

Capturing Cosmic Magic Through Astrophotography

Chanan Greenberg

Thursday, December 11, 2025



Dedication



Dr. Ken Lum



Ed Pieret

Agenda

- Why do people bother with astrophotography?
- What's in an image? Seeing physics
- Astrophotography comes in different flavors
 - Smartphone Astrophotography
 - Digital Cameras
 - Electronic Telescopes
 - Dedicated Astrophotography Cameras
- Capturing images: nightscapes, solar system and deep space
- Processing Images: Deep Space and Solar System

Why Bother with Astrophotography?

- For over 30 years amazing high-quality images are available for free on the internet
- Why bother trying to capture your own image that is unlikely going to be better than Hubble..?



Why Bother with Astrophotography?

- Doing it yourself – the same reason you might take a picture in Yosemite, there are a million professional images, but this one is yours. Capturing and sharing what ***you*** experienced
- Technical challenge and the experience
- A connection to the cosmos, you reached out and grabbed those photons. You had the experience of imaging and processing, not just passively looking at a picture



What's In an Image? Seeing Physics

Planetary Nebula M27
(Dumbbell Nebula)

Exposure: 4 hours & 15
Minutes

Scope: AP 5" Refractor

Mount: AP 900

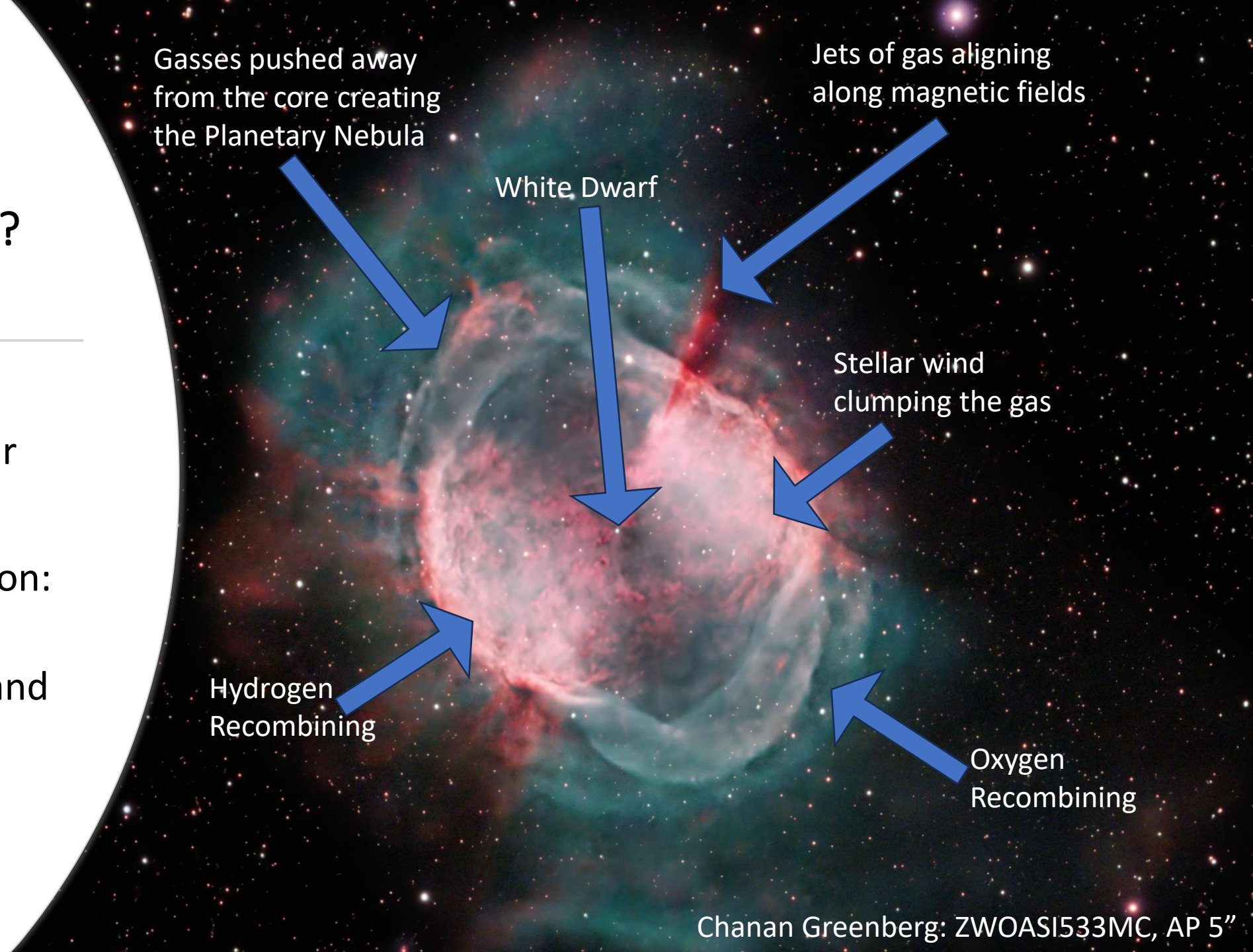
Processed in PixInsight



Chanan Greenberg: ZWOASI533MC, AP 5"

What's In an Image? Seeing Physics

- Planetary Nebula / death of sun-like star
- White Dwarf
- Chemical Composition: Hydrogen & Oxygen
- Jets of stellar wind and magnetic fields



Astrophotography comes in different flavors

Smartphones

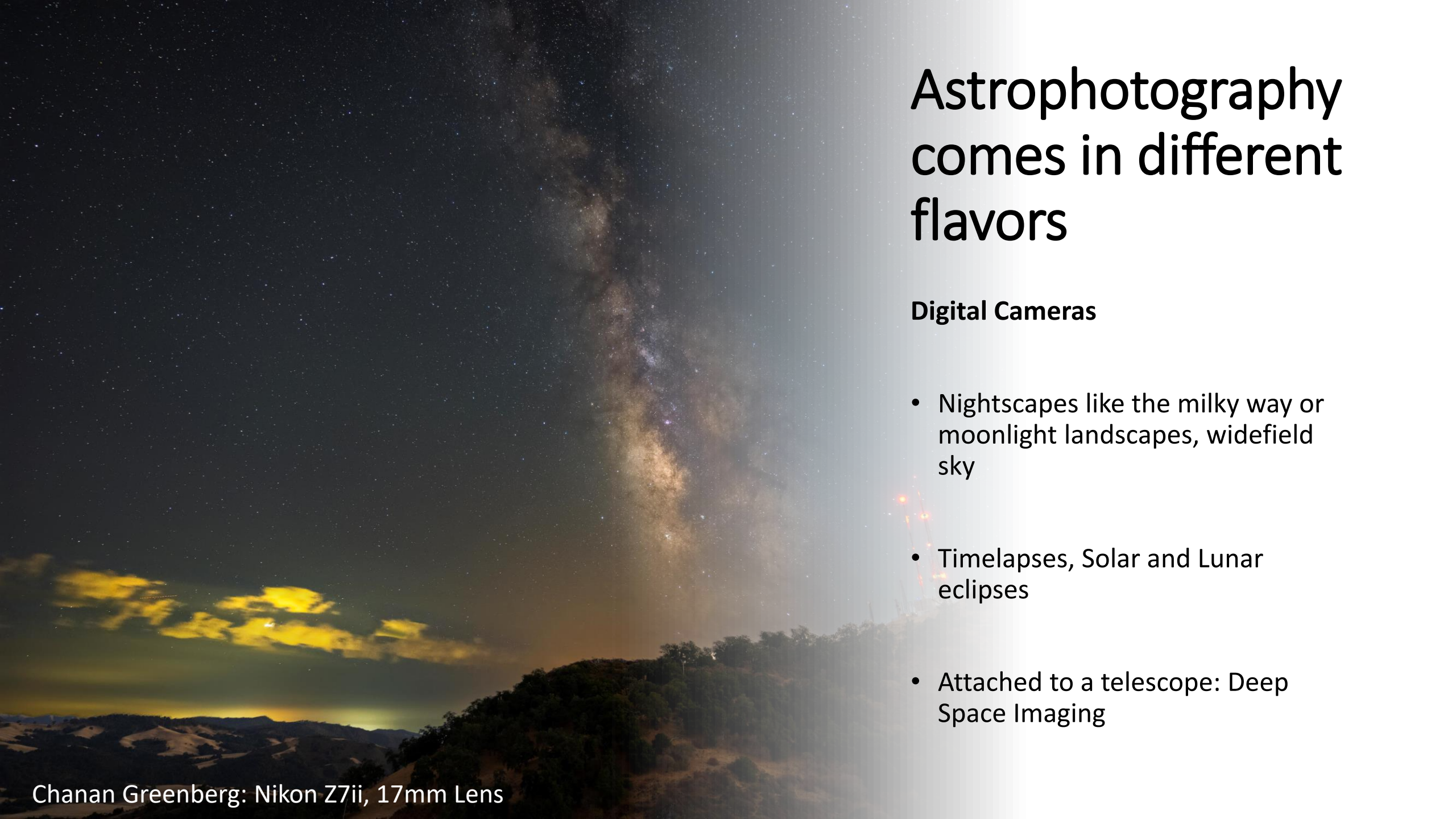
- Constellations, Nightscapes like the milky way or moonlight landscapes
- Eclipse timelapses
- Attached to a telescope: Sun, Moon



Chanan Greenberg: iPhone 11ProMax through 12" Dobsonian



Stock Image



Astrophotography comes in different flavors

Digital Cameras

- Nightscapes like the milky way or moonlight landscapes, widefield sky
- Timelapses, Solar and Lunar eclipses
- Attached to a telescope: Deep Space Imaging





Digital Camera



Chanan Greenberg: Nikon D5000, 10mm Lens



Chanan Greenberg: Nikon Z7ii, 500mm Lens

Electronic Telescopes

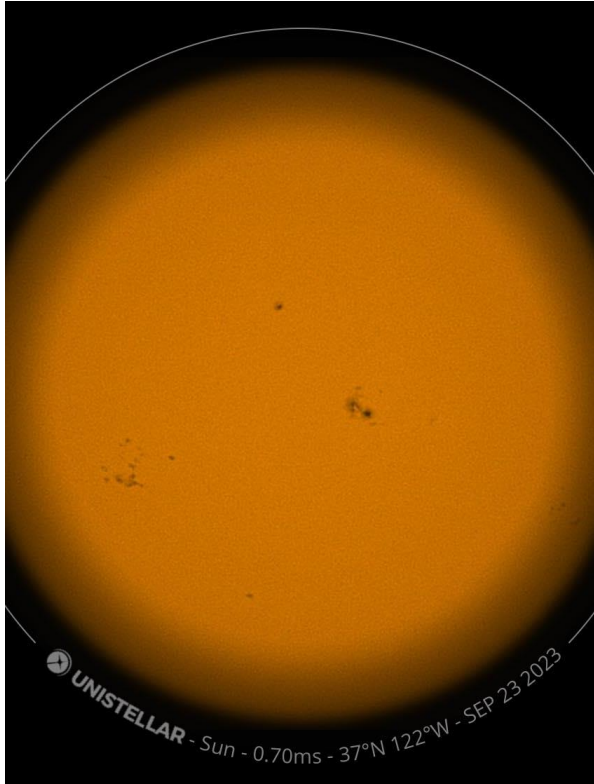
- First to market: Meade ETX-LS with a 6" and 8" version in 2008/2009
- Built-in camera and external monitor with ability to connect to a computer
- Camera used for self alignment, wide field constellations and solar system objects



Electronic Telescopes



Electronic Telescopes



Before Smart Scopes you needed to know how to:

- Match scope and chip (focal length and FOV)
- Balance the scope
- Polar Alignment (Drift Alignment)
- Software part 1: Image capture, autoguiding
- Software part 2: Image Processing

PROS:

- Close to zero setup time
- Very easy to use
- Near real-time viewing
- Easy to share
- Very low learning curve

CONS:

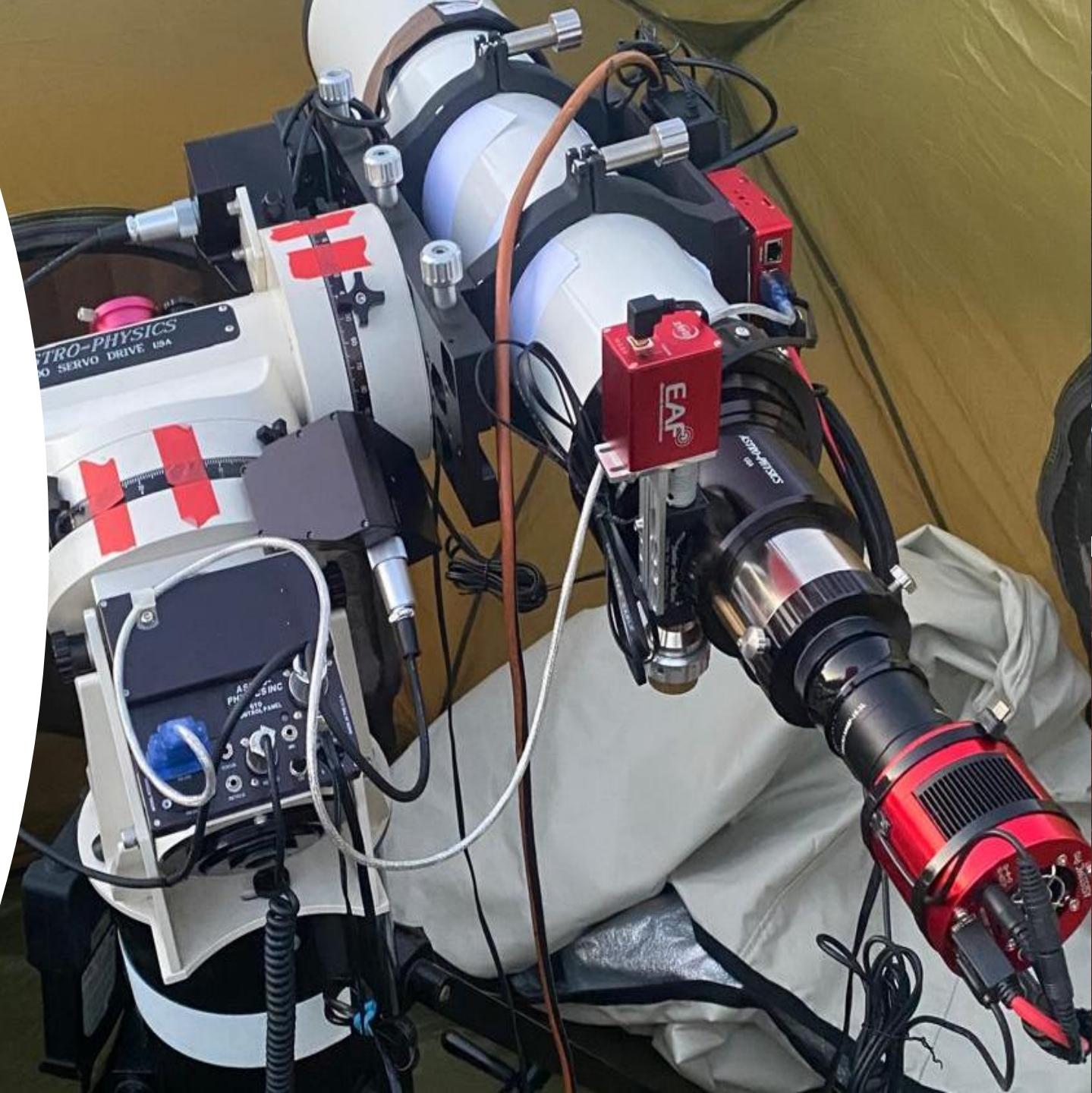
- Limited optical quality
- Limited focus control
- Limited image processing
- Clusters and solar system
- Field rotation

All Temporary

Dedicated Astrophotography Cameras

Still the gold standard

- Equatorial mount offers more accurate tracking
- Cooled camera reduces image noise (signal-noise ratio)
- More support from imaging and processing SW



Capturing: Nightscapes

Nikon Z7ii, 17mm Lens

ISO 1600

30 Seconds Single Image

iOptron Skywatcher mount



Capturing: Nightscapes

Nikon Z7ii, 600mm Lens

ISO 100

0.2 Seconds Single Image

Tripod

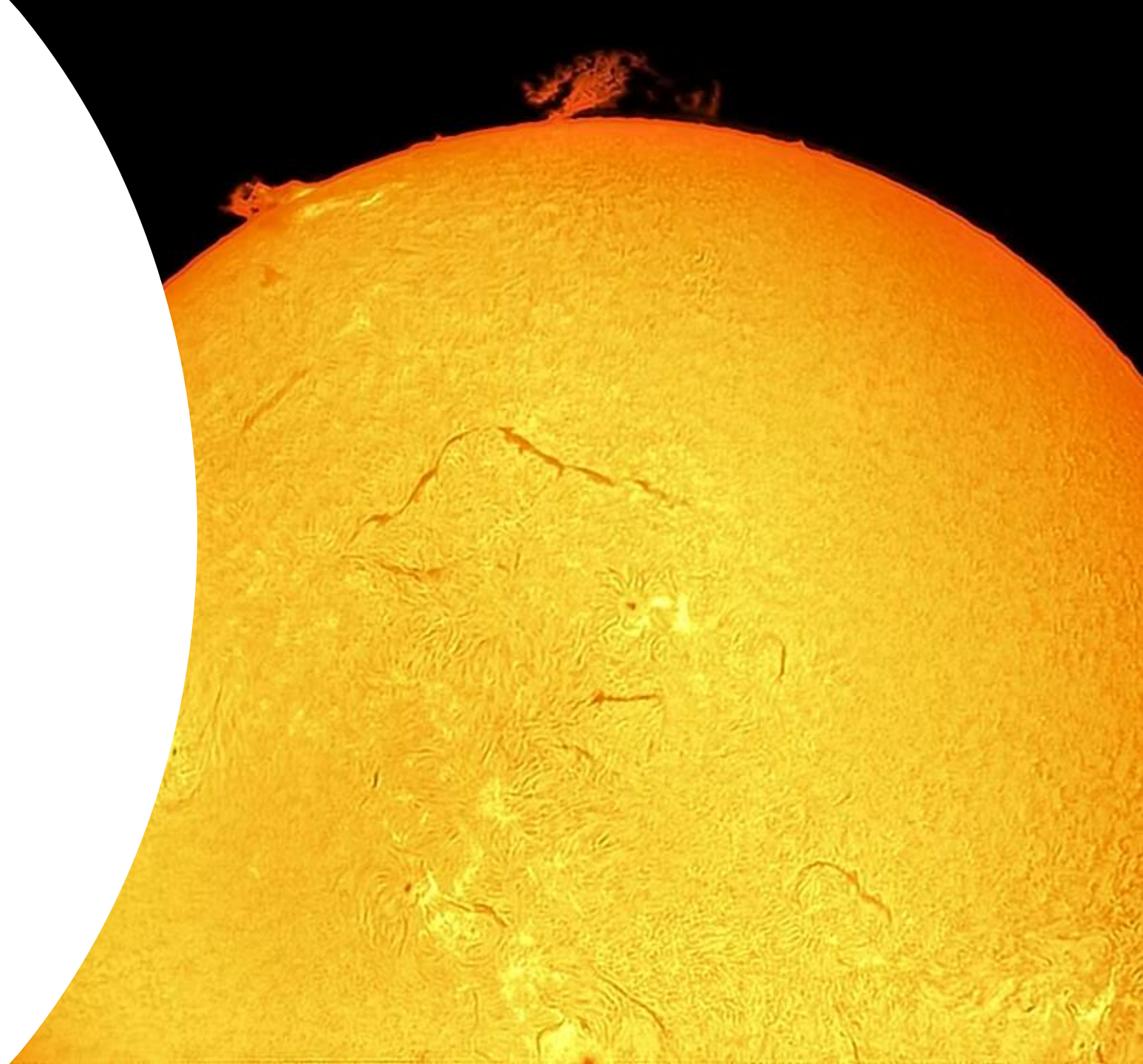


Capturing: Solar System

ZWO 120mm mini

Lunt 100mm Hydrogen Alpha Telescope

1 minute video at 30 frames per second



Capturing: Deep Space

ZWO ASI 533MC camera

AP 5" 780mm F6 telescope

4 hours and 15 minutes (51 5-minute
subframes)

Samuel Greenberg, July 2025



Image Processing

How do you go from the image on the left to the image on the right

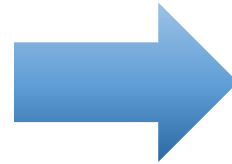


Image Processing Dos and Don'ts

Do

Reduce noise

Sharpen stars

Sharpen object details

Increase contrast

Correct colors

Remove defects (planes / satellites, star blooms)

Increase vibrance and saturation

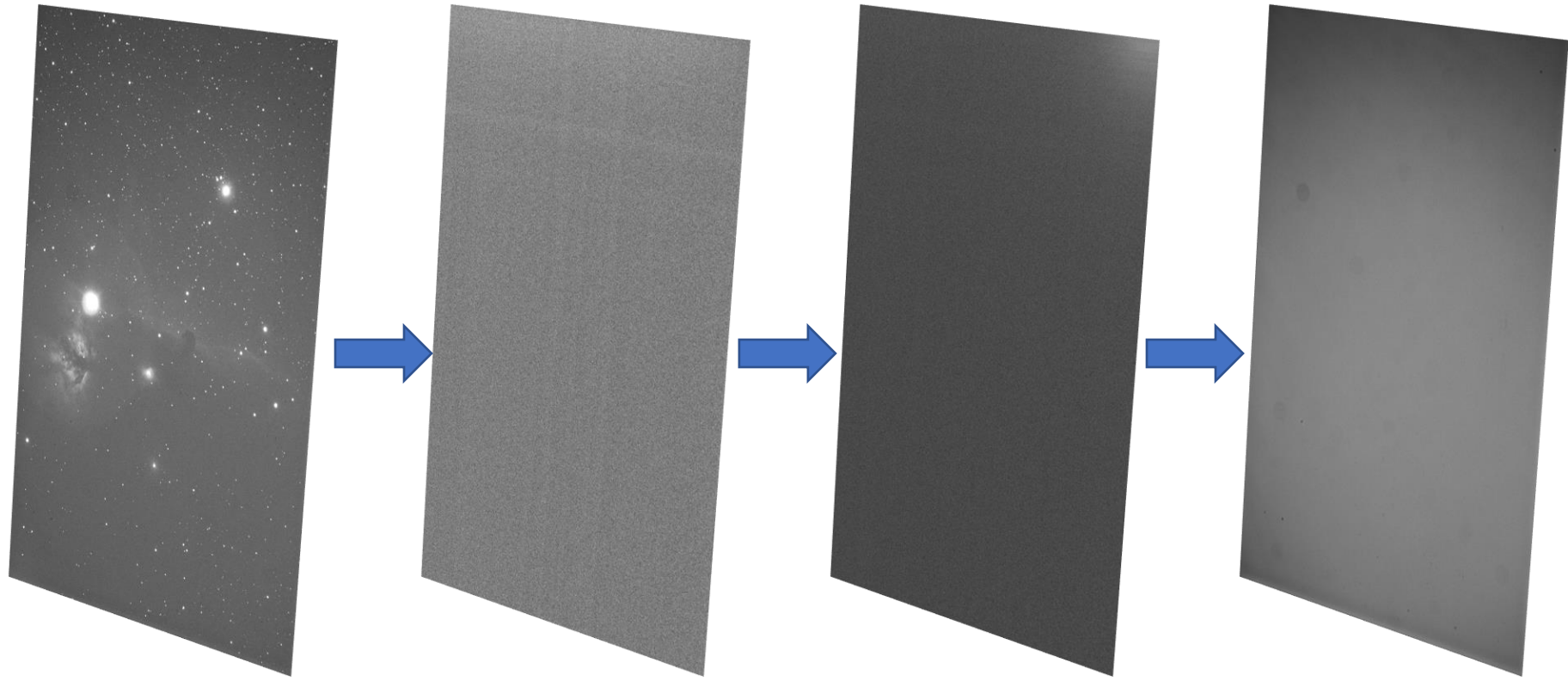
Don't

Add data (draw, copy/paste elements)

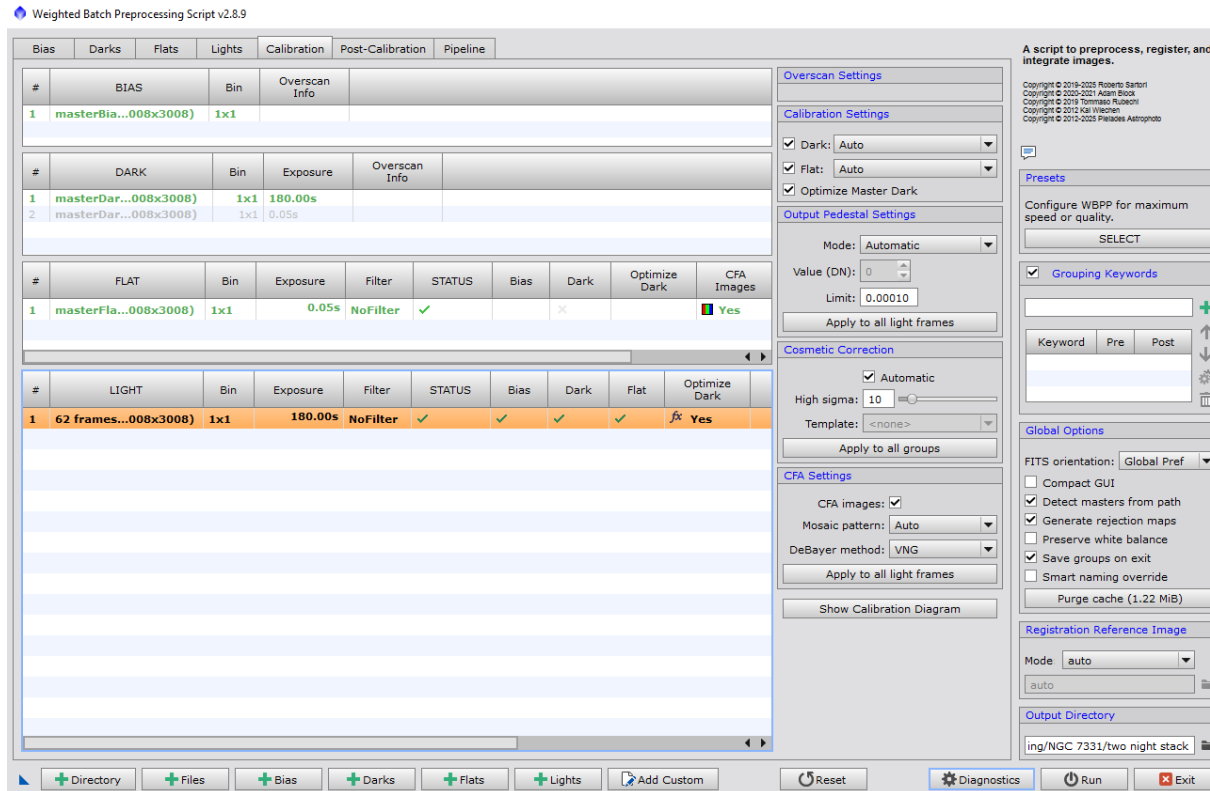


Image Processing

Calibration: subtracting dark, bias and flat frames from the light frame



Processing: Deep Space



Calibration & Stacking

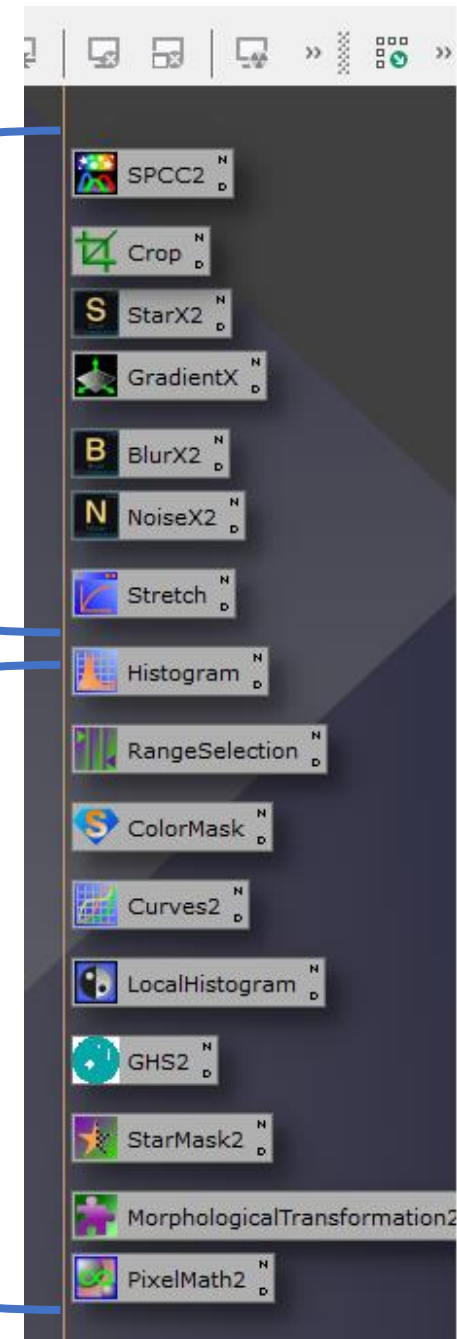
Calibration – removing noise, optical imperfections from the image

Stacking – combining many images into a single image primarily to improve signal to noise ratio and additional processing to remove “hot pixels”, satellite streaks etc.

Processing: Deep Space

Linear Processing

Non-Linear Processing



Processing: Deep Space

Linear Processing

SPCC – color correction using space survey data to remove color palette distortion

Crop – centering your object

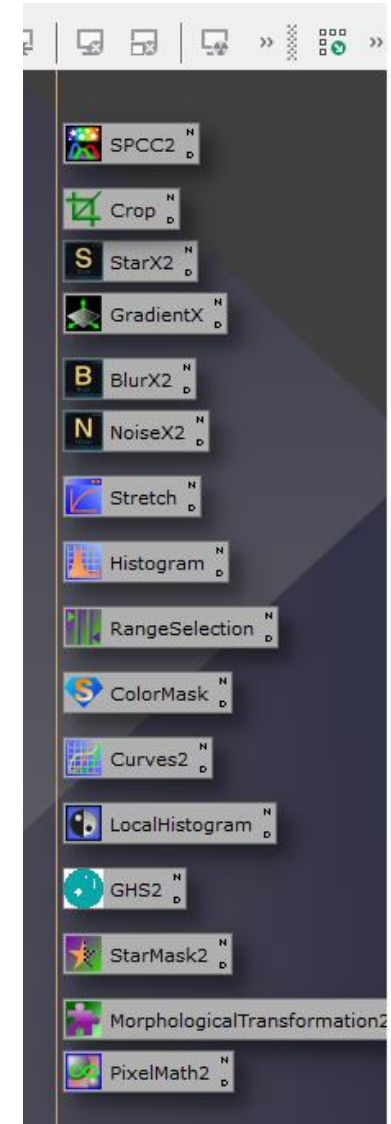
StarX – remove stars from the image using AI

Gradient X – remove sky gradients from the image

BlurX – sharpening function using AI

NoiseX – remove image noise using AI

Screen Stretch – limit the data range to only show what you want (at this point you are removing potentially 90% or more of the data in your image)



Processing: Deep Space

Nonlinear Processing

Histogram / Curves – accentuating (increasing or decreasing highlights or colors)

Range Selection – allows selecting specific parts of an image to mask and protect while applying histogram changes

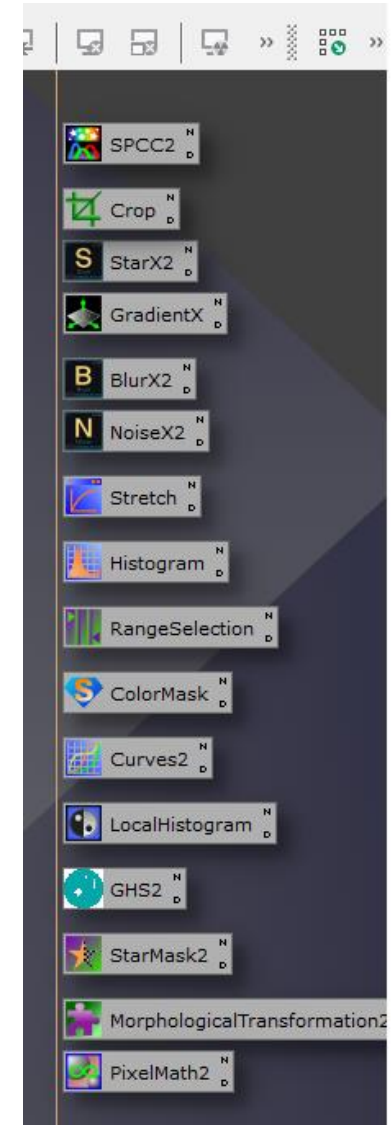
Color Mask – allows selecting specific color ranges of an image to mask and protect while applying histogram changes

Local Histogram / GHS – ways to manage high dynamic range within an image

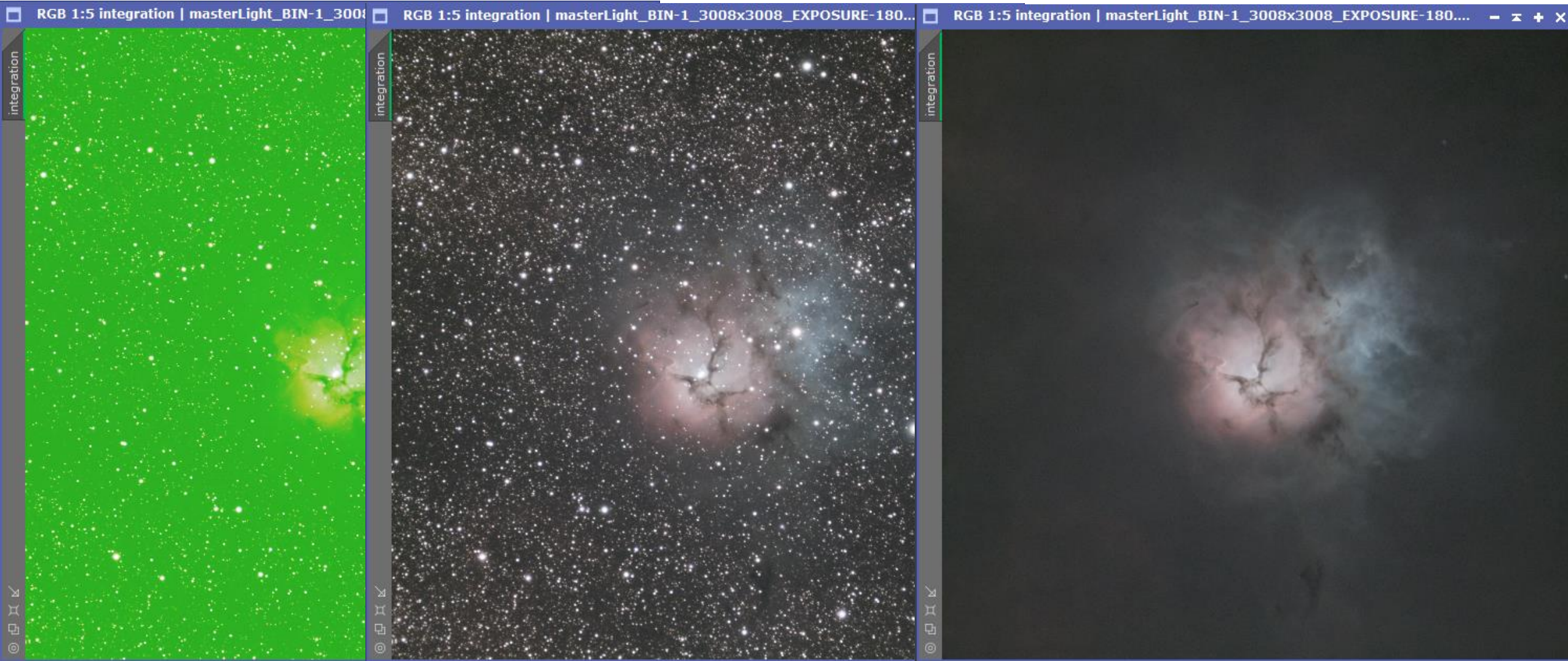
Star Mask – select the stars

Morphological Transformation – fix minor guiding issues

Pixel Math – recombine the star image with the deep space object image into a single image



Processing: Deep Space

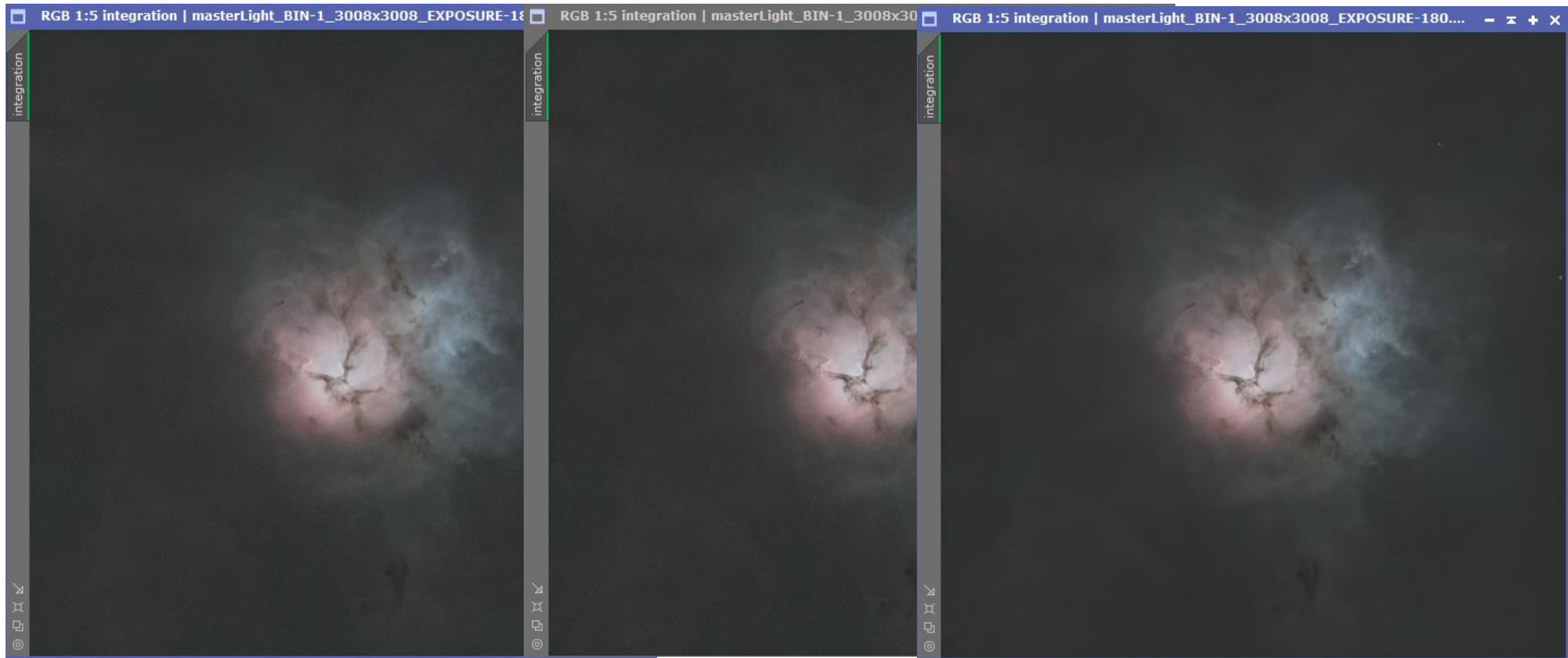


Stacked Image
Unprocessed

Color Correction

Stars Removed

Processing: Deep Space

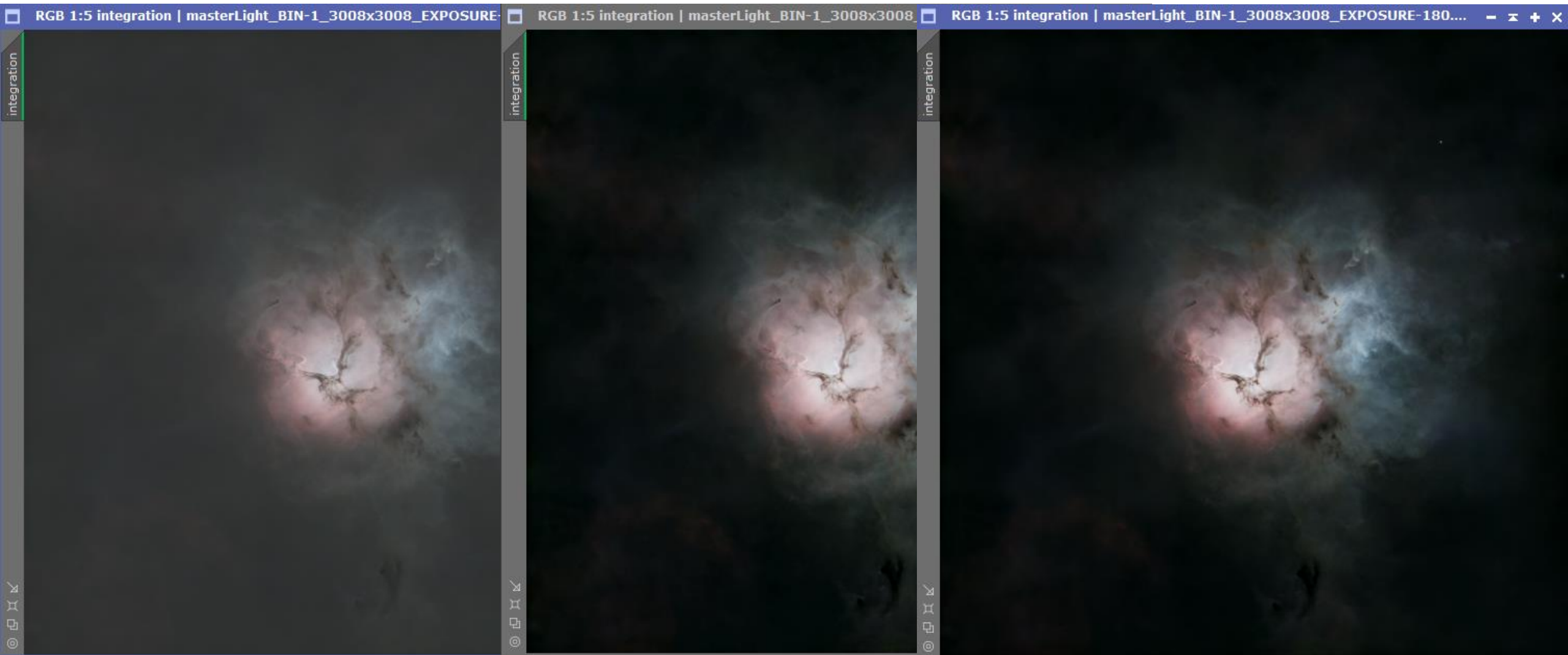


Gradient Removed

BlurX

Noise Removed

Processing: Deep Space

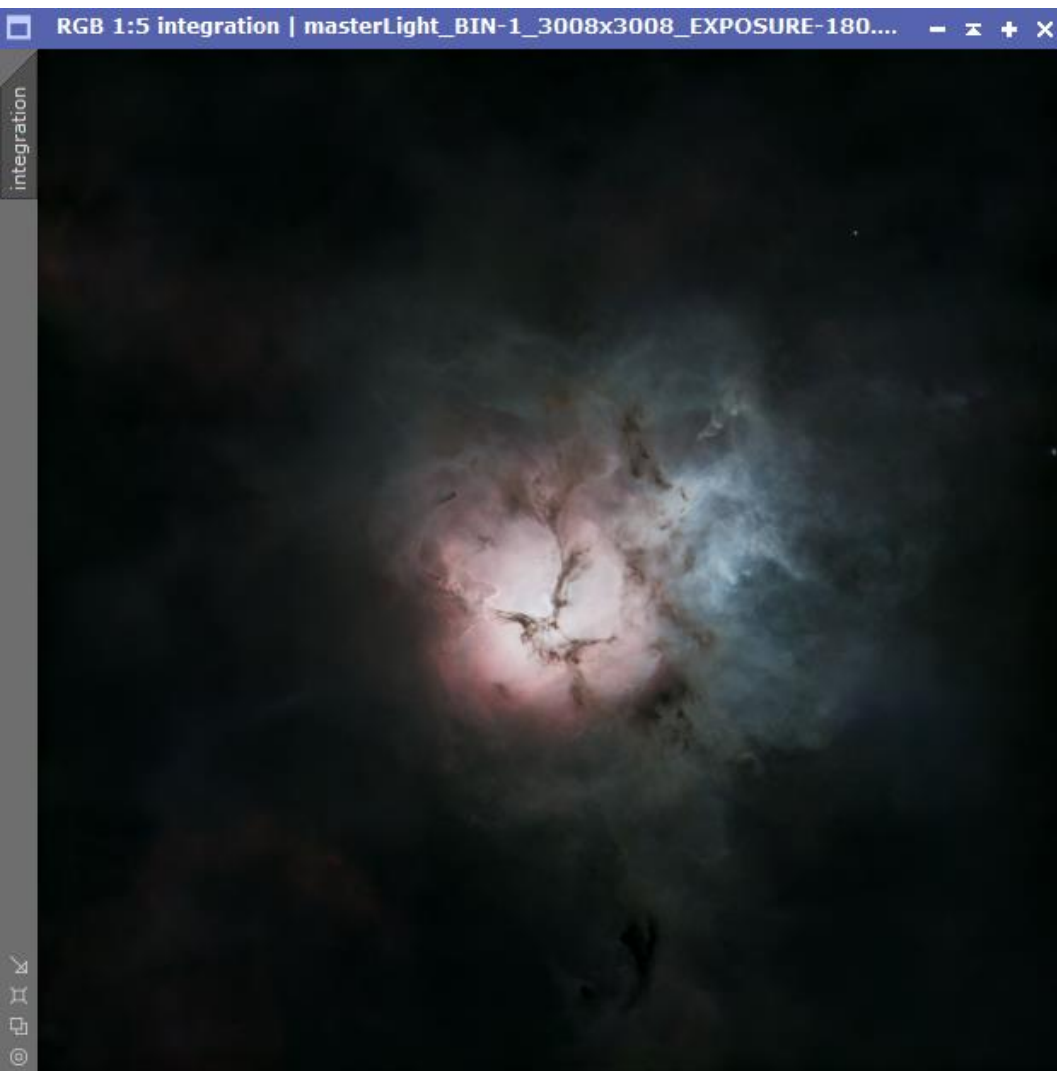


Noise Removed

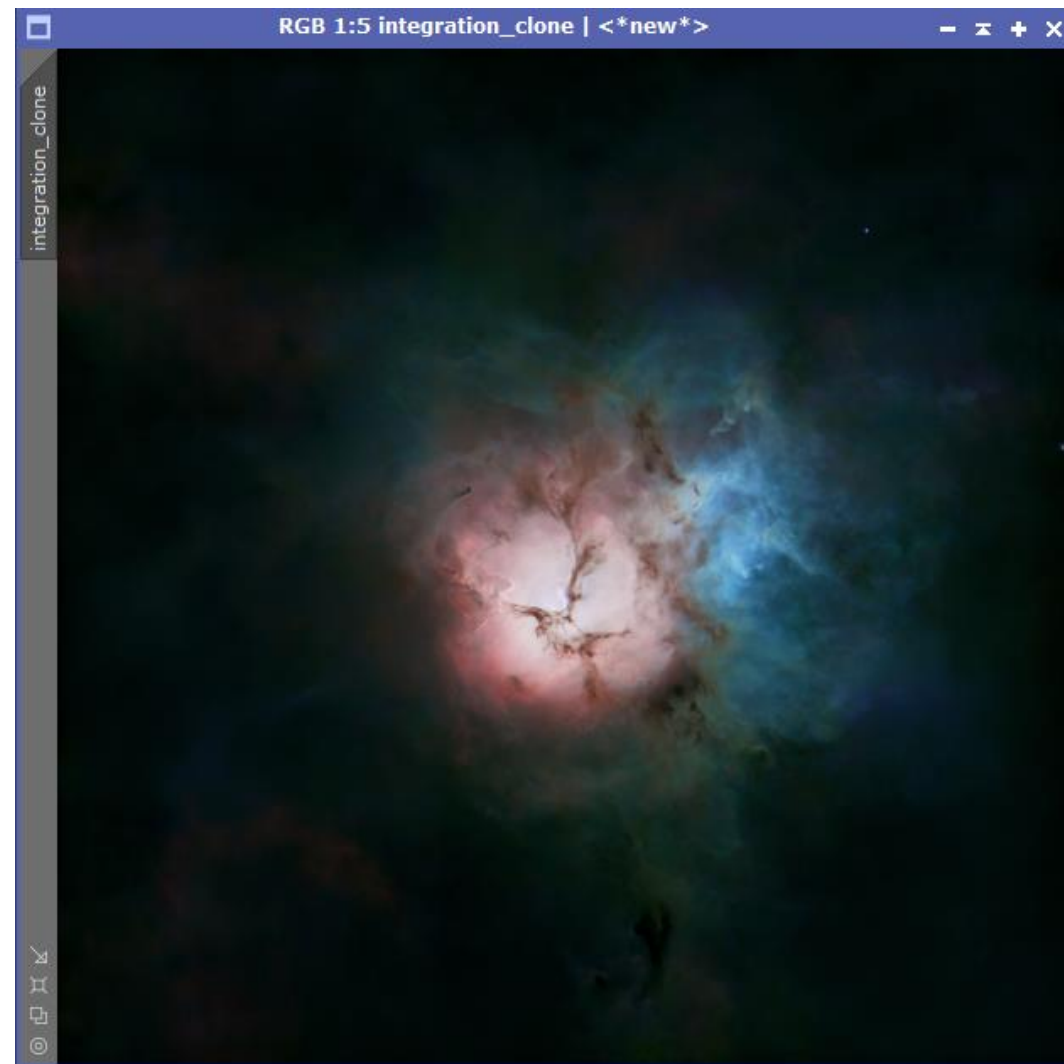
Screen Stretch

Range Selection /
Curves

Processing: Deep Space

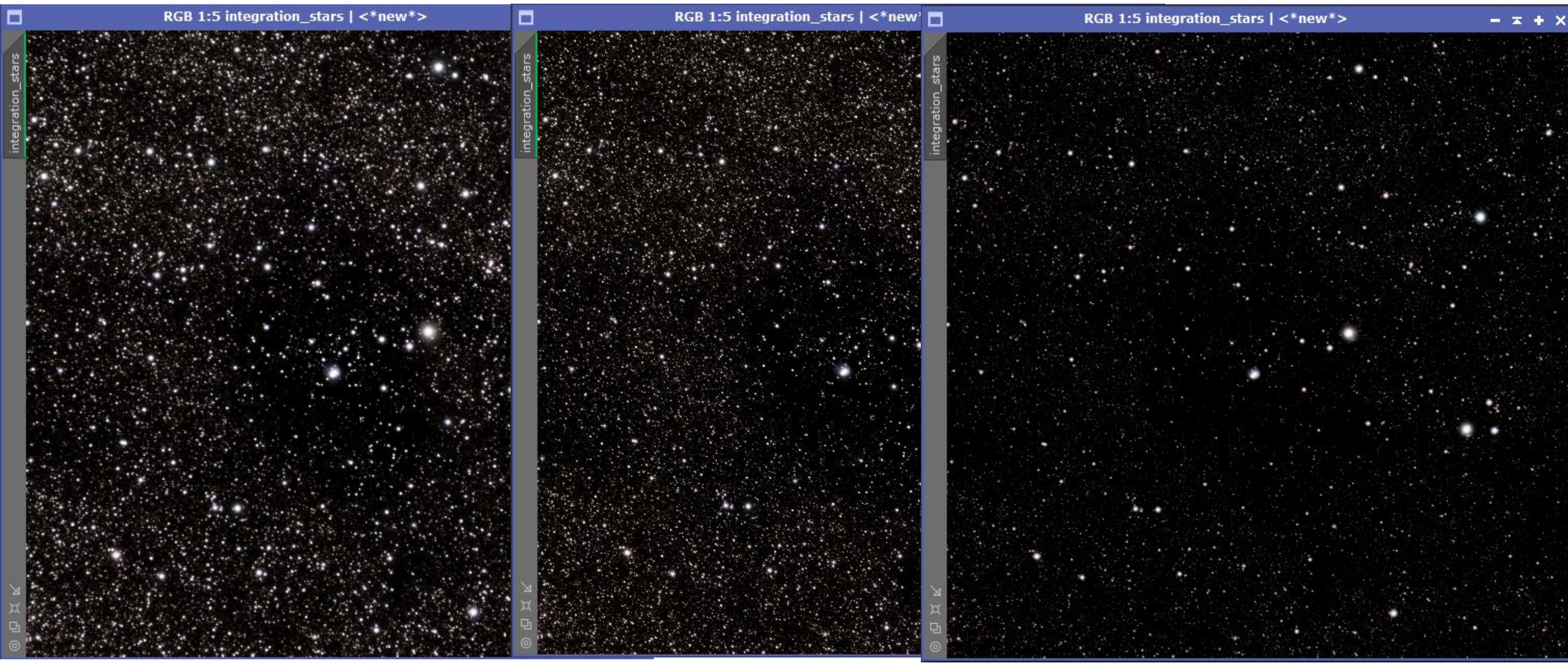


Range Selection /
Curves



Color Saturation

Processing: Deep Space



Stars

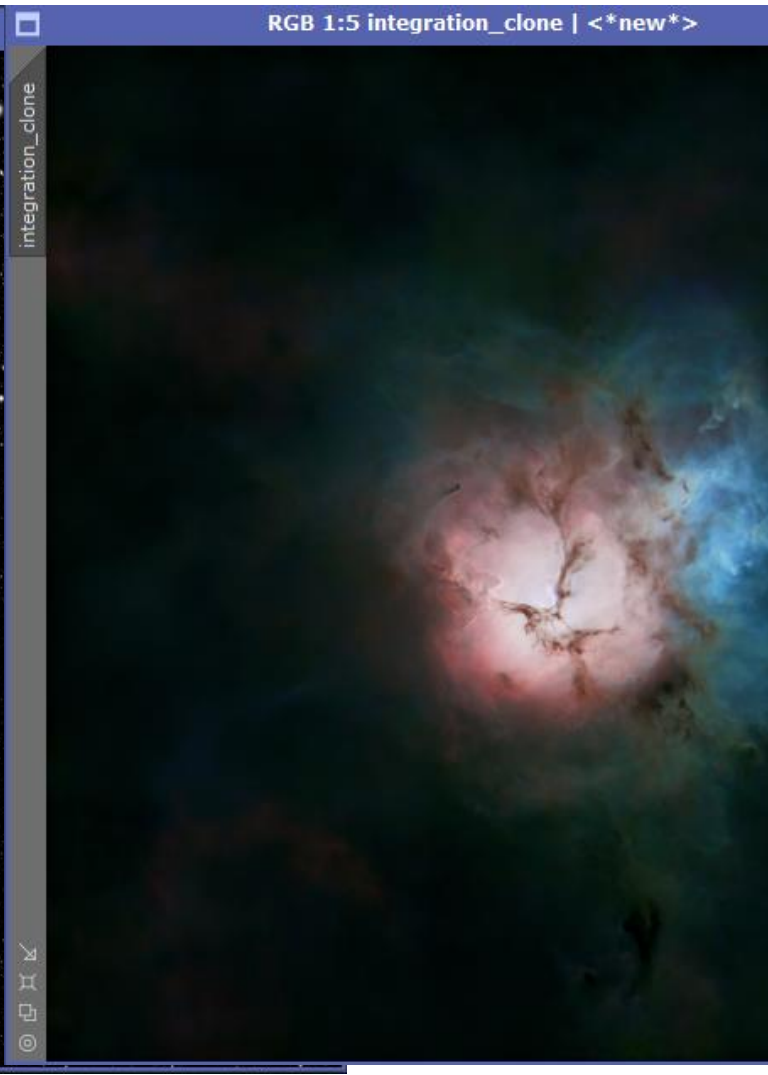
Sharpened Stars

Screen Stretch & Morphological
Transformation

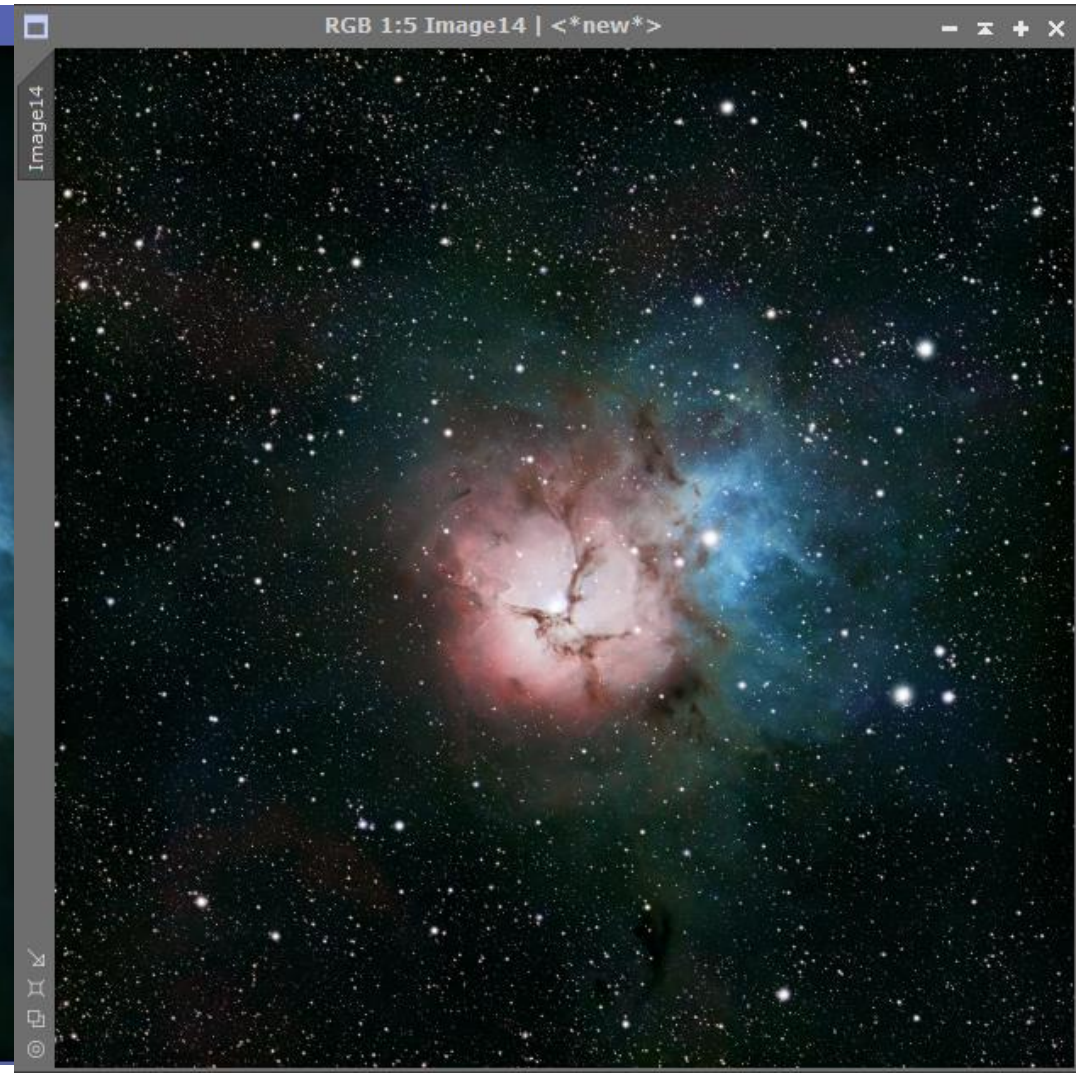
Processing: Deep Space



Final Stars



Final Nebula



Pixel Math / Final Combined Image

Processing: Solar System

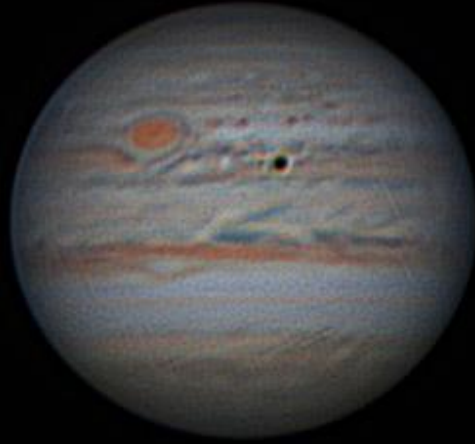
Lucky Imaging

Video File – high speed imaging at 30-60 frames per second. 2-minute file will produce over 5,000 frames (SharpCap)

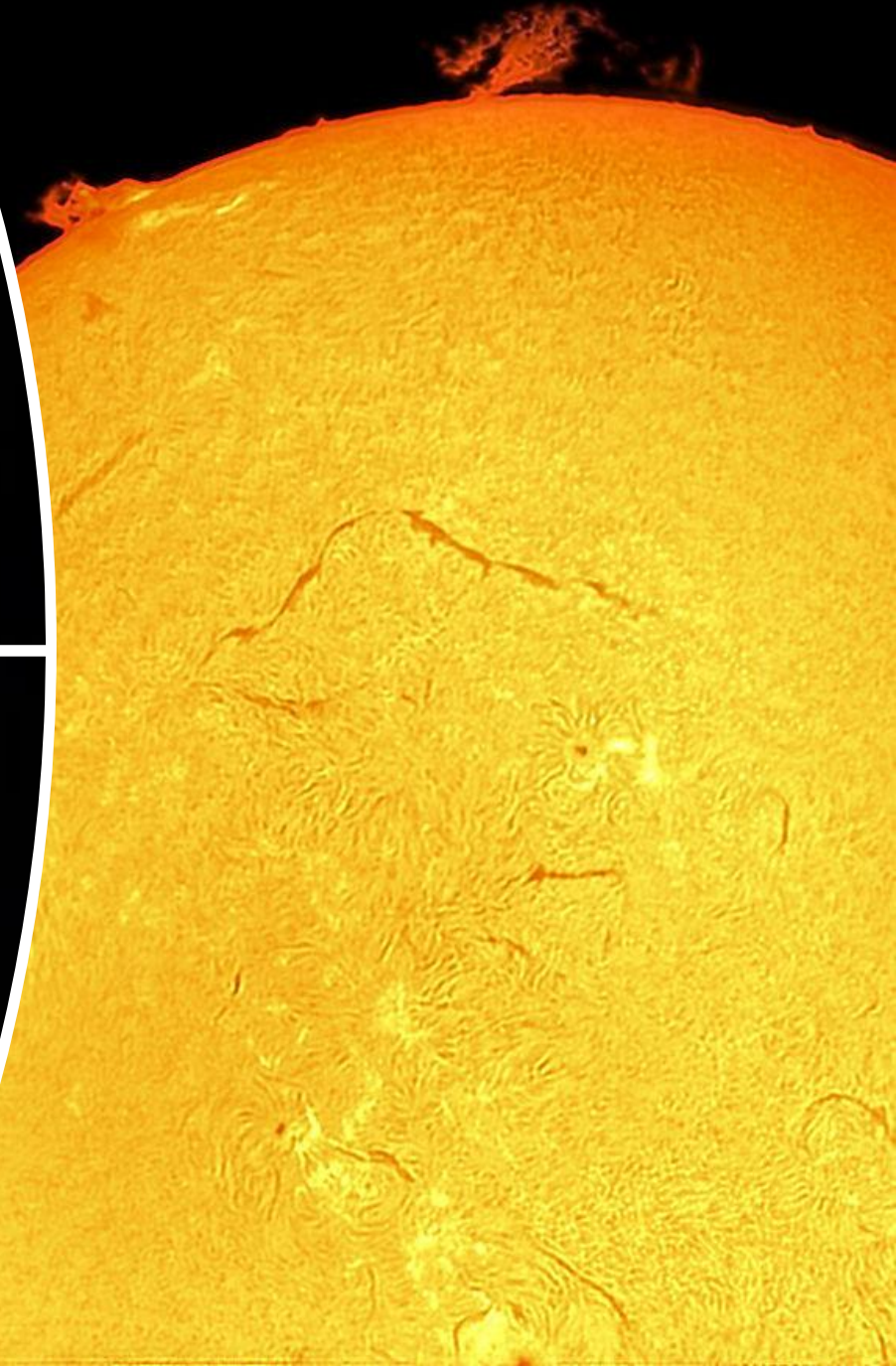
Stacking – software analyzes and combines the best frames into a single image (Autostakkert)

Sharpening / Wavelets – selective sharpening of large to fine details (Registax, ImPPG, NAFE)

Contrast / Color Balance – Photoshop or any other image processing tool



All Images By Chanan Greenberg



A deep space photograph showing a nebula with intricate green and blue filaments and structures against a black background filled with stars. The text "Questions ?" is overlaid in the upper left.

Questions ?

www.greenhawkobservatory.com