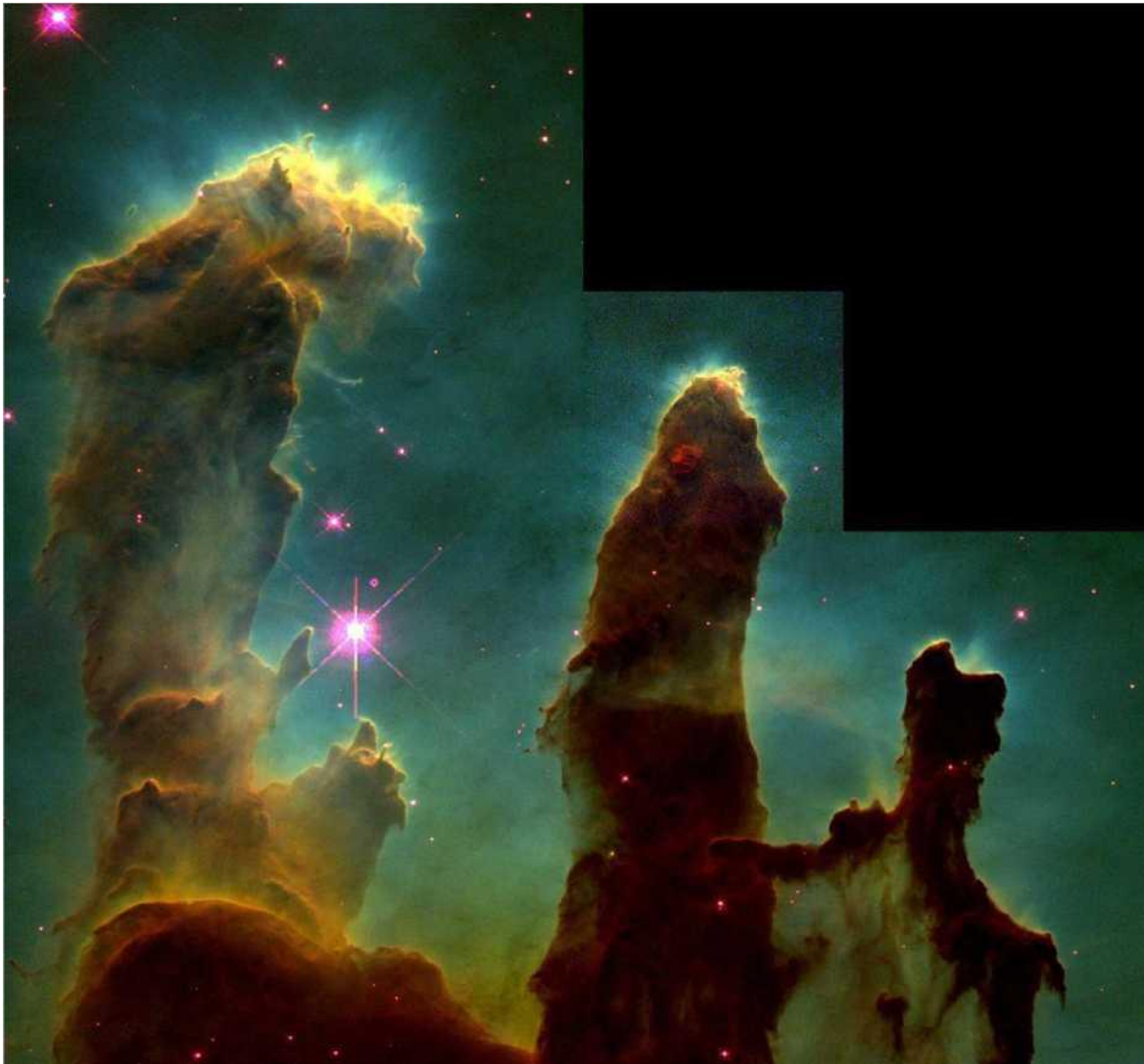


## Halos – no problem!

### The history of the Hubble palette



Credits: NASA

This breathtaking photograph of the Pillars of Creation was taken by the Hubble Space Telescope in 1995 and has been burned into the collective consciousness of humanity.

In addition to the wealth of details, two facts are particularly interesting. When we look at the Pillars of Creation, we notice that it is a false-color image. And it is striking that the stars look strangely pink and the brighter ones are surrounded by halos.

The light from the emission of different types of atoms is used to create color images. Red shows the emissions of single ionized sulfur atoms, green shows the emissions of hydrogen and blue shows the light emitted by double ionized oxygen atoms.

This classification according to the Hubble palette is due to the fact that both the H- $\alpha$  line and the SII line are deep red and practically indistinguishable from human perception. Only in the false color representation many details become visible.

This technique is not only reserved for NASA professionals, but is also used by countless hobby astrophotographers.

The pink stars are created by combining the individual lines of the Hubble palette and have become the hallmark of the Hubble Space Telescope's world-shaking images.

According to the premise of the J-P Metsavainio, the stars recorded with narrow-band filters do

not carry any relevant broadband color information. The stars should either be displayed in white or the effort should be spent and real RGB data should be recorded.

At this point, the question arises as to the appropriate technique, which allows separate processing of the stars and the nebula areas.

With such a technique, as a waste product, one is able to remove the halos or use them as a stylistic means.

As a rule, filters in the blue spectral range cause more pronounced halos than in the red.



A pronounced OIII Halo at the bright star Alnitak (in the belt of the Orion)

But also the optical windows of the astro cameras can intensify this problem. I took the trouble to study various narrow band recordings at [astrobin.com](http://astrobin.com) and I saw that the halo problem is not bound to a certain filter or camera manufacturer.

But halos are not a real problem with the tone mapping technique according to J-P Metsavainio.

## **Tone Mapping Technique according to J-P Metsavainio**

### **The motivation**

In addition to the pink stars, there are far more important reasons to design the image processing of the stars and the nebula areas separately.

In order to display the 65536 grayscales of a 16-bit astro camera on a monitor, for example, the image must be stretched accordingly. When the weak nebula areas become visible, the brighter stars burn out completely.

On a starless image, image processing methods such as deconvolution can also be performed much more easily.

After separate processing, the images must be reassembled. This can easily be achieved in Adobe Photoshop by multiplying layers negatively with each other. One can imagine this as if

one were projecting both images onto one screen with two slide projectors.

This technique was invented and described by the famous Finnish astrophotographer J-P Metsavainio:

<https://astroanarchy.blogspot.com/2009/11/power-of-tone-mapping.html>

### **Removing the stars**

An essential step in this process is the removal of the stars. There are several tools and methods:

- 1.) The J-P Metsavainio method is based on the dust and scratch filter in PS and is described here: [http://www.cedic.at/arc/c11/dwn/CEDIC11\\_JukkaMetsavainio.pdf](http://www.cedic.at/arc/c11/dwn/CEDIC11_JukkaMetsavainio.pdf)
- 2.) The Annie's Astro Actions include a PS tool to remove the stars: <https://www.eprisephoto.com/astro-actions>
- 3.) My colleague Straton Zipproth has written the now widely used software STRATON: [https://zipproth.com/index.html#Straton\\_main](https://zipproth.com/index.html#Straton_main)

This list is not complete and the tools work differently depending on the image.

The astrophotographer Horst Ziegler has made the following comparison on this topic:

<http://www.astrovis.at/cs25072013.php>

### **New techniques in Adobe Photoshop**

In the latest version of Photoshop, Adobe has implemented content-based surface filling. The functionality of this tool is impressively demonstrated here:

<https://www.fotoespresso.de/inhaltsbasiertes-fuellen-photoshop/>

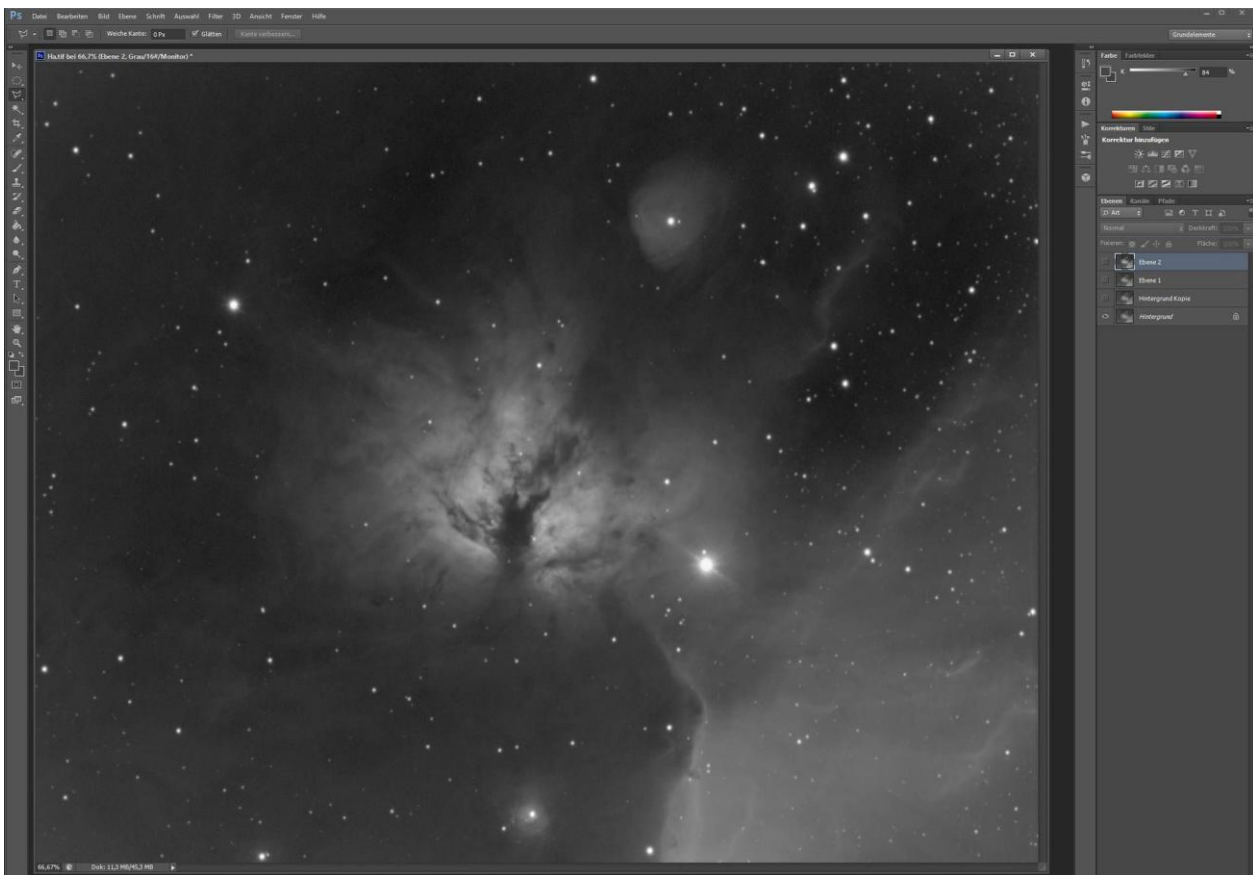
If you use the Tone Mapping technique according to J-P Metsavainio, you can easily separate the halos with the content-based filling of surfaces. Then you can decide whether to show the data in the final image or not.

### **Hint**

At this point I would like to emphasize that we are talking about advanced techniques in hobby astrophotography without any scientific claim = Pretty Pictures.

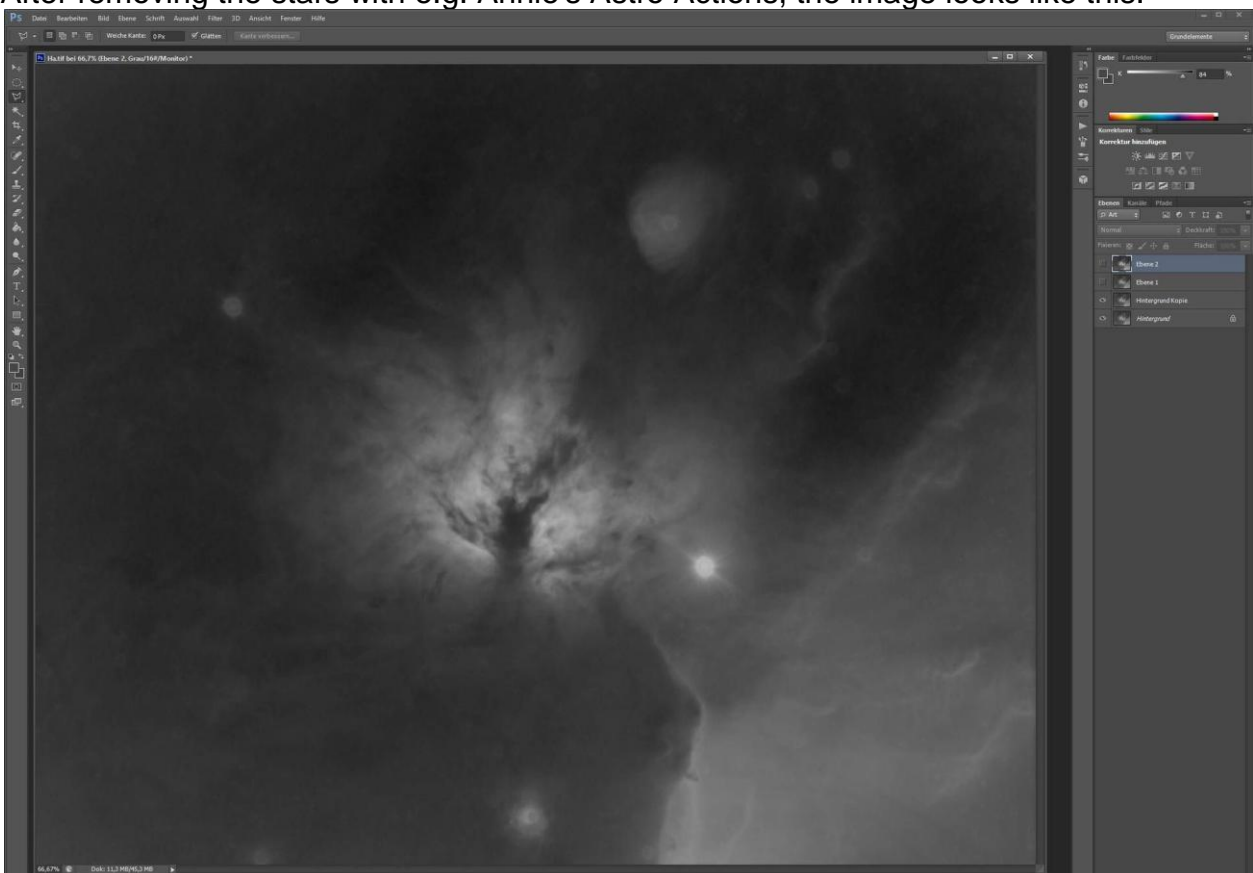
## Example of an image processing

To show this technique, I chose an older picture of the flame nebula and re-processed it.



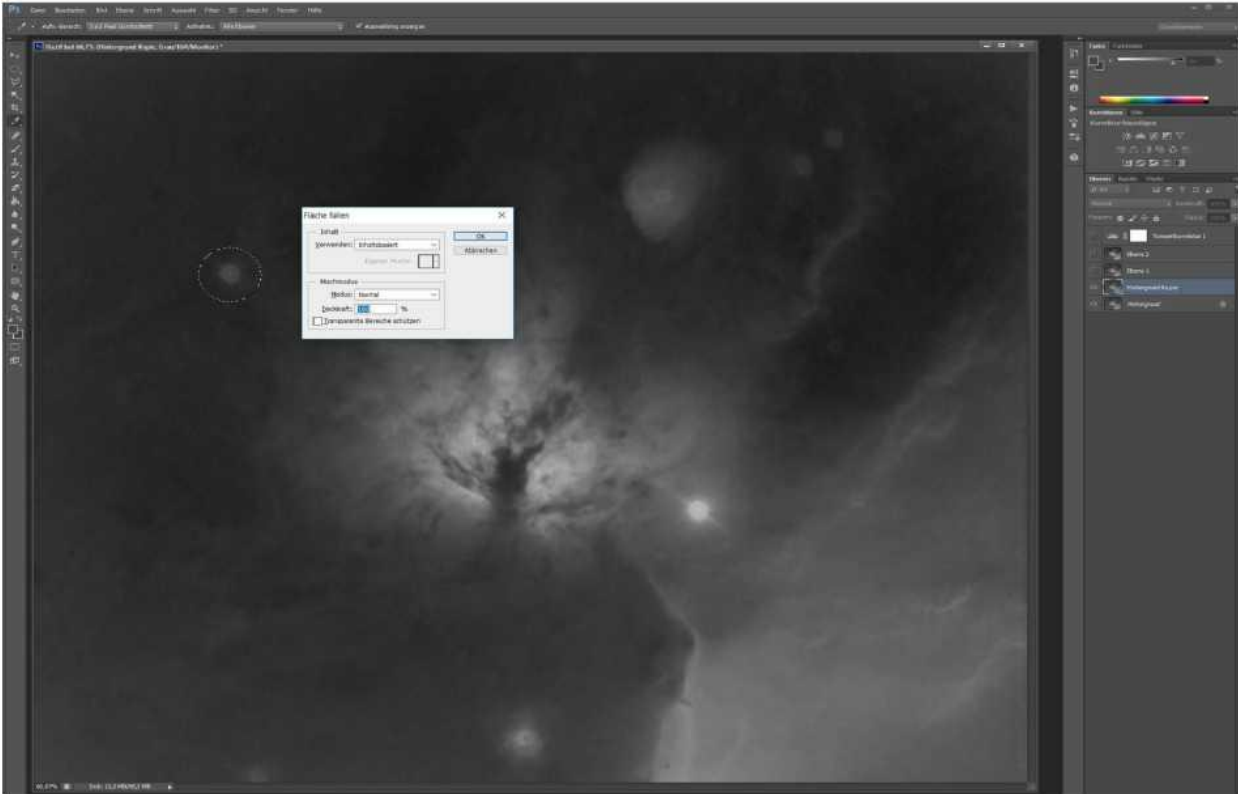
Flame nebula with stars and a halo around the burnt out star Alnitak

After removing the stars with e.g. Annie's Astro Actions, the image looks like this:



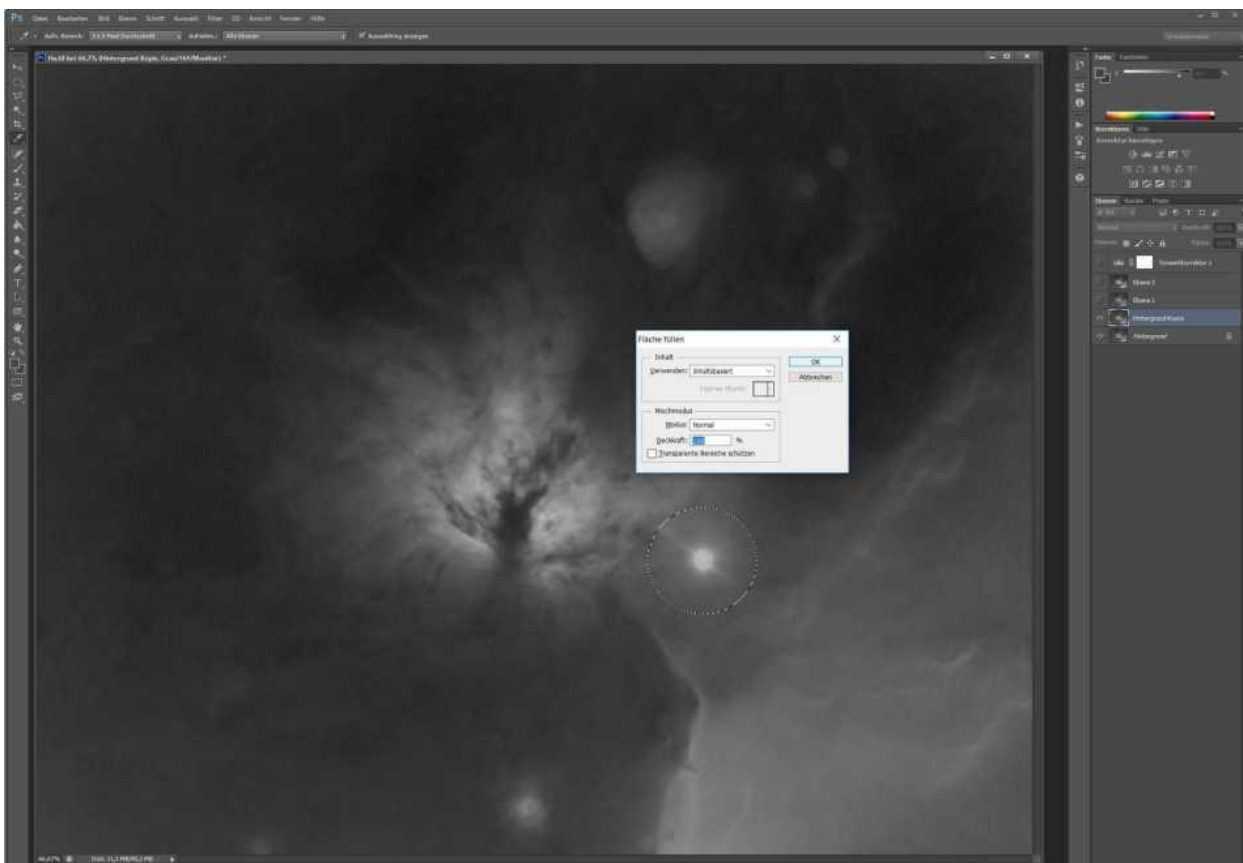
Starless image with halo and star remnants

In order to remove the remains of the bright stars one can already use the content-based filling of surfaces.



The content-based filling of surfaces can be started with <Shift-F5>

We also remove the halo in this



The halo is marked with the selection ellipse...



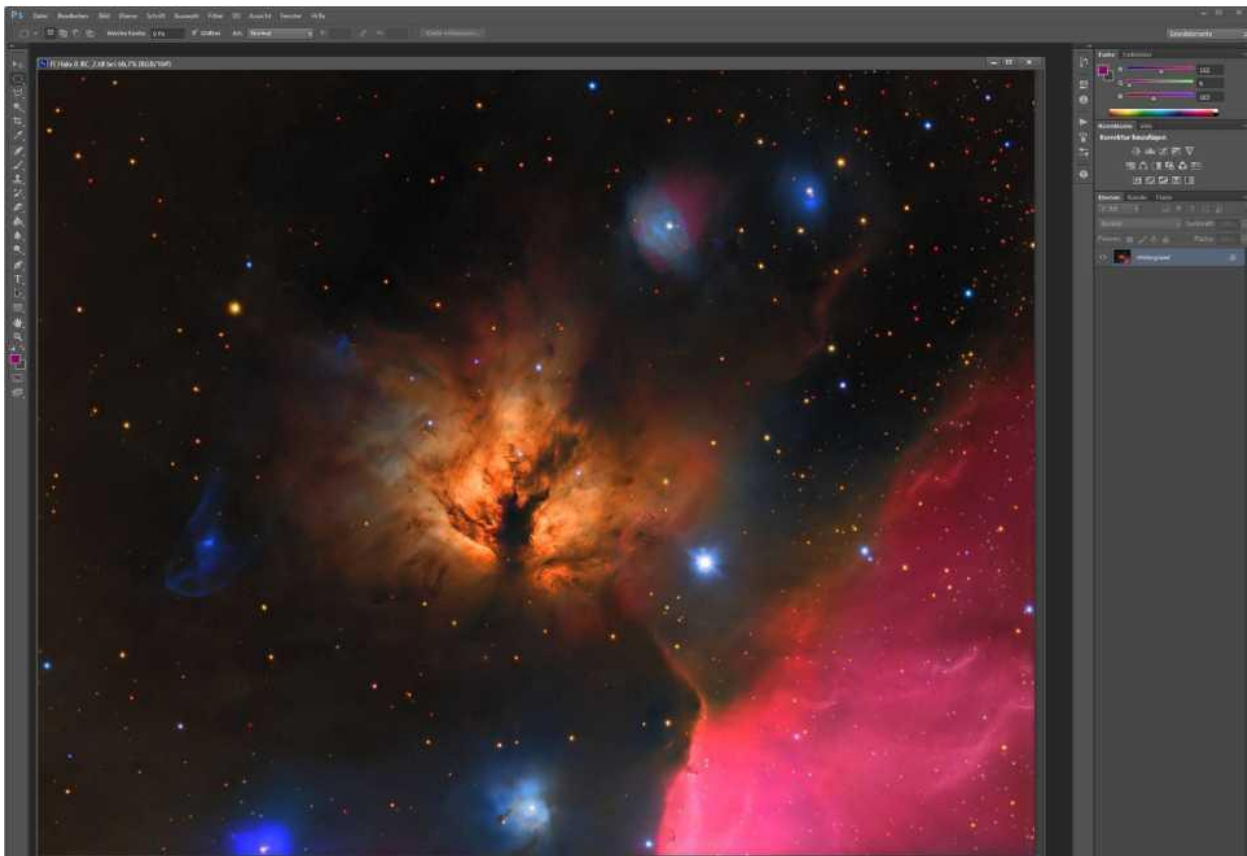
... and removed, based on content.



After a few minutes of work, all star remnants and halos are removed, and after a few processing steps, such as high-pass sharpening and noise reduction, the image looks like this:



An image without stars and Halos ...

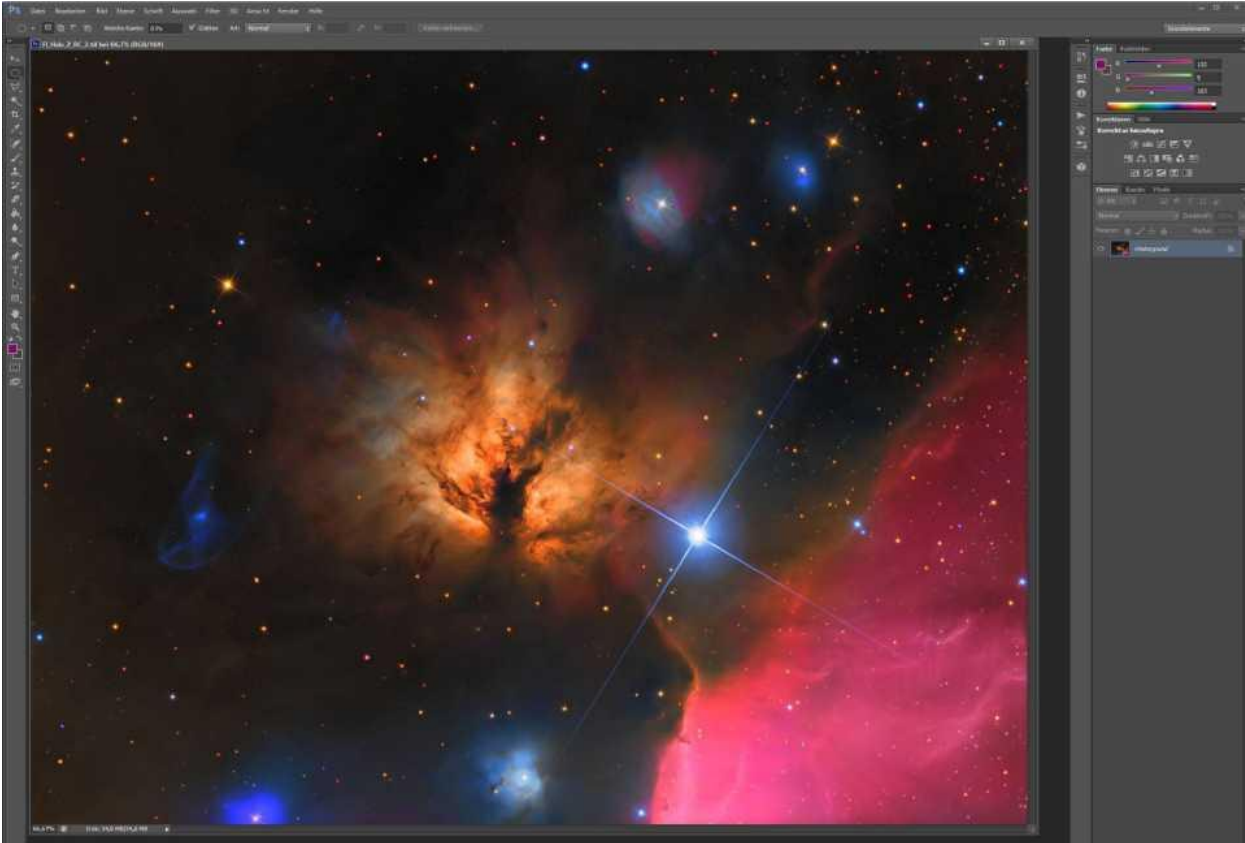


... and the result of our efforts.

Remains the legitimate question about the whereabouts of the stars?

As long as you do not stretch the data, change the gamma or the brightness or contrast, etc., you can subtract a starless image from the original image e.g. with the freeware Fitswork and get back the stars or halos as difference.

It is still possible to add the halo back to the image:



The company ProDigital Software with StarSpikes Pro provided for the joy of the Star-Spikes here.

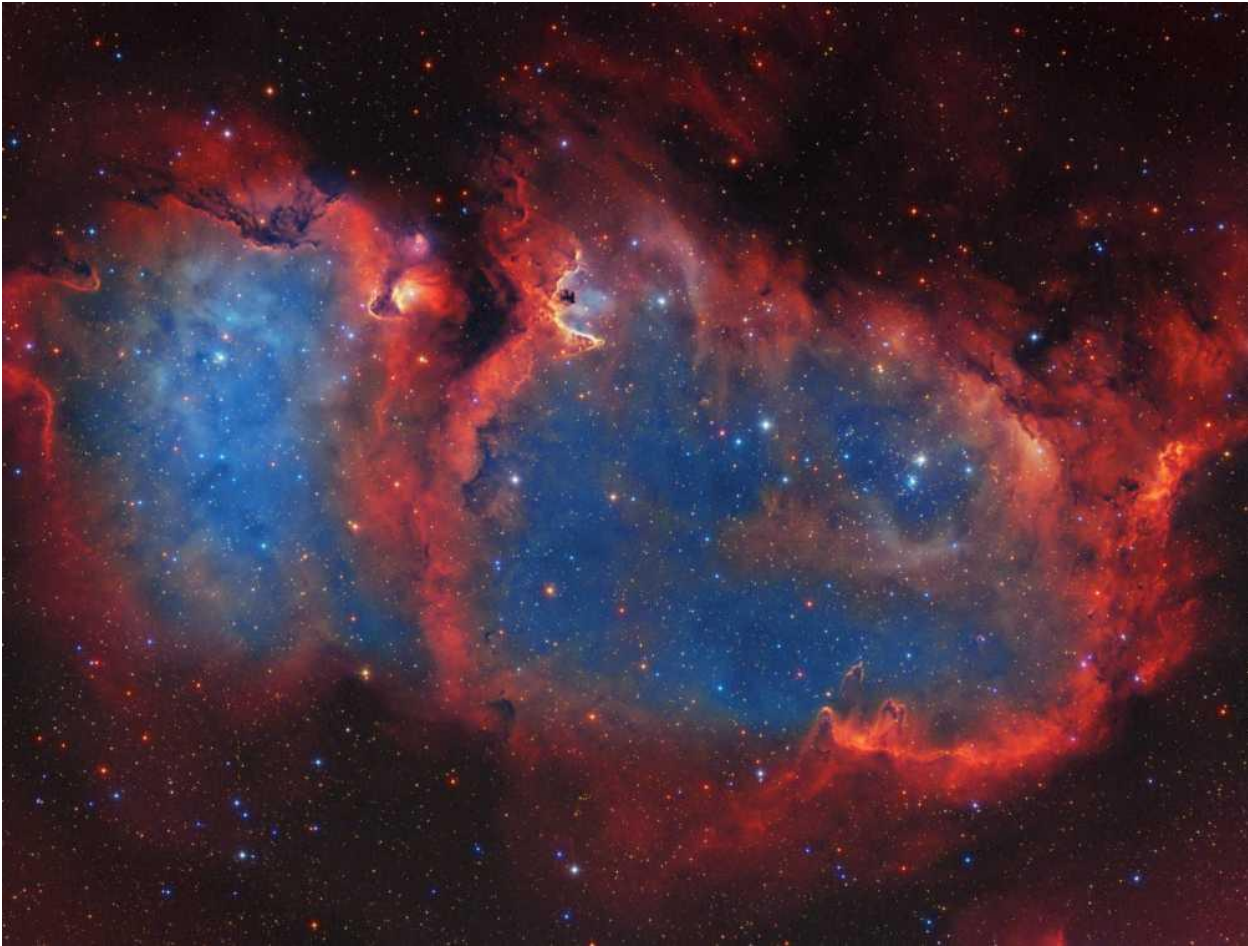
### **Advanced techniques for editing the stars**

Since the stars recorded with narrow-band filters do not carry any relevant broadband color information, there are two options for the ambitious astrophotographer.

If you only have narrowband data, you can leave the stars white with the Tone Mapping technique.

The narrow band RGB composition is somewhat more elaborate.





SH2-199 - Soul Nebula in SHO-LRGB <https://www.astrobin.com/350015/C/?nc=>

### **bottom line**

The content-based filling of surfaces has really enriched the tone mapping technique in my eyes. Eliminating halos or star remnants makes this tool much easier. Sometimes a halo around a bright star can make an image more interesting. The photographer has everything in his hands with this technique.

### **Link collection**

A gif animatine illustrating the tone mapping technique:

[https://www.astrobin.com/338123/B/?image\\_list\\_page=2&nc=](https://www.astrobin.com/338123/B/?image_list_page=2&nc=)

Galerie of my astrophotos at astrobin.com:

<https://www.astrobin.com/users/equinox/>

And the observatory:

<https://www.baader-planetarium.com/de/blog/first-light-2-6-m-baader-classic-dome-in-ingolstadt-deliver-the-first-astrophotos/>



<https://www.astrobin.com/380401/B/?real=&nc=equinox>

Andreas Bringmann