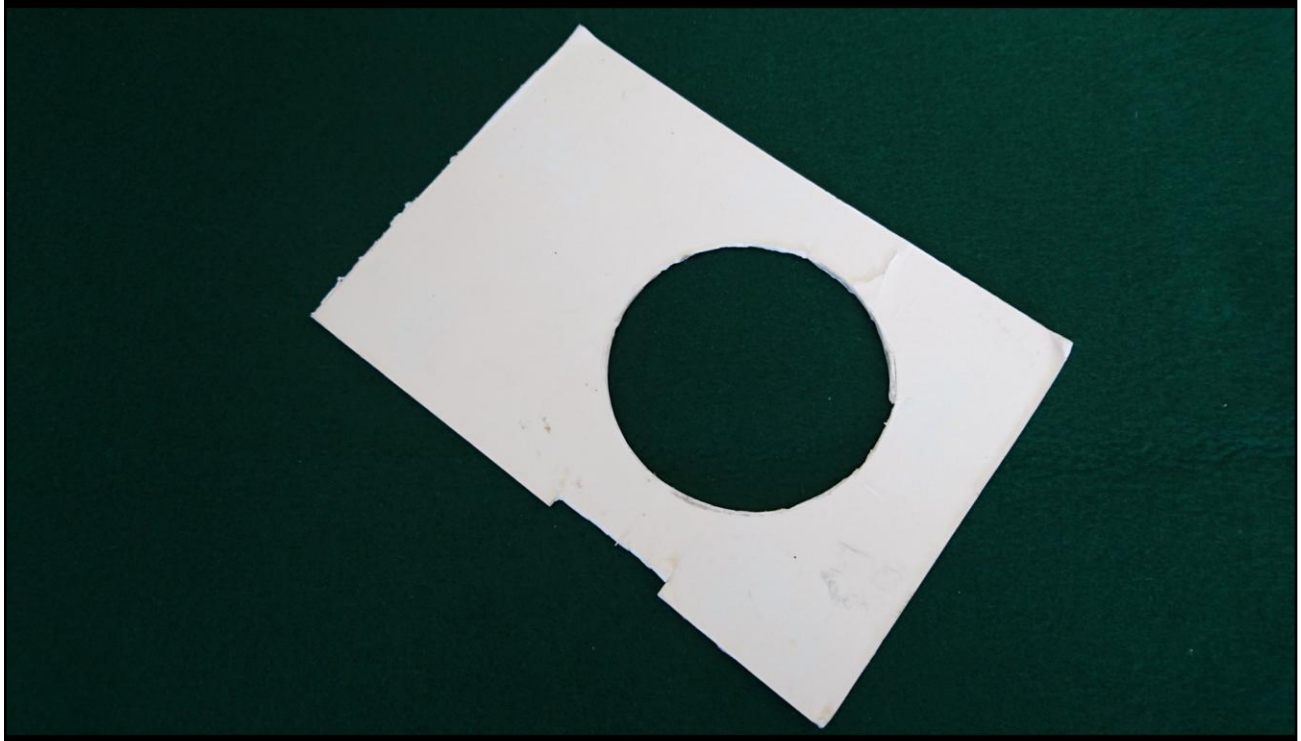
A spot of sunlight can be seen on the white screen.

The Sun can then be centred ready for observing with the telescope.

The Finder Telescope would normally be removed for open public viewing events.

The telescope is adjusted until the spot of sunlight is located in a small circle drawn on the white screen.

The Sun Shield



This is a cardboard shield fitted to the telescope tube

The Sun Shield shown above is the one used on the solar telescope shown above.

The Shield was cut from a sheet of white cardboard.

It is fitted to the telescope and held in place by the Dew Shield on the telescope.

This provides shade from the Sun when using the telescope at the eyepiece.

The Sun Finder fitted to the telescope

A special Solar Finder has been made and fitted to the telescope to help locate the Sun.

This is done by projecting the light of the Sun through a pinhole in the front (black) screen on to the white rear screen.

A spot of sunlight can be seen on the white screen.

The Sun can then be centred ready for observing with the telescope.

The Finder Telescope would normally be removed for open public viewing events.

The telescope is adjusted until the spot of sunlight is located in the small circle drawn on the white screen.

Advantages of using a Projection Screen

It is cheap and easy to make

It is easy to use

A group of people can see the image

The image can be magnified using different eyepieces

The Sun's image can be photographed using a camera

Disadvantages of using a Projection Screen

The image is not so clear

It may damage the eyepiece

There is a chance of burning someone's skin

Advantages of using a Solar Filter

The Solar Filter gives a true view of the Sun

It gives the same colours as the naked eye

The image is clearer than the projected image

The image can be magnified using a Barlow Lens

The Sun can be imaged directly using a DSLR or webcam

The observer can be seated and more comfortable

Disadvantages of using a Solar Filter

The glass type filter can be a bit expensive

Only one person can look at the Sun at a time

This presentation is available

(with notation) on the:

Beginner's Website naasbeginners.co.uk