Solar Filters: Ready-made and Homemade

By: Susan Sawyer-Beaulieu
For: RASC Windsor Centre
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Are you ready for Aug. 21st, 2017?

May 10th, 1994
Annular Solar Eclipse
Outline

• Common Solar Filters Types
• Ready-made filters
  • Manufacturers & Materials
• Homemade filters
  • Styles
  • Construction Techniques
  • Materials
• Suggested Reading
Common Solar Filters Types

White Light Filter
- Simply very dark neutral density filter
- Transmits entire visible-light spectrum, but attenuated to safe level for observing; only 0.001% of the sun's light transmitted
- Shows photosphere of the sun

Hydrogen Alpha (Hα) Filter
- Specialized filter
- Transmits one specific wavelength of light, 656.3nm, deep red color of light emitted by hydrogen atoms
- Also attenuate light to safe level for observing; only 0.001% of the sun's light transmitted
Common Solar Filters Types

White Light Filter
- Shows sun’s photosphere, i.e. "surface"

Hydrogen Alpha (Hα) Filter
- Shows sun’s chromosphere
Common Solar Filters Types

White Light Filter

- Visible features:
  - Sunspots
  - Granulation
  - Faculae
  - Limb Darkening
Common Solar Filters Types

Hα Filter
• Visible features:
  • Prominences
  • Flares
  • Filaments
  • Spicules
  • Plages
  • Granulation
  • Faculae
  • Limb Darkening
Ready-Made Filters – Hα Filters/Devices

- Specialized filters that tend to be very expensive
- Available as a separate Hα filter system that mounts on a user’s personal telescope or as a dedicated Hα telescope
Ready-Made Filters – Ha Filters/Devices

• Consist of three parts

1. Energy rejection filter (ERF): removes dangerous radiation which is way outside of the desired band of light, i.e. Hα

2. Etalon: heart of the system; interference-type filter; gives the very narrow bandpass required but "leaks" (i.e. passes) a lot of energy at other wavelengths

3. Blocking filter: removes "spikes" (i.e. light “leaks”) near to the wanted transmission band
Ready-Made Filters – 
Ha Filters

- Manufacturers/Retailers
  - Meade Coronado Solar telescopes (USA), http://www.meade.com/products/coronado.html
  - DayStar Filters (USA), https://www.daystarfilters.com/
  - Thousand Oaks Optical (USA), http://www.thousandoaksoptical.com/halpha.html
  - Manx Precision Optics Solarscopes (UK) http://solarscope.co.uk/products.html
Ready-Made Filters – White Light Filters/Devices

- Thin-film solar filters
- Glass solar filters
- Hershel Wedges
Ready-Made Filters – White Light Filters/Devices

• Herschel Wedges
Ready-Made Filters – White Light Filters/Devices

- Thin-film solar filters
- Glass solar filters
Ready-Made Filters –
White Light Filters/Devices

- Manufacturers/Retailers
    - *AstroSolar Safety Film Solar Filters, Sheets, & Viewing Glasses*
  - Seymour Solar, USA, [https://www.seymoursolar.com/](https://www.seymoursolar.com/)
    - *Glass Solar Filters*
    - *Black Polymer Thin-film Solar Filters, Sheets, & Solar Viewing Glasses*
    - *Glass Solar Filters*
    - *SolarLite Thin-film Filters & Sheets*
    - *Silver-Black Polymer Thin-film Sheets & Solar Viewing Glasses*
Ready-Made Filters – White Light Filters/Devices

• Manufacturers/Retailers
    • Ident-view Premium Glass Solar Filters (Class “A”, “B” & “C”)
  • Astrozap, USA, https://www.astrozap.com/scripts/prodList.asp?idCategory=30
    • Baader AstroSolar Safety Film Solar Filters
    • Glass Solar Filters
    • Black Polymer Thin-film Solar Viewing Glasses
    • Black Polymer Thin-film Solar Filters, Sheets & Viewing Glasses
Ready-Made Filters – White Light Filters/Devices

• Manufacturers/Retailers (cont.)
  • Spectrum Telescope, USA, http://spectrumtelescope.com/
    • Glass Solar Filters
    • Black Polymer Thin-film Solar Filters & Viewing Glasses
  • Orion Telescopes & Binoculars, USA,
    • Glass Solar Filters (made by J.M.B. Inc?)
    • Baader AstroSolar Safety Film Solar Filters
    • Black Polymer Thin-film Solar Filters & Viewing Glasses
  • Kendrick Astro Instruments, Canada,
    http://www.kendrickastro.com/solarfilters.html
    • Baader AstroSolar Safety Film Solar Filters
## Ready-Made Filters – White Light Filters - Guarantees

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<tr>
<td>Glass Solar Filters</td>
<td>n.a.</td>
<td>15 years</td>
<td>?</td>
<td>Class “A”: Lifetime Class “B”: 8 years Class “C”: Lifetime</td>
<td>90 days</td>
<td>30 days</td>
<td>n.a.</td>
<td>1 year</td>
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<td>AstroSolar Safety Film Filters</td>
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<td>n.a.</td>
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<td>30 days</td>
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<td>SolarLite Thin-film Filters</td>
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<td>15 years</td>
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<td>Silver-Black Polymer Thin-film Filters</td>
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<td>10 years</td>
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<td>Black Polymer Thin-film Filters</td>
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Homemade Filters – Thin-film Based

- Availability of thin-film filter materials makes do-it-yourself solar filters easy and affordable.
- Appearance of sun through solar filters varies with the material.

Sun through Baader AstroSolar Safety Film

Typical Sun through black polymer thin-film, glass solar filters, etc.
Homemade Filters –

Styles

Cap-style
- Slips over end of telescope

Plug-style
- Slips into end of telescope
Homemade Filters – Construction Techniques

• **Instructions for “do-it-yourself” filters available on-line**, for example:
  - “How to make an inexpensive filter cell” (http://astrosolar.com/en/information/how-to/how-to-make-an-inexpensive-filter-cell/)
  - “How to make your own objective solar filter for your camera, telescope, spotting scope or binocular” (http://astrosolar.com/en/information/how-to/how-to-make-your-own-objective-solar-filter-for-your-camera-or-telescope/)
  - “Constructing a Solar Filter for Binoculars with Baader AstroSolar Film” (http://astrosolar.com/en/download/how-to-make-your-own-solar-filter-for-binoculars/)
  - Joe Cali’s “Mounting A Thin Film Solar Filter” (http://joe-cali.com/eclipses/EQUIPMENT/solarfilters.html)
Homemade Filters – Construction Techniques

• Instructions for “do-it-yourself” filters, example:
  “Making an inexpensive filter cell for BAADER AstroSolar TM Safety Film”

Here You are invited to download a pdf file (140 kByte) with the description of “Constructing a Solar Filter for Binoculars with Baader Astro Solar Film”.

Making an inexpensive filter cell for BAADER AstroSolar TM Safety Film

The film must be removed from the film reel and be free of any tension - only then will the outer circumference of your Telescope eyepiece or eyepiece. To achieve this, cut a whole sheet of cardboard, approx. 5 cm x 10 cm (2 inches x 4 inches). Wrap a piece of cardboard around your eyepiece stake and glue one end onto the other.

Peel a second and third layer of cardboard in the same manner until you have manufactured a filter cell of cardboard, approx. 4 cm x 10 cm. Wash out the largest “cylinder” well and cut a piece of your Astroturf into the tube and that it is easy to slide it on end the telescope.

Note: For telescopes with small apertures one could try to find an appropriate “adapter tube” and cut off a piece of paper. Approx. 5 - 10 cm length. The diameter should be determined by using adhesive felt liner or by giving the cardboard into the paper tube.

The “Filter Cell”

Cut out two rings of cardboard (each having 1.5 - 2 mm thicknesses). The outer diameter of the ring - stripped cardboard should match the outer diameter of your telescope filter. The inner diameter should correspond to the total aperture of the instrument (installation may vary depending on the type of objective). (Because of the requirement for a certain window size this was frequently a compromise).

After having prepared the rings, both should be equipped with adhesive strips with a tape of the width of the double tape along the outer circumference of both rings. Now comes the tricky part: how to get the Solar film onto the “filter cell” without wrinkles or bubbles. The film must not be stretched.

Here are some hints for this step:
- Wrap the filter cell with Astroturf and carefully slide it onto the “filter cell” to avoid any wrinkles or bubbles.
- If the film is not properly applied, carefully remove it and start over.
- If the film is removed, carefully reapply it to avoid any wrinkles or bubbles.

Finally, your homemade filter is ready to use. If you want to use it, you should also consider the following:
- Keep the filter out of direct sunlight to avoid any damage to the film.
- Store the filter in a cool, dry place.
- Avoid exposing the filter to extreme temperatures.

By following these instructions, you can create a simple and effective solar filter for your telescope at a fraction of the cost of commercial filters. Have fun!”
Homemade Filters – Construction Techniques

• Making an inexpensive filter cell:

The “Cylinder”  The “Filter Cell”
Homemade Filters – Materials

- Foam core (black; white)
- Matte board
- Bristol board
- Corrugated cardboard
- Craft foam
- Empty cardboard “cans”
- Wood veneering
Homemade Filters – Materials

- 6-inch “cell” in progress
- Cap-style cell made with a foam core ring and laminated wood veneer outer “cylinder” (wood veneer layers glued to foam core)
Homemade Filters – Materials

- 80mm solar filter with Baader AstroSolar Safety film
- Cap-style filter made with matte board front face ring mounted on a laminated wood veneer “cylinder”
- Filter “cell” consists of Baader thin-film sandwiched between two Bristol board rings (black ring inside; white ring outside); secured in place using double-sided sticky tape
- Filter “cell” can be easily removed from “cylinder” and thin-film replaced if damaged.
Homemade Filters – Materials

- 4in (100mm) solar filter with Baader AstroSolar Safety film
- Cap- or plug-style filter made out of end of empty cardboard can
- Filter “cell” Baader thin-film sandwiched between two Bristol board rings (black ring inside; white ring outside); secured in place using double-sided sticky tape
- Filter “cell” can be easily removed from “cylinder” and thin-film replaced if damaged.
Homemade Filters – Materials

• Off-axis black polymer thin-film solar filter, for 80mm SCT, with foam core board front face mounted on laminated cardboard “cylinder”

Filter pictures courtesy of Mahayarrah-Starr Livingstone
Homemade Filters –
Materials

- 80mm refractor filter made from a PVC pipe cap
- 50mm finder scope filter made using a plastic cap from a spray can

Filter pictures courtesy of Mahayarrah-Starr Livingstone
Homemade Filters – Materials

- Baader AstroSolar Safety film mounted in an embroidery hoop

Closing

• There is more than one way to build a solar filter… easily and affordably
• Collect your materials and start building…

March 7th, 1970
Total Solar Eclipse
References & Suggested Reading


Canadian Retailers of Baader AstroSolar Safety Film