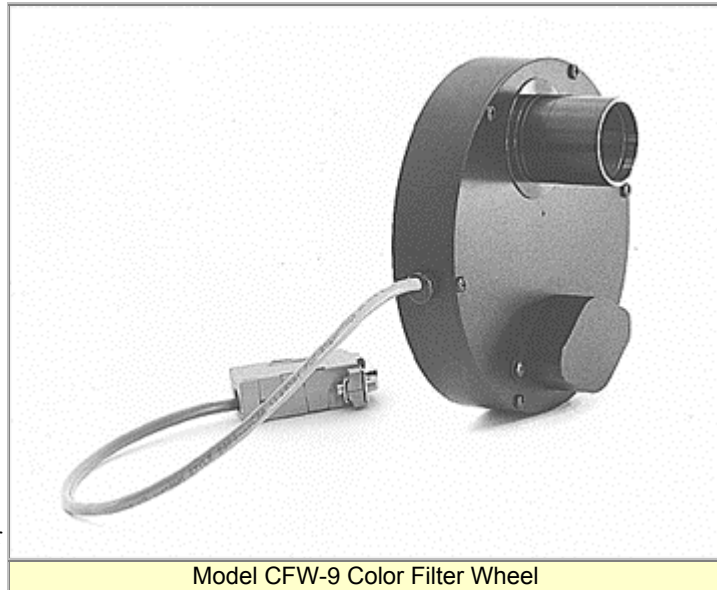


MODEL CFW-9 COLOR FILTER WHEEL

SBIG pioneered tricolor imaging for amateurs by developing hardware and software to register and color balance Red, Green, and Blue images that display spectral emission of deep space objects. When interference filters are carefully selected to match the spectral regions of ionized gases the images taken through the filters can be summed together to represent the distribution of these gases. Tricolor images are taken through the CFW-9 Color Filter Wheel and processed with CCDOPS, CCDSoftV5, or third party software. The primary color images are taken through Red, Green and Blue filters. After the images are taken they are processed with the software to co-align the Red, Green and Blue images. The co-aligned image is then color balanced on the computer monitor to become a tricolor RGB image, which can then be saved to disk. A similar process is used to make LRGB images except that a greyscale luminance image is added for detail. CCDOPS software also allows the user to perform image processing functions such as smoothing and sharpening as well as saving images in TIFF format. The raw images can also be saved in a variety of formats for export to any of the many commercially available software programs for color image processing such as Maxim DL and Photoshop.



Model CFW-9 Color Filter Wheel

The CFW-9 system is designed to be "direct connected" to any ST-7/8/9/10/2000 imaging camera for a thinner, more rigid mounting. An optional male-to-male t-thread adaptor is also available allowing easier (but less rigid) attachment and detachment for occasional use. On the front end a variety of optional



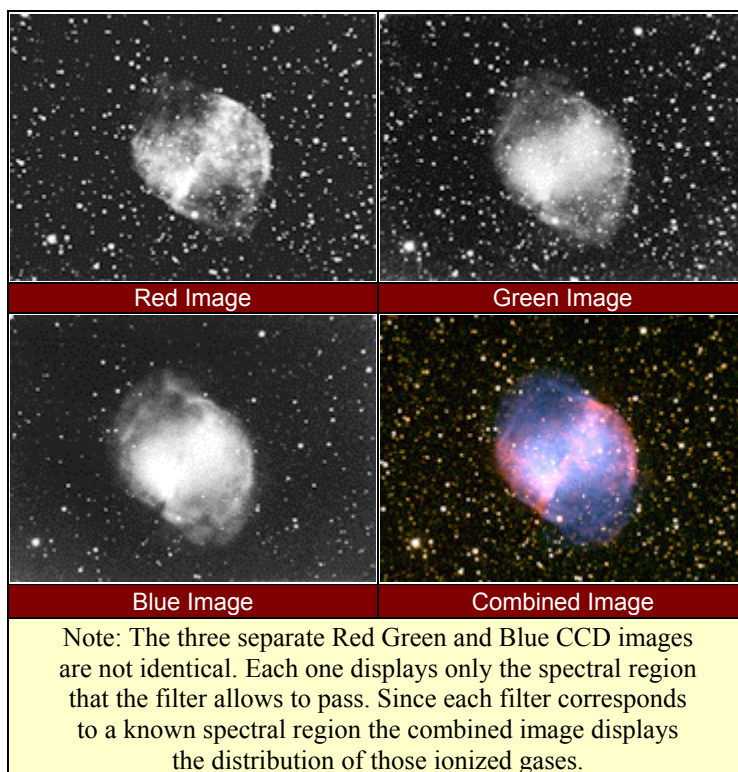
CFW-9 Attached to an
"ST" Series Camera

T-Thread accessories are available including 1.25 inch and 2 inch diameter nose pieces as well as a "Visual Back Adaptor" for direct connection to SCT's. A new optional accessory is the AO-8 which is fully compatible with the CFW9 filter wheel's I2C accessory port and the I2C accessory port on all ST cameras with USB.

The CFW-9 is operated through the CCDOPS software and utilizes a closed loop stepper motor system with positional accuracy of ± 0.01 inches. It holds up to five standard 1.25" diameter thread-in filters. It is available with Red, Green, and Blue (RGB) interference filter sets and a clear filter (focusing). The new SBIG RGB filters also block Infrared (IR) so an inline IR Blocking filter is no longer required.

These filters are mounted in standard size cells that normally fit into 1.25" eyepiece barrels. The CFW-9 adds back focus of approximately 1 inch. Although some examples of tricolor imaging are shown in this catalog it is difficult to display the wide range of techniques that our customers have developed. The CFW-8 can produce photographic quality tricolor images that rival color astrophotographs. However, these RGB images also contain an entirely new and added level of valuable information; the identification and

distribution of different ionized gasses in an object. SBIG also furnishes precision UBVR filter sets with the Model CFW-9, filters that allow the user to perform color photometry to measure the classification and temperature of objects.



THE RGB PROCESS IN THREE SIMPLE STEPS

1. Using the CFW-8 and CCDOPS software take three images, one each through the Red, Green, and Blue filters respectively.
 2. Using CCDOPS, CCDSoftV5 or third party software, register the three images and color balance them on the computer monitor.
 3. Combine the RGB files to create a tricolor image.
-

Model CFW10 and CFW10-SA Filter Wheel

The new CFW10 is a ten-position filter wheel designed for the USB version of our ST camera series or any camera where a serial port is available for controlling the wheel. The CFW10 accepts control input via either the I2C port or the RS232 serial port. When attached to an ST-



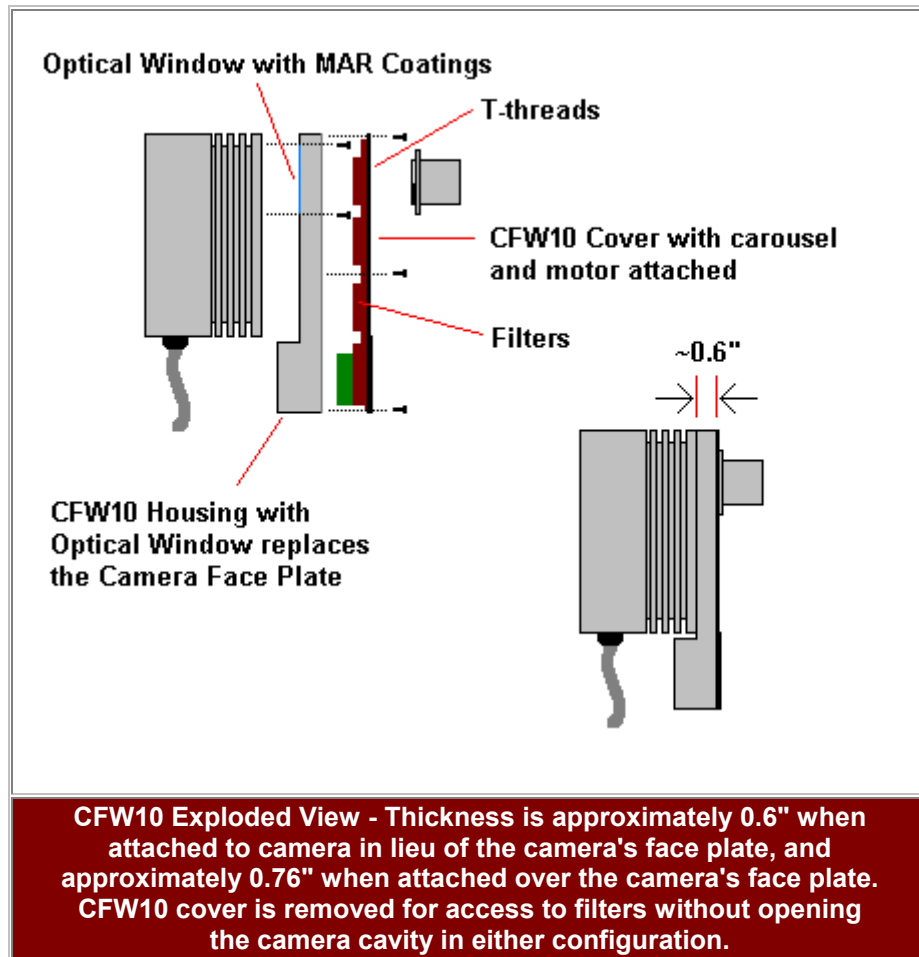
7/8/9/10/2000 USB camera, the filter wheel receives power and control commands through the I2C accessory port of the camera - no additional power or cable to the computer is required. The stand-alone version, CFW10-SA, is for use with other cameras, the filter wheel is controlled via an RS232 serial port and is powered by an external 12VDC power supply. The filter slots are threaded for standard 1.25" filters.

The portion of the housing between the camera and the telescope is only about 3/4" (20mm) thick for minimum back focus. Two versions of the housing make it possible to use the CFW10 either as a separate unit, or as an integral piece replacing the face-plate of the ST series camera. The replacement version contains a high quality optical window with superior AR coatings. By using the filter wheel housing as a replacement face plate for the camera, an additional 1/4" (6mm) in back focus is eliminated and normal 35mm camera lenses may be used with the filter wheel in place.

The front aperture of the CFW10 contains standard t-threads. A custom camera lens adapter will be available for commonly available 35mm Nikon, Canon, Olympus and other lenses. For attachment to the telescope, a 1.25" nosepiece (shown) or 2" nosepiece may be used, or a t-thread to visual back adapter for more secure fit to Schmidt-Cassegrain scopes. For other scopes, any adapter with male t-threads can be used to secure the filter wheel.

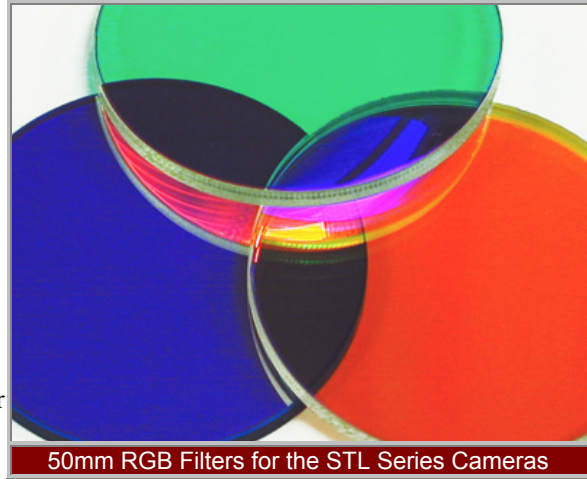
The CFW10 will be offered in addition to the CFW8A as an option for any ST series camera. It should be noted, however, that the CFW10 will not work with

older parallel cameras unless one has an available serial port on the computer to control the CFW10 through a separate serial cable.



Filters for RGB and LRGB Color Imaging, Narrow Band Imaging and Photometry

Many of the best astro images seen in Sky & Telescope and Astronomy magazine are taken with monochrome CCD cameras and color filters using RGB or LRGB combination techniques (L=luminance, R=red, G=green, B=blue, C=clear). A luminance filter typically blocks UV and IR light, passing only the same wavelengths as the RGB filters. A clear filter does not block UV or IR but is used for maximum signal transmission over the full range of the CCD. By taking separate images through custom filters, and combining the results to make an RGB image, the full resolution of the CCD is utilized and a great deal of latitude is preserved for image processing.



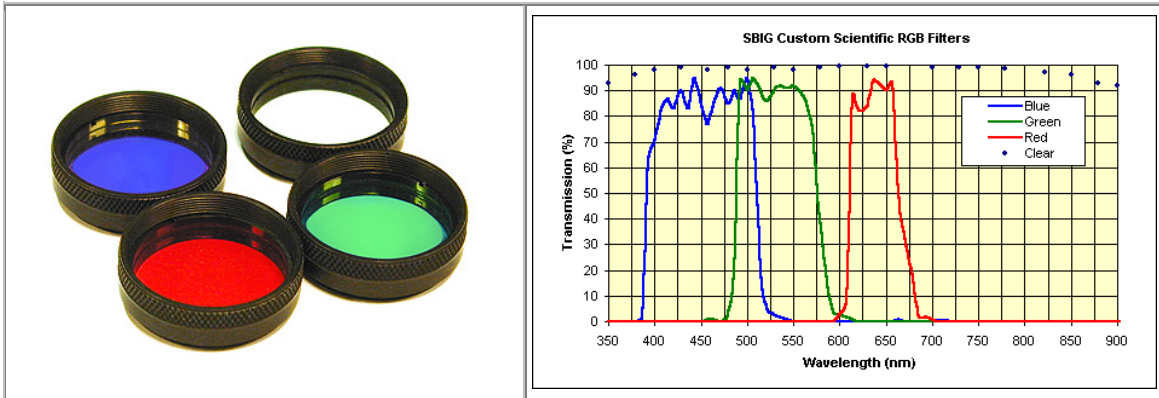
In addition to traditional Red, Green and Blue filters, some astro imagers combine H-alpha with RGB to enhance the appearance of emission nebula. Narrow band filters may also be used exclusively to create dramatic "Hubble like" false color images of emission nebula. Some of the most beautiful images taken of large emission nebula are simple monochrome images taken through an H-alpha filter. One of the benefits of narrow band imaging is that light pollution and sky glow is suppressed by the narrow band filters. With the right filter, it is possible to capture detailed images of emission nebula from one's backyard in the middle of the city under the light of a full moon!

1.25" Filters:	1.25" Filters	50mm Filters:
Custom Scientific RGBC Filter Set	Astrodon LRGBCH-a Filter Set	Custom Scientific LRGBC Filter Set
Custom Scientific H-alpha Filters	Astrodon H-alpha, [O-III], [SII] Filters	Custom Scientific H-alpha Filters
Custom Scientific UBVR I Filter Sets	Baader UV / IR Blocking (Luminance) Filter	Custom Scientific UBVR I Filter Sets

Those studying variable stars and performing other photometric measurements use standardized UBVR I or BVI filter sets to record their observations. These photometric filters have evolved over the years to provide results that are as close as possible to the measurement obtained with earlier instruments such as the photometer.

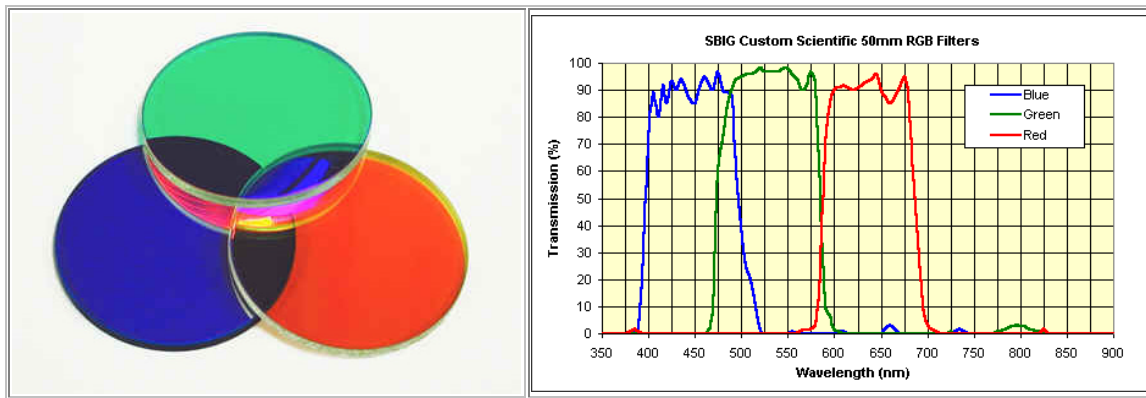
All of the filters described below are of the best quality. The RGB sets are dichroic filters designed for the highest transmission. The passbands are carefully designed for SBIG cameras. Our Custom Scientific RGB filter set is designed for excellent all around use with an accurate balance of emission sources and continuum light. In the case of the Astrodon filters, where the goal was equal exposure times, there is a different set for cameras using interline CCDs and those using full frame CCDs due to the different response curves of the two types of CCD. One benefit of the Astrodon filters is that they are parfocal with Astrodon narrow band filters and the full set of LRGBCH-a [OIII] [SII] can be used in our CFW10 ten-position filter wheel without having to refocus between filter changes.

Custom Scientific 1.25" RGBC 4 filter set:



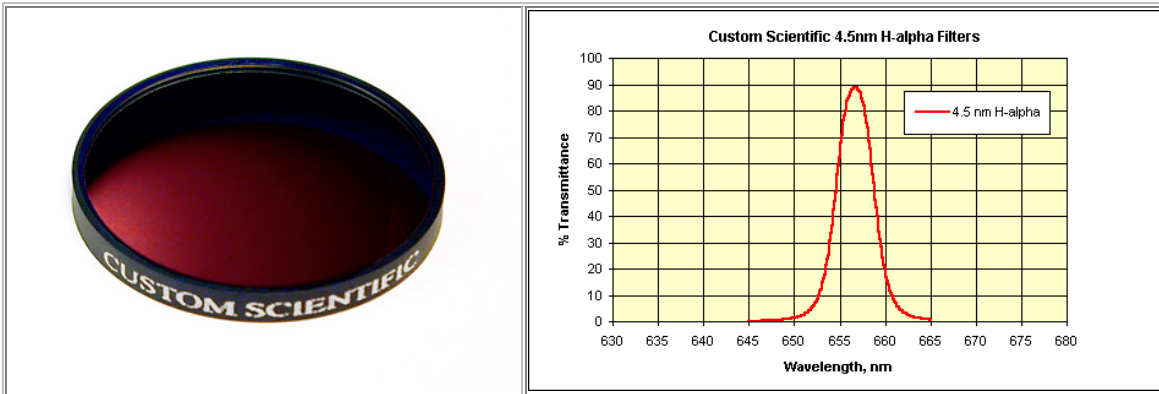
This RGBC filter set is the standard SBIG set that comes with the CFW8A filter wheel and is intended for use with the ST-7/8/9/10/2000 cameras. The set is also available separately. It is designed to give a proper balance of continuum light from stars and proper ratios of H-alpha and [O-III] emission line sources (e.g., bright nebula and planetary nebula) at the same time. These professional quality, high transmission, dichroic filters have been tested over time by some of the best astro-imagers in the world. Many of the remarkable images seen in the gallery of Sky & Telescope and Astronomy magazines have been taken with this filter set and an "ST" series camera. The colored filters are parfocal, antireflection coated and IR blocked. The clear filter is AR coated.

Custom Scientific 50mm LRGBC five-filter set



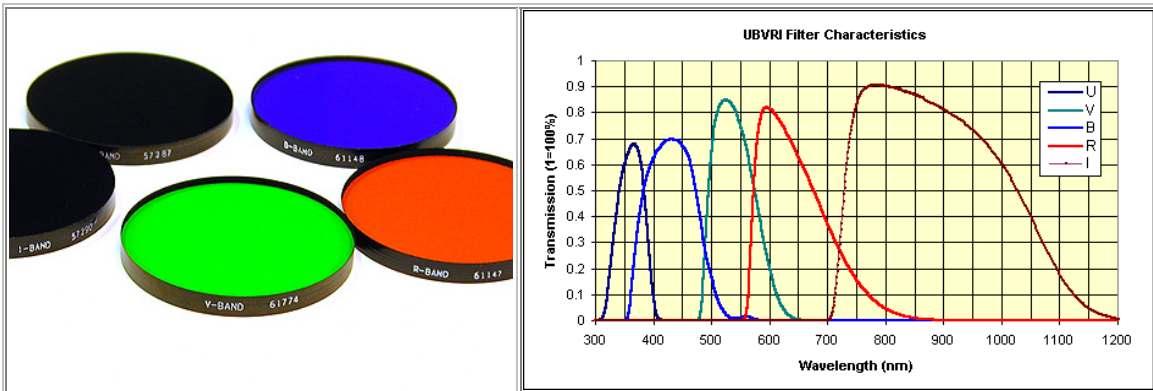
This LRGBC five filter set for the STL series cameras is designed to drop into the STL filter carousel without vignetting the largest (35mm format) CCD in the series. The STL carousel is threaded for 48mm ("2") filter cells as well, but the full 50 mm diameter of these filters provided the maximum aperture for the large format CCDs. For this reason they are supplied without threaded cells. Like the smaller Custom Scientific RGB filters, this 50 mm filter set is professional quality, antireflection coated, IR blocked. The Luminance filter is UV and IR blocked to match the RGB cutoffs, it is also AR coated. The clear filter is AR coated only.

Custom Scientific 1.25" and 50mm H-alpha Filters



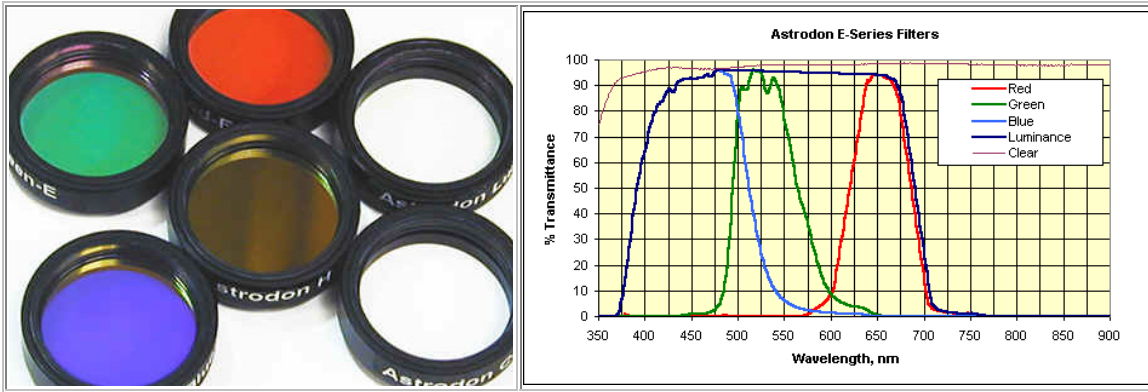
SBIG offers two versions of H-alpha filter from Custom Scientific, a relatively narrow 4.5 nm filter and a wider 10 nm filter. Both are available in either 1.25" size or 50 mm size. The smaller 1.25" filter fits in the CFW8A or CFW10 filter wheel and is suitable for the ST-7/8/9/10/2000 cameras. The 50mm size fits in the STL carousel and is suitable for any of the large format STL series cameras. The benefit of the narrower 4.5nm filter is greater suppression of sky background and light pollution. Very detailed images of faint H-alpha nebula can be faithfully captured even when imaging in heavily light polluted skies or under the glare of a full moon. The 10nm filter is also very good at suppressing light pollution, but not quite as good as the narrower 4.5nm filter. The 10nm filter is better for darker skies, and it is also less expensive than the 4.5nm filter.

Custom Scientific 1.25" and 50mm UBVR I Photometric Filters



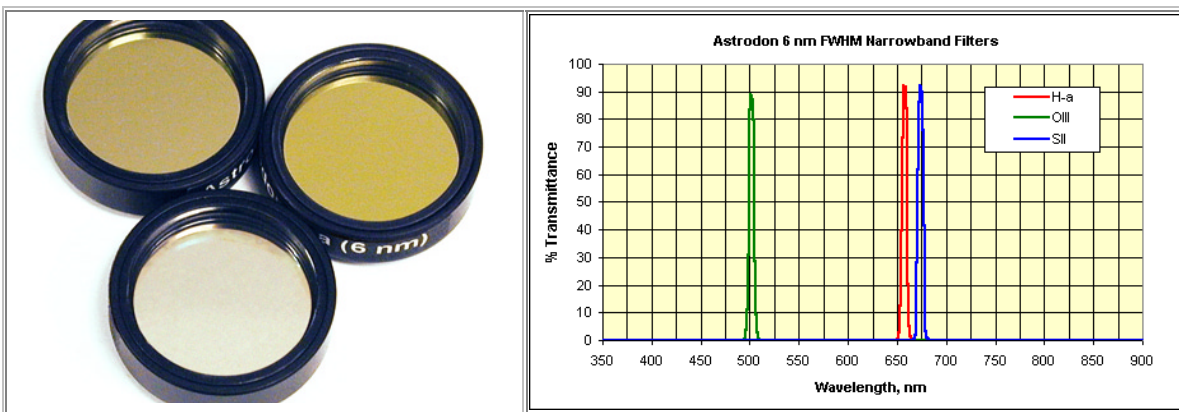
In the 1950's Harold Johnson (Yerkes and Macdonald Observatories) established three photometric bands, the U, B, and V based on the sensitivity of the photomultiplier tube that he used at the time. Later on he established red and infrared (R and I) bands using a PMT with enhanced red sensitivity. In the mid-1970's, A.W.J. Cousins and John Menzies (South African Astronomical Observatory) used different filters, that when used with a newer, better detector, would reproduce the Johnson bands. Then, in the 1980's CCD detectors were beginning to replace the photomultipliers so a new set of filters was required that, when used with the CCD's would give the same results as the older filters when used with the PMT. Bessell (Mt. Stromlo and Siding Spring Observatories in Australia) did this in 1990 (PASP, 102, 1990, 1181). It is Bessell's filter definitions that are the industry standard today when using CCD's. These professional quality, polished, AR coated, photometric filters are available in both 1.25" and 50mm sizes.

Astrodon 1.25" LRGB plus Narrowband Filter Sets



This "expanded" color imaging set from Astrodon is a new entry for SBIG. In May of 2005 we began delivering our new CFW10 ten-position filter wheel for the ST-7/8/9/10/2000 cameras. This filter wheel lets the user put a variety of filters in the carousel and not worry about which ones might be needed at a given time. For maximum flexibility both a Luminance and a Clear filter are included in the Astrodon sets. A parfocal H-alpha filter rounds out the expanded set. Many imagers prefer to take H-alpha images along with RGB images and combine them using the H-alpha frame as one color channel or as the luminance layer. This process of capturing H-alpha at the same time as the rest of the RGB frames is made much easier if the process can be automated. Astrodon filters, RGB and narrow band, are all parfocal. This eliminates the need to refocus between any filter, even the H-alpha filter, when automatically capturing a sequence of images and it makes them ideal sets for the larger 10 position filter wheel. Individual narrow band, [O-III] and [SII] can be added later, or a "Super Set" can be ordered that includes all 8 filters. These are also parfocal with the rest of the Astrodon line. SBIG offers two sets of Astrodon filters: A 6 piece "Expanded" Color set consisting of LRGBCHa, and an 8 piece "Super Set" consisting of LRGBCHa [O-III] [SII]. These Astrodon filters are currently available from SBIG only in 1.25" size. The "E" series is designed for the ST-7/8/9/10E/ME cameras, and the "I" series is designed for the ST-2000XM camera.

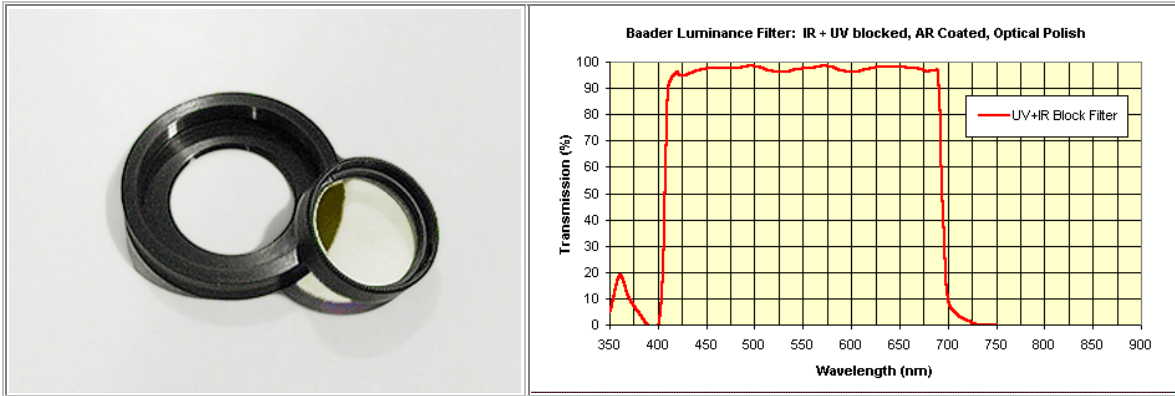
Astrodon 1.25" Narrowband Filters



The three narrow band Astrodon filters included in the "Super Set" are [O-III] (500.3 nm), H-alpha (656.3 nm), and [SII] (680 nm). These passbands are chosen by amateurs most often because of the abundance of emission nebula containing some or all of these emission lines. Narrow band filters are designed to pass

the emission line wavelength while rejecting other wavelengths outside the filters passband. This makes them very effective at suppressing light pollution. Some imagers restrict their imaging to only these narrow bands, assigning a "color" (R,G and B) to each filter in order to create a false color image. The most famous example of such a false color image is probably the Hubble Space Telescope's "Pillars of Creation." Each of these narrow band filters has a 6 nm passband, and each is parfocal with the other Astrodon RGB filters.

Baader 1.25" UV / IR Blocking Filter



The Baader UV / IR blocking filter is essentially a luminance filter. It is included with ST-2000XCM color cameras to improve the color balance of the single shot color CCD by blocking the near IR light. It is shown here along side the optional T-ring with filter threads for use on any ST cameras. It can be placed behind a camera lens adapter and used to block the out of focus near IR light that causes stars to look bloated with using a typical 35mm camera lens to shoot wide field images.

BAADER NARROWBAND FILTERS

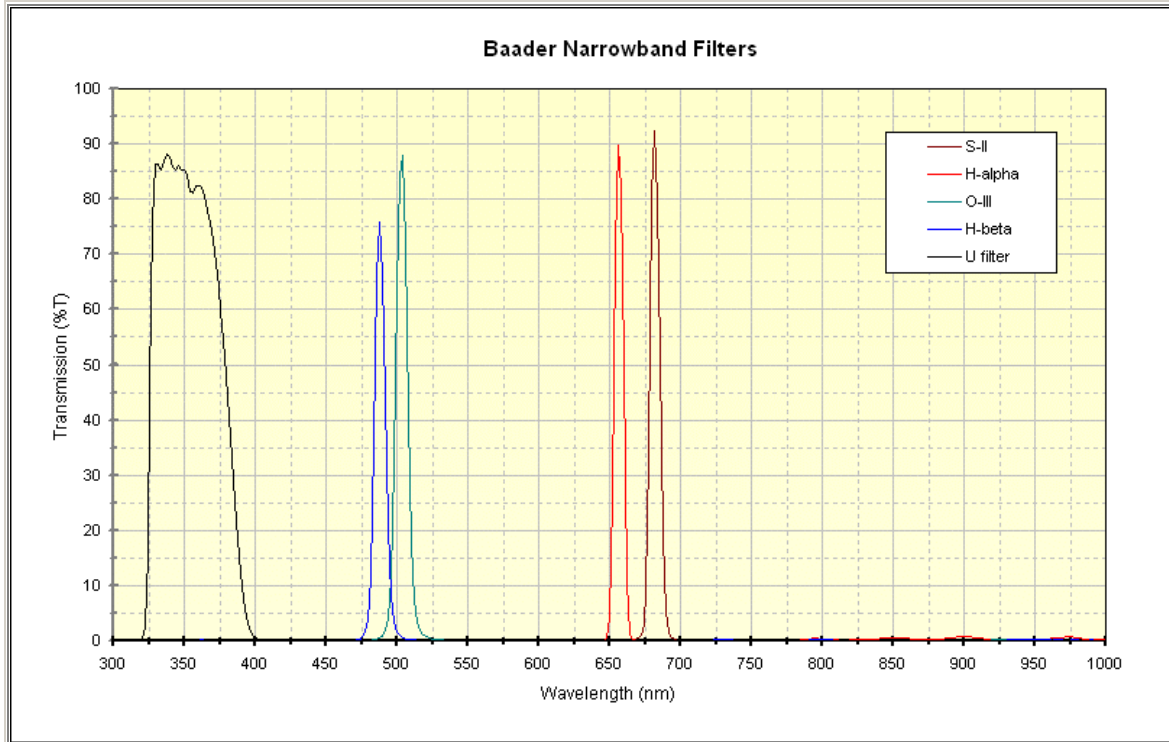
SBIG is pleased to offer a custom set of Baader narrowband filters for the ST and STL cameras effective as of this announcement. SBIG and Baader Planetarium, Mamendorf, Germany, have enjoyed a longstanding relationship. Some accessories for the

ST and STL cameras have been made by Baader for SBIG over the years, including the UV/IR cut filter that we supply with every single-shot color camera for optimum color balance. Now, this relationship translates into incredible savings for SBIG customers. Baader Planetarium has developed a set of narrowband filters in 1.25" and 2" sizes. The 2" filter is specifically made for the STL series cameras in the 50.8mm (2" unmounted) size for the STL filter carousel. These drop in both the 5 position and 8 position filter wheels for the maximum clear aperture in a 2" filter for our large 11000 CCDs. Moreover, these new narrowband filters are the same thickness as our standard 50.8mm LRGC set making them all parfocal for the STL models. Each filter



is made of high quality substrate, polished to yield 1/4 wave flatness or better, with hard multiple anti-reflection coatings on both sides. The narrowband filters are available in a 7nm wide H-alpha filter, 8nm wide H-beta filter, 8nm wide OIII, and 8.5nm wide SII. In addition, there are some specialty filters such as an IR pass filter and a U filter ("Venus" filter). The narrowband filters typically have around 90% peak transmission at the design wavelength. These filters are also available in 1.25" sizes for ST series cameras, in threaded cells for the CFW8A, CFW9 and CFW10 filter wheels. Note, however, that due to the different thickness of the smaller 1.25" RGBC filters the narrowband filters are not parfocal in the smaller size at this time. The remarkable news is that a set of the 3 most commonly used narrowband filters (H-alpha, OIII, SII) is available for under \$400 for the ST cameras (1.25" size), and under \$900 for the STL camera (50.8mm size)!





The IR-Pass filter blocks wavelengths below 670 nm. At these longer wavelengths, planetary images are less disturbed by wavefront distortions in the atmosphere. By combining a luminance image taken with the IR-Pass filter, along with RGB frames, overall image sharpness is significantly enhanced. Some of the world's best amateur planetary images have been taken with this technique. This filter is available only in 2" OD threaded cell (48mm threads).

The latest coating technologies permit the Baader U Filter (Venus Filter) to transmit from 300nm to 400nm, with a peak transmission of 80%! The filter completely blocks the rest of the region from 200nm to 1500nm, through the use of a complex 20 layer dielectric coating stack, on top of a special UG-11 substrate. Up till now, Amateur efforts typically relied upon deep violet colored filters, or combinations with simpler interference filters, which do not provide the high transmission and efficient rejection outside the important spectral region from 320nm to 390nm. Given the poor transmissions of many optics in the UV and the lower sensitivity of some CCDs to this wavelength, high filter efficiency and complete rejection at longer wavelengths becomes paramount to recording good contrast at reasonable exposures. The same high optical quality and features as the other Baader filters ensures the highest contrast and sharpest images possible. Interestingly, the solar Calcium K-Line is also within the pass band of this filter. This opens up the exciting possibility

for recording flare structures on the solar disk or edges. This filter is available only in 2" OD threaded cell (48mm threads)

Baader's innovative new designs and features, together with the very latest thin film coating technologies, result in outstanding performance, efficiency, and image quality. Baader filters are unique, in that they utilize true optically polished flat substrates. Ultra-thin precision cells deliver the maximum clear aperture and minimize vignetting. Ion beam hardened coatings ensure your filter will withstand real-world use and repeated cleaning - they are tough enough to survive boiling water!

Baader Planetarium filters are made from striae-free substrates, and actually fine optically polished flat to within 1/4 wave p-v over the entire surface, plane parallel to within 30 seconds of arc. This important and unique custom step adds cost - but the result is a filter that maintains the full wavefront quality of the telescope without double images or ghosting, even at high magnifications. Critical to maintaining this level of flatness are Baader's carefully balanced coating designs, which prevent coating surface stresses from warping the substrate. Such high flatness enables Baader filters to be used far in front of the focal plane, ahead of star diagonals.

Durability has always been a hallmark of Baader Planetarium. The multi-layer dielectric coatings are plasma assisted and Ion beam hardened using the latest technology (the coatings are harder than the glass substrate itself!). Baader filters withstand repeated real-world exposure to the elements and physical cleaning. Users need not leave their precious filters dull and dust encrusted to avoid cleaning - Baader filters may be used and cleaned without fear. Baader Filters will truly last lifetimes.

Baader's special filter cell design offers unique features that enhance their reliability and usability. Though difficult to produce, the ultra-thin filter cell results in the maximum possible clear aperture, in order to minimize vignetting (1 1/4" Filter clear aperture is 27mm!). The special threading has been designed to fit the wide variety of eyepieces and accessories (there is significant variation between the 1 1/4" filter threading used by eyepiece and accessory manufacturers). The front 'crown' of the filter incorporates milled notches which make handling and threading the filter a more secure operation in the dark.

Despite the high quality and advanced technology, Baader Planetarium filters are affordable. By leveraging high volumes across all filters in the Baader family, these filters can be offered at very reasonable prices.