

ASTRONOMY FILTERS

Throughout our history, we have designed and manufactured custom filters and standard prescription filters to the highest imaging quality standards for astronomers, atmospheric scientists, and aerospace instrumentation companies worldwide. Applications include both terrestrial and space-based observational instruments. We are the supplier of choice for a wide variety of prestigious universities, observatories, government agencies, and international consortia. As instrument technologies and applications evolve, we work collaboratively with our customers to develop solutions for the spectral, optical, and environmental demands that will define observational astronomy and aerospace applications in the future.

Hubble Space Telescope (HST)

We have played a key role as the supplier of interference filters throughout the existence of the Wide Field Planetary Camera 2 and 3 (WFPC2, WFPC3), in service from 1993 – to date. Our contribution of broad-band and medium band filters, covering the ultraviolet to near infrared spectrum, helped extend the world's view to the furthest reaches of space through observations of the Hubble Deep and Ultra-Deep Fields. Closer to home, the now iconic "Pillars of Creation" in the Eagle Nebula, demonstrating star birth in stellar nurseries, was a major achievement in astronomical imaging. We are pleased to have been instrumental in the investigation of countless phenomena from galactic super clusters to intricate nebulas and the first direct observation of an extra-solar planet. As a supplier of filters for the next generation WFPC3 we are proud to continue our support as NASA extends its reach to the edge of the visible universe.

Mars Rovers

Our filters continue to explore the Martian landscape on the recently launched Curiosity as well as both the Spirit and Opportunity Rovers. The original launch of Spirit and Opportunity utilized a total of 3 sensor systems sending images of Mars in unprecedented clarity. Since 2004 the "Pancam" has delivered high resolution multispectral images using a total of 16 filters divided between two detectors. Among the many mineralogical discoveries, our filters helped prove that water was present on the surface of Mars, furthering the consideration that life may have once existed on the red planet.

Custom Filters & Sets

Our ability to customize filters for imaging systems sets us apart from other filter companies. With over 25 deposition chambers in service employing a range of coating technologies from reactive sputtering and ion-assisted refractory oxide to physical vapor deposition, we have the most important capacity for a filter supplier, design flexibility. Below are general guidelines of our capabilities:

- ▶ **Wavelength Range:** 185nm – 2500nm
- ▶ **Bandwidths:** minimum 0.15nm to several hundred nm
- ▶ **Design Considerations:** Critical throughput, band-shape and bandwidth requirements
- ▶ **Size:** 2mm – 210mm
- ▶ **Sets:** Matching physical and optical performance attributes
- ▶ **Materials:** Space-flight compatible

High Spectral Performance

We achieve maximum throughput while adhering to critical band-shape tolerances from the UV to NIR. Placement of cut-on/cut-off edges are carefully controlled and optical densities in excess of OD6 ensure that adjacent spectral regions do not impart noise on one another through crosstalk.

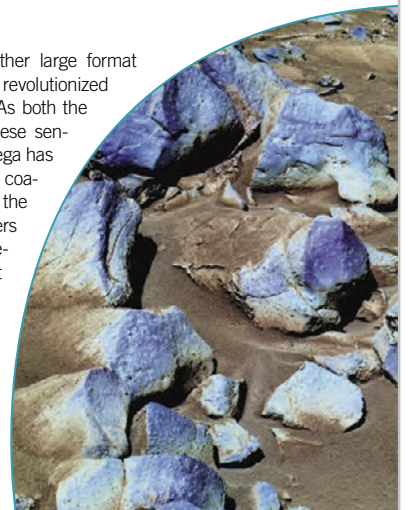
Optical Performance

As critical to the spectral performance of our filters is the preparation and care taken in the choice of substrates. Each filter is polished to guarantee optimum image quality.

Large format filters

The use of CCD and other large format imaging detectors has revolutionized the study of astronomy. As both the size and sensitivity of these sensors have increased, Omega has pushed the envelope of coating technology to meet the need for large format filters up to 210mm. Our designs achieve the highest level of uniformity while maintaining the critical surface quality and transmitted wave-front requirements so critical to precision imaging.

Martian surface.
Photo courtesy of NASA/JPL/Cornell



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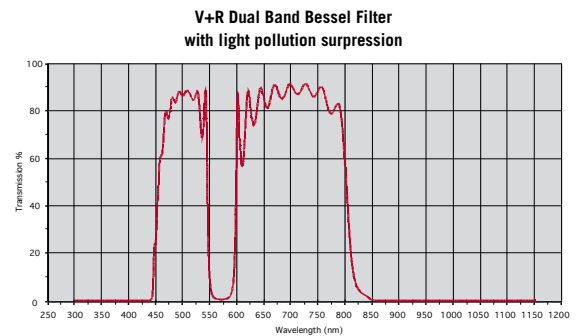
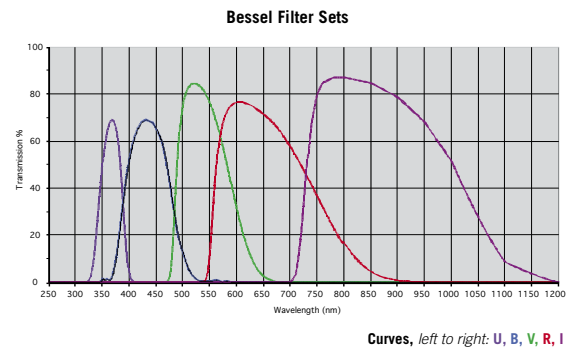
Photometric Sets

Common to the astronomy community is the need for precision photometric sets. Omega manufactures a wide range of interference filters for color imaging from Bessel, SDSS, and Johnson/Cousins in custom configurations to accommodate specific detector sensitivities. In addition to the materials and construction of our photometric sets, filter matching is an important consideration. Consistency between filters in relation to band shape, cut-on/cut-off, placement of adjacent spectral regions, throughput, attenuation, sensitivity to system focal ratio, as well as operating temperature, is controlled within strict tolerances.

Bessel Sets

Omega Optical Bessel Photometric Sets are manufactured to the highest optical standards as defined by M. Bessel. In addition to our stock Bessel sets, custom filters are available to compensate for such aberrations as atmospheric light pollution and dedicated imaging applications.

- ▶ **TWD** ¼ wave (or better) per inch
 - ▶ **Wedge** <30 arc seconds
 - ▶ **Surface Quality:** E/E as defined by Mil-C-48497A
 - ▶ **Anti-Reflective Coating:** multi-layer dielectric AR coating on both surface. R typically <0.5% for optimal transmission & reduce ghosting.
 - ▶ **Anti-Reflective Coating Durability:** to moderate abrasion as defined by Mil-48497A
 - ▶ **Curves:** Spectrophotometric curves are provided for each filter set.
- ▶ Please see our website for all options.

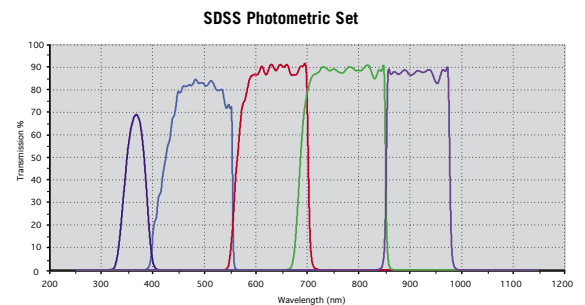


SDSS Photometric Set

(Sloan Digital Sky Survey)

We now offer a new photometric filter set matching the specifications set forth by the Sloan Digital Sky Survey. These filters, comprising the u' g' r' i' z' (ultraviolet, green, red, near infrared, and infrared) spectrum, cover wavelengths from 3543 to 9134 angstroms. Our new set takes advantage of new glass types to provide higher transmission and sharper edges.

- ▶ Please see our website for all options.



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Projects

Omega Optical has many years of experience designing and manufacturing imaging system filters critical to astronomy and aerospace applications for organizations such as:

- ▶ **AURA** - Association of Universities for Research in Astronomy
- ▶ **Canadian-France-Hawaii Telescope**
- ▶ **ESA Giotto Mission**
- ▶ **European Southern Observatory Very Large Telescope**
 - **CONICA** - COuld Near Infrared CAmera (VLT)
 - **OSIRIS**
- ▶ **Canadian Space Agency**
 - **BRITE- BRIGHT** Target Explorer Constellation
- ▶ **GRANTECAN**
- ▶ **NASA JPL Star Dust Project**
- ▶ **NASA JPL Hubble Space Telescope WFPC2 & WFPC3**
- ▶ **NASA JPL Martian Rovers**
 - Spirit and Opportunity
- ▶ **Observatories of the Carnegie Institute of Washington**
- ▶ **US Naval Observatory**

Optical Filter Capabilities

Our filters are used for a wide range of astronomy studies. Following is a partial list of products utilized by researchers, universities, observatories and government agencies.

- ▶ **Solar Observation:**
 - H-alpha
 - H-beta
- ▶ **Nebula and Cometary Studies:**
 - OII
 - OIII
 - SII
 - CII
 - CIII
- ▶ **IR Astronomy:**
 - J, H, K Bands
- ▶ **Photometric Sets**
 - Bessel (UBVRI)
 - Johnson/Cousins (UBVRI)
 - Stromgren (UBVY) – Beta Wide & Narrow
 - SDSS (u', g', r', i', z')
 - Thuan-Gunn
 - V+R Dual Band Bessel Filter with Light Pollution Suppression
- ▶ **Other**
 - Detector Compensation
 - Harris R
 - Mould R-I

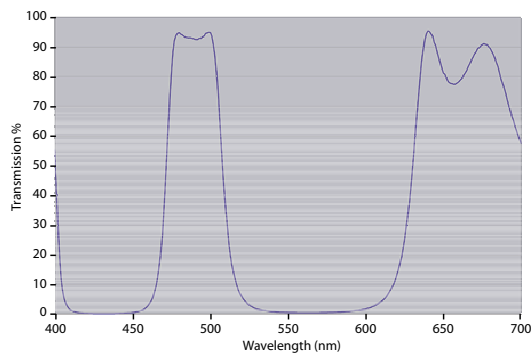
*Brian W. Allan, MSc., PhEng.
shot the M42 nebula using Omega
Optical's VHT filter, TeleVue 102 with
0.8 reducer (700 mm) and
Canon 50D camera.*



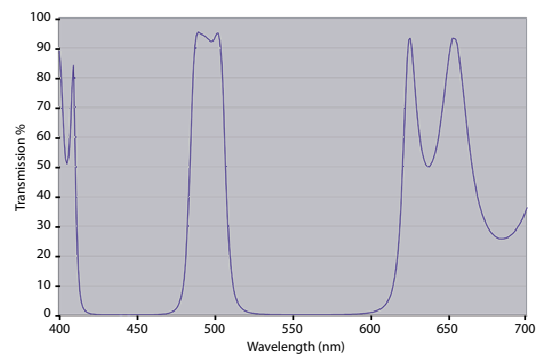
AMATEUR ASTRONOMY FILTERS

Designed to benefit both visual and CCD imaging, each filter is crafted with the knowledge that every photon counts. With this principle in mind, our coatings achieve transmission in excess of 90%, while tightly controlled parallelism and transmitted wavefront keep the image crisp and distortion free. Each design also attenuates the critical 540-590nm range where light pollution is most prevalent. In eliminating these wavelengths, the contrast between intricate nebulas, faint galaxies and the background of space is more apparent.

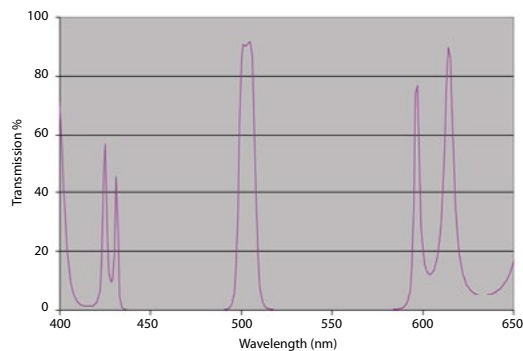
Amateur Astronomy filters are available in both **1-1/4" and 2" diameter** threaded rings and are housed in a protective case for storage. Interference coatings are single-surface, ion beam sputtered for maximum resistance to environmental stress.



Measured spectral data for typical **VHT** filter



Measured spectral data for typical **NPB** filter



Measured spectral data for typical **HPOIII** filter

► Please see our website for all options.

Customer Reviews

I recently purchased GCE, NPB and VHT filters from you. I have used the VHT filter to shoot Orion nebula (M42) and it has been my best shot ever!

Brian, Sundre, Alberta, Canada

The filter just works. It really does enhance the galactic structure and shape. It just does the job. The galaxies I looked at really "popped" and did not look like a subtle fuzz against bright sky.

Howard, Cleveland, Ohio

I am still loving the VHT and NPB filters... they are the best...

Darren, Brisbane, Australia