# High Pass Filters in ImagesPlus

A high pass filter preserves or accents high frequency detail of an image while at the same time blocks or attenuates lower frequency detail. ImagesPlus 5.5 and later has two high pass filters. The high pass filter on the left vertical toolbar blocks or attenuates low frequencies by blending a Gaussian blurred and inverted version of the image with an opacity of about 50% with the original image. So the only control parameters are Gaussian blur radius and possibly opacity. I believe the high pass filter in Photoshop is of this type. The Frequency filter on the Smooth Sharpen menu is a true Fourier based filter and has high pass and band pass options along with cutoff, decay, and width parameters that allow the selection of a feathered range of frequencies and offers more control than the Gaussian blur based high pass filter. Both filters can be useful at sharpening and enhancing contrast.

The examples below show how to use the Gaussian blur and Fourier frequency based high pass filters with and without a mask to enhance contrast. The last example uses a multi scale decomposition into 3 detail levels to split star and nebula detail into three images so that stars can be processed differently than larger scale nebula structure. The frequency high pass filter is applied to the 3rd detail level or larger scale level to enhance contrast and sharpen the nebula. The small scale star and nebula detail in the first detail level is sharpened using a standard sharpening filter. The 2nd detail level is not changed. All three detail levels are then merged to get enhanced nebula contrast with smaller stars.
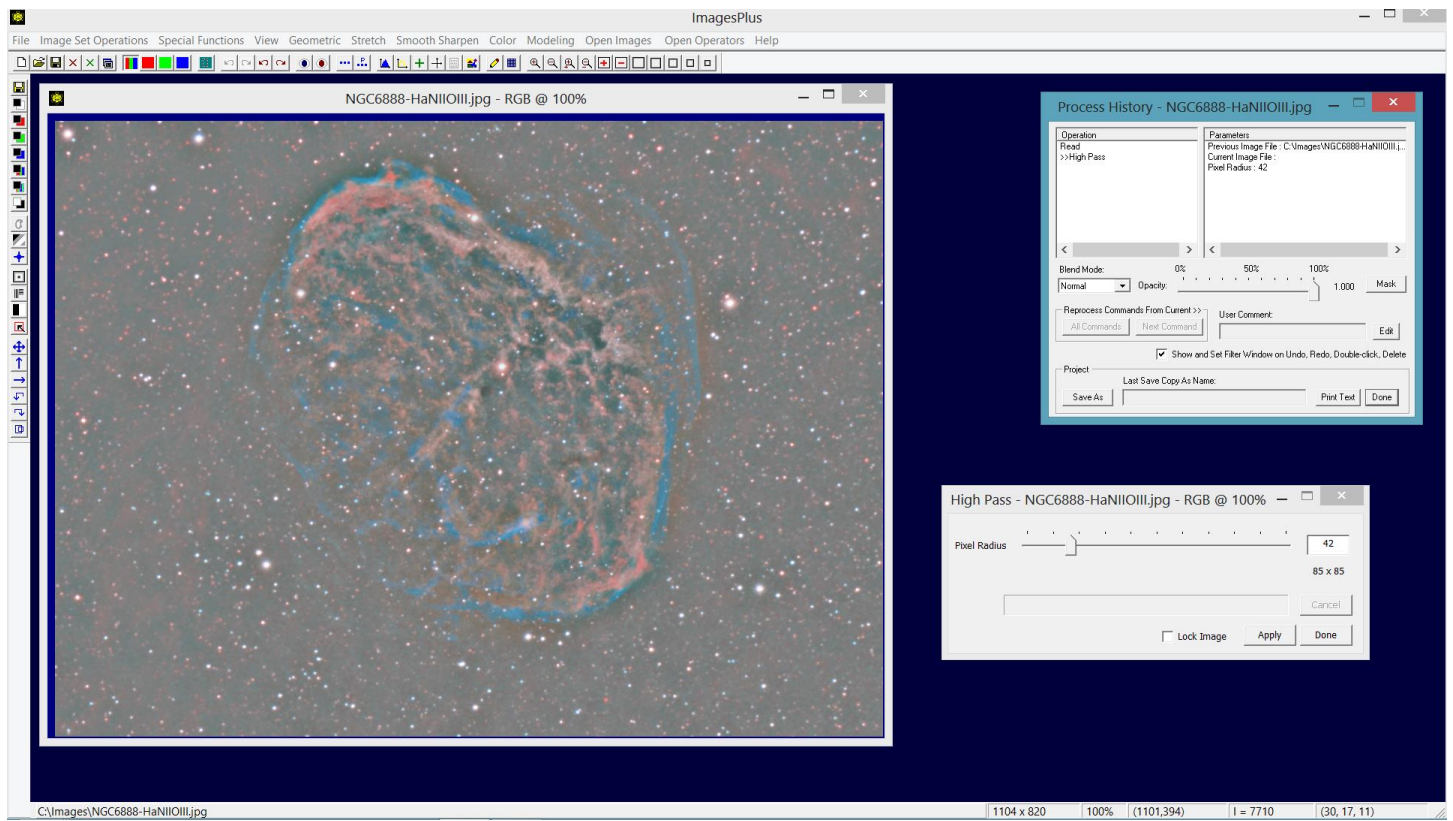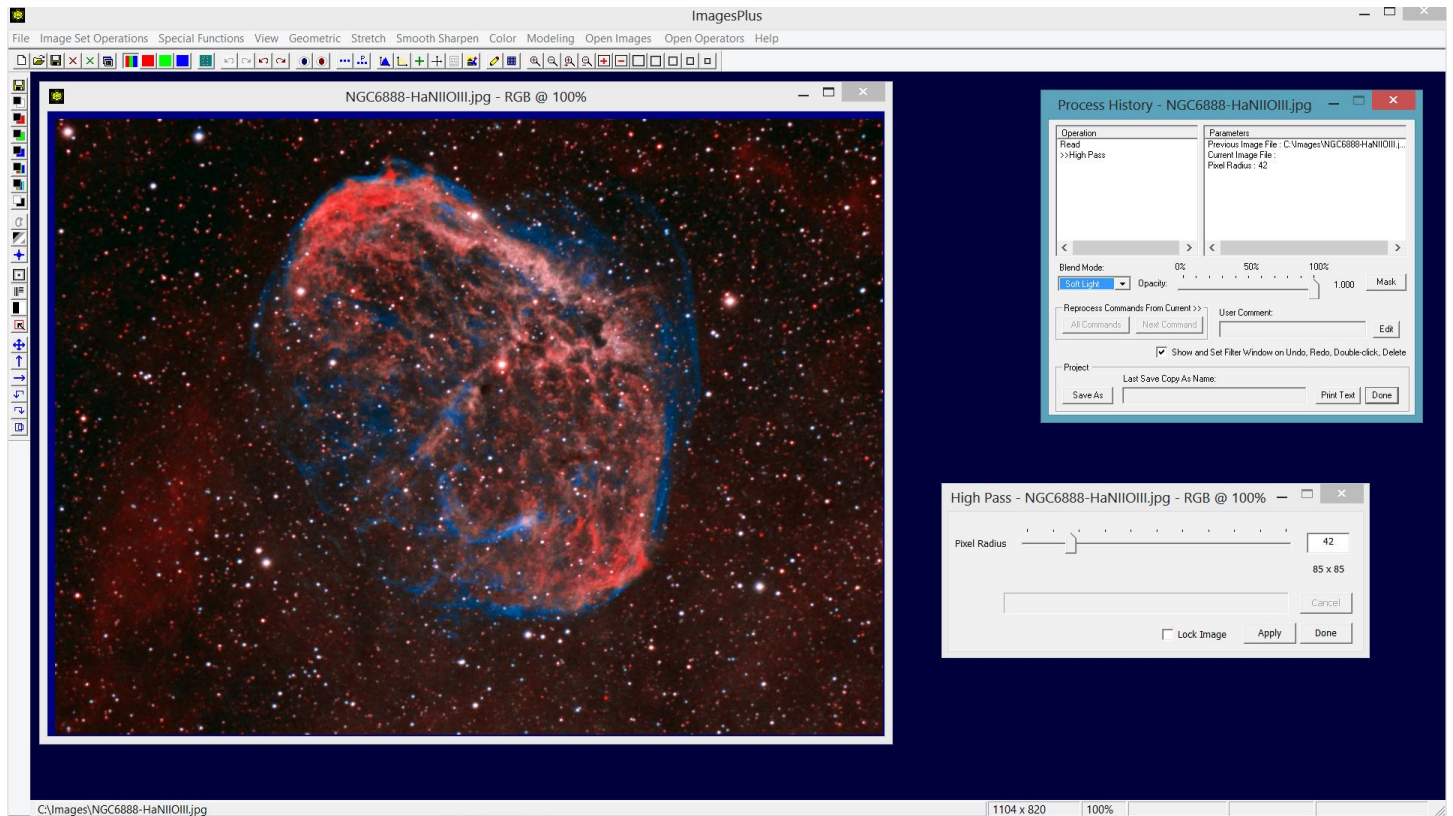
Gaussian Blur High Pass

Step 1)
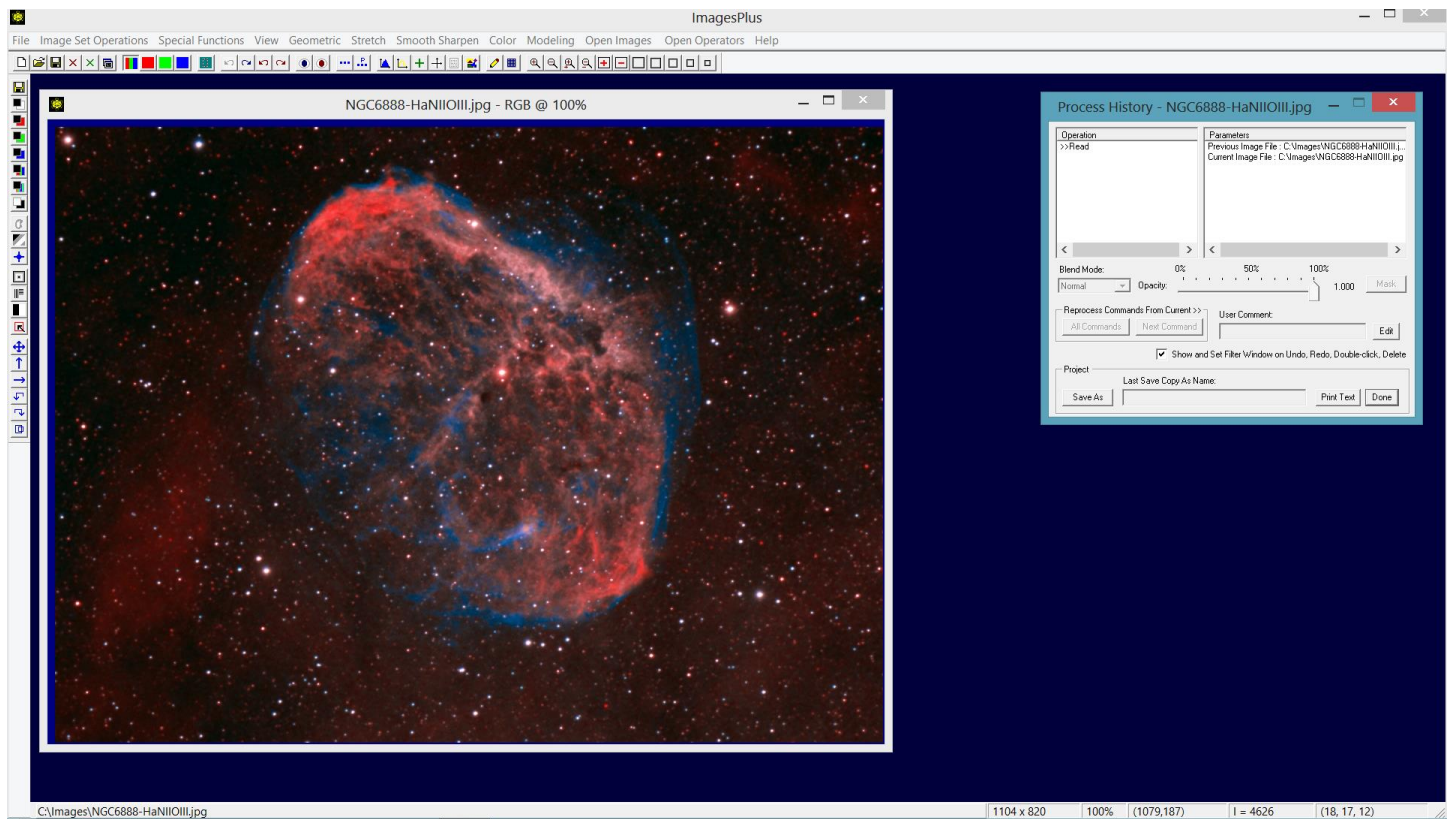
Initial image before Gaussian blur high pass contrast and sharpening.

Step 2)

The High Pass filter on the left vertical toolbar is applied to the initial image. Pixel radius is used to adjust the high frequency content of the image.

Step 3)

Soft light blend mode is set on the high pass filter to blend the high frequency image from step 2 with the initial image. Screen or overlay blend modes can also be used along with different opacity values to adjust the contrast and sharpening. Pixel radius on the High Pass filter is also varied to adjust contrast and sharpening.
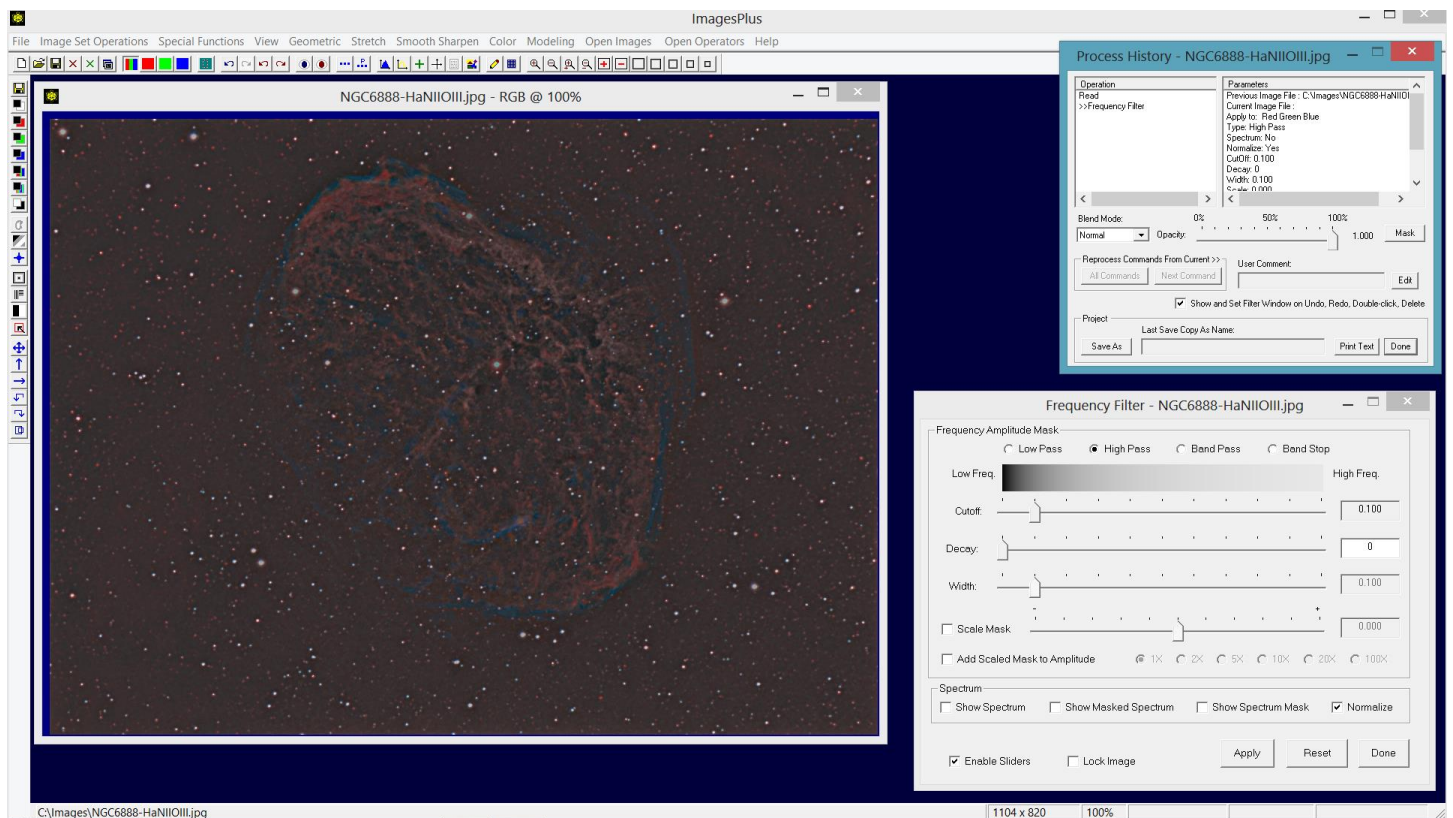
Step 4)
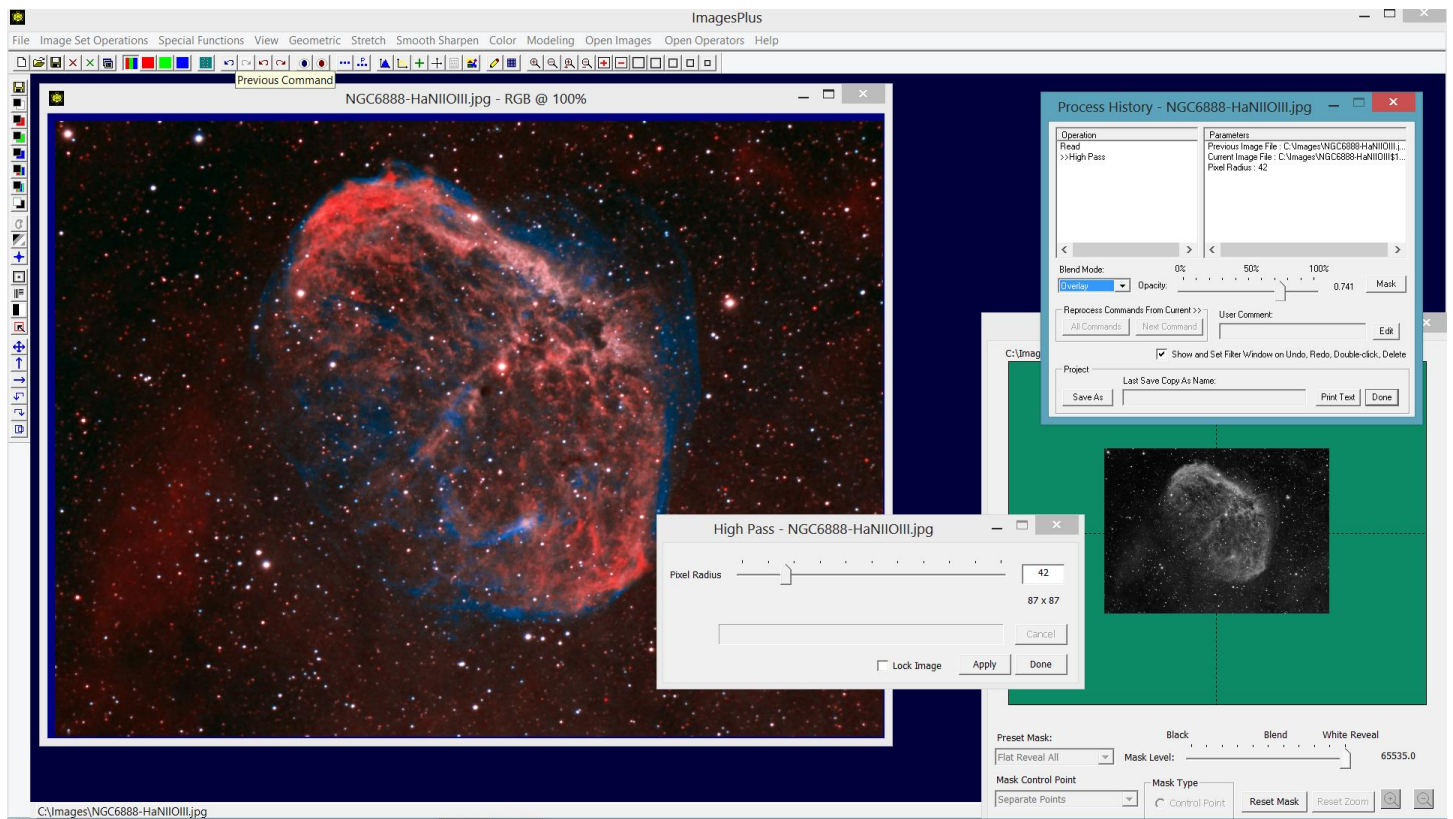
Luminance and other masks can be used with High Pass, blend modes, and opacity to soften or localize the enhancement.
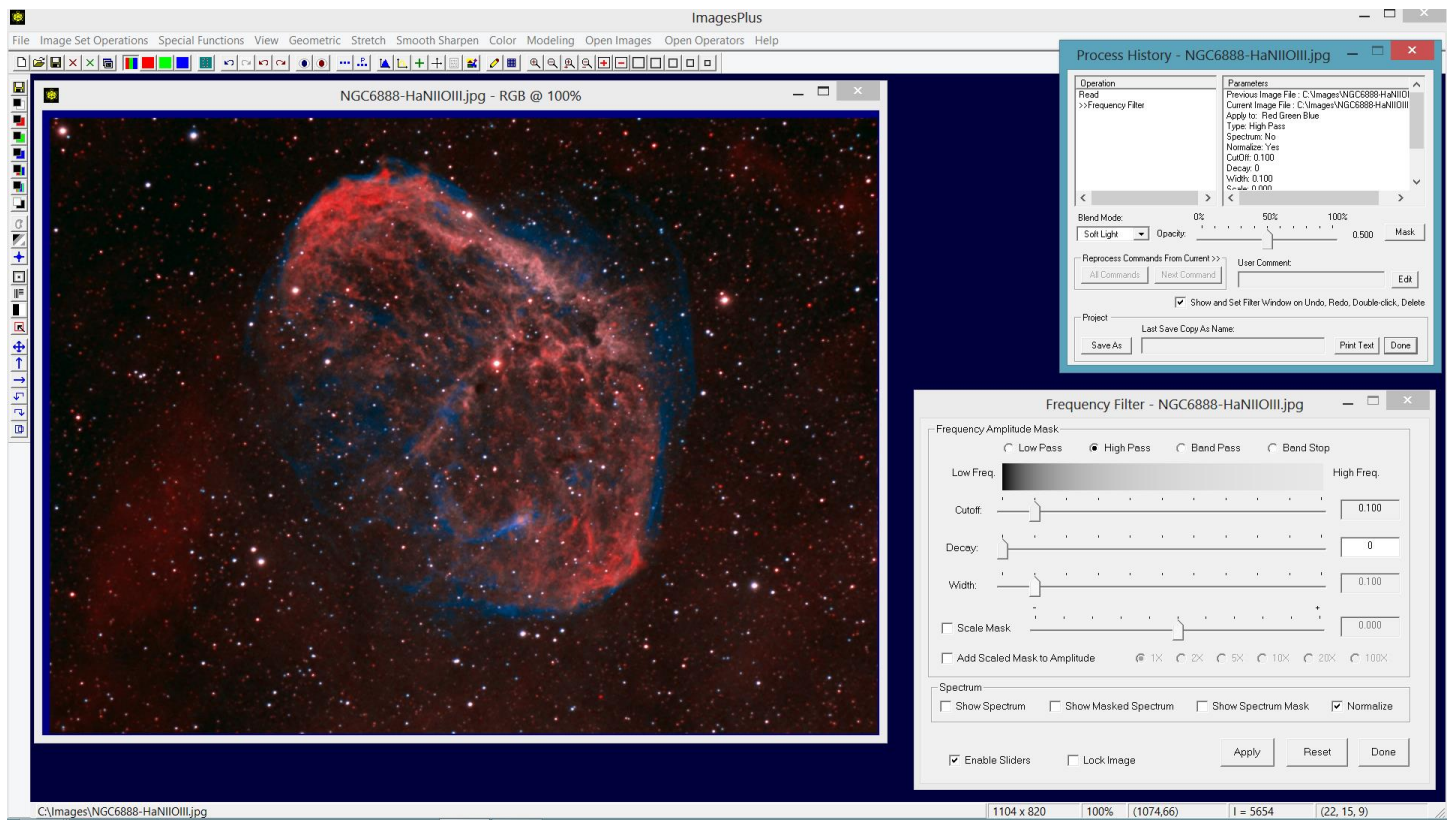
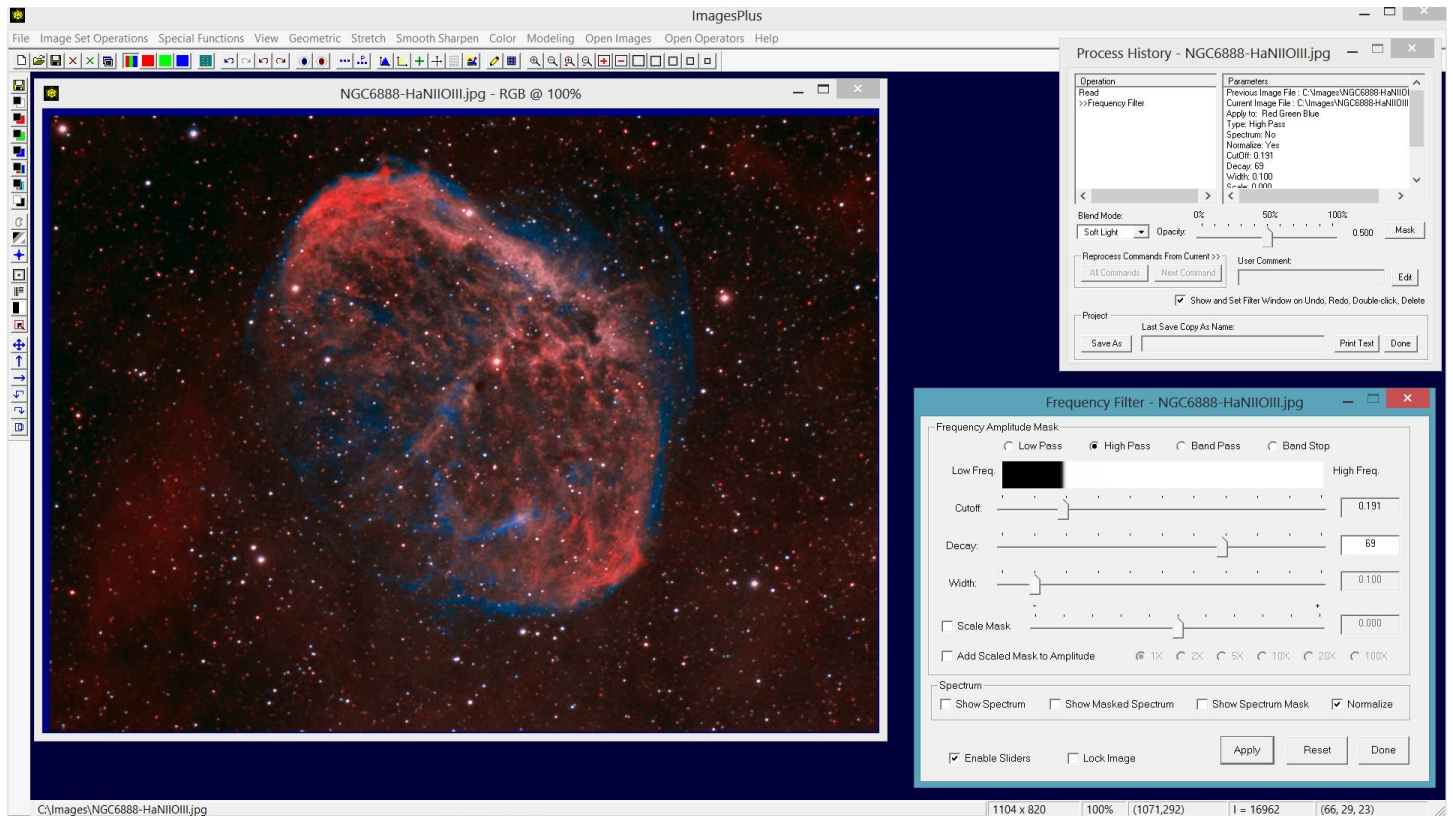**Frequency Filter High Pass & Band Pass**

Step 1)

The Smooth Sharpen | Frequency Filter with High Pass and Normalized output checked is applied to the initial image to create the high frequency image. Note the fine structure of the high pass image above compared to the Gaussian blur high pass image in step 2) of the Gaussian blur example.
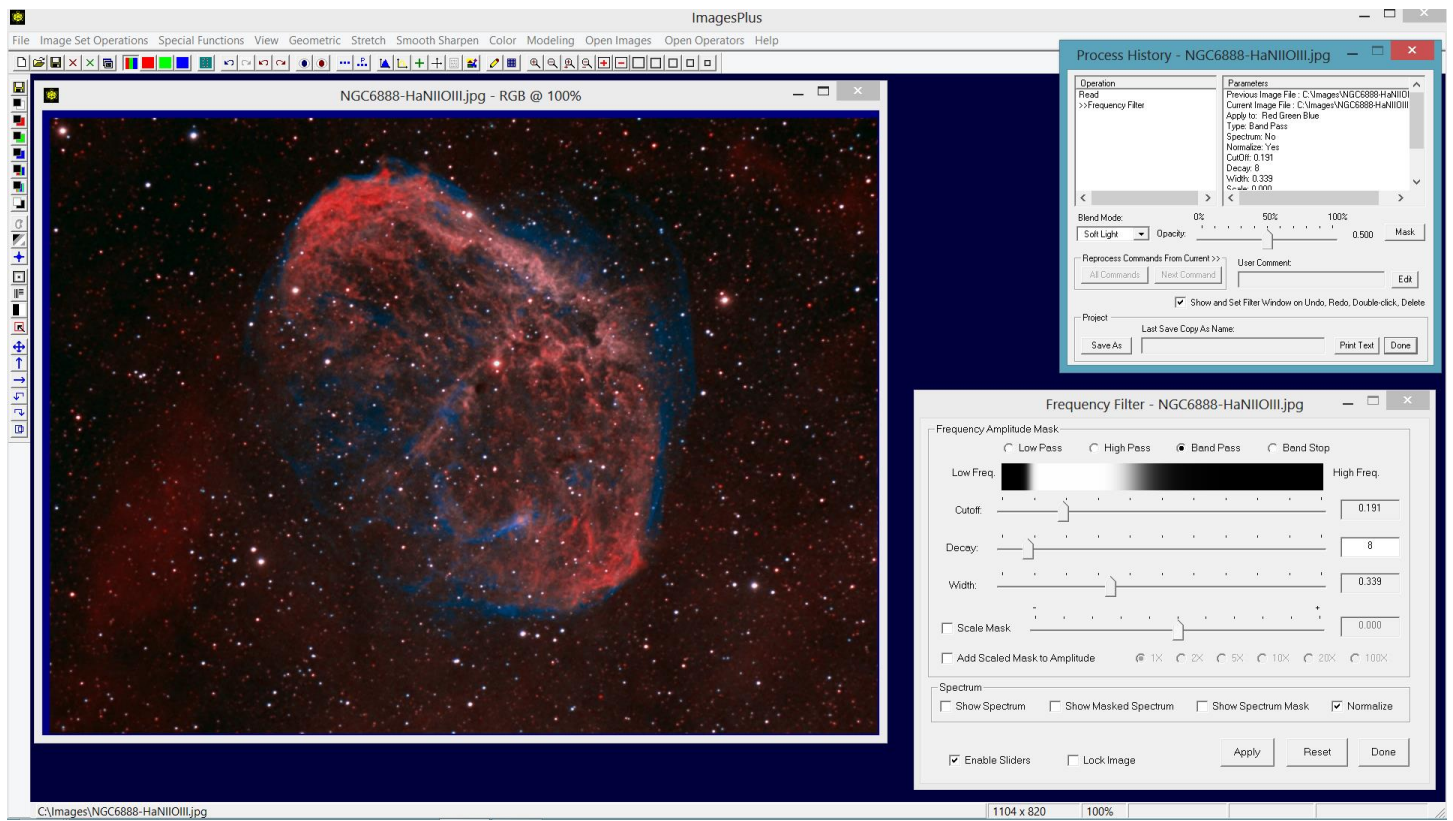
Step 2)

Soft light, screen, or overlay blend modes are now set on the high pass frequency filter and opacity is adjusted down to 50% to get the contrast enhanced image.

Step 3)

For a given blend mode and opacity cutoff and decay are adjusted on the high pass frequency filter to adjust contrast.

Step 4)

The Band Pass option on the Frequency Filter can also be used to enhance contrast. With Band Pass the Cutoff, Decay, and Width parameters are used to define a feathered high pass frequency range as shown by the white area on the frequency graph at the top of the Frequency Filter.
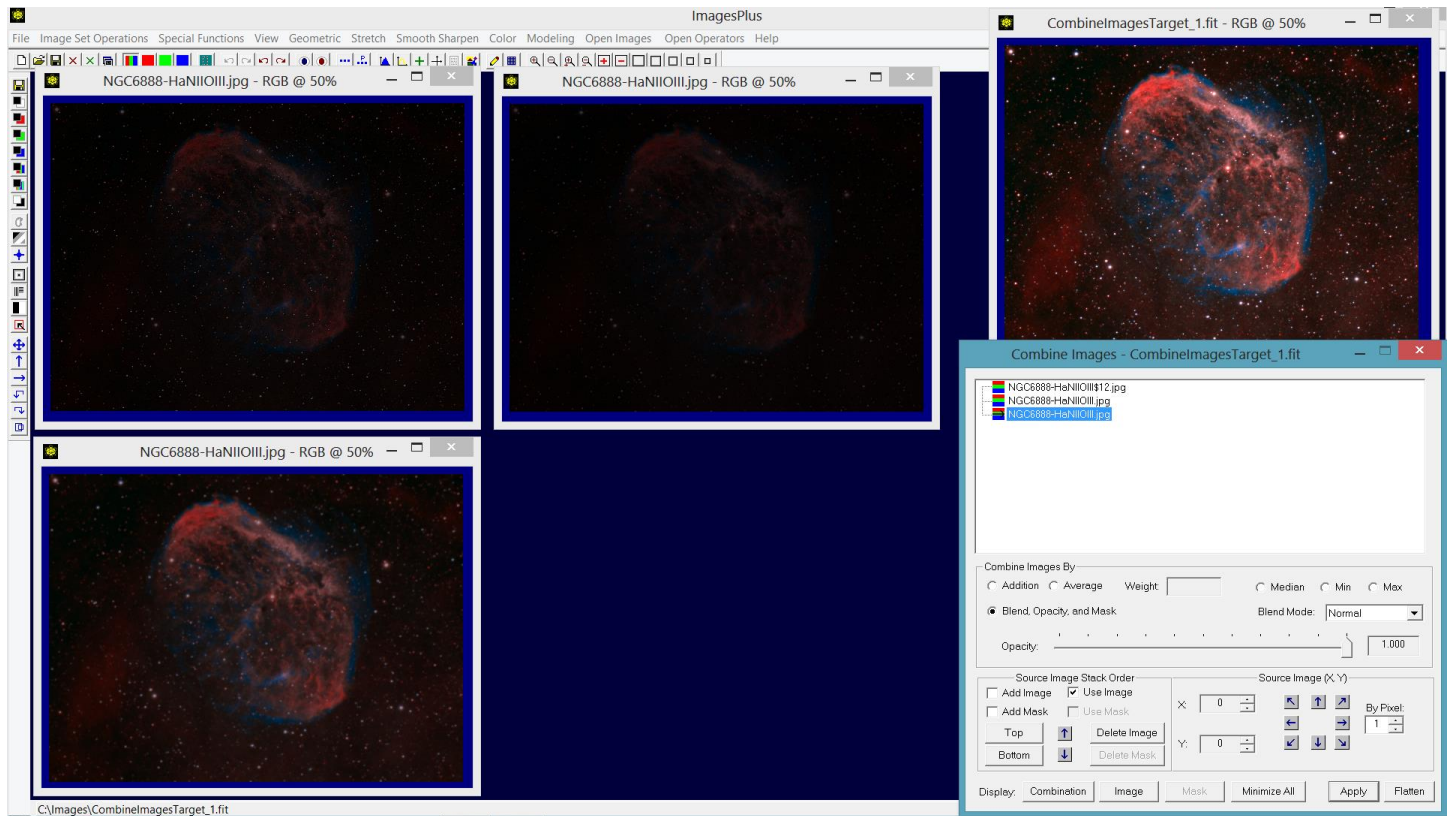
Step 5)
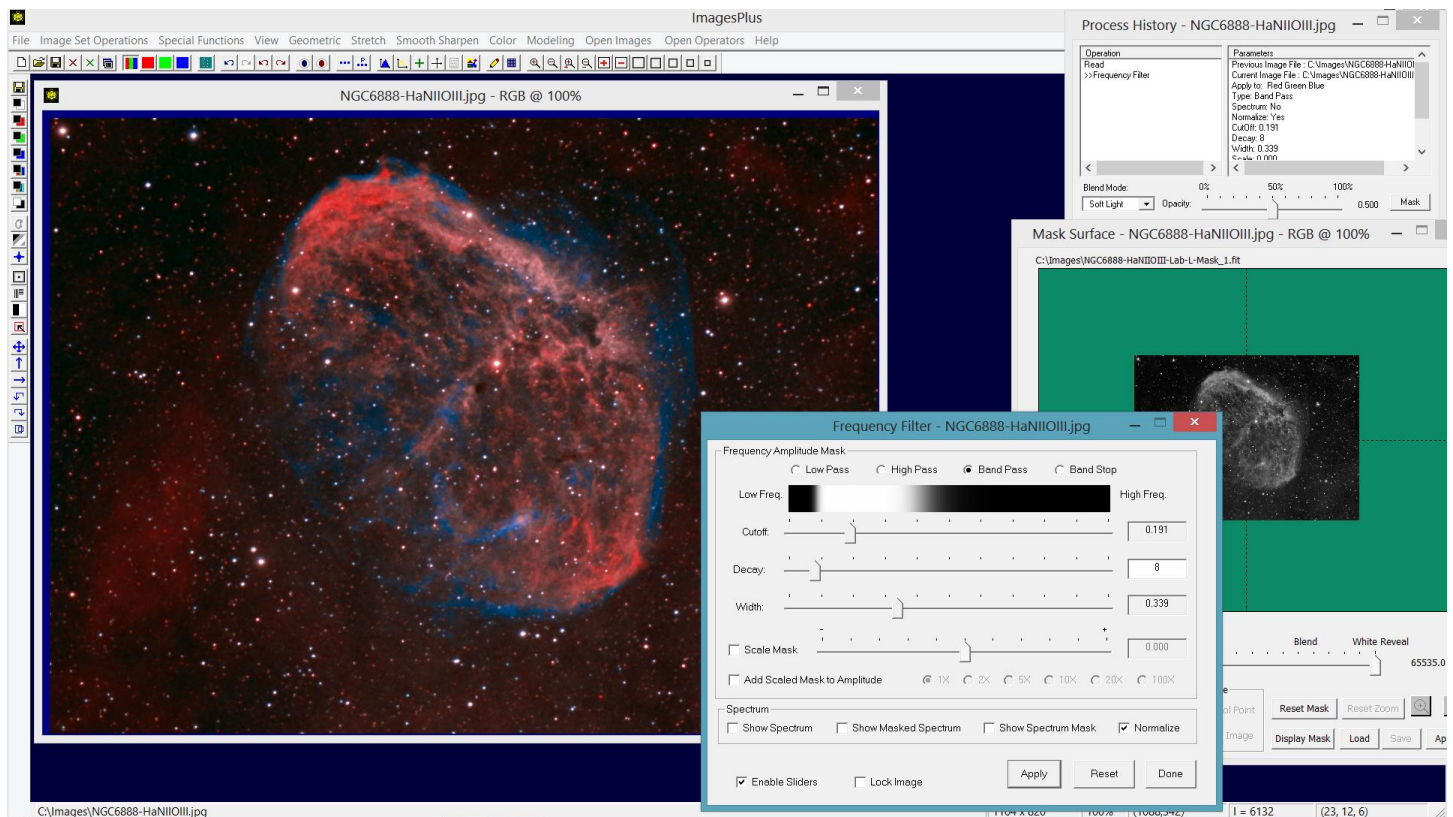
A luminance mask can always be used to soften or localize the contrast enhancement of the frequency high pass or band pass filters.

**Multi-Scale Decomposition & Frequency High Pass**

Step 1)

Multi-scale decomposition of an image can be used to protect stars size while high pass contrast enhancement is applied to the larger scale detail like the nebula in the above image. Initial image is shown top right with the first small scale detail image shown top left, second scale detail image top center, and larger scale detail image lower left. Multi-scale decomposition is automated in ImagesPlus 6 but earlier version of ImagesPlus can be used to create the detail level images.
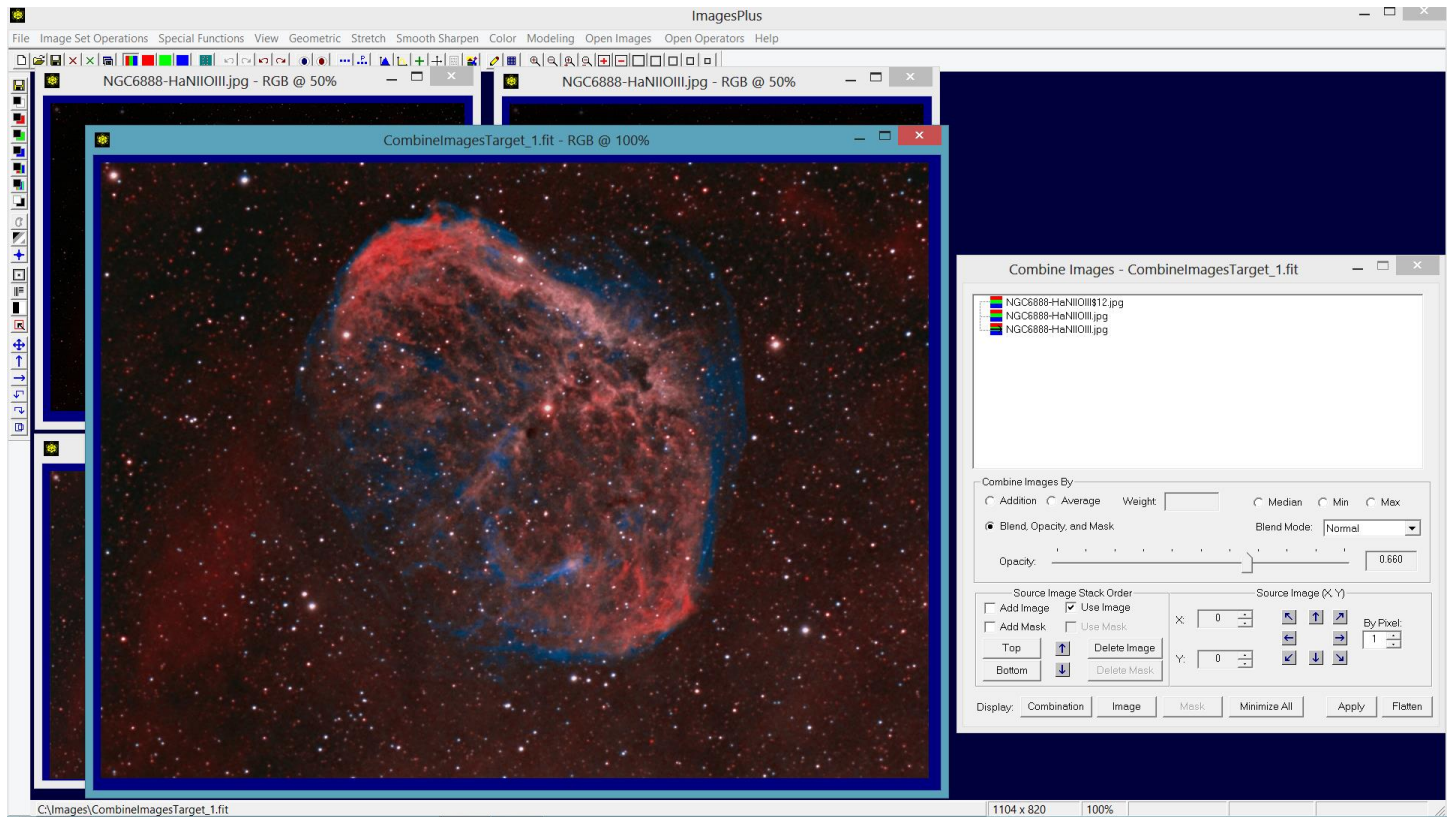
Step 2)
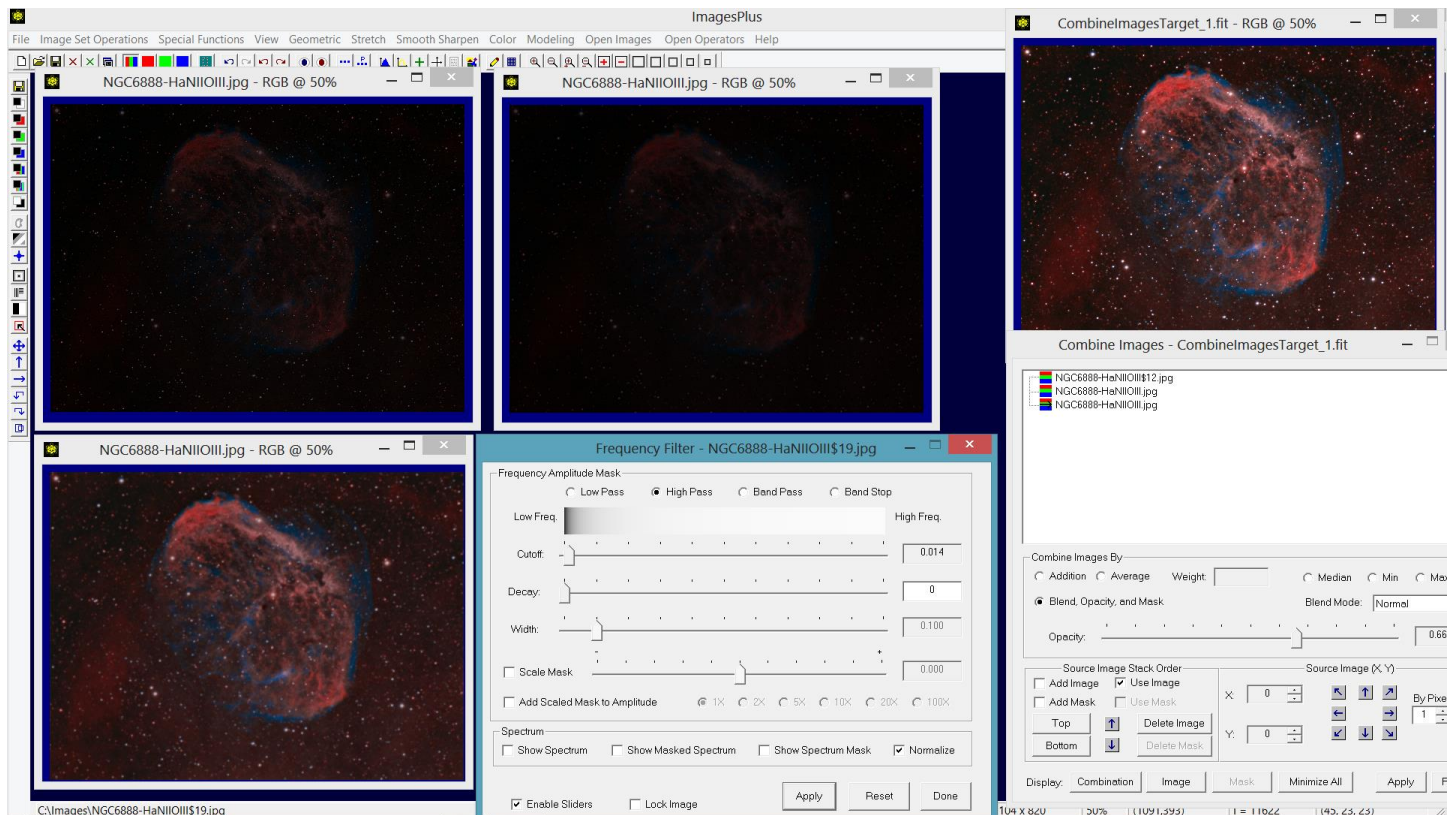
Above the high pass frequency filter with soft light blend mode is applied to the large scale detail image at lower left to increase contrast.

Step 3)
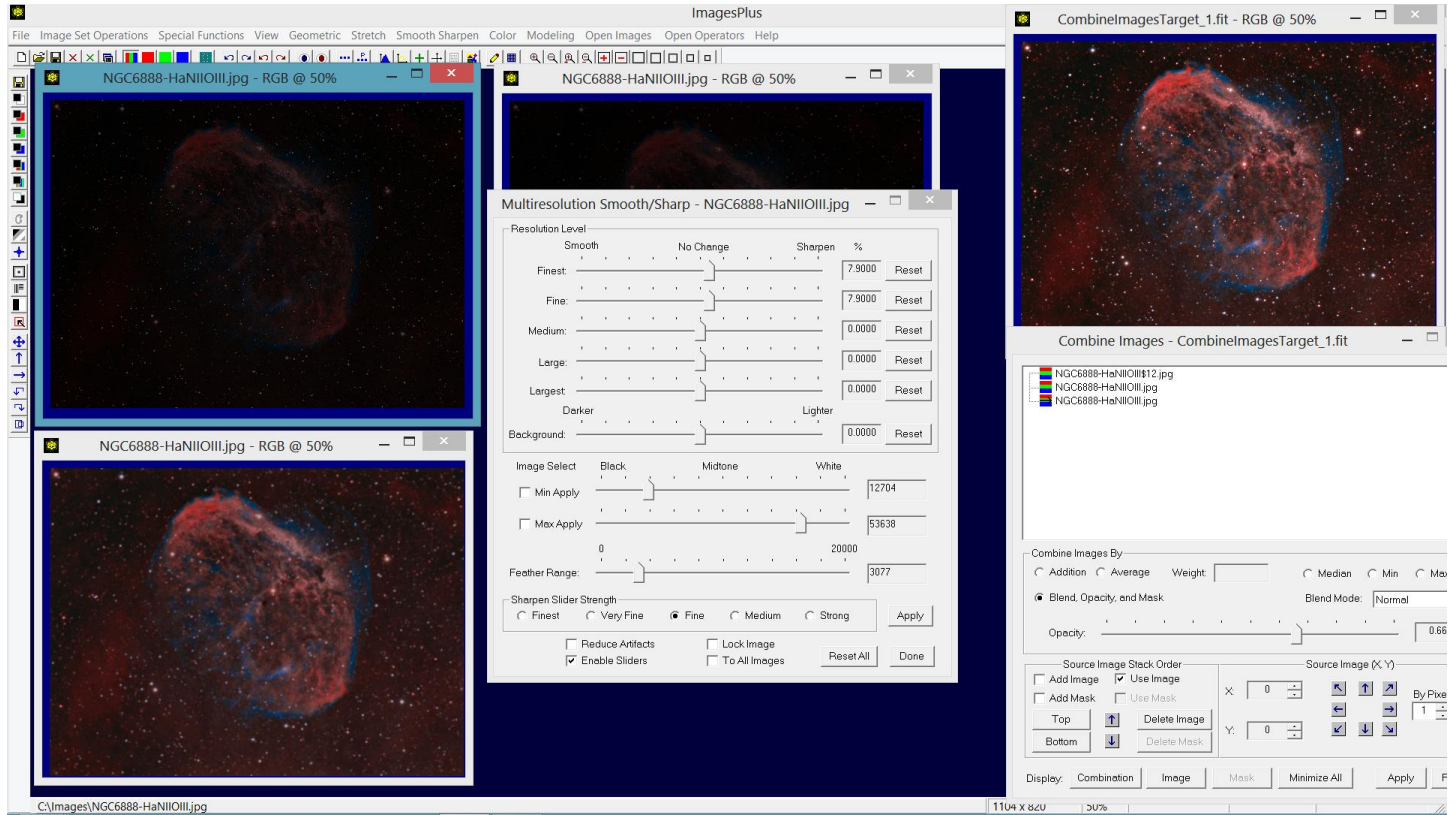
Mild Multi-resolution sharpening is applied to the top left fine detail level 1 image to sharpen stars and fine nebula detail. The second detail level at top center is not changed in this example.

Step 4)

The contrast enhanced large scale level 3 image is merged with the sharpened detail level 1 image and unchanged detail level 2 image using merge split blend mode. The bottom layer is the large scale contrast enhanced level 3 image with normal blend mode and 100% opacity. The middle layer is the unchanged detail level 2 image with merge spilt blend mode and 100% opacity. The top layer is the sharpened detail level 1 image with fine star and nebula detail and has merge split blend mode with 100% opacity set.

The final image shown above has contrast enhanced nebula and reduced star size.