Omega Optical Improved NPB DGM Filter
by Jim Thompson, P.Eng
Test Report – January 30th, 2015

Introduction:

Omega Optical is a well renowned optical coating and interference filter supply company located in Brattleboro, Vermont. Founded in 1969, they supply high precision optical coatings and filters for a wide range of applications including medical research, machine vision, and the defense industry. They even fabricated filters used by the cameras aboard the Spirit and Opportunity Mars rovers. They provide a very wide selection of filters in stock, or they can custom make filters to the user's specifications.

My relationship with Omega began about four years ago when I had them build me a custom IR cut filter for use in video astronomy. Since then I have been nothing but impressed by the quality of their products and service. It is for this reason that I have offered to review one of their latest filters sold for use in astronomical observation: the Improved NPB DGM, which is available in their Ebay store (search on BJOMEJAG). This new filter design is pretty much the optimum filter for multi-purpose full colour emission nebula observing. It delivers two very narrow pass bands, one around Hβ/O-III and the other around Hα. Outside of these two bands the filter has virtually zero transmission, even up into the near-infrared. Figure 1 presents the filter's spectral response as provided by Omega.

Objectives:

Theory suggests that when observing an emission type nebula (including planetary and SN remnants) under light polluted skies the perceived contrast of the object improves the narrower you can make the LP filter's pass bands around the nebula's principal emission wavelengths, the most important being: Hβ (486.1nm), O-III (495.9 & 500.7nm) and Hα (656.3nm). The Improved NPB filter boasts just that; the narrowest band passes in all three key bands available on the market today. My objective for this test was to compare the performance of the Improved NPB filter to that of some other well known light pollution filters. The filter is intended for both visual use as well as imaging, so my testing included the evaluation of the filter in both applications. Points of comparison include: image contrast/clarity, ability to see faint nebulosity, and overall image brightness.

Methodology:

The methodology of this test is simple: look at the same object with the same telescope using a variety of LP filters under light polluted skies. In this case the common object that was observed was M42 "The Orion Nebula". I collected my observations during two sessions, both from my backyard in central Ottawa, Canada. The details for the observing sessions are summarized in Table 1 below. It just so happened that the Moon was present in the sky during both my observations, presenting an additional challenge to the LP filters being tested.

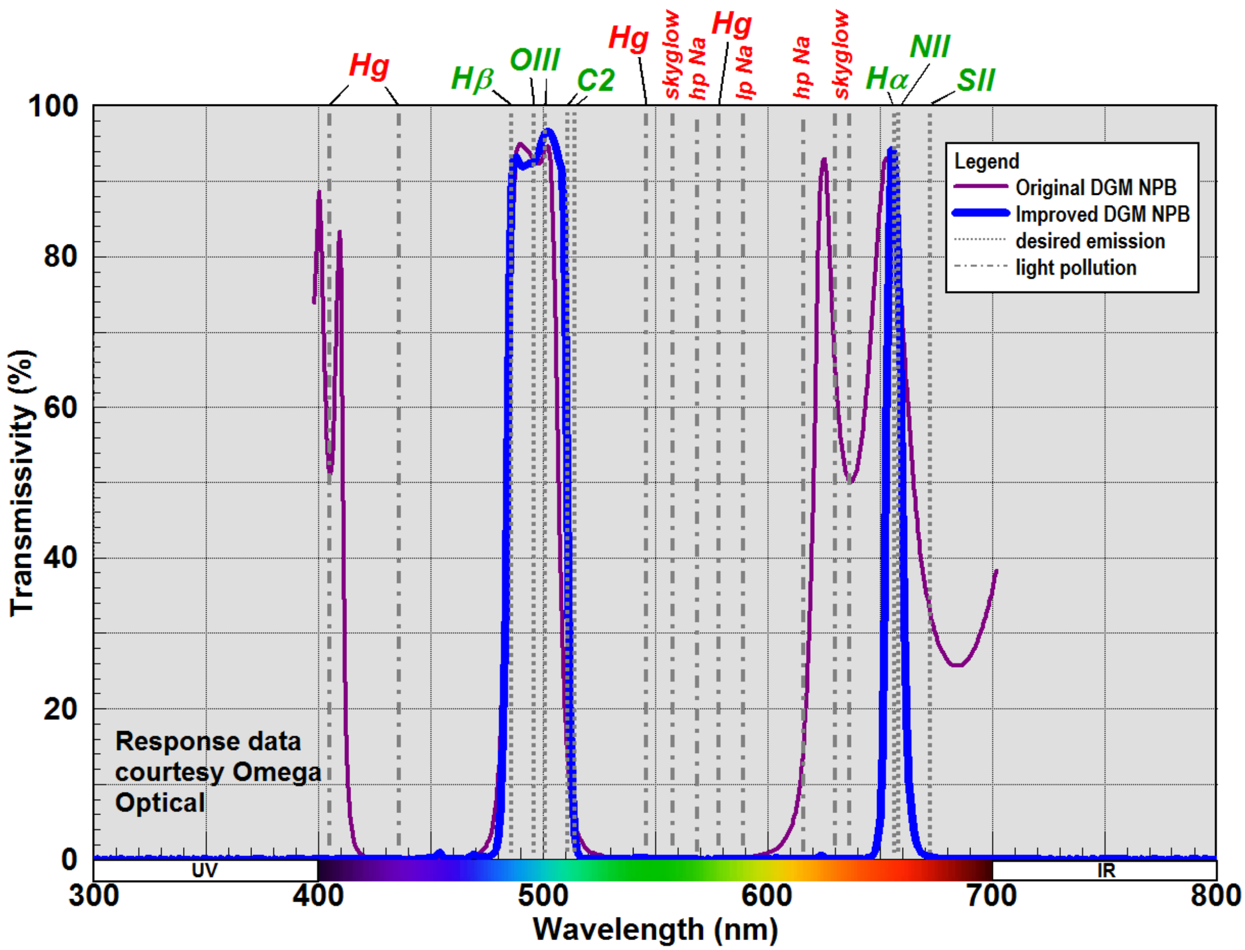


Figure 1 Omega Optical NPB DGM Filter Spectral Response

Date	Conditions	Moon	Mount	Scope	Method
29 Dec 2014	100% clear, 4/5 trans, 3/5 seeing, -10°C, Mv~ +3.5	First 1/4, 45° west	Orion Atlas EQ/G	WO FLT98	Visual w/Meade 5k Series 6.7mm UWA (pencil sketch), Astro-video w/Xtreme classic @ f/4.5 (frame capture)
05 Jan 2015	100% clear, 2/5 trans, 2/5 seeing, -20°C, Mv~ +2.0	Full, 28° east	Orion Atlas EQ/G	VRC 10"	Astro-video w/Xtreme classic @ f/4 (frame capture)

Table 1 Summary of Observation Night Details

During the first observing session I compared four different filter configurations: no filter, Astronomik UHC, Astronomik O-III, and Omega Improved NPB DGM. To record my visual observations I made an attempt to sketch what I saw at the eyepiece with pencil and paper, but that proved challenging to do considering the ambient conditions and the fact that I am not a very good sketcher. After the visual observations I switched to an astro-video camera in order to evaluate filter performance on a CCD based device. I used a Mallincam brand Xtreme (classic), which uses a mild cooled Sony ICX418 one-shot-colour sensor. When testing with the camera I evaluated two additional filter configurations: Astronomik UHC + Baader UV/IR Cut, and Meade O-III + Omega BDRB, where the BDRB (Blue & Deep Red Blocker) is the custom filter I had made by Omega. Adding a UV/IR cut filter to the LP filters I tested further enhances their light pollution rejection capability on nebulae.

During the second observing session I tested a larger assortment of LP filters, including:

- no filter
- Meade Broadband Nebular
- Astro Hutech IDAS LPS-P2
- Astronomik UHC
- Astronomik UHC + Baader UV/IR Cut
- Meade O-III + Omega BDRB
- Omega 40nm Hα (machine vision filter XMV660)
- Omega 10nm Hα
- Omega Improved NPB DGM

When switching between filters, I moved my scope to Rigel to facilitate focusing using a Bahtinov mask. Other than that the only camera settings that had to be adjusted between filters was the white balance which was accomplished using the manual WB settings on the camera. Individual video frames were captured with each filter for a set range of exposure times, ranging from 2 sec up to 96 sec.

Results:

4" Refractor - Visual:

The view of M42 from my backyard is all too familiar to me. The four stars of the Trapezium were clearly visible in the middle of a fairly bright field of grey-green nebulosity. Some detail was visible around the perimeter of the brighter central triangle shaped region, but the nebulosity was quickly lost in the ambient glow of the background sky. Figure 2 illustrates what the nebula generally looked like with no filter. The addition of the Astronomik UHC filter resulted in a noticeable darkening of the background, making it easier to make out the fainter detail outside of the central bright triangle. The stars were also noticeably dimmer. Figure 3 presents a sketch of what the nebula appeared like using the Astronomik UHC filter.

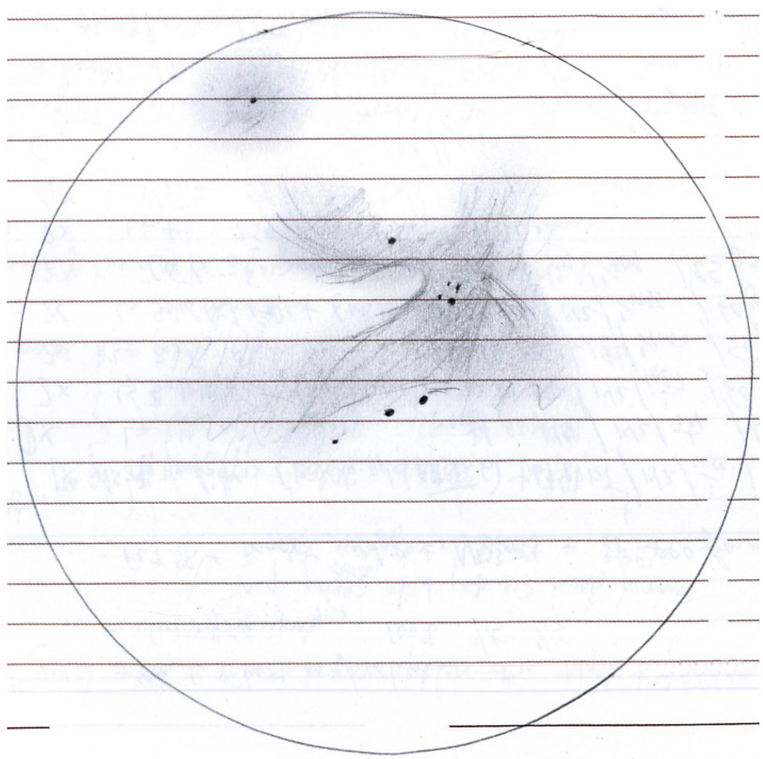


Figure 2 Hand Sketch of M42 Using No LP Filter

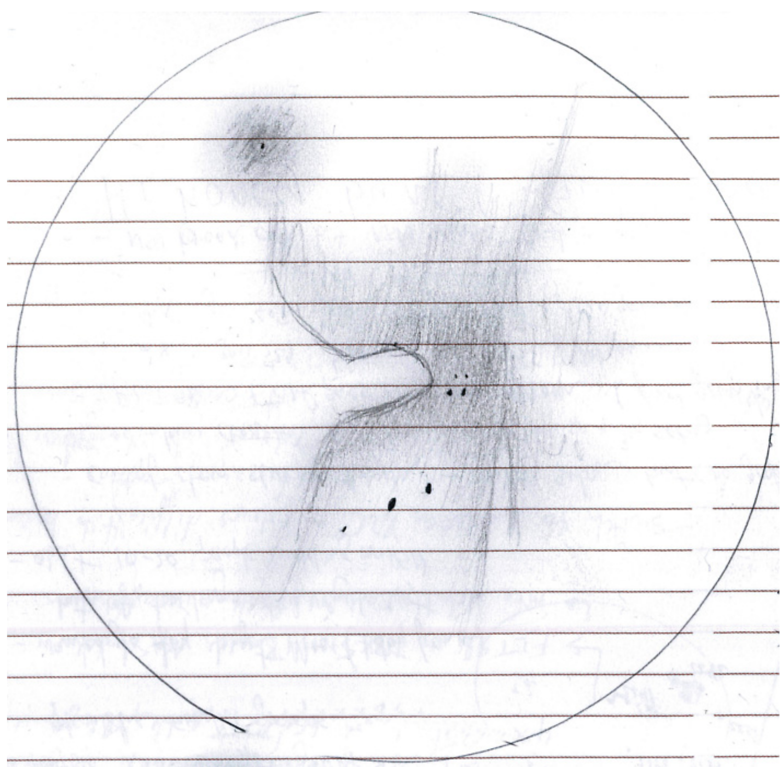


Figure 3 Hand Sketch of M42 Using Astronomik UHC Filter

When I switched to the Astronomik O-III filter, the first thing I noticed was that the whole scene was significantly dimmer; stars, background and nebulosity. As a result I had to study this view longer to discern that the filter does indeed reveal more faint detail than the UHC filter. For the first time I could tell that the whole field is filled with nebulosity, with even darker swaths passing through it. The dimmest star in the Trapezium, Theta B Orionis, was no longer visible. Figure 4 shows my sketch of how the nebula appeared using the O-III filter. Finally, when I switched to the Omega Improved NPB DGM filter I found that the scene was significantly brighter than with the O-III and as a result was much easier to observe. The nebulosity had a similar brightness to that with the UHC filter, but the level of detail visible was slightly more pronounced than with the O-III filter. It was very clear with this filter the extent of the nebulosity over the entire eyepiece field as well as the presence of darker dust lanes. The view of M42 with this filter was the most detailed of all the filters tested. Figure 5 presents my sketch of what the nebula appeared like using the Omega Improved NPB DGM filter.

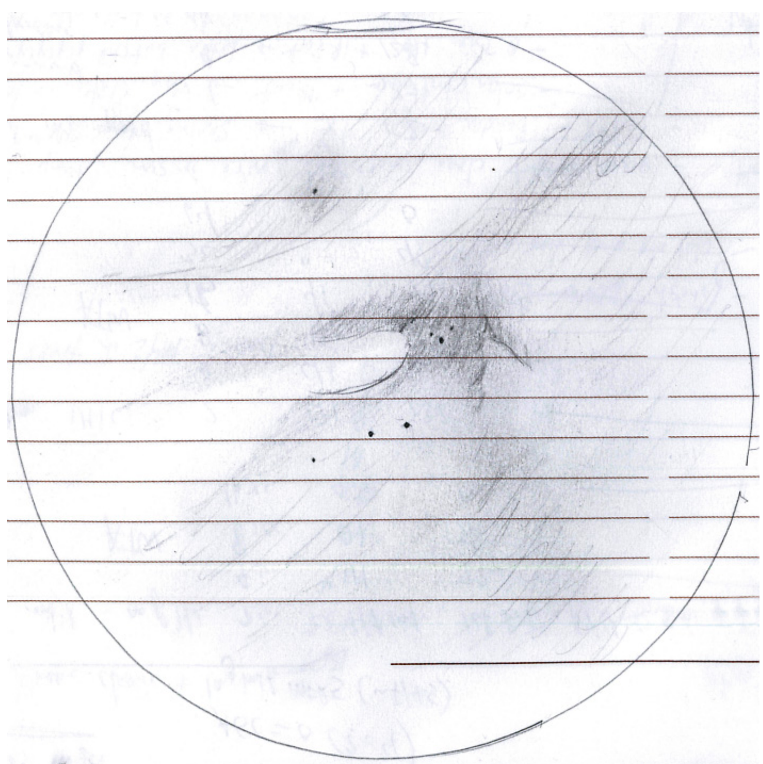


Figure 4 Hand Sketch of M42 Using Astronomik O-III Filter

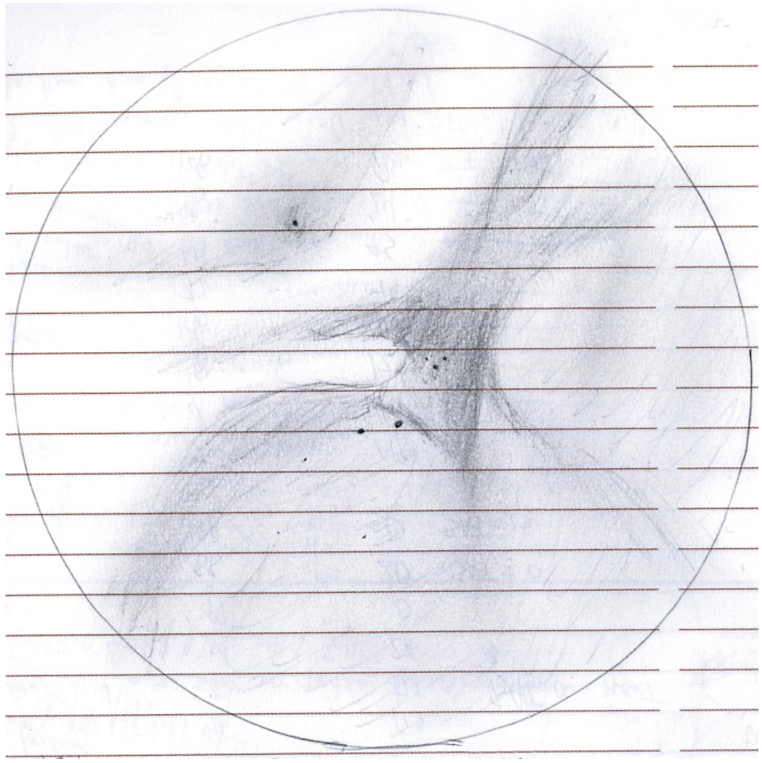


Figure 5 Hand Sketch of M42 Using Omega Optical NPB DGM Filter

4" Refractor - Video:

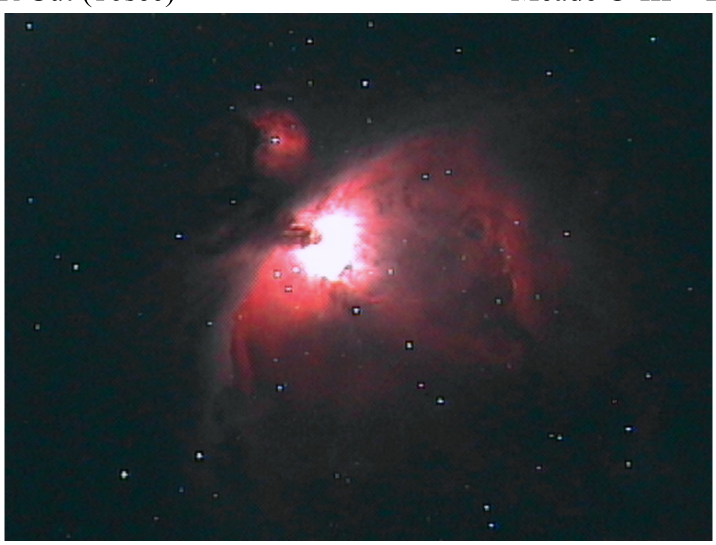
The CCD detector in an astro-video camera (or imaging camera for that matter) is more sensitive to long wavelengths than the human eye. As a result they are better suited to showcase the effectiveness of light pollution filters on the visibility of emission type nebulae. Figure 6 presents single video frames from my astro-video camera captured to computer for each filter used. For the particular setup I was using on this evening, I was able to get to 16sec of exposure with no LP filter before the background started to become too washed-out. Adding the Astronomik UHC filter greatly reduced the brightness of the background, and enhanced the colour and detail visible within the nebulosity. With this filter I was able to further increase my exposure time to 64sec before the background started to wash-out, thus allowing me to see even more faint detail in the nebula. Adding a UV/IR cut to the UHC further darkened the background and increased detail, but only to a small degree. What was more noticeable was the reduction in the brightness of stars that resulted from the addition of the IR cut. I was able to go to an exposure of 88sec with the UHC + UV/IR cut before the sky began to wash out. Similary when I switched to the Meade O-III + Omega BDRB filter combo I observed a bit more of an improvement in contrast and detail plus further reduction in the brightness of stars. The reduction of the visibility of stars I have found to be an important feature when observing star rich nebulosity such as NGC7000 (North American nebula) or NGC2244 (Rosette nebula). With the Meade O-III + Omega BDRB combo installed I was able to go to 128sec exposure before the sky washed-out.

no filter (16sec)

Astronomik UHC (16sec)

UHC + UV/IR Cut (16sec)

Meade O-III + BDRB (16sec)



Improved NPB DGM (16sec)

Figure 6 Single Video Frame Captures - FLT98

When I switched to the Omega Improved NPB DGM filter I found it quite difficult to manage the white balance of the image. For some reason the image was very intensely RED and I was not able to compensate for it. I resolved this issue to some extent during my second test, see below. Beyond this, the Improved NPB DGM showed a similar level of contrast and detail in the nebula as the previous filter combo, and stars were slightly less visible. The maximum exposure time I could achieve with the filter before the sky was washed-out was 128sec. I also noticed while I was focusing on the bright star Rigel that it had a fuzzy halo, where the other filters tested did not; perhaps a result of there not being any anti-reflection coatings on the Omega brand filter.

10" Reflector:

On my second test evening I had more time available, and so was able to consider a larger number of filters in my comparison, plus I was able to figure out how to adjust the camera and capture device to get a white balance that was more comparable to that achieved with the other filters. Initially I started the test by adjusting the RED and BLUE manually on the camera, which worked fine at short exposure times but resulted in a gradually more and more blotchy green background at longer exposure times. Near the end of the test I discovered that the ATW WB setting on the camera worked well as long as I turned down the video capture device colour saturation compared to what I would normally use with other filters.

The video frame captures from this test have been organised in Figures 7 to 9 based on the exposure time used. The first group are all taken at 6sec exposure, which was the longest I was able to go with no filter for my scope setup and ambient conditions (full Moon). The second group are all captured at 16sec, which was the longest I was able to go using the Meade Broadband Nebular, an example of a typical inexpensive LP filter that many amateur astronomers may already have in their observing gear. The third group are all taken at 32sec which was the longest exposure I was able to use with the Improved NPB DGM filter before the background sky started to wash out. The number of filter images included in each group gets smaller with increasing exposure time because for some filters that particular exposure time resulted in an excessively washed-out background. Also included in the figures is the BRIGHTNESS setting on my video capture device at the time of the frame capture (out of 128). CONTRAST and GAMMA were kept fixed between all filters.

Even with my eventual figuring out of how to properly WB with the Improved NPB DGM, the filter still seems to put more emphasis on the Halpha part of the object. A variety of objects will need to be observed to confirm if this is due simply to the reduction in the reflection component or if Hbeta and O-III are also affected (they shouldn't be). With the WB correctly set the level of detail visible is pretty much equivalent to the Astronomik UHC + IR cut and Meade O-III + BDRB. The overall image with the Improved NPB DGM did appear slightly less sharp than the other filters tested, possibly due to a lack of anti-reflective coatings.

no filter (6 ec, 0 BRT)

LPS-P2 (6sec, 31 BRT)

Meade Broadband (6sec, 57 BRT)

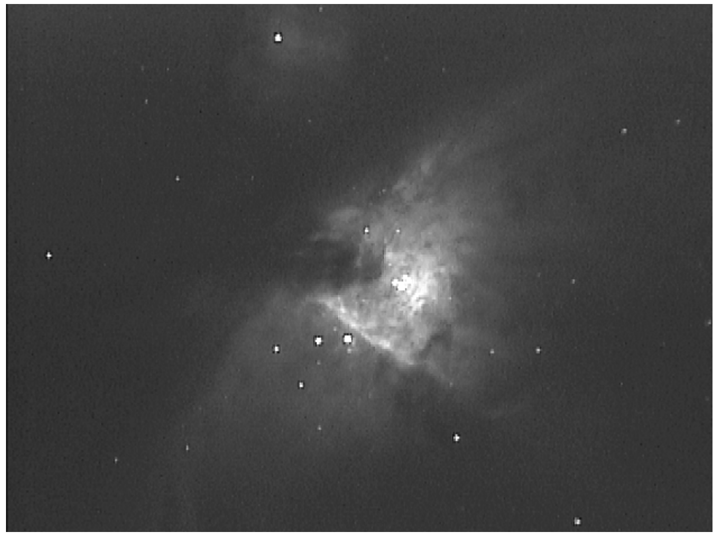
Astronomik UHC (6sec, 68 BRT)

Astro. UHC +UV/IR Cut (6sec, 75 BRT)

Meade O-III + Omega BDRB (6sec, 96 BRT)

Figure 7 Single Video Frame Captures @ 6sec - VRC10"

Improved NPB DGM (6sec, 75 BRT)



Omega 40nm Hα (6sec, 113 BRT)

Omega 10nm Hα (6sec, 125 BRT)

Figure 7,cont'd   Single Video Frame Captures @ 6sec - VRC10"

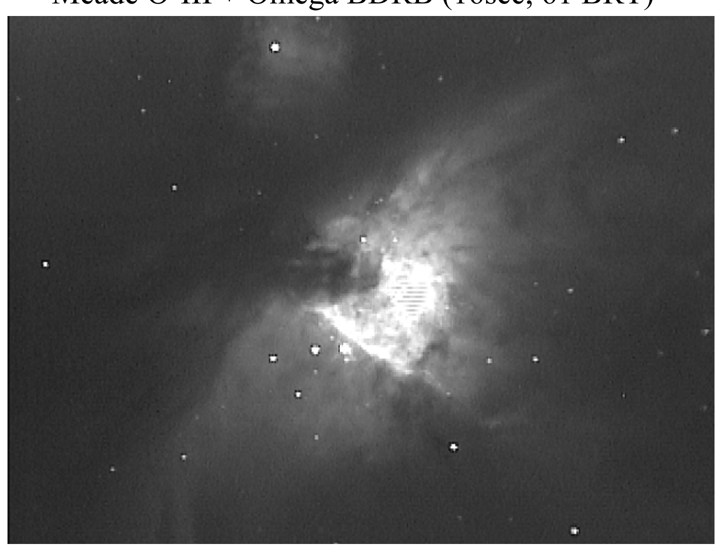
Meade Broadband (16sec, 0 BRT)

Astronomik UHC (16sec, 17 BRT)

Astro. UHC +UV/IR Cut (16sec, 42 BRT)

Meade O-III + Omega BDRB (16sec, 61 BRT)

Improved NPB DGM (16sec, 38 BRT)



Omega 40nm Hα (16sec, 90 BRT)

Figure 8 Single Video Frame Captures @ 16sec - VRC10"

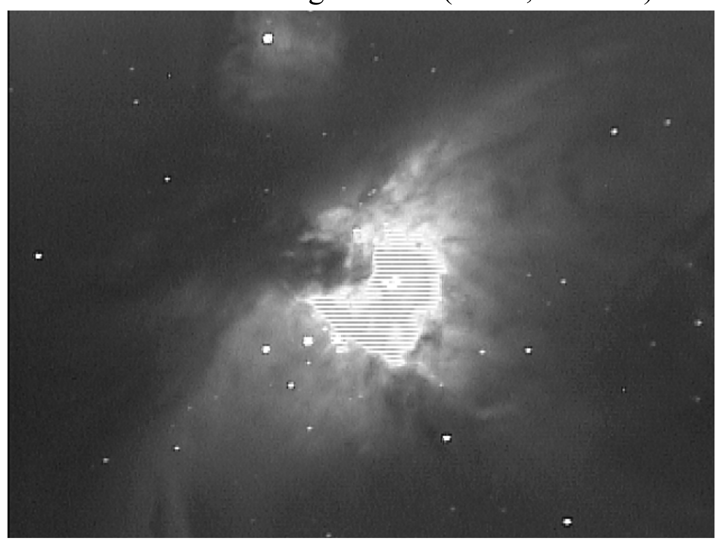
Omega 10nm Hα (16sec, 117 BRT)

Figure 8,cont'd   Single Video Frame Captures @ 16sec - VRC10"

Astro. UHC +UV/IR Cut (32sec, 0 BRT)

Meade O-III + Omega BDRB (32sec, 24 BRT)

Improved NPB DGM (32sec, 0 BRT)



Omega 40nm Hα (32sec, 64 BRT)

Omega 10nm Hα (32sec, 102 BRT)

Figure 9 Single Video Frame Captures @ 32sec - VRC10"

Conclusions:

For the limited amount of visual observing I did, I found the Improved NPB DGM filter to work exceptionally well. I was impressed at how it delivered a similar level of detail to that of the O-III filter but with a much brighter image.

From the CCD video imaging results presented above, the Improved NPB DGM filter seems able to deliver a similar level of detail and contrast to the other filter combos that I consider to be the narrowest available and still get a full colour image (Astronomik UHC + UV/IR Cut, Meade O-III + BDRB). It was important however to get the white balance (WB) correct, which proved to be a bit more of a challenge than I was expecting. Further testing is required, on a range of emission nebulae, to know for sure if there is any performance advantage to using the Improved NPB DGM over the other filter combos tried. This excludes Halpha and other narrowband filters which for imaging applications will always give the best contrast and detail. Note also that this filter is intended for use on emission nebulae only, and as a result it will perform poorly on galaxies due to its lack of infrared response.

One certain advantage of this filter is the price; at $99.50 USD for the 1.25" version and $159.50 USD for the 2" version, this filter is a great value compared to the UHC + UV/IR Cut combo (1.25" - $173, 2" - $332) or Meade O-III + BDRB combo (1.25" - $273, 2" - $494) I used during my testing.

One improvement that I would recommend for this filter is anti-reflective coatings. I believe that adding an anti-reflective coating will help to reduce halos around bright stars, secondary reflections, and will help to sharpen the image.

As usual, please feel free to contact me if you have any questions.

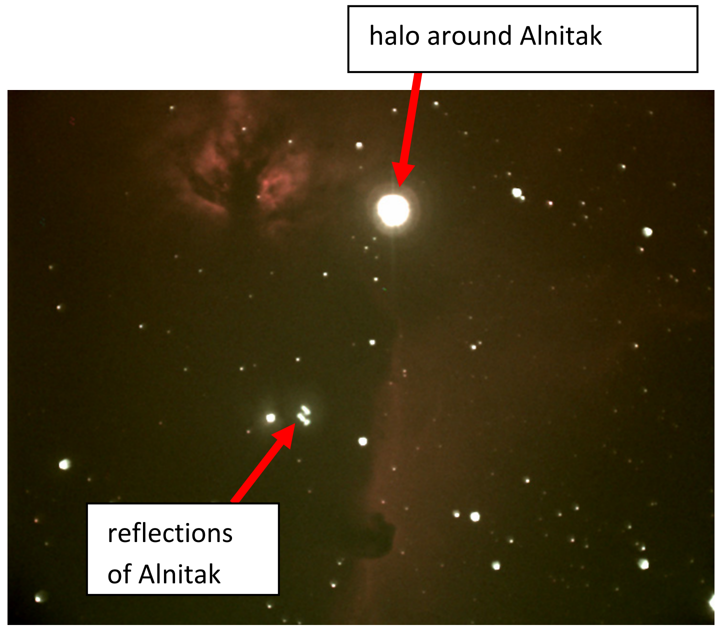
Cheers,

Jim Thompson
AbbeyRoadObservatory

Epilogue: Follow-on Video Observing

About two weeks after the testing documented above I had another astro-video observing session using a different camera, this time one based on a Sony ICX829 sensor. My white balance was better, but on M42 the Halpha regions were still clearly more emphasized than the reflection, Hbeta and O-III areas. In fact when I tried to observe the nearby reflection nebula "The Running Man" (NGC1973/5/7) I could not pick it up at all. Nonetheless I was able to generate some pleasing results using the filter on a number of Halpha rich nebulae.

NGC2244 Rosette Nebula
60sec EXP, 8 frame live mean stack



NGC2024 (Flame) & B33 (Horsehead)
45sec EXP, 15 frame live mean stack

NGC2174 Monkey's Head Nebula
60sec EXP, 10 frame live mean stack

M42 The Orion Nebula
45 sec EXP, single frame