Looking Ahead to Solar Eclipse 2024

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Agenda:

- Purpose
- Solar Viewing & Eye Safety
- What is a Solar Eclipse?
- Interesting Solar Eclipse Facts
- Solar Eclipses: Total & Partial / Annular & Hybrid
- Partial & Total Eclipse Phases – What can be seen and/or photographed?
- Planning for the Solar Eclipse
- Solar Filters
- Alternate Indirect Eclipse Observing Methods
- Thoughts on Solar Eclipse Photography
- When is the Next Solar Eclipse?
- Useful References & How to Suggestions/Examples

Content is accurate to best of my knowledge – if errors are found, please inform the author for correction.
Purpose:

The purpose of this presentation is to:

• provide an overview of solar eclipse types & what can be seen or photographed in a solar eclipse
• stress importance of solar observing safety precautions
• identify eclipse planning considerations
• describe types of solar filters & alternate observing methods
• and share thoughts on eclipse photography

Note: While this presentation briefly touches on solar eclipse photography, it does not go into imaging details or processing of solar images.

Disclaimer:
Always follow safe eclipse viewing procedures. The author assumes no responsibility for any person causing harm to themselves or others by following unsafe eclipse viewing procedures or using an unsafe, defective, or counterfeit product.
Solar Viewing Safety:  
*Eye Safety During a Solar Eclipse*

**Safety Precautions:**

- When viewing solar eclipses, wear special glasses approved by the International Organization for Standardization (ISO) ISO 12312-2.

- Regular sunglasses are not safe for viewing the Sun.

- During total eclipse phase (& only at total phase called ‘totality’ when Sun is totally blocked), the Sun is observed without filters.

- It is critical that you know when to take off & put back on solar-safe glasses; same for telescope and/or camera equipment. Check local information for timing when total eclipse begins & ends. See NASA's page of eclipse times.

- An alternate ‘Indirect’ method to observe the Sun without filters; can be used – see slide titled *Alternate Indirect Eclipse Observing Methods* later in this presentation

- Do not leave telescope/equipment used to observe the Sun unattended with children and/or adults not familiar with safe operation of the equipment.

- Additional safety precautions are at end of this presentation, on slide titled *Solar Filter Usage – Safety Precautions*
WARNING:
NEVER look directly at the sun without proper eye protection. You can seriously injure your eyes and/or cause permanent eye damage or blindness.

A total solar eclipse is about as bright as the full Moon — and just as safe to look at. But the Sun at any other time is dangerously bright. View it only through special-purpose solar filters that comply with the transmission requirements of the ISO 12312-2 international standard for filters for direct viewing of the Sun.

Credit: American Astronomical Society - How to View a Solar Eclipse Safely | Solar Eclipse Across America (aas.org)
Eye Safety During a Solar Eclipse

How to View a Solar Eclipse Safely
(Annular Eclipse)

WARNING:
NEVER look directly at the sun without proper eye protection. You can seriously injure your eyes and/or cause permanent eye damage or blindness.

Except during the total phase of a total solar eclipse, the Sun is dangerously bright. At all times during an annular or partial solar eclipse, or when no eclipse is occurring at all, view the Sun only through special-purpose solar filters that comply with the transmission requirements of the ISO 12312-2 standard.

Credit: American Astronomical Society - How to View a Solar Eclipse Safely | Solar Eclipse Across America (aas.org)
What is a Solar Eclipse?

**Definition:**

*A solar eclipse occurs when the Moon passes between Earth and the Sun, thereby obscuring Earth's view of the Sun, totally or partially.*

*Such an alignment coincides with a New Moon, indicating the Moon is closest to the plane of the Earth's orbit. In a total eclipse, the disk of the Sun is fully obscured by the Moon.* (Wikipedia)

**WARNING:**

NEVER look directly at the sun: It can permanently damage your eyes! You must use proper safety equipment to look at any type of solar eclipse.

Credit: NASA
What is a Solar Eclipse?

Note: This presentation focuses mainly on Total & Partial Eclipses.

Credit: NASA's Goddard Space Flight Center

Not to scale: If drawn to scale, the moon would be 30 Earth diameters away. The sun would be 400 times that distance.
Interesting Solar Eclipse Facts

• Solar eclipses happen 2 – 5 times a year.
• A total solar eclipse occurs every 18 months somewhere on Earth.
• A solar eclipse always occurs about 2 weeks before or after a lunar eclipse.
• On average, a specific location will only experience a total solar eclipse roughly every 375 years.
• The United States has only seen 21 Total Eclipses since country founded in 1776.
• Uncommon for a total solar eclipse with long cross-country path across a wide section of the US. Before 2017 eclipse, last cross-country total solar eclipse happened in 1918.
• After the 2024 eclipse, a cross-country total solar eclipse will not happen again until 2045.
• Earliest eclipse writings go back about 5,000 years.
A solar eclipse occurs when the Moon passes between Earth and Sun, whereas a Lunar eclipse occurs when Earth is between the Sun and Moon:

- Alignment coincides with a full Moon, indicating Moon is closest to the plane of the Earth's orbit.
- In a full Lunar eclipse, the disk of the Moon is fully obscured by the Earth.
- A Total solar eclipse lasts a few minutes, whereas total lunar eclipse phase can last from 30 minutes to nearly 2 hours.
- The Earth’s atmosphere causes changes in color (i.e., red) appearance of moon.

Note:
A Lunar Eclipse does not require filters for safe viewing
Solar Eclipses: Total & Partial

There are 4 types of solar eclipses:

1. **Total Solar Eclipse:**
   - During a Total Solar eclipse, Moon casts 2 shadows onto Earth:
     - one is called umbra; the other is called penumbra.
   - Total eclipse is only visible from small area on Earth, & only lasts a few minutes, within the umbra.
   - People who see a total eclipse are in center of Moon’s dark shadow when it hits Earth, which is visible in umbral (umbra) area.
   - Moon appears same size as Sun, thereby Sun is completely blocked by Moon.
   - For a total eclipse to take place, the Sun, Moon, & Earth must be in same plane – the Ecliptic.

2. **Partial Solar Eclipse:**
   - Occurs when Sun, Moon & Earth are not exactly lined up.
   - People who see a partial eclipse are in weak/pale part of Moon’s shadow called penumbra, where Sun is partially blocked by Moon.
   - Sun appears darkened on only part of its surface (< 100%).
   - Takes 75-80% partial eclipse before darkening in sky is noticed.

**WARNING:**
NEVER look directly at the sun: It can permanently damage your eyes!
You must use proper safety equipment to look at any type of solar eclipse.

Eclipse images by Ken Diller
Solar Eclipses: Annular & Hybrid

3. **Annular Solar Eclipse:**
   - Occurs when Moon is farthest from Earth – too far from Earth to completely cover Sun.
   - Moon appears smaller and does not block entire view of Sun.
   - New Moon’s umbra does not reach Earth.
   - Moon in front of Sun looks like a dark disk on top of larger sun-colored disk. Creates what looks like a ring around the moon.

4. **Hybrid [Annular-Total] Eclipse – very rare:**
   - Occurs when eclipse appears annular and total along different sections of its path across Earth.
   - Most times it begins as annular; transforms into total eclipse, then reverts back to annular before end of eclipse.
   - Rarely it begins as annular and ends as total eclipse, or vice versa.

**WARNING:**
NEVER look directly at the sun: It can permanently damage your eyes! You must use proper safety equipment to look at any type of solar eclipse.
Partial & Total Solar Eclipse Phases
- What can be seen and/or photographed?

*Example of an eclipse sequence*
For full Sun viewing & partial solar eclipse duration, you must use a solar filter.

**WARNING:**
NEVER look directly at the sun: It can permanently damage your eyes!
You must use proper safety equipment to look at any type of solar eclipse.

Eclipse images by Ken Diller
Transition to Total Solar Eclipse Phase
(Immediately before beginning of Total Eclipse phase)

**Diamond Ring:**
Opposing ‘horns’ of crescent Sun converge toward one another just before totality begins, & at end of totality.

**Baily’s Beads:**
Sunlight that filters between crater walls along the Moon’s limb

(Both are very short lived)

**Shadow Bands:**
As Sun is about to enter totality, shadow bands may be present:
- Rapidly moving wavy lines of alternating light & dark band.
- In upper atmosphere turbulent air acts like lenses to focus & defocus sharp-edged light from solar surface just before totality.
- Might be seen on sides of buildings or ground just before & after totality.

**WARNING:**
Still not safe to look at Sun without solar filters. After Diamond Ring & Baily’s Beads disappear, then you can safely look at Sun.

Eclipse images by Ken Diller

Credit: Wikipedia
Total Solar Eclipse Phase – What can be seen/photographed?
(At full Total Eclipse phase)

Note:
If you are not in the path of Totality, then you will not see this (corona).

Stars and/or Planets in darkened blue sky (Arcturus is seen here)

Earthshine: Light reflected from Earth – photographed only

Solar Corona: Sun’s outermost atmosphere; 2 million-degree plasma

HDR processed w/multiple bracketed images to show expansive corona (a single view/image will not capture full expanse of corona)

During Total Eclipse phase only, you can safely look at Sun.

Eclipse images by Ken Diller
Prominences seen in Sun’s Chromosphere (2-3 km high). Crimson-pink due to emissions from energized hydrogen atoms.

Total Solar Eclipse Phases – What can be seen/photographed?
(near end of Total Eclipse phase)

Very Important:

• Only take your glasses off during short time when Moon completely obscures the Sun – known as period of totality.

• It's crucial that you know (exact time) when to take off & put back on your solar eclipse glasses. The same goes for solar filters on telescopes, binoculars, cameras, etc.

• Silhouette of Lunar shadow on ground, near moment of mid-totality may possibly be seen.

• Average speed of shadow travels 1,700 mph across the country.

Eclipse images by Ken Diller
Transition out of Total Solar Eclipse Phase
*(immediately after Total Eclipse phase)*

Before Baily’s Beads & Diamond Ring appear, you must place solar-safe glasses back on.

**Note:**
Diamond Ring & Baily’s Beads are photographed only without solar filters, then solar filter is immediately placed back on telescope/camera.

Baily’s Beads on Opposite Side

Diamond Ring on Opposite Side

Eclipse images by Ken Diller
For full Sun viewing & partial solar eclipse duration, you must use a solar filter.

WARNING:
NEVER look directly at the sun: It can permanently damage your eyes!
You must use proper safety equipment to look at any type of solar eclipse.

Eclipse images by Ken Diller
Partial & Total Solar Eclipse Phases
– Example Eclipse Timelapse Video

Video timelapse shows partial/total eclipse sequence:

• Example is from Aug 21, 2017 Solar Eclipse

• Video timelapse - see separate file/link

Solar Eclipse 2017 from Logan County, NE
8/21/2017, 11:31 am - 2:22 pm CST
© 2017 Ken Diller

Equipment:
- AT72ED F6, Canon T2i, Atlas EQ6 mount
- Thousand Oaks Solarlite filter
- Partial: ISO 100, 1/800 sec at 15 sec intervals
- Full Eclipse: ISO 100, 1/4000 to 0.8 sec at 2.5 sec intervals

Software:
- Eclipse Orchestrator Pro, Adobe Lightroom 6 & Premiere Elements 14

Eclipse images by Ken Diller
Planning for the Solar Eclipse

Where do you plan to be on Eclipse Day?

- Monday April 8, 2024
Using Melbourne, FL (Local Standard Time) as example*:

- Partial Eclipse begins: 12:48:12, Sun Alt 69°
- Total Eclipse: *Not seen in Florida*
- Max [Partial] Eclipse: 14:04:12, Sun Alt 59°
- Partial Eclipse ends: 15:17:20, Sun Alt 44°

- Eclipse Obscuration in Melbourne (percent Sun eclipsed): 54.7%

Total Solar Eclipse only occurs in path of totality:
- Shown as black dot
- 122.4 miles wide (@ Greatest Duration)
- Longest duration of totality is at center of dot
- Partial eclipse is within larger outer circle (Penumbra)

Greatest Duration of total eclipse occurs:
- North of Torreón, Mexico, lasting 4m 28s
- This total eclipse is considered reasonably long in totality duration

*Site to determine eclipse times for your location:*
- EclipseWise - Solar Eclipse Circumstances Calculator
  (www.eclipsewise.com/solar/SEcirc/2100/SE2024April08Tcirc.html)
You must be in path of totality to see full Total Eclipse.
If you are near edge (i.e., 99.9% of totality), you will not see a Total Eclipse.
Eclipse Planning Pointers

Location:
• If you are not in path of Totality, then you will not see a total eclipse.
• Consider staying with family/friends you know if totality path.
• Recommend arriving a couple days early to plan out your specific site; setup prep, etc.
• The closer you are to center of path, the longer totality lasts.
• Be up early to be at your site. Pack plenty of water, sunscreen, etc.

Traffic:
• A significant portion of the USA, along with international guests, will be traveling for the April 8, 2024 eclipse.

Reservations:
• Hotels fill up fast; even a year ahead of eclipse.
• Some people reserve camping space on private landowners property.
• Reservation costs will increase.

Vacation Planning: Schedule time off.

Crowds:
• Millions of people across the country will migrate to path of totality.

Credit: NASA
Some Eclipse watchers travel on the ocean to see a solar eclipse

"Eclipse Predictions by Fred Espenak, EclipseWise.com"
Solar Eclipse Path on Monday April 8, 2024

When planning, consider access to interstate highways & roads

"Eclipse Predictions by Fred Espenak, EclipseWise.com"
Eclipse Planning: Weather

- On day of eclipse, local weather broadcast channel may be best resource.
- Prep and mobility is important if you chose to relocate due to bad weather.
- Excellent weather data and considerations are described at:
  - **Total Solar Eclipse April 8, 2024 | Eclipsophile site**
  - Shows historical weather patterns for locations across the country
Eclipse Planning: Weather

Another graph showing location (State/City) vs predicted cloud cover as a fraction. *(from beginning to end of eclipse)*

Weather can prevent you from seeing any part of the eclipse.

*Courtesy of Jay Anderson, Eclipsophile | Climatology and weather for celestial events*
Solar Filters
Solar Filter Types - Examples

Recommend purchasing filters from a reputable source, meeting ISO 12312-2:
• See Reputable Vendors of Solar Filters & Viewers | Solar Eclipse Across America (aas.org)

White Light Filters:
• Block 99.999% of sunlight; to see visible surface – photosphere
• Typically use 3 types of materials:
  • Metal-coated glass  Glass with metallic coating; most durable & expensive
  • Black polymer  Yellow-Orange; low cost
  • Metal-coated polymer
  • Baader AstroSolar film  Very thin, wrinkles not an issue, blue-white view
• Solar Eclipse Glasses:  Quick & easy to use
• Threaded Camera Filters:  Specific to camera lens sizes
• Herschel Wedge:  Used with refractors only

Hydrogen-alpha Filters (not shown in example photos):
• Blocks all wavelengths of sun except for one (emitted by hot hydrogen atoms)
• Can be used for partial eclipse phases but challenging to switch configuration quickly for full total eclipse and back to partial eclipse.

Notes:
1. Some filters are for visual use or photographic use – research manufacturers details for your needs.
2. Polymer or metal-coated polymer are available in sheets to make your own filters.
3. For large aperture telescopes, a full-aperture filter is not recommend (increased atmospheric turbulence impact); suggest making an off-axis masked filter.
Solar Filters – DIY Examples

White Light Filters:
- Still need to use solar-safe filter material
- Ensure filters are secure and will not accidently fall off
- There are many other methods to make solar filters using various materials, possibly available at home and/or at hardware stores.

Binocular Solar Filters by BAS Member Wick Hoffler
(see How-To details at end of presentation)

Solar Filter by author for use on small finderscope
(lid from peanut butter container)

Solar Filter by author for use on small refractor
(from cardboard cylinder container & Baader film)
Solar Filter Usage – Safety Precautions

• Prior to using a solar filter, check for damage, pinholes, and proper/secure fit.
• If you use binoculars, both objectives require a solar filter.
• Solar filters are to be placed 1st in-line between Sun & telescope, binoculars, camera lens, etc. where light first enters.
• Point telescope, binocular, camera, etc. away from Sun when installing and removing solar filter.
• Finders & finderscopes need solar filters also, or securely capped, or removed:
  • Looking at sun with unprotected finder has same dangerous effect as a larger unprotected telescope & can cause permanent eye damage/blindness.
  • Sunlight can also melt finder crosshairs
• A punctured solar filtered should be thrown away.
• Be sure your solar filter is firmly secured to the telescope, binoculars, or camera, and that it does not come off by accident.
• Never use filters at eyepiece; even solar glasses – it will burn up quickly, with your eye next.

• Do not use an eyepiece “Sun” filter:
  • They are dangerous & can be disastrous to your eyes.
  • Concentrated sunlight by telescope will crack the glass filter
Alternate Indirect Eclipse Observing Methods

Alternate observing methods:

• **Pinhole Projection:**
  - Small hole in paper/foil:
    • Projects sun on piece of paper, wall, card
    • Very small, dim image
    • Multiple people can view at same time
  - Trees acting as Pinhole:
    • Leafy trees passing dappled sunlight on ground during partial or Annular eclipse
    • Lots of crescent Suns projected by small spaces between leaves
  - Hands crossed with lightly outstretched fingers (in waffle pattern):
    • With back to Sun, look at hands’ shadow on ground
    • Small spaces between fingers project small crescent Suns (during partial eclipse)
    • Other items with lots of small holes will do same.

• **Optical Projection** - with telescope or binoculars:
  • Projects bigger, brighter, & sharper image onto paper

2D/3D Printable Pinhole Projector at: [https://eclipse2017.nasa.gov/2d3d-printable-pinhole-projectors](https://eclipse2017.nasa.gov/2d3d-printable-pinhole-projectors)
Thoughts on Solar Eclipse Photography

• Don’t try to do too much – make sure you look at the eclipse visually also
• If this is your 1st time seeing a total solar eclipse, think twice before moving forward with photographing it.
• Check your cables to ensure sufficient length over full length of eclipse as mount/telescope moves.
• Need wide Field of View for corona.
• Don’t use autofocus.
• Have plenty of computer/storage space.
• Solar-safe filters are also critical for your camera equipment; improper or incorrect use can destroy equipment.
• Practice solar photography well before eclipse day, & know your equipment.

There are many resources available for eclipse photography, such as:
• *How to Photograph a Solar Eclipse (mreclipse.com)*
Thoughts on Solar Eclipse Photography (continued)

Cameras can be controlled automatically by eclipse camera control software:
• Requires extensive prep, practice, accurate location & timing, etc.
• Allows observer to watch eclipse while imaging occurs automatically.
• Requires accurate daytime solar tracking.

Some options on market for eclipse Camera/Exposure control software:
• Eclipse Orchestrator Pro (Canon/Nikon DSLRs) – has not been updated for latest imaging cameras
• Solar Eclipse Maestro for MacOS
• SET’n’C: Solar Eclipse Timer & Camera Controller for Windows
• EclipseDroid for Android

[Screenshot of imaging sequence from 2017 eclipse]
When is the Next Solar Eclipse? (2021-2030)

When will a Total Solar Eclipse cross Florida?

(Many years out)

On August 12, 2045 a Total Solar Eclipse will cross Florida, & Brevard County will be in path of totality!

Eclipse Duration in Melbourne: 5m 36s

"Eclipse Predictions by Fred Espenak, EclipseWise.com"
Useful Reference Links

- MrEclipse.com
  - Observing Solar Eclipses Safely (mreclipse.com)
  - How to Photograph a Solar Eclipse (mreclipse.com)
- EclipseWise - Total Solar Eclipse of 2024 Apr 08
- Eclipsophile | Climatology and weather for celestial events
  - Total Solar Eclipse April 8, 2024 | Eclipsophile
- Eclipse America 2024 | Solar Eclipse Across America (aas.org)
- How to View a Solar Eclipse Safely | Solar Eclipse Across America (aas.org)
- Eye Safety During a Total Solar Eclipse | NASA
- Eclipse 101 | Total Solar Eclipse 2017 (nasa.gov)
- Reputable Vendors of Solar Filters & Viewers | Solar Eclipse Across America (aas.org)
- 2D/3D Printable Pinhole Projectors | Total Solar Eclipse 2017 (nasa.gov)
How To Suggestions / Examples

➢ How to Make Binocular Solar Filters (Wyck Hoffler)
➢ Making a Solar Filter (Baader)
How to Make Binocular Solar Filters

Courtesy of BAS Member Wyck Hoffler

As to solar filters for binoculars (and anything, even eyes alone), the foremost consideration is SAFETY—as all amateurs know.

So, the first matter is to purchase assured safety sheet film from known sources, like Thousand Oaks, Baader, Orion, and others.

Next, I select and purchase gray PVC with inside diameter slightly less than the external diameter of the objective’s cell. This I chuck in lathe and turn the inside diameter to a snug fit over the object cell, before cutting off that piece, and duplicating the second one. Of course, for binoculars, one needs two of everything.

Then I select and purchase gray PVC with inside diameter slightly less that the external diameter of the first. This I turn inside diameter to press fit over the first item. I also make sure that I do not compromise the aperture, but that is really not a problem with the excess light of the Sun.

While a true press fit over the lens cell is probably safe enough, I also bore and tap the first element and use a nylon thumb screw to tighten onto the object cell (does not scar).

Finally I trim a circular piece of solar safe film to fit the outside diameter of the first element. The larger element is then press fitted over the first to hold the film flat, secure, without wrinkle.

The attached images show my filters thus made to fit my old 7x35 binos and my better quality (roof prisms) 10x 28 Zeiss. Higher power is nice but, but even with the small/light Zeiss pair, one needs a post, car door, or something to steady holding by hand. When viewing nature or ball games intermittently in horizontal position, movement is usually not an issue, but trying to watch the Sun at higher elevation tires the arms and motion is annoying.
Making an Inexpensive Filter Cell for BAADER AstroSolar™

The film must be mounted reasonably flat and free of any tension. It is more desirable to have slight wrinkles than to stretch the material, which will damage the optical quality and possibly the coatings. Wrinkles, creases and folds in the material are normal and will not affect the function and performance in any way.

The "Cylinder"

Construct a cylinder out of posterboard to fit over the front aperture of your telescope or dewcap. Start by cutting several long strips of the posterboard approximately 2" wide and wrap those around the lens cell or dewcap until you have 3 or 4 layers. Glue the layers to each other to form a thick, sturdy cylinder approximately 1/4" thick. (Do not glue this to the scope, please!). The finished cylinder should snugly fit over the scope yet slide easily on and off.

Hint: For small aperture telescopes, you might be able to find just the right-sized cardboard tube to fit over the aperture. Simply cut off 2" and use that as your cylinder. If the tube is slightly too large, use an adhesive felt liner or cork pads to make it fit snugly.

The "Filter Cell"

Cut out two rings of posterboard or cardboard with the outer diameters equal to your fabricated cylinder. The inner diameter should correspond to the actual aperture of your telescope. On one side of each ring near the outer edge, attach a number of pieces of double-sided tape.

Now comes the tricky part – how to get the AstroSolar™ film onto the taped ring without wrinkles or ripples. The film must not be scratched. So, put one sheet of Kleenex™ (or other soft tissue) onto a flat table. Tape the tissue onto the table so that it is stretched out evenly and cannot move. Now place a square piece of AstroSolar™ material (slightly larger that the outer diameter of the cardboard rings) onto the piece of soft tissue. Do not tape the film and do not stretch it! Just let it rest relaxed and flat on the tissue.

Now, take one of the cardboard rings with the sticky tape face down and lower it straight down onto the film until the entire ring has made contact with the film. Turn this assembly around and tape the other ring onto the opposite side of the film. Now you can trim away any overhanging parts of the film. Your AstroSolar™ filter should now be free from strain and wrinkles, sandwiched between the two cardboard rings. Finally, glue this "filter cell" assembly onto your prefabricated "cylinder." Lift the filter up to the sky and inspect the cell for light leaks prior to using it on your telescope or binoculars. Use a black felt-tip marker to cover tiny pinholes in the filter material. Now your "do it yourself" filter is ready. Enjoy it!

When covering a larger Newtonian or Schmidt-Cassegrain Telescope for solar observation, it may be that "Less is More"! Do not try to make a filter as large as the telescope aperture. The bigger aperture will be greatly affected by air turbulence, which can ruin fine detail. We suggest that you produce an off-axis filter cell, to observe the sun with a smaller (but much improved) telescope.

Storing Your Filter

It is very important to store your filter safely so that it will not be damaged. If the filter is small enough, we suggest that you use a plastic food storage container with a cover. In addition to protecting the filter material, it will keep the cardboard material from becoming wet and soft.

If your filter is damaged in any way, it must be replaced. DO NOT use if the AstroSolar™ material has any holes or the cell is weakened and will not stay on the telescope.

Please observe the following safety precautions with EVERY solar observation

Prior to each and every solar observation session, check the filter’s fit and, if necessary, tape it to the telescope to prevent slipping. Cover any pinholes with black felt-tip marker.

- NEVER use the filter at the eyepiece. It will burn up in less than a second! It will not filter out the concentrated and very dangerous light energy at the eyepiece end. Unfiltered solar light can and will cause blindness. The filter will ONLY work when attached to the FRONT aperture of a refractor objective, in front of the Schott plate (Schmidt-Cassegrain telescope) or in front of the tube of a Newtonian telescope.

- If you use a binocular, protect both objectives with a filter.

- Be sure that the viewfinder of your telescope is properly covered, either with a solar filter made as described above or with the original dust cover. Unprotected views through your finderscope would have the same catastrophic consequences for your eyes as a look through the main telescope itself.

- A filter made of AstroSolar™ filter material is relatively resistant to breakage in comparison to a glass filter. However, care should be taken with sharp pointed objects. A punctured filter should be thrown away and replaced with a new one (same as with a cracked glass filter).

- Emphasize the importance of safety to those observing with you, especially children. Intentional removing or damaging the filter can endanger their eyesight. This is no place for jokes. Never leave the telescope outside unattended during the daytime!

- We recommend that you tape your filter directly onto your telescope to be sure that it does not come off by accident.

04-02-01
Be safe, and enjoy the eclipse!

Questions