

Instruction Manual and Tips + Tricks for the

Baader Cool Ceramic (Safety)- Herschel – Solar Prism



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Instruction Manual

Baader Cool Ceramic Safety Herschel-Prism



The new BAADER 2" **COOL-CERAMIC SAFETY** Herschel-Prism for white light Solar observation, including ceramic Solar finder screen and 2" ClickLock® eyepiece clamp.

There is no better – and most of all no safer way for unparalleled visual and photographic contrast for white light Solar observation.



TABLE OF CONTENTS

Chapter	Contents	Page
1.	Safety instructions (important – read by all means for your own safety!)	3
1.1.	Additional important information	3
2.	Included in delivery	4
2.1.	Visual version	4
2.2.	Photographic version	4
3.	The optical train within the Herschel Prism – general description.....	4
3.1.	The pre-mounted filters	5
4.	Observation techniques	6
4.1.	Visual observation	7
4.2.	Tips for visual observation	7
4.3.	Photographic observation	8
4.4.	Tips for photographic observation	9
4.5.	The Herschel-Prism in combination with the Baader Astro T2 System™	10
5.	The Herschel-Prism for experts	11
6.	Technical data of the Herschel-Prism	12
7.	Weblinks	12



1. SAFETY INSTRUCTIONS

Solar observation in white light (the Solar photosphere – Sun spots, Solar granulation and Solar faculae) is one of the most interesting activities in astronomy. However this kind of observation may be dangerous, if the device is being handled incorrectly. Improper use may cause damage to the eye – even complete blindness. For this reason please read these safety instructions carefully.

The Baader Safety Herschel-Prism was designed specially for Solar observation with refracting telescopes (also see below). Any commercial refractor with an aperture ranging from 90 to 110mm (e.g. Celestron Omni-XLT series refractors) will already show all visible Solar phenomena accessible to the Astro amateur.

The Baader Safety Herschel-Prism is a professional accessory for the serious amateur. Using it requires responsible handling.

Following precautions apply for visual observation:

- Do not use this product if you do not feel well informed about possible hazards and the consequences of wrong handling. If you have questions, please contact us.
- Never remove the pre-mounted neutral-density filter (#2458332) 1:1000 (OD 3.0), except for eyepiece projection photography (see pages 5-6).
- Always mount the Baader Safety Herschel-Prism onto the focuser before aiming the telescope at the Sun.
- If more than one telescope is attached to your mount, be sure that the lenses of all other optics – except for the one utilizing the Baader Safety Herschel-Prism – are being carefully and securely covered to exclude any Solar radiation entering unnoticed into any other telescope or finder scope pointing towards the Sun.
- Never will you leave this instrument – or any telescope – unattended during the day-time respectively during Solar observation, especially with inexperienced observers and/or CHILDREN.
- Children especially must be prevented from using this instrument on their own, without expert supervision! This device is not a toy. It is not intended to be used by children under 13 years of age.



The Baader Safety Herschel-Prism features a ceramic window which works as Solar finder screen and “heat cage” at the same time. Due to the closed design of the magnesium prism body there is no dangerous amount of light exiting the Baader Safety Herschel-Prism. Due to this improvement the Herschel-Prism evolves into a safe device for Solar observation – even and especially for educational purposes.

Following precautions apply for photographic observation:

- Never remove the pre-mounted neutral-density filter (#2458332) 1:1000 (OD 3.0) for prime focus imaging (see page 8)
- When checking focus during focal- or eyepiece projection photography be sure, that the image of the sun is not too bright. In case the image appears too bright, use a neutral density filter (#2458245 1:64 OD=1.8) and hold it between your eye and the camera.

1.1. Additional important advice

1. Never mount any filter into the front 2” nosepiece of the Baader Safety Herschel-Prism. During Solar observation the full energy of the Sun reaches the Herschel-Prism unabated. For this reason any additional filtering or reduction of light must never happen in front of the Herschel-Prism since the heat load would be so large that any filter mounted in this place would be shattered immediately (in the focus of an unfiltered 6” refractor at f/10 to f/15 temperatures up to 600°C are being measured).
2. In case of using the photographic version of the Herschel-Prism for visual application the user must make absolutely sure that the neutral density filter OD 3.0 (#2458332) is mounted in the correct place directly above the Herschel-Prism in the beam of light that is exiting from the Herschel-Prism into the eyepiece. This ensures that no harmful amount of energy can enter into the eye of the observer. However it will be necessary to further reduce Solar light for reaching comfortable brightness. This is being achieved either by adding a Solar Continuum

Instruction Manual

Baader Cool Ceramic Safety Herschel-Prism



filter, alternatively by using appropriate neutral density filters of the photographic version or by using a polarizing filter as explained on page 7/8.

3. The Baader Safety Herschel-Prism is an accessory, which is to be used in combination with refracting telescopes only. Any other optical designs (like Newton, SC, MAK and so on) use optical or mechanical parts near the focal plane, which will be destroyed by the heat of solar radiation. If you want to utilize any reflective telescope for solar observation, shield the front aperture with our patented Baader AstroSolar safety film. You will find all information on AstroSolar safety film on our website:
<http://www.baader-planetarium.de/sektion/s46/s46.htm>
4. Never use welding glasses, emulsion film or similar auxiliary aids for filtering Solar light. All these means are not designed to fully shield off dangerous radiation of the IR or UV part of the spectrum.

Please note: Baader Planetarium GmbH cannot be held liable for consequences of wrong handling of the Baader Safety Herschel-Prism during Solar observation.

If you do not understand any part of this manual or if you have questions regarding the handling of the Baader Safety Herschel-Prism, please contact us: Tel.: 08145-8802, Email: kontakt@baader-planetarium.de.

2. INCLUDED IN DELIVERY

The Baader Safety Herschel-Prism contains the following accessories:

2.1. Visual version (# 295 6500 V):

- Baader Safety Herschel-Prism with 2" nosepiece and 2" Baader ClickLock® eyepiece clamp
- #2458332 2" Neutral Density filter OD 3.0 (1:1000, transmission 0.01%)
- #2458391 2" Baader Solar Continuum filter

Both filters are pre-mounted above the Herschel-Prism itself (see page 5-6). If you wish to observe with 1¼" eyepieces, use a reducer adapter 2" to 1¼" or remove the 2" ClickLock® eyepiece clamp and exchange it against optional Astro T-2 system part #27 (#1508035 2"/T-2 thread adapter and 2" filter holder) and add one of several optional 1¼"/T-2 eyepiece holders. For various 1¼"/T-2 eyepiece holders see our website:

<http://www.baader-planetarium.de/sektion/s08/s08.htm>

2.2. Photographic version (# 295 6500 P):

- Baader Safety Herschel-Prism with 2" nosepiece and 2" Baader ClickLock® eyepiece clamp
- #2458332 2" Neutral Density Filter OD 3.0 (1:1000, transmission 0.01%),
- #2458391 2" Baader Solar Continuum filter
- additional one of each 2" Neutral Density filters, OD 0.6 (#2458321), 0.9 (#2458322) and 1.8 (#2458331).

The Baader Solar Continuum- and the Neutral Density filter OD 3.0 are pre-mounted into the prism-body in the as-delivered-condition.

3. THE OPTICAL PATH WITHIN THE SAFETY HERSCHEL-PRISM

The graphic on page 5 shows the optical path within the Baader Safety Herschel-Prism. The Solar light enters into the prism body from the right and falls onto the 45° inclined first prism surface. Approx 4.6% of Solar light are being reflected into the eyepiece or camera respectively. The much larger percentage of light (95.4%) exits the rear face of the prism and would form a focal point outside of the prism body.

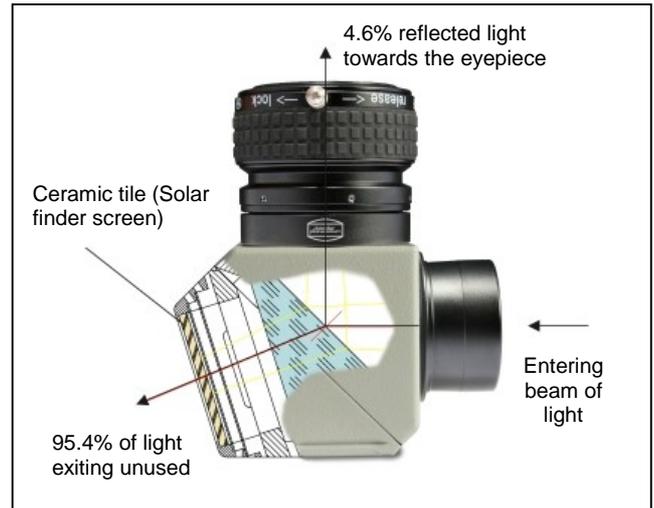
The exiting beam in the Baader Safety Herschel-Prism is fed into a separate “heat cage” which is sealed with a special heat-absorbing ceramic tile. Like on a space shuttle the ceramic tile traps the radiant energy without overheating its surroundings. The body of the Baader Safety Herschel-Prism is closed on all sides which prevents any danger of contacting direct Sunlight, making it safe for educational work. Since the “heat cage” is separated from the prism body and only connected with four screws, there is virtually no heat distribution extended into the prism itself.

The translucent ceramic tile also acts as projection screen showing an unfocused image of the Sun. Aiming the telescope at the Sun is now easier than ever before.

The 2" ClickLock® clamp securely clamps any 2" eyepiece or 2"/1¼" reducer with only the small rotation of a lever. Change eyepieces with only one hand even in winter with heavy gloves.

IMPORTANT ADVICE:

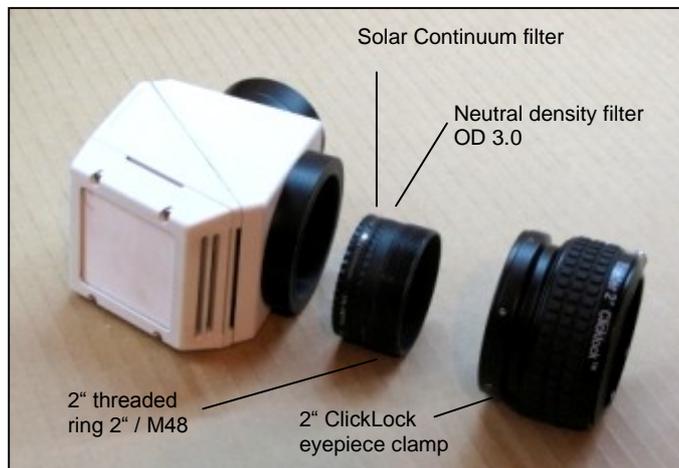
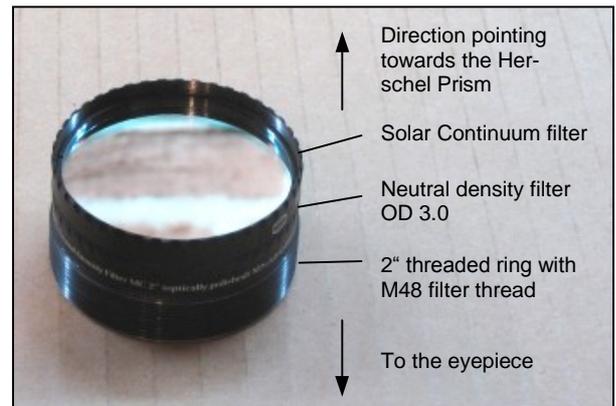
Due to production standards, the 2" nosepiece in front of the Baader Safety Herschel-Prism features a 2" (M48) filter thread. However - never attempt to mount any 2" filter in front of the Herschel-Prism! Any filter mounted into the full beam of Solar energy so near to the focus will become extremely hot and will be damaged within seconds (see safety advice, page 3). Each and every filter must be mounted above the exiting side of the prism.



3.1. The pre-mounted filters in the prism body

Both versions of the Baader Safety Herschel-Prism (visual and photographic) are equipped with two 2" filters mounted above the exiting side of the Herschel-Prism. Mounted directly above the prism is a 2" Solar-Continuum filter (#2458391), with the strongly reflecting surface facing the prism. Above that – i.e. directly in front of the eyepiece or camera – a neutral density filter OD 3.0 (1:1000) #2458332 serving as energy reducer. This orientation of filters ensures a Solar image free of unwanted reflections.

The Illustration to the right exemplifies the filter arrangement.



For changing filters unthread the 2" Click Lock® clamp from the prism body. Now separate the connecting threaded ring 2"/M48. This ring serves as connecting element to attach the 2" Click Lock® clamp onto the prism body and additionally as filter holder for one or two standard 2" filters.

The 2" Solar Continuum filter may be removed and exchanged against another neutral density filter. As detailed earlier (page 3), the OD 3.0 filter #2458332 must only be removed during photographic observation and exchanged against one of the other neutral density filters supplied with the photographic version of the Baader Safety Herschel-Prism to achieve shortest possible exposure times.

Instruction Manual

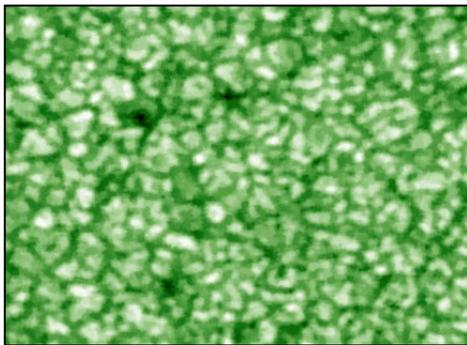
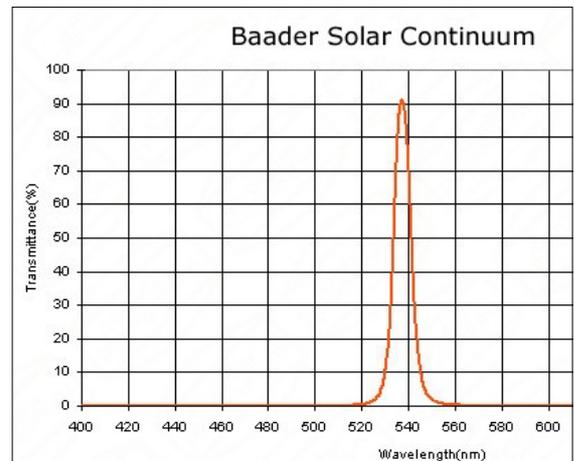
Baader Cool Ceramic Safety Herschel-Prism



The **Solar Continuum filter** is a true narrowband filter featuring 10nm half-bandwidth (HBW) at the passband of 540nm at the same time supplying maximum spectral transmission. This has following advantages for Solar observation:

Most achromatic doublet objectives used in Astronomy are not corrected equally well across the full visual spectrum (actually they have a noticeable color error). For such lenses the Solar Continuum filter isolates the very spectral range where these objectives are well corrected. This will yield best possible contrast and sharpness for economy refractors and enable much higher magnifications.

Additionally Solar granulation is most contrasty in that very spectral range around 540nm.



At the same time, the Baader Solar Continuum filter greatly improves seeing conditions by supplying a steadier Solar image because the short portion of the Solar spectrum below 535nm is being blocked (thermally induced seeing effects become less prominent with longer wavelengths of light).

When using apochromatic (fully color corrected) APO-refractors (e.g. Astro Physics, TEC, Zeiss) the Solar Continuum filter may be removed, in order to observe the Sun in integral white light with the same contrast as is only achievable using the Solar Continuum filter when observing with ordinary achromates.

4. OBSERVATION TECHNIQUES

In case you acquired a Baader Safety Herschel-Prism around 2010 it will enable you to observe a complete Solar cycle stretching approximately across the next 11 years. At the moment, the Sun appears virtually "blank". However the amount of Sun spots should greatly increase within the year 2010 to reach a climax during maximum activity, approximately 2015/2016.

Tips and Tricks:

Especially when observing the Sun, seeing plays an important role because the atmosphere heats up much more during the day especially in summer.

Depending on the location there is a specific daily cycle of seeing conditions normally from better to worse and back. According to experience, there are two preferable observation windows during the day – namely in the early morning before the atmosphere gets heated up and late in the afternoon (before sunset) while the atmosphere is slowly and continuously cooling down.

Important also is the type of landscape overlooked with the telescope. When looking over territory abundantly covered with vegetation (parks, forrests) or large lakes or sea, seeing conditions will be much improved compared to looking over "chaotic" terrain like city-rooftops. For regular repeated Solar observation it is important to register the "seeing cycle" for the chosen location.

Two additional considerations in order to improve seeing conditions – i.e. image quality:

- Using the Solar Continuum filter as detailed above
- Every time when not observing, the optical axis of the telescope should not be facing the Sun, in order to enable the air trapped within the telescope as well as the Herschel-Prism to cool down.

4.1. Visual observation

- Limb darkening

Limb darkening of the Sun is a constant Solar phenomenon and immediately visible when aiming the telescope at the Sun. Limb darkening is caused by the fact that the Sun consists of hot gas whose temperature is reducing towards the surface. Looking at the middle of the Sun means to look onto the hottest and deepest region. Looking at the edge however shows less dense and consequently less bright regions. Were the Sun a solid body, no limb darkening could be observed.

- Sun spots

Sun spots consist of a core region (Umbra) and a brighter surrounding region (Penumbra). Sun spots are cooler (approx. 8000°C) than the undisturbed Solar face. At this locations magnetic storms are bursting through the granulated photosphere.

All Sun spots go through a detailed cycle – normally from a small single spot evolving into a complex group of spots developing distinct magnetic north and south poles. Changes in these complex groups are the fastest moving changes observable in the Solar system. Complex changes may take just minutes, making the Solar observation in white light so very interesting.

Additional phenomena:

- Light bridges
- Umbral dots
- Penumbra filaments
- Schuelen – Wilson phenomenon

- Photospheric faculae

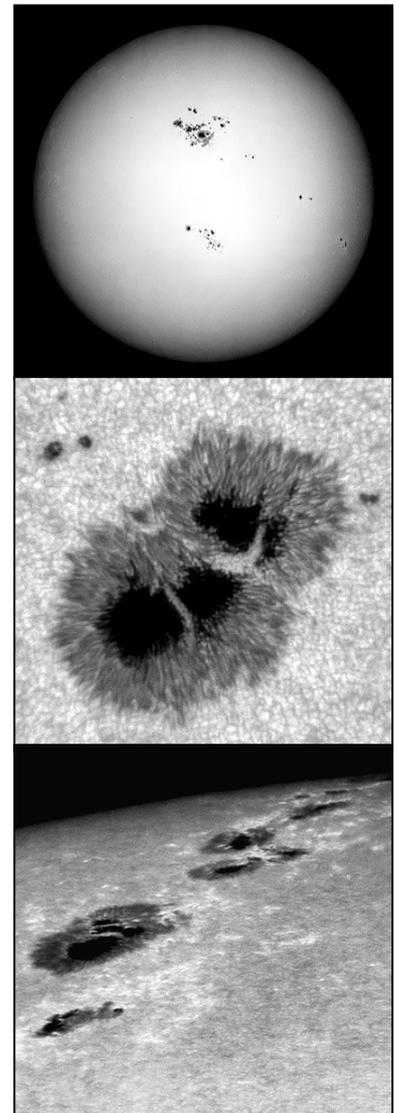
Faculae are being recognised as bright areas within the Solar surface and usually are grouped around Sun spots. These faculae regions are hotter than the rest of the Solar photosphere. During observation in integral light with a Herschel-Prism such bright regions are mainly visible near the limb of the Sun, since the area appears darker than the central regions (see page 11)

4.2. Tips for visual observation:

- Check for correct filtering:

If the Solar image appears too bright, f.e. when using a short focal refractor, when using very low magnification or after having removed the Solar Continuum filter (so that only the OD 3.0 filter remains in the beam of light) it is mandatory to add an additional neutral density filter instead of the Solar Continuum filter. We offer three additional neutral density filters, OD 0.6 / 0.9 / 1.8 – each being available in 2" or 1¼" size in order to reach a convenient brightness of the Solar image. See filter selection on our website:

<http://www.baader-planetarium.de/sektion/s39/s39.htm>



Instruction Manual

Baader Cool Ceramic Safety Herschel-Prism



- Continuous variation of brightness using Baader Polarising filters

The light reflected from the Herschel-Prism surface is already partly polarized. For this reason a single polarizing filter can be mounted directly onto the 1¼" or 2" nosepiece of any eyepiece allowing to vary the image brightness just by rotating the eyepiece.

This allows an exceedingly easy way to adjust brightness for any observing conditions, be it summer or winter, clear or partially overcast sky, focal ratio of telescope and eyepiece magnification. 2" and 1¼" Single Polarizing filters can be found on our website:

<http://www.baader-planetarium.de/sektion/s38/s38.htm>



- Binocular Solar observation

The Baader Safety Herschel-Prism in principal enables binocular vision. The "stereo" vision of the Sun – for instance using our Maxbright Binocular viewer is a very special experience as the Sun appears stereoscopic. We will gladly guide you to find out if and how you can use a binocular viewer in combination with your telescope and the Baader Safety Herschel-Prism.

4.3. Photographic observation

Solar photography is divided into prime focus imaging and Solar projection photography. In any case the sensor in use today is the CCD chip, chemical emulsion photography has virtually disappeared. Phenomena observed are the same as detailed in chapter 4.1.

- Prime focus imaging (= direct connection of CCD or DSLR-camera body without camera lens)

Prime focus imaging is being applied, when the complete Sun is to be imaged. As shown in the image to the right the camera body is being connected onto the Baader Safety Herschel-Prism using a standard 2"/T-2 nosepiece and T-mount ring.



Rule of thumb for calculating the size of the Solar image on the chip plane:

1. APS camera chips: 1000mm focal length of the telescope will provide approx. 10mm diameter of Solar image on the chip.
2. For smaller chip formats the appropriate reduction factor has to be applied, normally 0.5x.

Initially leave the OD 3.0 neutral density filter as well as Solar Continuum filter mounted inside the Prism body. Attach the camera and choose b/w mode. Exposure times (at moderate ASA/ISO settings of /125) should be around 1/1000 sec. This ensures that seeing (air movement) will be almost "frozen". If 1/1000 sec exposure times are not achieved, exchange the OD 3.0 filter against a filter with OD 1.8 (#2458331) in order to shorten exposure time.

- Afocal photography (= using a fixed-lens digital camera)

Afocal photography mostly is applied, if no DSLR camera is available and the camera used is equipped with a non-removable zoom-lens. Afocal photography is a special version of projection photography. It can be applied for imaging the complete Solar disc as well as for enlarged views of Solar regions. The changing of so-called equivalent focal length is being effected by varying the zoom factor of the digital camera lens.



Information concerning necessary accessories for afocal photography can be found on our website:
<http://www.baader-planetarium.de/sektion/s15/s15.htm>

For more information concerning the techniques of afocal photography, please visit:
http://www.baader-planetarium.de/sektion/s15/kundenreferenz/afokales_projektiv/infoseite-projektiv.htm

- Projection photography

This method for Solar photography is used for detailed imaging of Solar granules or individual Sun spots. In this case the focal image of the Sun is being projected onto the imaging chip similar to projection techniques used in a slide projector or beamer, see also:

<http://www.baader-planetarium.de/sektion/s16/s16.htm>

In this case a projection system is being required which causes exposure times to increase exponentially. For this kind of Solar photography, webcams and video cameras are preferable which allow a stream of images to be stacked. Also see:

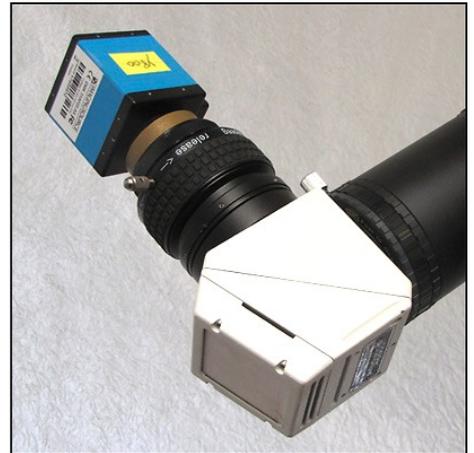
http://www.baader-planetarium.de/dmk/dmk_start.htm

Suitable projection lenses are:

- Eyepieces with low distortion (preferable Ortho eyepieces)
- Eyepiece holding systems such as Baader **OPFA** systems
- Alternatively Baader **FFC** – Fluorid Flatfield Converter, see also <http://www.baader-planetarium.de/sektion/s30/s30.htm>

Whereas the Baader FFC will provide the highest known contrast and sharpness of any projection eyepiece or barlow lens, owing to its two fluorite doublet lens groups.

For initial test images using DSLR cameras, a simple barlow lens or existing photographic teleconverter may be used, which roughly doubles the telescope focal length.



Important advice:

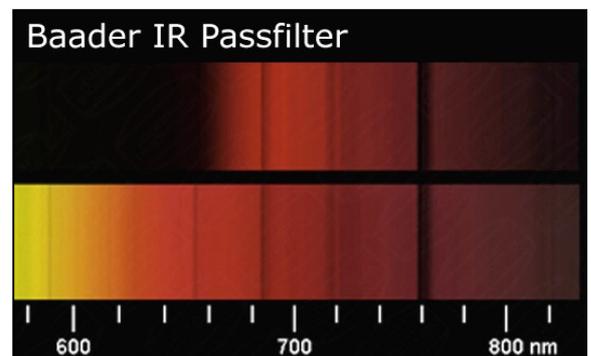
For each and every type of projection photography – be it by barlow lens, eyepiece projection, teleconverter projection or with FFC – the projection device must be mounted above the Herschel Prism. It is not possible to use any cemented lenses in front of the Herschel Prism as they will be damaged beyond repair within seconds.

4.4. Tips for photographic observation

Photography in prime focus mode requires very short exposure times which keep seeing effects quite low. However when using projection photography exposure times significantly increase together with the equivalent focal length. This greatly increases the influence of seeing effects such as air turbulence.

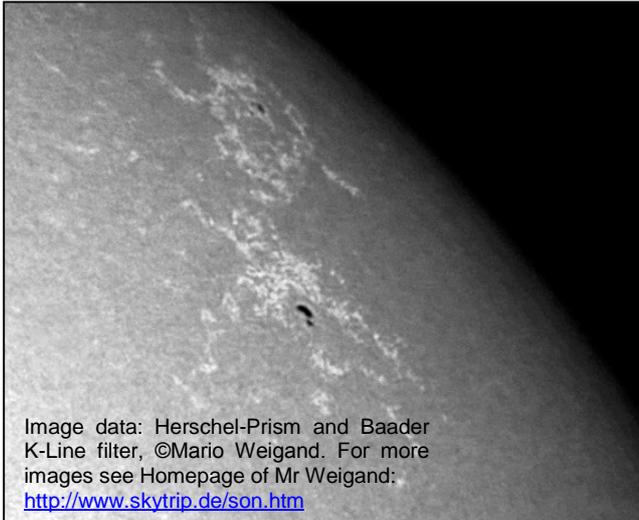
As mentioned before seeing effects are depending on wave length, stronger in the blue wing of the spectrum and less prominent in the longer wave length in the red end of the spectrum. For this reason it can be beneficial to only image in the red spectral range. Many successful Solar imagers are using a **Baader IR-Passfilter** (#2458386) in order to minimize seeing effects – the same technique is being applied for planetary imaging. When using an IR-Passfilter, the Solar Continuum filter must be removed from the path of light. Also see:

<http://www.baader-planetarium.de/sektion/s34a/s34a.htm>



5. THE HERSCHEL-PRISM FOR EXPERTS

Solar photography in the blue spectral region



In the dark blue spectral range around 400nm photospheric faculae show up prominently in the vicinity of Sun spots everywhere on the Solar surface. When observing in integral light, these faculae regions are visible only at the limb of the Sun. For observing in the spectral passband of 395nm the 1¼" Baader K-Line filter (#2458355) can be applied.

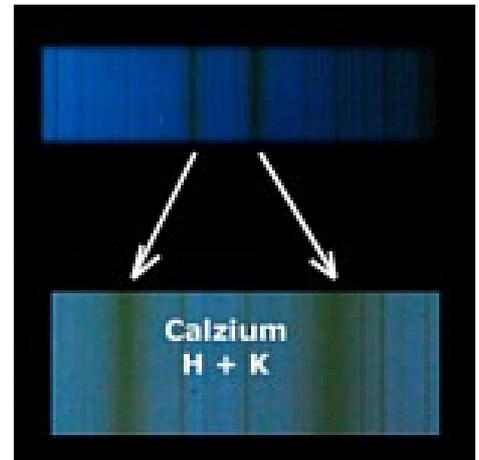
The two emission lines of Ca II, the single ionized Calcium at 397nm (H-line) and 393nm (K-line) are prominent in that wavelength. The half bandwidth (HBW) of the Baader K-Line filter measures 8nm.

Tips and Tricks:

The human eye is very insensitive (almost blind) in the spectral region below 420nm, therefore visual observation is **not** possible respectively not pleasing. The only appropriate sensors will be DSLR cameras, but even more successful will be webcams.

It is a miracle to us, why competitors offer "CaK"-telescopes for visual observation in that passband of the spectrum, while every sun-tan-studio is required by EU-law to warn customers not to look straight into UV-A-radiation. Observing below 400nm is nothing else than looking into UV-A.

In order to make use of the high quality of the Baader K-Line filter in combination with a Herschel-Prism, the astronomical lens used for this purpose should be of apochromatic quality grade or be specially designed to deliver a color corrected image at 400nm. Most simple achromatic doublets are very badly color corrected so far in the blue wing of the spectrum so that images made with such optics will not supply pleasing results.



Now we would like to wish you all success and much pleasure observing our star, using the Baader Safety Herschel-Prism.

Your BAADER Team

Instruction Manual

Baader Cool Ceramic Safety Herschel-Prism



6. TECHNICAL DATA

Adaptation options facing the telescope (included in delivery as standard):

- 2" (50.8 mm) nosepiece with safety notch (do not use M48 filter threads!)
- 2" (50.8 mm) female thread at the front end of the prism body
- circular dove tail (circular groove) S58 x 3.7mm at the front end of the prism body
- Female thread within the prism body itself, measuring M55 x 1mm
- Optional telescope adapters are available for Carl Zeiss M 68 and various other thread standards

Adaptation options facing the eyepiece side:

- 2" (50.8 mm) ClickLock® clamp with brass-clamp-ring (included in delivery)
- Optional: 2"/T-2 adapter #27. Converts from 2" female thread in the prism body into photographic T-2 male thread for attaching camera t-mounts directly atop the prism body without using the 2" ClickLock® clamp

Optical length: 114mm in the as delivered condition

Weight: 530 gram

Prism Body: Dye-cast magnesium, machined; flat black anodized; pearl white painted

Should you be interested in further kinds of Solar observation after experiencing the virtues of the Baader Safety Herschel-Prism we recommend to evaluate using ultra-narrowband H-alpha filters made by SolarSpectrum. Please also see:

http://www.baader-planetarium.de/solarspectrum/sol_spec_start.htm

A detailed introduction into the history of Solar observation and various observation techniques is available at:

http://www.baader-planetarium.de/solarspectrum/funktion_halpha/index_halpha.htm

7. WEBLINKS

Please check our news site from time to time for updates on Solar observation:

http://www.baader-planetarium.de/news/baader_news.htm

Sun and Solar observation in general:

<http://www.baader-planetarium.de/zubehoer/zubsonne/sonne/index-sonne.htm>

Current images of the Sun in integral light:

<http://spaceweather.com>

Current images of the Sun in different spectral regions taken by SOHO-spaceprobe:

<http://sohowww.nascom.nasa.gov/data/realtime-images.html>

Version of this manual: June 2010. We reserve the rights for changes of the manual if required.

Current version can be downloaded from:

<http://www.baader-planetarium.de/sektion/s37/s37.htm>

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