



# *Solar Filters: Ready-made and Homemade*

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For: RASC Windsor Centre

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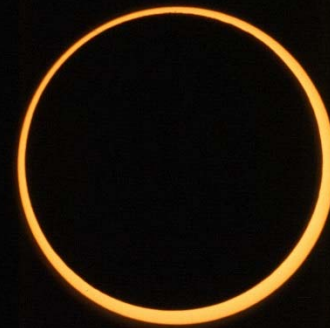


*Are you ready for Aug. 21<sup>st</sup>, 2017?*

May 10<sup>th</sup>, 1994  
Annular Solar Eclipse



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## *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 (H $\alpha$ ) 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 (H $\alpha$ ) Filter**

- Shows sun's chromosphere





# *Common Solar Filters Types*

## **White Light Filter**

- **Visible features:**
  - **Sunspots**
  - **Granulation**
  - **Faculae**
  - **Limb Darkening**





# *Common Solar Filters Types*

## **H $\alpha$ Filter**

- **Visible features:**
  - **Prominences**
  - **Flares**
  - **Filaments**
  - **Spicules**
  - **Plages**
  - **Granulation**
  - **Faculae**
  - **Limb Darkening**





## *Ready-Made Filters – H $\alpha$ Filters/Devices*

- Specialized filters that tend to be very expensive
- Available as a separate H $\alpha$  filter system that mounts on a user's personal telescope or as a dedicated H $\alpha$  telescope







## *Ready-Made Filters – H $\alpha$ 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. H $\alpha$
  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 – H $\alpha$ Filters*

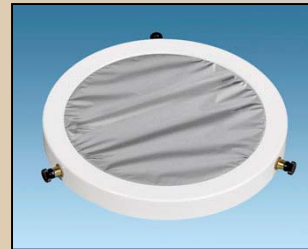
- **Manufacturers/Retailers**
  - Meade Coronado Solar telescopes (USA), <http://www.meade.com/products/coronado.html>
  - Lunt Solar Systems (USA), <https://luntsolarsystems.com/>
  - DayStar Filters (USA), <https://www.daystarfilters.com/>
  - Thousand Oaks Optical (USA), <http://www.thousandoaksoptical.com/halpha.html>
  - Manx Precision Optics Solarscopes (UK) <http://solarscope.co.uk/products.html>
  - Baader Planetarium (Germany), [http://www.baader-planetarium.com/en/solar-observation/special-solar-filters/baader-d-erf-energy-rejection-filter-\(75---180mm\).html](http://www.baader-planetarium.com/en/solar-observation/special-solar-filters/baader-d-erf-energy-rejection-filter-(75---180mm).html)





# Ready-Made Filters – White Light Filters/Devices

- Thin-film solar filters
- Glass solar filters
- Herschel Wedges

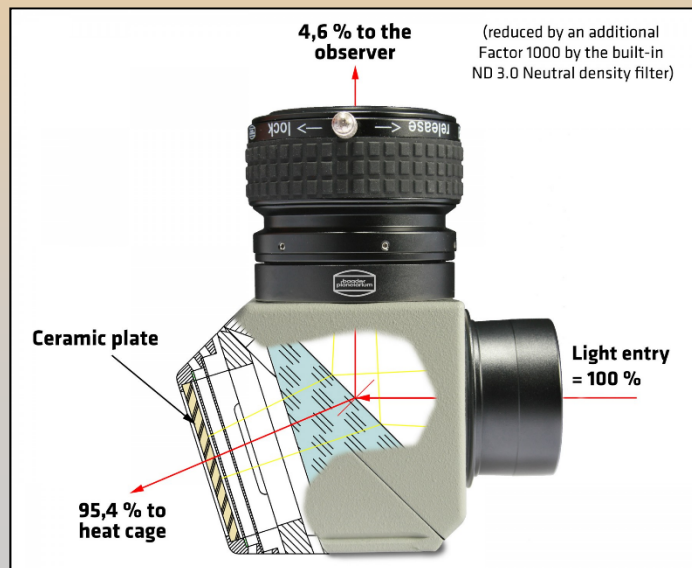




# Ready-Made Filters – White Light Filters/Devices

- **Herschel Wedges**

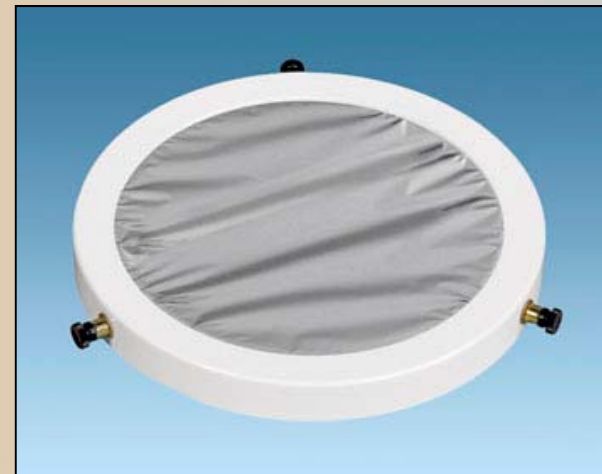
- **Baader Planetarium, Germany**, <http://www.baader-planetarium.com/en/solar-observation/safety-herschel-prism.html>
- **Lunt Solar Systems (USA)**, <https://luntsolarsystems.com/product/white-light-solar-wedges/>





## *Ready-Made Filters – White Light Filters/Devices*

- Thin-film solar filters
- Glass solar filters





# *Ready-Made Filters – White Light Filters/Devices*

- **Manufacturers/Retailers**
  - Baader Planetarium, Germany, <http://www.baader-planetarium.com/en/solar-observation/baader-solar-filter.html>
    - *AstroSolar Safety Film Solar Filters, Sheets, & Viewing Glasses*
  - Seymour Solar, USA, <https://www.seymoursolar.com/>
    - *Glass Solar Filters*
    - *Black Polymer Thin-film Solar Filters, Sheets, & Solar Viewing Glasses*
  - Thousand Oaks Optical, USA, <http://www.thousandsoptical.com/solar.html>
    - *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**

- J.M.B. Inc., USA, <http://www.identi-view.com/welcome.html>
  - *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*
- Rainbow Symphony, USA,  
<https://www.rainbowsymphonystore.com/collections/eclipse-glasses-safe-solar-viewers>
  - *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,  
[http://www.telescope.com/catalog/search.cmd?form\\_state=searchForm&siteCode=US&keyword=solar+filters](http://www.telescope.com/catalog/search.cmd?form_state=searchForm&siteCode=US&keyword=solar+filters)
    - *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*





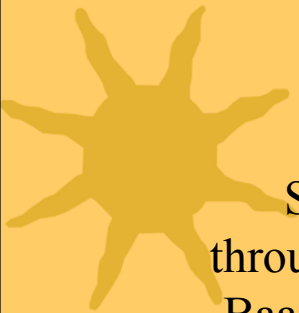
# *Ready-Made Filters – White Light Filters - Guarantees*

	Baader	Thousand Oaks	Seymour Solar	J.M.B. Inc.	Spectrum Telescope	Orion	Rainbow Symphony	Astrozap
Glass Solar Filters	n.a.	15 years	?	Class "A": Lifetime Class "B": 8 years Class "C": Lifetime	90 days	30 days	n.a.	1 year
AstroSolar Safety Film Filters	?	n.a.	n.a.	n.a.	n.a.	30 days	n.a.	1 year
SolarLite Thin-film Filters	n.a.	15 years	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Silver-Black Polymer Thin-film Filters	n.a.	10 years	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Black Polymer Thin-film Filters	n.a.	n.a.	?	n.a.	90 days	30 days	?	n.a.



## *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.

Evan Zucker



# *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™ Safety Film”

BAADER PLANETARIUM GmbH

[order form](#) [Filter Cell Mount](#) [Interferometric Protocol](#) [tech. info](#)

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

**Making an inexpensive filter cell for BAADER AstroSolar™ Safety Film**

The film must be mounted flat and free of any tension - Only this will provide first class Solar images. The quality of this patent pending material is so high that any wrinkles or strain on the film will lead to a very noticeable deterioration of optical quality.

When mounted carefully, AstroSolar™ Film can reach the quality levels of truly precision polished glass plates (not to compare with several glass filters made of ordinary window glass w/o ever having seen a polishing machine).

**The “Cylinder”**

At first you have to produce a cylinder of cardboard, to exactly match the outer circumference of your Telescope tube or dew cap. In order to achieve this, cut a whole number of cardboard layers, approx. 5 - 6cm (2 inches) wide. Wrap one piece of cardboard around your dew cap or lens cell and glue one end onto the other.

Fasten a second and third a.s.f. layer of cardboard in the same manner, until you have manufactured a stiff roll of cardboard, approx. 4 - 5mm thick. Watch out that the finished “cylinder” will slide snugly over the tube and that it will be easy to slide it on and off the telescope.

**Hint:** For telescopes with smaller aperture one could try to find an appropriate “poster tube” and cut off a piece of approx. 5 - 6cm length. Variations in diameter could be equalized by using adhesive felt liner or by gluing Kork pads into the paper tube.

**The “Filter Cell”**

Cut out two rings of cardboard (each having 1 - 2mm thickness). The outer diameter of the ring - shaped cardboard should match the outer diameter of your fabricated “cylinder”. The inner diameter should correspond to the actual aperture of the instrument (some mm less may improve on image quality, due to hiding sunken edges on imported objective lenses).

After having prepared two such rings, both should be equipped on adjacent sides with a large number of small cutouts of double tape along the outer circumference of both rings. Now comes the tricky part - how to get the Solar film onto the taped ring w/o wrinkles or ripples. The film must not be scratched -

Take the first cardboard ring and insert it straight down onto the film until the double tape clipping made contact with the film. Turn this package around. The other ring onto the opposite side. Cut away the overleaf. Now your AstroSolar™ film should be mounted free of strain and wrinkles between the two cardboard rings. Finally glue this “Filter Cell” onto the prefabricated “Cylinder”. Your “Do it Yourself” filter is ready. Buy it - you just saved about US\$ 100 - the filter cell alone.

**observation**

Essary - tape it to prevent slipping. Mount of the Schmidt-plate (SC-owners) or not inside your instrument and inside the viewfinder of your telescope is enough your finder scope would have the itself!

r. However, care should be taken with intentionally removing or damaging scope outside unattended during the

<http://www.baader-planetarium.com/sofi/fc/sofi/sofi.html>[2012-02-24 9:42:18 AM]

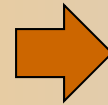
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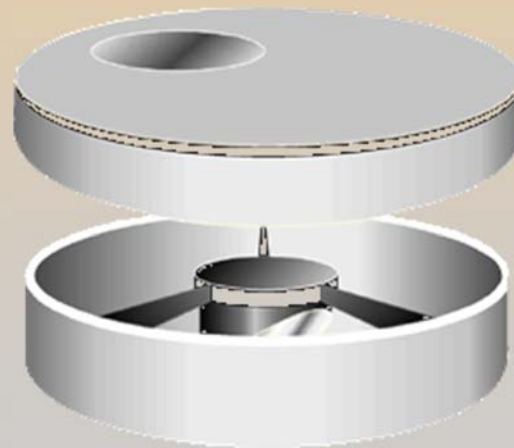
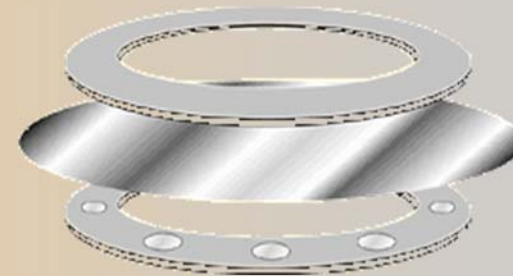
# *Homemade Filters – Construction Techniques*

- Making an inexpensive filter cell:

The “Cylinder”



The “Filter Cell”





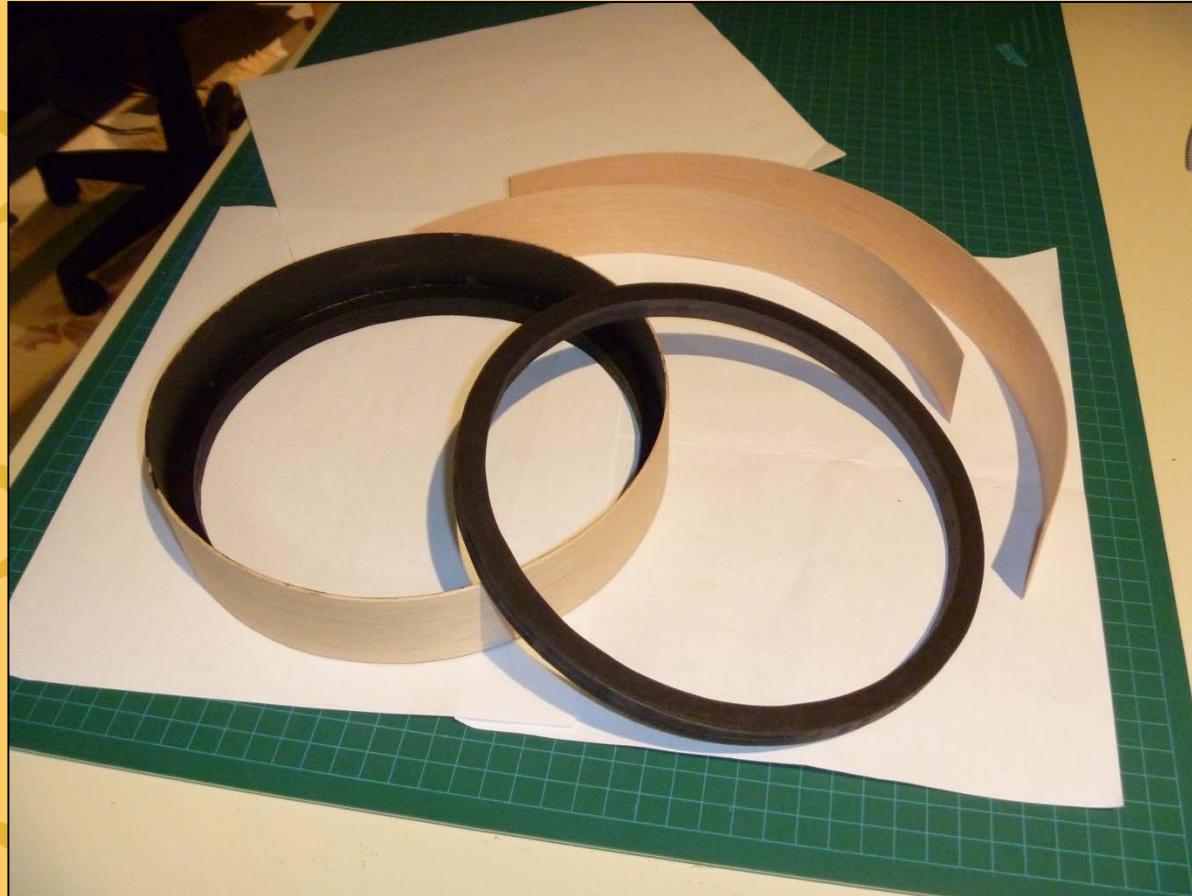
# *Homemade Filters – Materials*



- 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



200mm SCT filter - foamcore and cardboard



200mm SCT filter - inside painted black -  
laminated cardboard retainer ring



- 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 Mahayarrahh-Starr  
Livingstone*



# Homemade Filters – Materials

80mm refactor filter - foamcore ring inside held with silicone glue



80mm Refactor filter made from PVC pipe cap



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

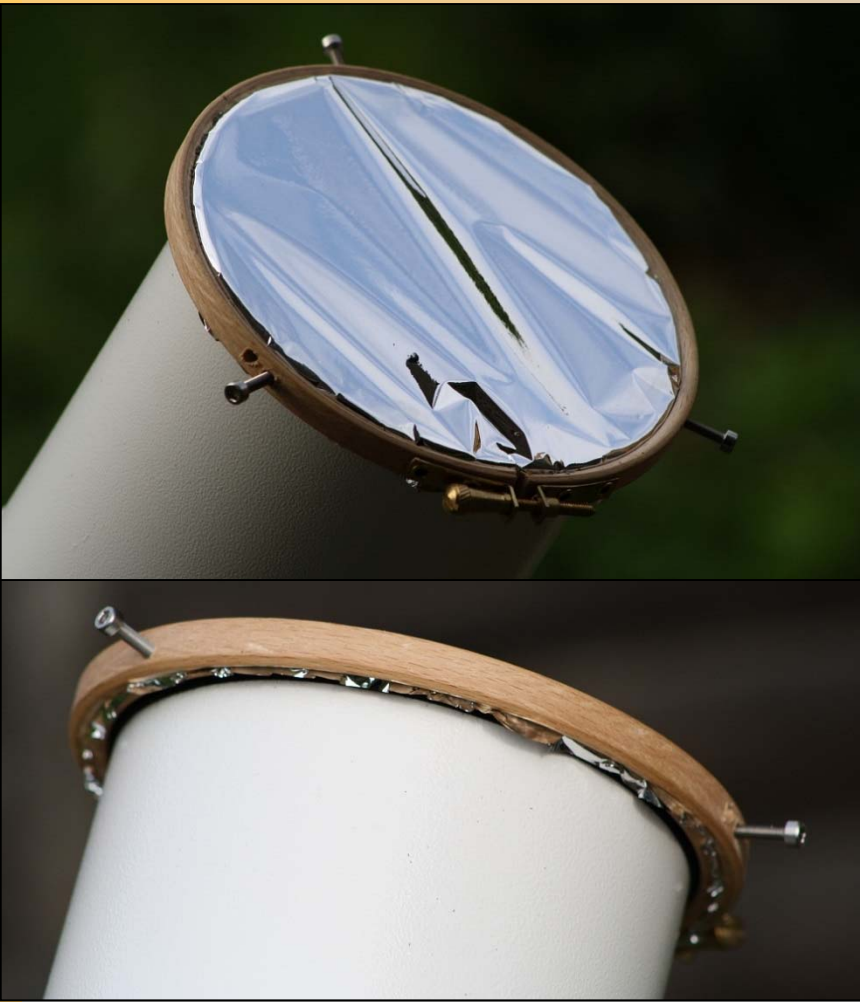


50mm Finder Scope filter made from plastic spray can top

*Filter pictures courtesy  
of Mahayarrahh-Starr  
Livingstone*



## *Homemade Filters – Materials*



- Baader AstroSolar Safety film mounted in an embroidery hoop

*Picture source:  
<http://www.cloudynights.com/topic/423396-solar-film-options/>*



## *Closing*

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



March 7<sup>th</sup>, 1970  
Total Solar  
Eclipse



## *References & Suggested Reading*



- King, Bob, Blank Sun? Faculae to the Rescue!, SkyandTelescope.com, July 23, 2014, <http://www.skyandtelescope.com/observing/celestial-objects-to-watch/how-to-see-solar-faculae-072320143/>
- King, Bob, Observer's Guide to the H-alpha Sun, SkyandTelescope.com, September 23, 2015, <http://www.skyandtelescope.com/observing/guide-to-observing-the-sun-in-h-alpha092321050923/>
- Solar Physics Website of NASA's Marshall Space Flight Center Solar Physics Group, <https://solarscience.msfc.nasa.gov/>





## *Canadian Retailers of Baader AstroSolar Safety Film*

- Kendrick Astro Instruments,  
<http://www.kendrickastro.com/solarfilters.html>
- KW Telescope, <https://www.kwtelescope.com/baader-astrosolar-a4-nd5-0-safety-film.html>

