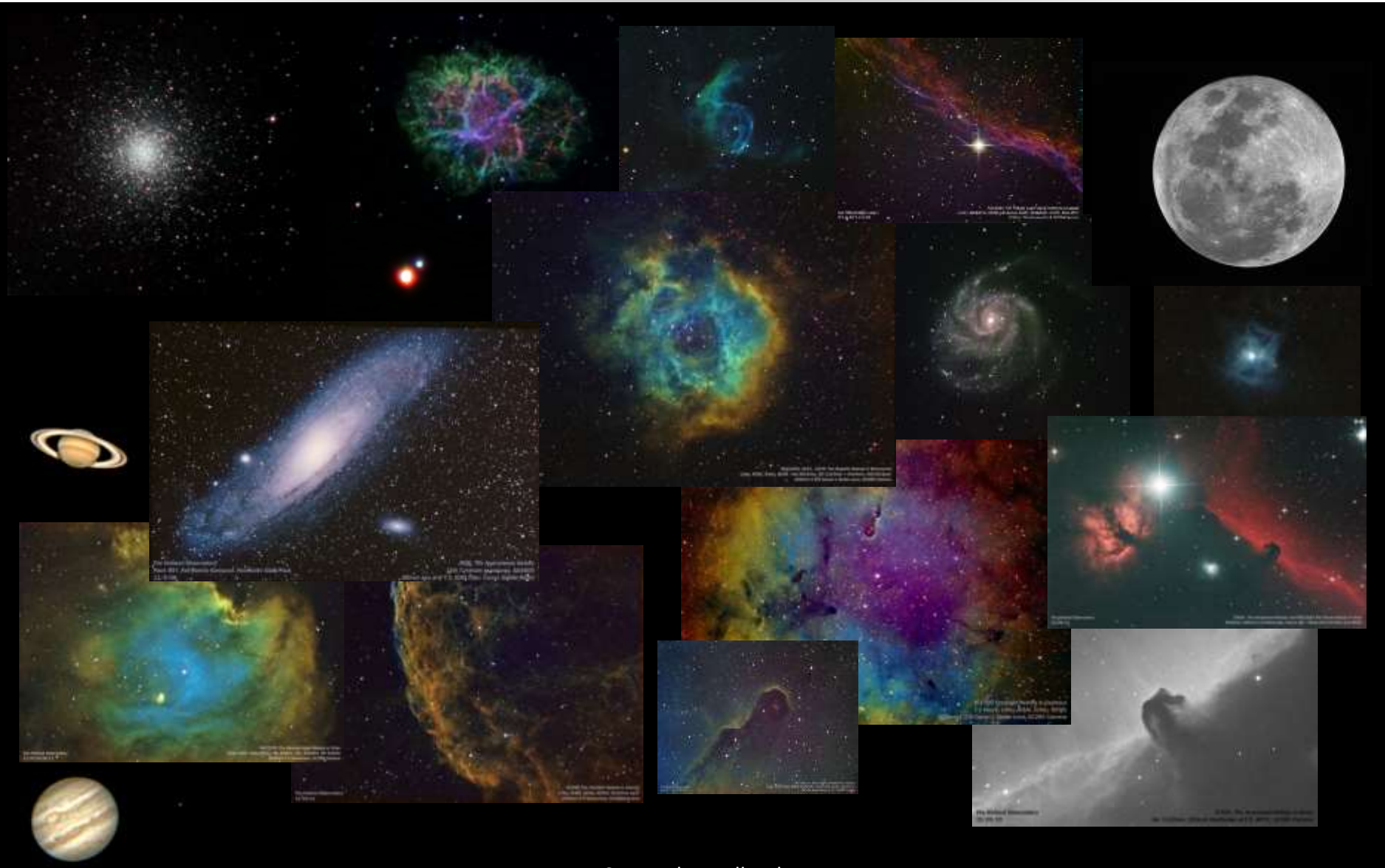
DSLR Astroimaging - Tutorial



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A step-by-step approach to Astroimaging:

The steps required to take this image =>

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DSLR Astroimaging - Tutorial

1. Equipment Selection
- Camera
- Telescope
- Mount
- Computer & Software

2. Gathering Data
- Equipment Setup
- Lights, Darks, Flat Lights, Flat Darks, Bias

3. Processing Image
- Align and Stack
- Post Processing

4. References

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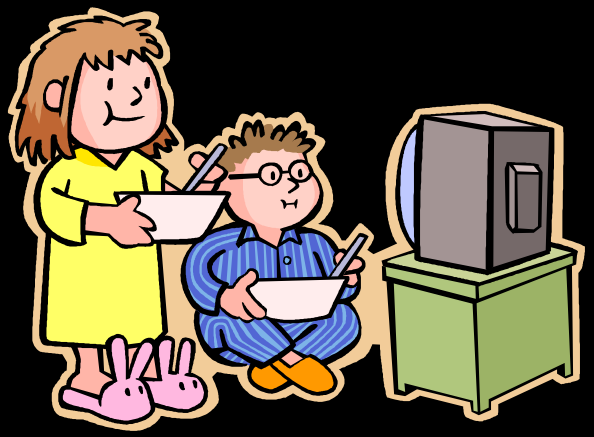
FIRST -

Astronomy ::



Watching TV?

Playing the Piano?

* Not endorsing any type of equipment or configuration

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1. Equipment Selection - Camera

Options -

Dedicated Astroimaging Camera?

- Best results
- Expensive
- Most difficult

Planetary Camera?

- Not a planet
- Not optimized for Nebulae

DSLR?

Digital Single Lens Reflex

- Easier to use
- Lots of support
- Lower cost
- Acceptable results
- Long exposures

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1. Equipment Selection – Camera (cont'd)

DSLR

MODIFIED

- Or -

UNMODIFIED

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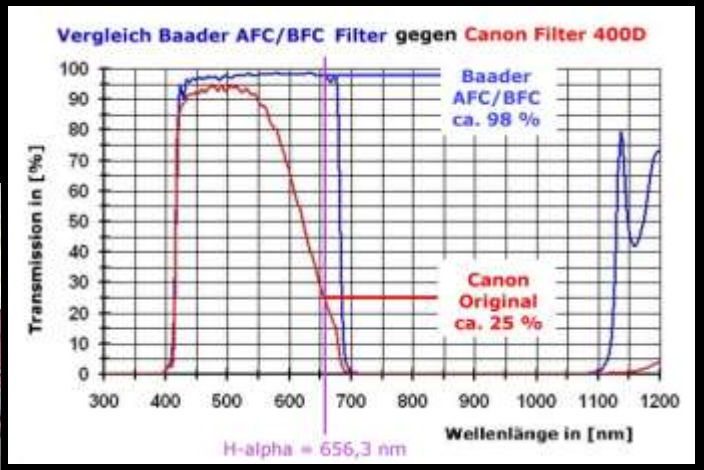
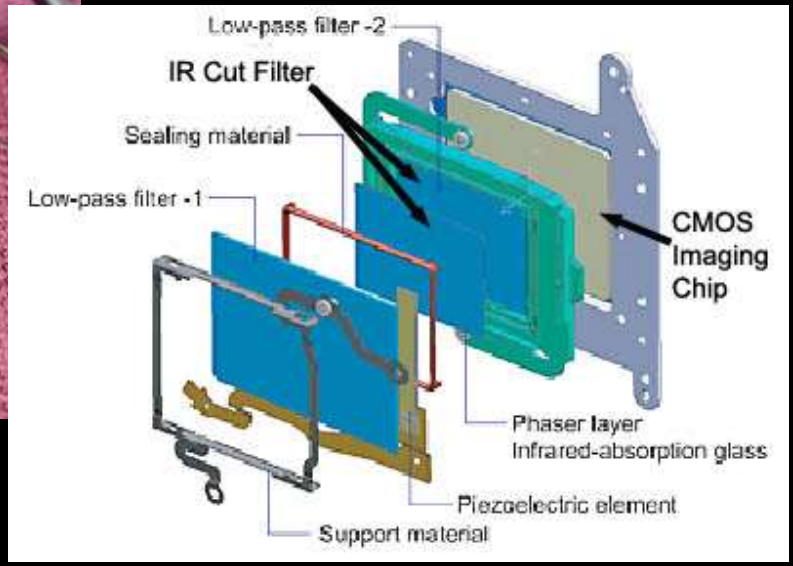
1. Equipment Selection – Camera (cont'd)





Replacing IR Cut Filter improves performance for Astrophotography.

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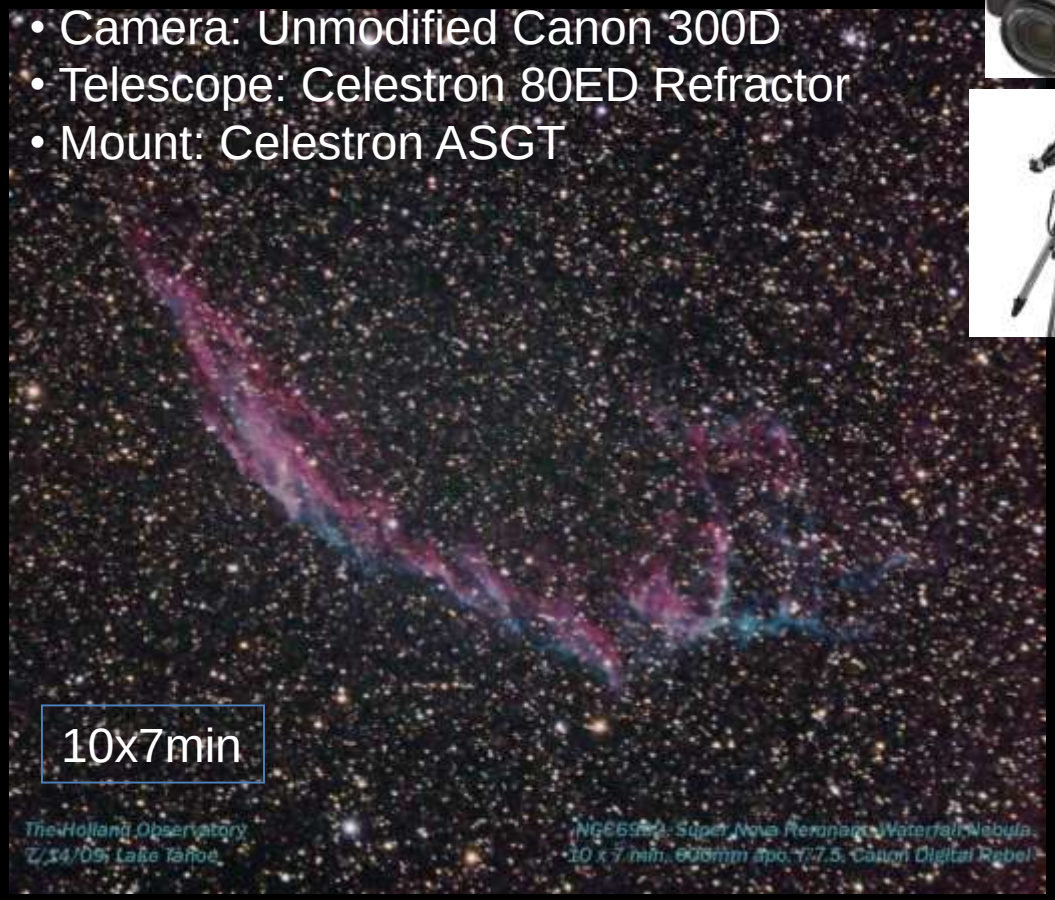
1. Equipment Selection – Camera (cont'd)

- Camera: Unmodified Canon 300D
- Telescope: Celestron 80ED Refractor
- Mount: Celestron ASGT



NGC6992: The Waterfall Nebula (Super Nova Remnant)

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NGC7000: The North American Nebula

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1. Equipment Selection – Camera (cont'd)

- Camera: Modified Canon 450D
- Telescope: Celestron 8" Newtonian
- Mount: Losmandy G-11
- Filter: Astronomik CLS

NGC2174: Monkey Head Nebula

IC434: Horsehead, NGC2024: Flame Nebula

IC410: The Tadpole Nebula

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1. Equipment Selection – Camera (cont'd)

Required Accessories:

1. T-Mount Adapter
   - In place of lens
   - Allows connection to telescope

$15 (Agena Astro Products)

2. AC Adapter
   - Battery produces heat
   - Batteries die at inopportune times
   - Battery life less in cold weather
   - Difficult to change without moving scope

Example: ACK-E5
eBay: approx. $16

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1. Equipment Selection – Camera (cont'd)

Required Accessories:

3. Cabling (minimize)

- USB – Exposure control & image transfer
  - Long to allow movement of telescope

4. Viewfinder Cover

- Prevents stray light from entering camera body
- ➢ Note – Not used on this picture

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1. Equipment Selection – Camera (cont'd)

Light Pollution from Imaging Site

Object to right ======➔

Located in front yard of imaging site

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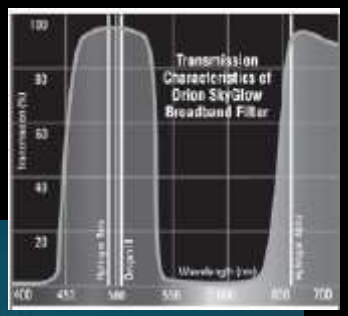
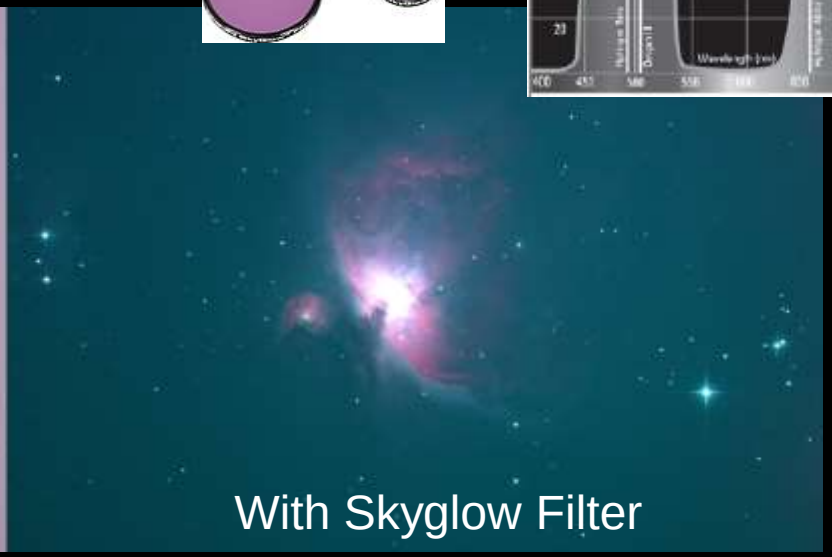
1. Equipment Selection – Camera (cont'd)

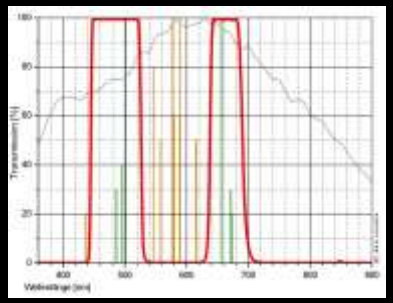
Required Accessories:

5. Filters - Light pollution reduction filters





Can significantly help – example 4 minute exposures



Astronomik CLS Clip-Filter

- Stays in camera
- Blocks broad band light pollution

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1. Equipment Selection - Telescope

First parameter: Focal Length (FL) which determines field of view (FOV)

If FOV too wide (short FL):

If FOV too narrow (long FL):

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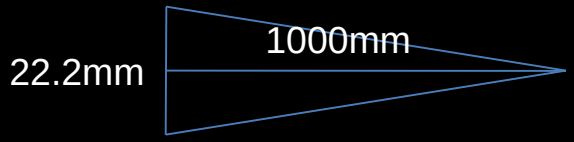
1. Equipment Selection – Telescope (cont'd)

How to calculate field of view:



$$2 \bullet \arctan\left(\frac{22.2mm/2}{1000mm}\right)$$

How to fit target within image –

- Field of View: the angle subtended by an image sensor's horizontal and vertical dimensions
  - Example: Canon APS-C sensor measures 22.2mm x 14.8mm. With a 1000mm fl telescope has a horizontal field of view of 1.27° , and a vertical field of view of .85°.

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1. Equipment Selection – Telescope (cont'd)

Second parameter: Aperture which determines light gathering and resolution

Note – focal ratio / f-stop [= FL / Aperture] determines exposure time

Trade off – Bigger is better, B-U-T: cost, ***weight***, ease of use….

24" Planewave Instruments
I wish, I wish….
$50,000

8" (200mm) Newtonian
Easy to use
Low cost
1000mm FL, f/5

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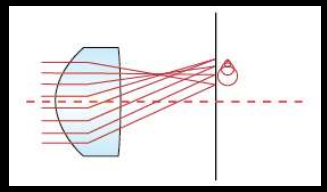
1. Equipment Selection – Telescope (cont'd)

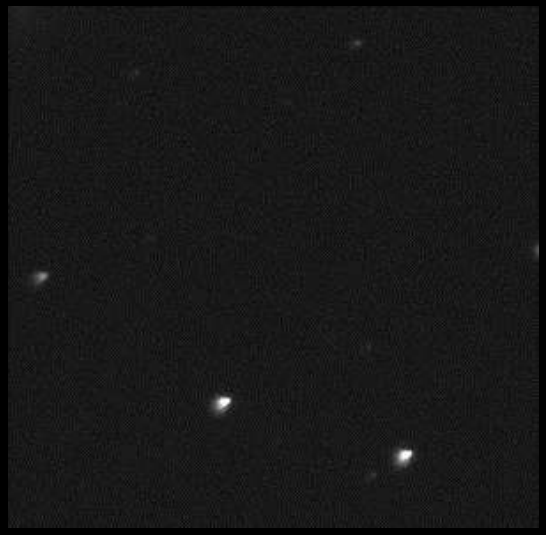
Major short coming of Newtonian telescope: Coma

In general, telescopes perform better on axis (middle) than off axis (edges).

WITHOUT



WITH



Coma Corrector

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1. Equipment Selection – Telescope (cont'd)

DSLR with
T-Thread Adapter
and
Coma Corrector

T-Thread Adapter

MPCC Coma Corrector

1. Equipment Selection – Telescope (cont'd)

Next issue: Focus

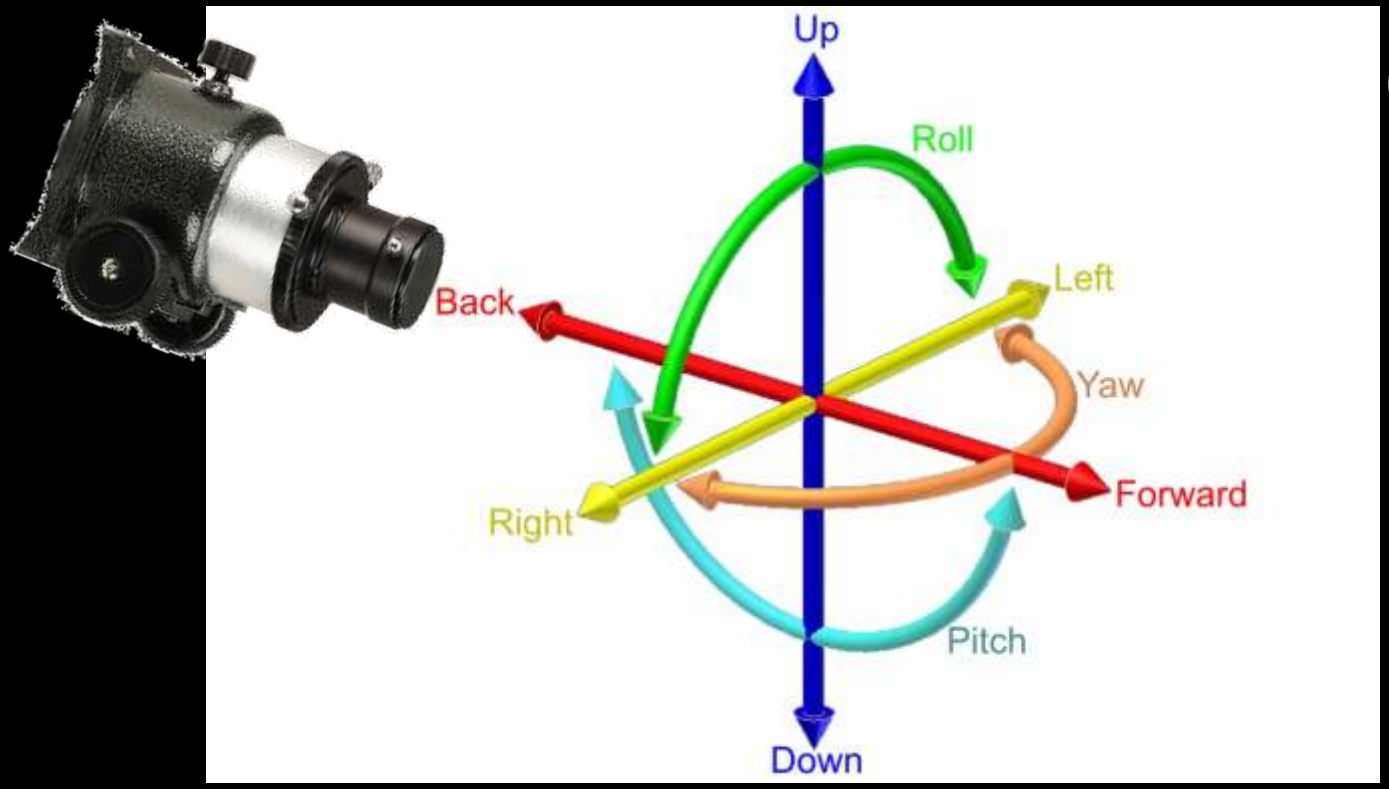

Image Shift

Image Tilt

Field Rotation

Slide courtesy of UT NASA_Focuser Team

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1. Equipment Selection – Telescope (cont'd)

8" Newtonian with Feathertouch Crayford Focuser

DSLR Astroimaging - Tutorial

Progress check -

1. Equipment Selection

- Camera
  - ✓ Canon DSLR
    - ✓ T-Mount Adapter
    - ✓ AC Adapter
    - ✓ Long USB Cable
    - ✓ Viewfinder Cover
    - ✓ Astronomik CLS Light Pollution Filter
- Telescope
  - ✓ 8” Newtonian, 1000mm FL, f/5
    - ✓ Coma Corrector
    - ✓ Good Focuser

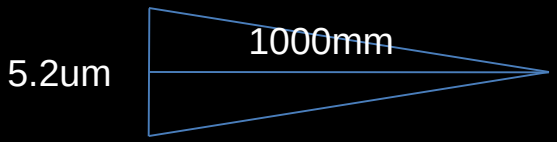
DSLR Astroimaging - Tutorial

1. Equipment Selection – Mount

Mount Requirements:
1. Support telescope
2. Track sky accurately

Losmandy G-11
w/ polar align scope

How to calculate image scale / resolution:



$$2 \bullet \arctan\left(\frac{5.2um/2}{1000mm}\right)$$

- Problem: Image pixel size corresponds to approx. 1 arc second (1”) of angle
- It is difficult to get a mechanical telescope mount to track accurately for long exposure pictures within around 1” of accuracy. Otherwise, pixels are smeared due to tracking errors. Good optics are of no use with a bad mount.

Image Scale: the angle subtended by one pixel

- Example: a 5.2um pixel (Canon 450D) with a 1000mm fl telescope has an image scale of 1.07”.

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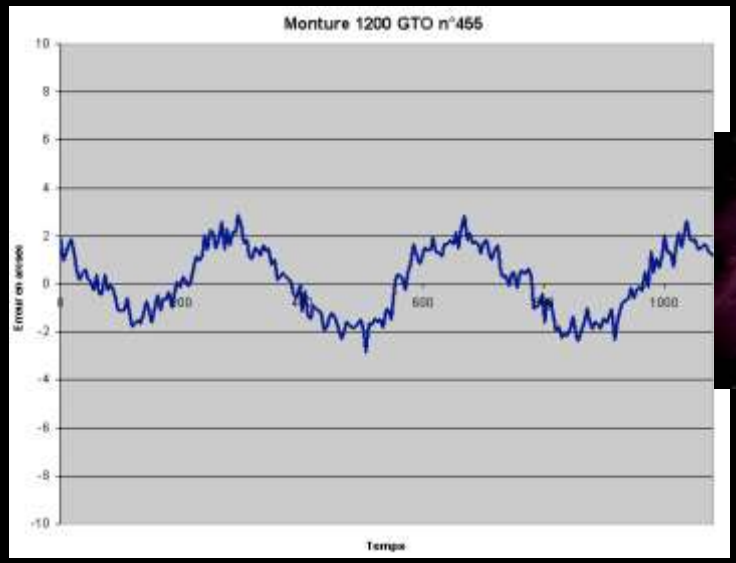
1. Equipment Selection – Mount (cont'd)

Even the best mounts still have some errors, e.g. periodic error -



Guide Telescope

Guide Camera

Need method of correcting the tracking errors:

1. Guide scope and guide camera to lock on star
2. Send corrections to mount

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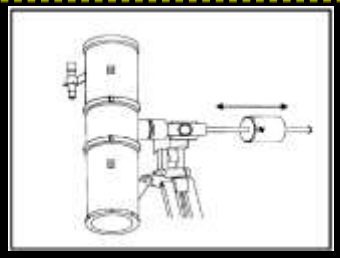
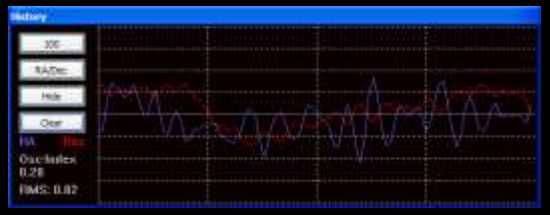
1. Equipment Selection – Mount (cont'd)

- How accurate tracking is accomplished: Autoguiding

Set counter weight heavy East





GPBUSB – USB to Guide Port Input Adapter

Autoguiding (summary):

1. Guide camera is selected in guiding software
2. Guide camera with guide scope focuses on star
3. Telescope mount is selected in guiding software
4. Software calibrates mount
5. Autoguiding starts

DSLR Astroimaging - Tutorial

1. Equipment Selection – Computer & Software

Programs Needed:

1. Mount Control: Guiding
   PHD Guiding

2. Camera Control:
   Backyard EOS

3. Image Calibration:
   Deep Sky Stacker

4. Post Processing:
   Photoshop

Computer Requirements:

1. USB Connections (3)
   a) Imaging Camera,
   b) Guide Camera
   c) Mount

2. Sufficient Speed & Memory
   Deep Sky Stacker

3. Lots of Hard Drive Space
   Each image: 14MBytes
   Final: 80x14MB = 1.12GB

3. Ability to Make Screen Red
   Rubylith: Scope Stuff

*** Will be demonstrated in next section =>

DSLR Astroimaging - Tutorial

Progress check -

1. Equipment Selection

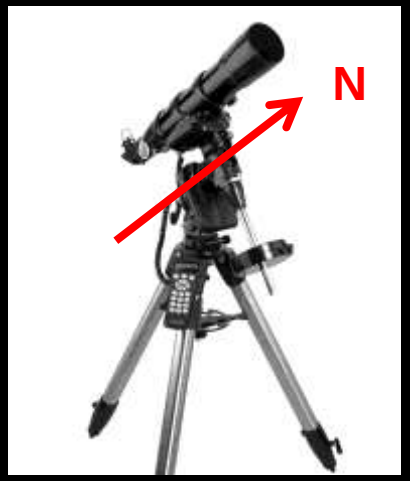
- Camera
  - ✓ Canon DSLR
    - ✓ T-Mount Adapter
    - ✓ AC Adapter
    - ✓ Long USB Cable
    - ✓ Viewfinder Cover
    - ✓ Astronomik CLS Light Pollution Filter
- Telescope
  - ✓ 8” Newtonian, 1000mm FL, f/5
    - ✓ Coma Corrector
    - ✓ Good Focuser

- Mount
  - ✓ Losmandy G-11 German Equatorial Mount
  - ✓ Polar Alignment Scope
  - ✓ GPUSB – USB to Autoguide Input Adapter
  - ✓ Guide Scope, Guide Camera
- Computer & Software
  - ✓ Laptop, USB ports, Large Disc
  - ✓ Rubylith Red Screen Cover
  - ✓ Software: PHD Guiding, Backyard EOS, Deep Sky Stacker, Photoshop

DSLR Astroimaging - Tutorial

2. Gathering Data – Equipment Setup

Daytime Setup: It is much easier to set up in the daylight!



Step 1 – Point your telescope mount North.

Compass

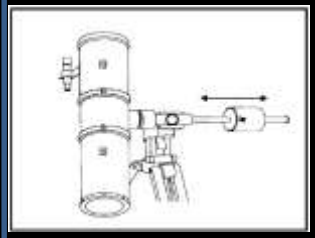
+

Magnetic Declination

Step 2 – Set latitude scale

Step 3 – Level mount: For setting up in same location

Step 4 - Mount and balance optical tube with imaging system



Step 5 – Verify collimation

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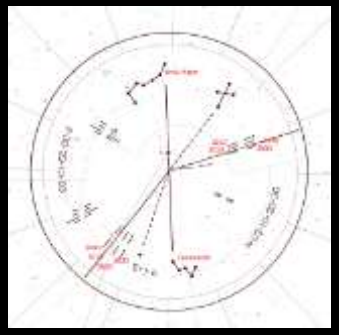
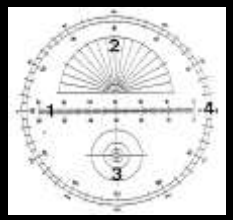
2. Gathering Data – Equipment Setup (cont'd)



Nighttime Setup:

- Polar Alignment Options:
  - North Celestial Pole Polar Alignment Scope
    - Quick, easy. Good enough for many targets
  - Polar Alignment Software in Hand Controller
  - Declination Drift
    - More difficult, takes time. Best method



- GoTo Setup (with eyepiece, then remount camera)
  - User will center 2 or more bright stars allowing scope computer to create an accurate map of the sky (typically use 6 or 7 stars).
    - Afterwards, targets can be entered into scope computer and scope will slew to them.
    - Some scopes have 'Accurate GoTo' features that aid in finding faint objects

- Dew
  - Dew can form on scope, camera, filters, etc.
    - Just extending the length of the end of the scope will combat dew.
    - Raising optics above dew point prevents dew from forming (heater).
- Stray Light
  - You will need to address any sources of stray light (same dew extensions help).

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2. Gathering Data – Equipment Setup (cont'd)

Focus

- There are many methods to obtain focus:
  - Hartman Mask, Measuring the Point Spread Function, Visual, Bahtinov Mask
    - Recommend Bahtinov Mask **
      - Can make your own

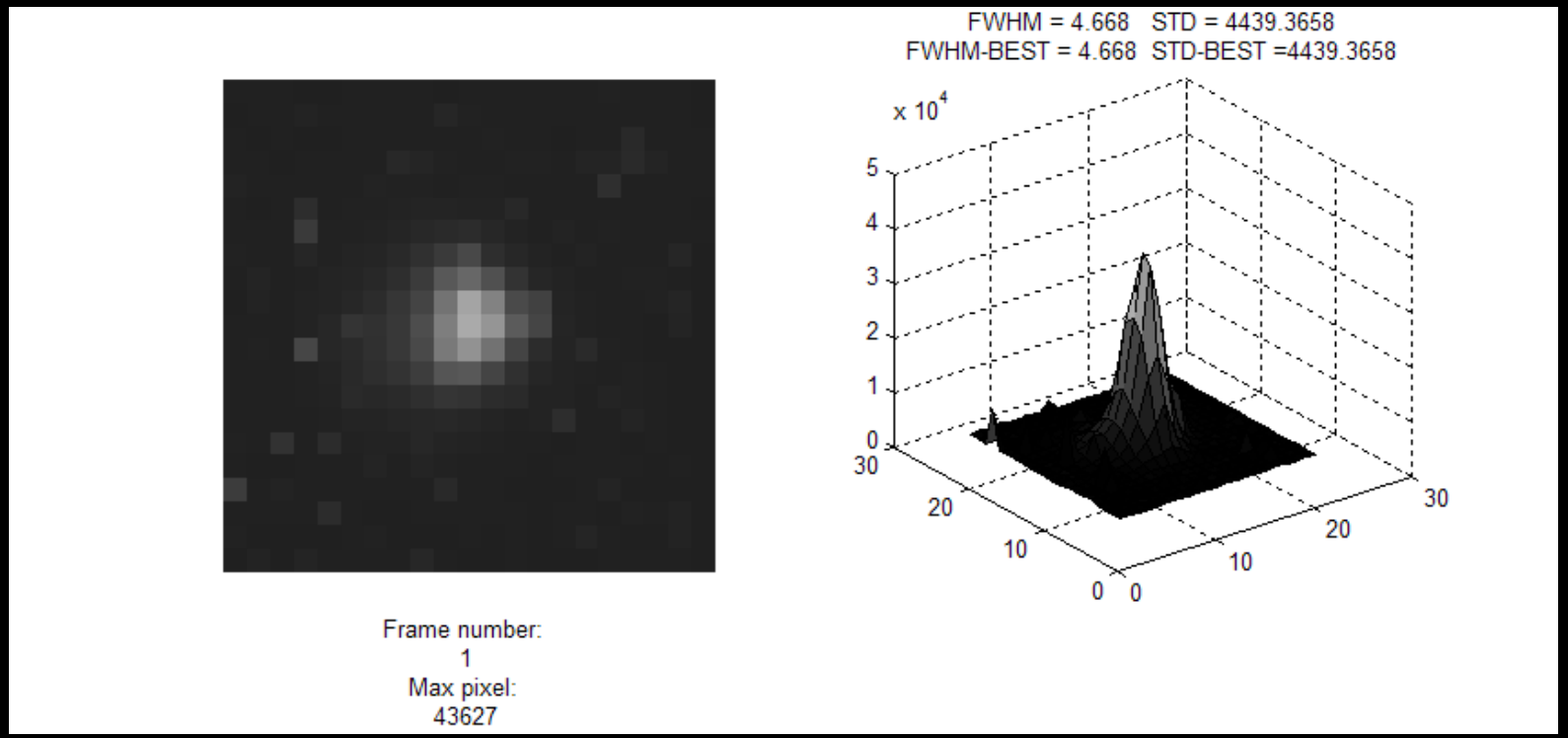
http://astrojargon.net/MaskGen.aspx?AspxAutoDetectCookieSupport=1

2. Gathering Data – Equipment Setup (cont'd)

Focus

Another method – Measuring Point Spread Function:

- Full Width Half Max – minimum
- Standard Deviation – maximum



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2. Gathering Data – Equipment Setup (cont'd)

Using Backyard EOS for Focus =>

Focus

Step 1:
Connect Camera

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2. Gathering Data – Equipment Setup (cont'd)

Using Backyard EOS for Focus =>

Focus

Step 2:
Select Frame & Focus
- Opens shutter
- Puts in live view

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2. Gathering Data – Equipment Setup (cont'd)

Using Backyard EOS for Focus =>

Step 3:
Focus Telescope
- Minimum FWHM
  - or –
- Center Diffraction Spikes if using Bahtinov Mask

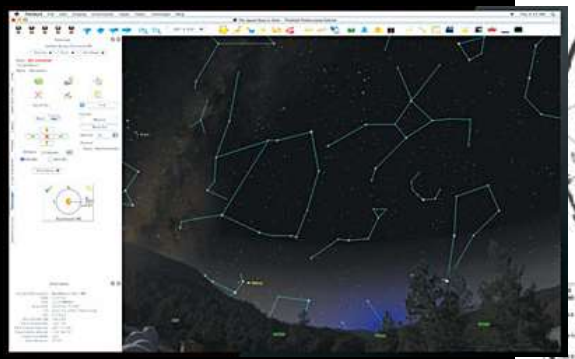
Step 4:
Focus Telescope
- Snap Image
- Live view, lower quality
- Snap view, high quality

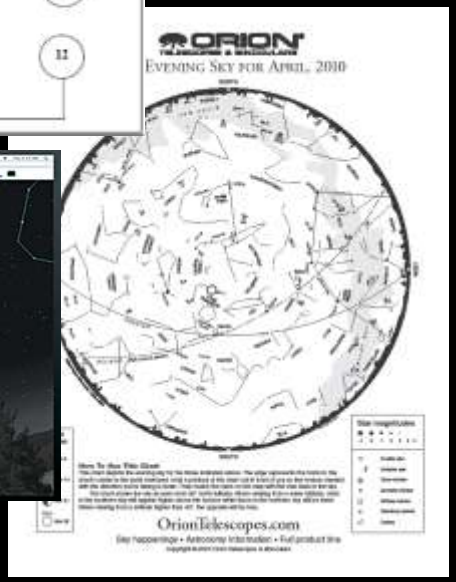
Focus

DSLR Astroimaging - Tutorial

2. Gathering Data – Lights, Darks, Flat Lights, Flat Darks, Bias

- Finding Your Target
  - At Least Three Options
    - GoTo Scope – select from list
      - Accurate GoTo function
    - Computer Control
      - Via scope RS-232 interface
      - ASCOM drivers
      - Planetarium Programs
        - » The Sky
        - » Cartes du Ciel
    - Star Hopping
      - Star charts
  - Note: Best results when target near Zenith due to atmosphere





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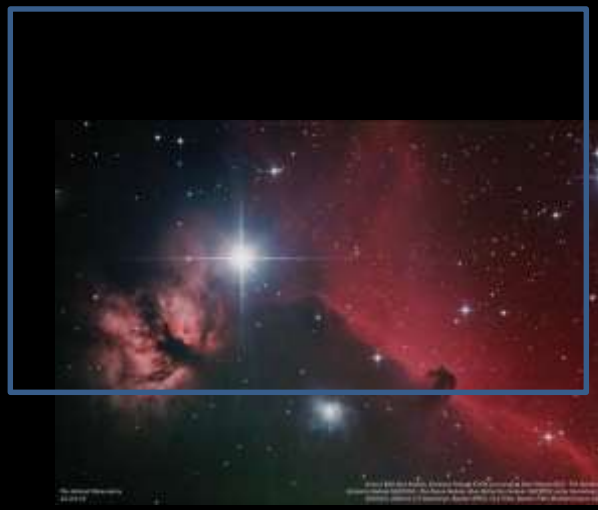
2. Gathering Data – Lights, Darks, Flat Lights, Flat Darks, Bias (cont'd)

Lights

Framing



1. Getting Close –
   - Precise Go-To, Adding nearby star to calibration stars
2. Fine Tune -
   - Take short test images, compare to star charts, fine movements

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2. Gathering Data – Lights, Darks, Flat Lights, Flat Darks, Bias (cont'd)

In addition to images of targets, will need calibration frames

- Build up of noise due to heat / thermal energy
- Imperfections in optical system and less than clean optics

Definitions:

Lights – Images of celestial object

Darks – Thermal noise (electron leakage), same duration, same temperature

Flat Lights – Evenly illuminated image showing imperfections in optics

Flat Darks – Thermal noise image, same duration, same temperature as Flat Lights

Bias – Image of shortest duration which provides offset from zero

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Lights: 40x5min
Darks: 10x5min

Flat Lights: 10x1/250s
Flat Darks: 10x1/250s

Bias: 10x1/4000s
All at ISO 400

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2. Gathering Data – Lights, Darks, Flat Lights, Flat Darks, Bias (cont'd)

With dark frame subtraction only, Imperfections remain (dust donuts, vignetting)

Thermal noise present in both light & dark frames

1 light frame (1 minute exposure)

(42 x 1 minute lights) – (10 x 1 minute dark), Then aligned and stacked

1 dark frame (1 min)

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2. Gathering Data – Lights, Darks, Flat Lights, Flat Darks, Bias (cont'd)

(42 x 1 minute lights) – (10 x 1 minute dark),
Then aligned and stacked

Flat field image

((42 x 1 minute lights) – (10 x 1 minute dark))
7 flat field images normalized

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2. Gathering Data – Lights, Darks, Flat Lights, Flat Darks, Bias (cont'd)

Multiple images are combined to improve the signal -

Why does aligning and stacking images increase the signal to noise ratio?

Answer – The signal adds linearly, the noise (being uncorrelated / orthogonal) adds as the square root of the sum of the squares.

Example: Take an image that has a signal of 2 and a noise level of 2. Its initial signal to noise ratio (SNR) is 2/2 = 1.

When we combine (2) images: signal = 2 + 2 = 4, noise = sqrt ($2^2 + 2^2$) = 2.828, SNR = 4/2.828 = 1.414.

When we combine (4) images: signal = 2 + 2 + 2 + 2 = 8,
noise = sqrt ($2^2 + 2^2 + 2^2 + 2^2$) = 4,
SNR = 8/4 = 2.

*** So, the more images we combine, the better the signal to noise ratio.
=> Works for lights, darks, flats, flat darks, and bias.

2. Gathering Data – Lights, Darks, Flat Lights, Flat Darks, Bias (cont'd)

Do you believe it?

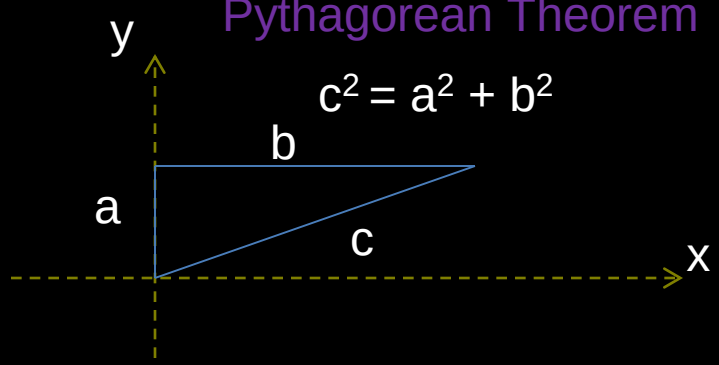
Answer - The signal adds linearly, the noise (being uncorrelated / orthogonal) adds as the square root of the sum of the squares.

Why is this true?

UNCORRELATED NOISE

Pythagorean Theorem

$c^2 = a^2 + b^2$



Noise a has no x value
Noise b has no y value

> uncorrelated

CORRELATED NOISE

Note – there is correlated noise!!

- Combining images does NOT decrease correlated noise.
  - Example: Fixed Pattern Noise
    - Use dithering

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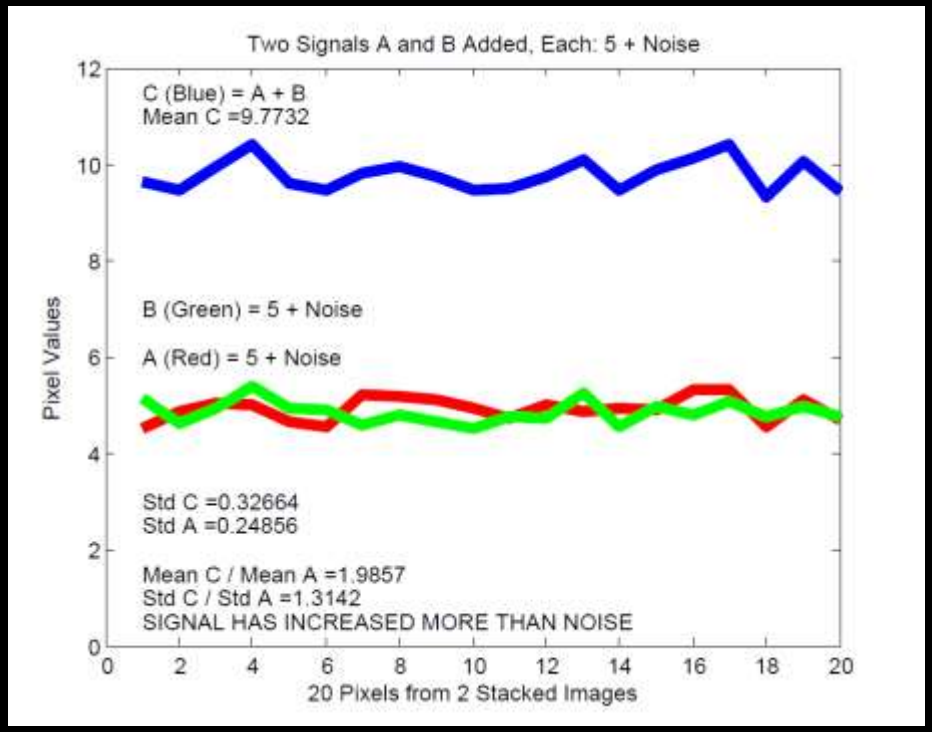
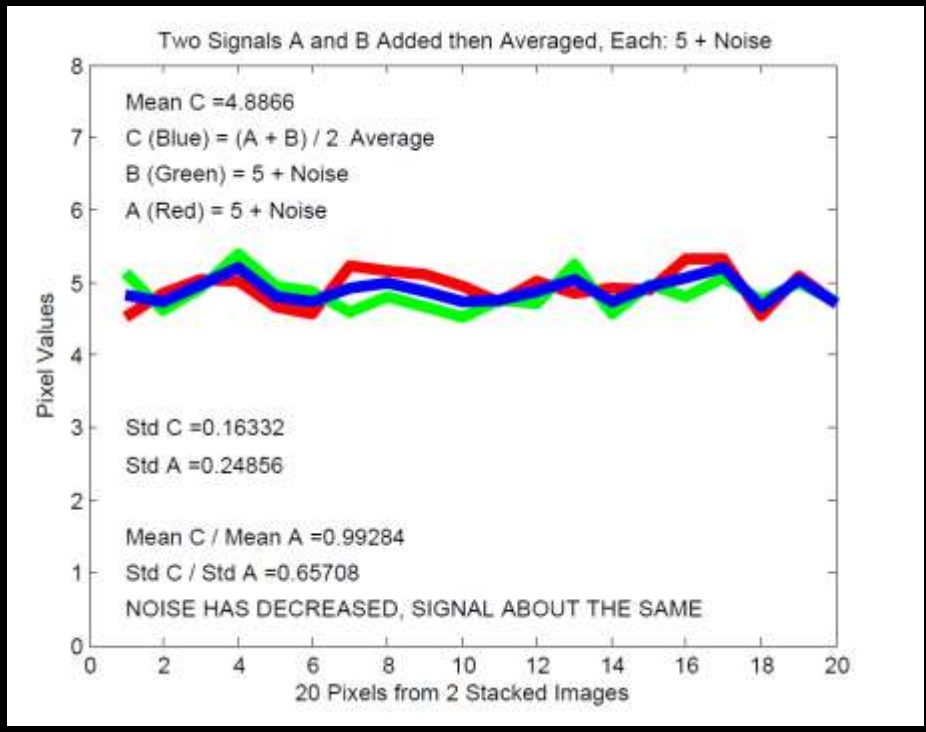
2. Gathering Data – Lights, Darks, Flat Lights, Flat Darks, Bias (cont'd)





Example of combining (stacking) 2 signals with noise:

- Signal increases more than noise increases
- Combining signals increases signal to noise ratio (SNR)

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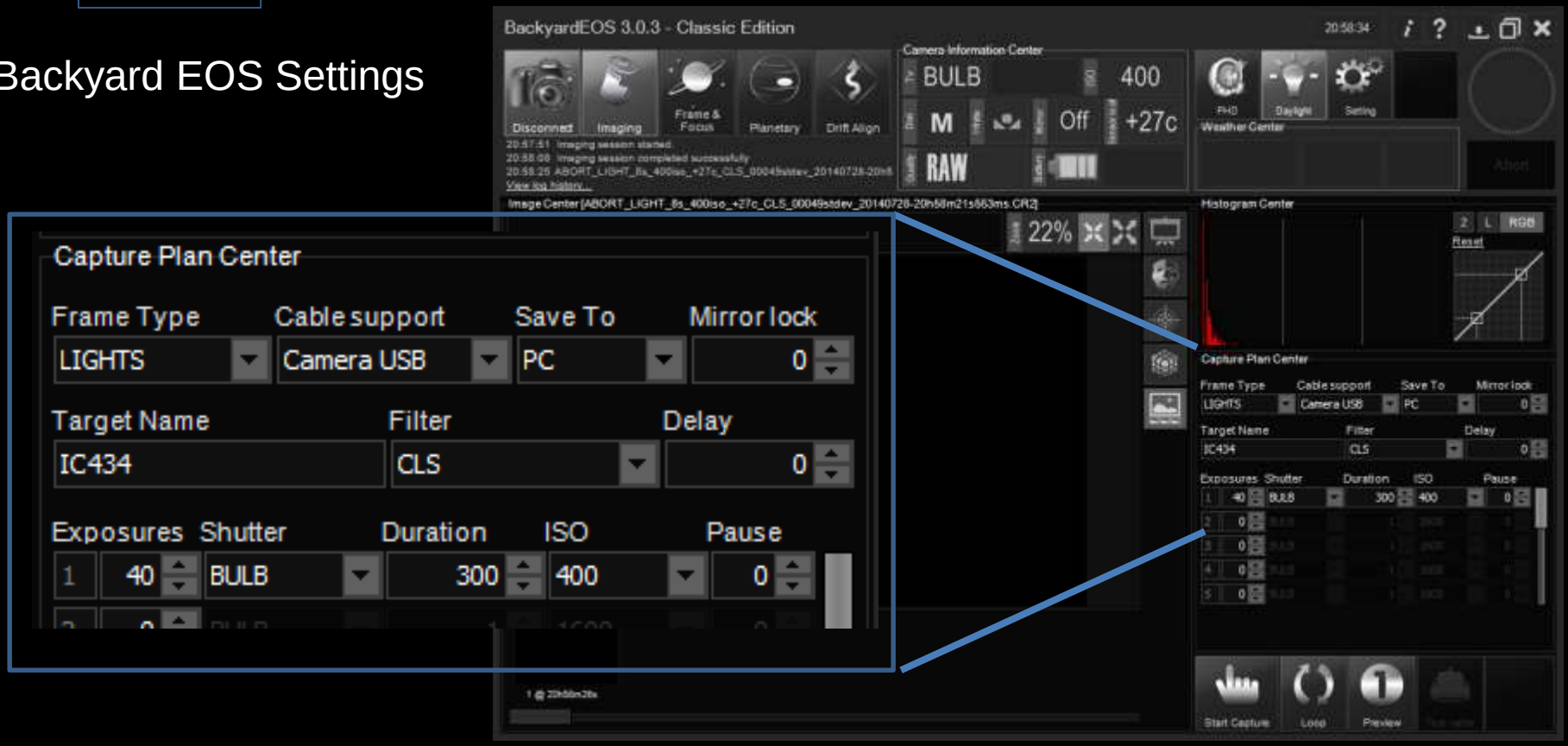
2. Gathering Data – Lights, Darks, Flat Lights, Flat Darks, Bias (cont'd)

Lights

Backyard EOS Settings



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2. Gathering Data – Lights, Darks, Flat Lights, Flat Darks, Bias (cont'd)

Lights

Configure for Dithering

With Dithering

Without Dithering

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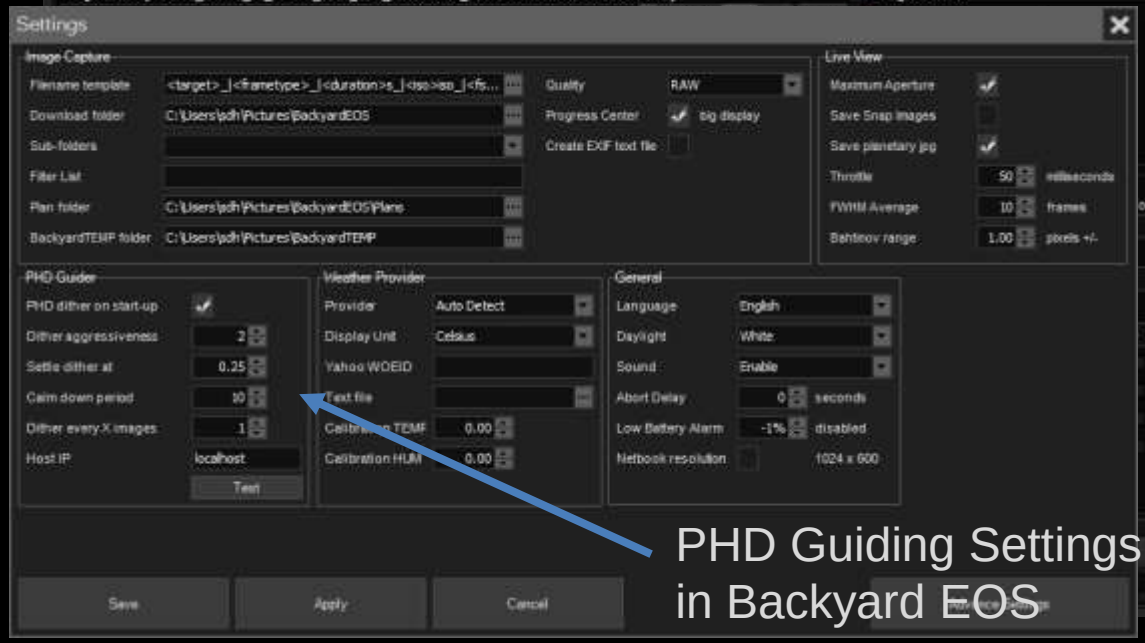
2. Gathering Data – Lights, Darks, Flat Lights, Flat Darks, Bias (cont'd)

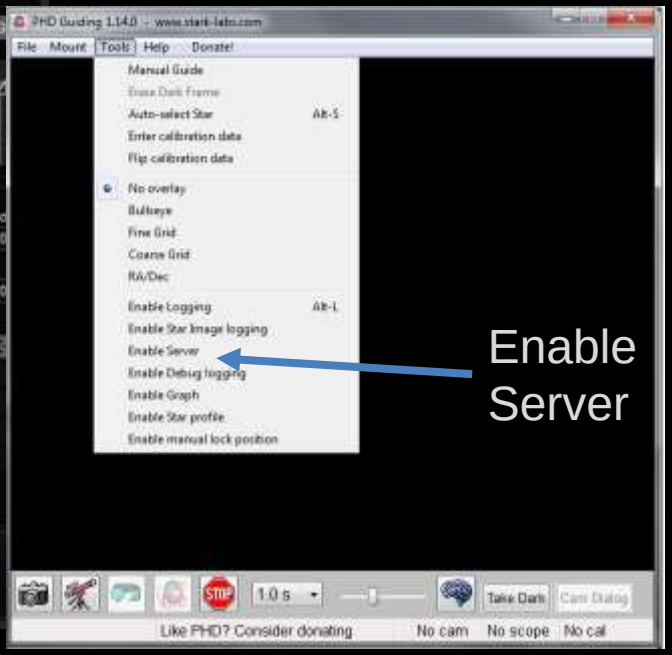
Lights

Click on Setting

Need to set:
Backyard EOS
&
PHD Guiding



PHD Guiding Settings in Backyard EOS



Enable Server

DSLR Astroimaging - Tutorial

2. Gathering Data – Lights, Darks, Flat Lights, Flat Darks, Bias (cont'd)

Lights

Completed:

- ✓ Focused
- ✓ Image Framed
- ✓ Backyard EOS Set – ready to take sequence of images
- ✓ Backyard EOS & PHD Guiding set for dithering

Left to Do:

- ⇒ Set up and start autoguiding
- ⇒ Start Backyard EOS image sequence
- ⇒ Monitor system for errors

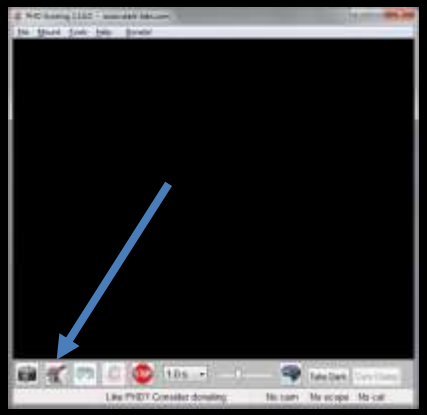
DSLR Astroimaging - Tutorial

2. Gathering Data – Lights, Darks, Flat Lights, Flat Darks, Bias (cont'd)

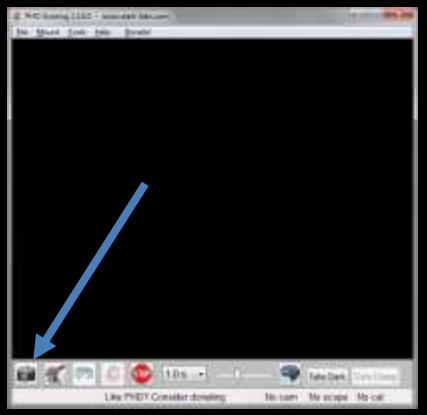
Lights

Autoguiding

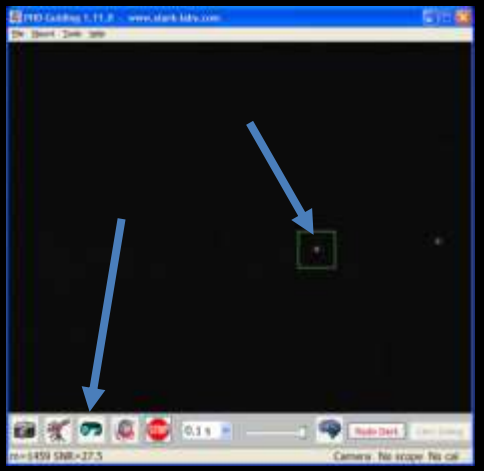
1. Select GPUSB for mount



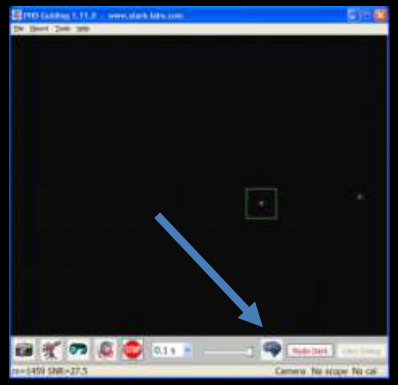
2. Connect to telescope



3. Select camera

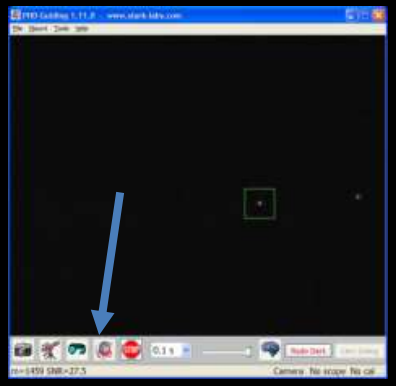


4. Start guide camera imaging, find guide star, click on guide star



=>

5. Adjust settings



6. Perform calibration

7. PHD Guiding starts autoguding after calibration =>

DSLR Astroimaging - Tutorial

2. Gathering Data – Lights, Darks, Flat Lights, Flat Darks, Bias (cont'd)

Lights

Start Backyard EOS image sequence

⇒ *Monitor system for errors [40x5mins = 3 hours, 20 minutes]*

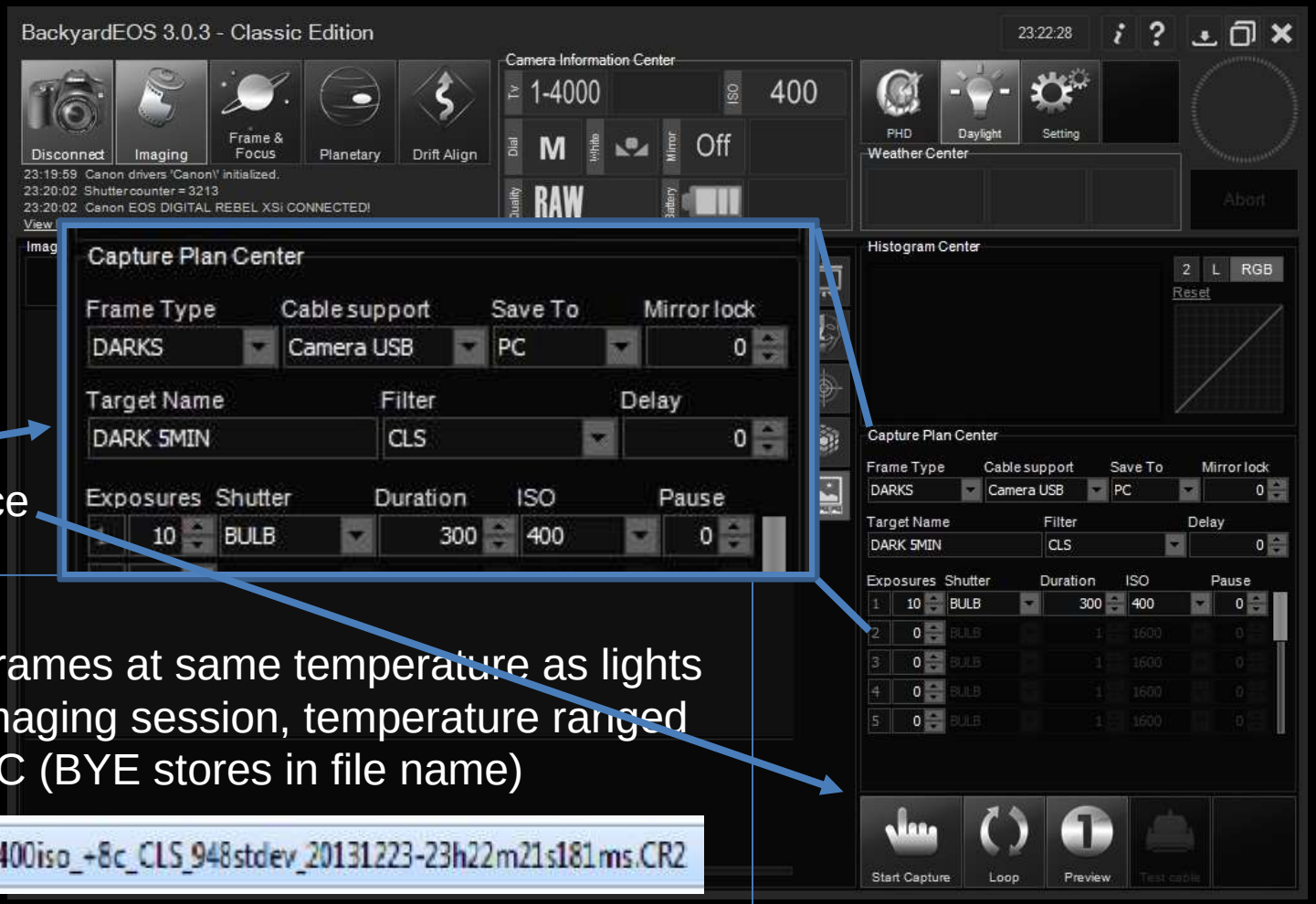
DSLR Astroimaging - Tutorial

2. Gathering Data – Lights, Darks, Flat Lights, Flat Darks, Bias (cont'd)

Darks

- ❑ Cover Scope
- ❑ Set BYE
- ❑ Start Sequence

Backyard EOS (BYE) Settings



Note –

- ➢ Ideally dark frames at same temperature as lights
- ➢ During this imaging session, temperature ranged from 7 to 18°C (BYE stores in file name)

* Dark current doubles for every approx. 6°C

DSLR Astroimaging - Tutorial

2. Gathering Data – Lights, Darks, Flat Lights, Flat Darks, Bias (cont'd)

FLAT LIGHTS

T-Shirt Flats

Light Box Flats

Backyard EOS (BYE) Settings

DSLR Astroimaging - Tutorial

2. Gathering Data – Lights, Darks, Flat Lights, Flat Darks, Bias (cont'd)

FLAT DARKS

- ❑ Cover Scope
- ❑ Set BYE
- ❑ Start Sequence

Backyard EOS (BYE) Settings

DSLR Astroimaging - Tutorial

2. Gathering Data – Lights, Darks, Flat Lights, Flat Darks, Bias (cont'd)

BIAS

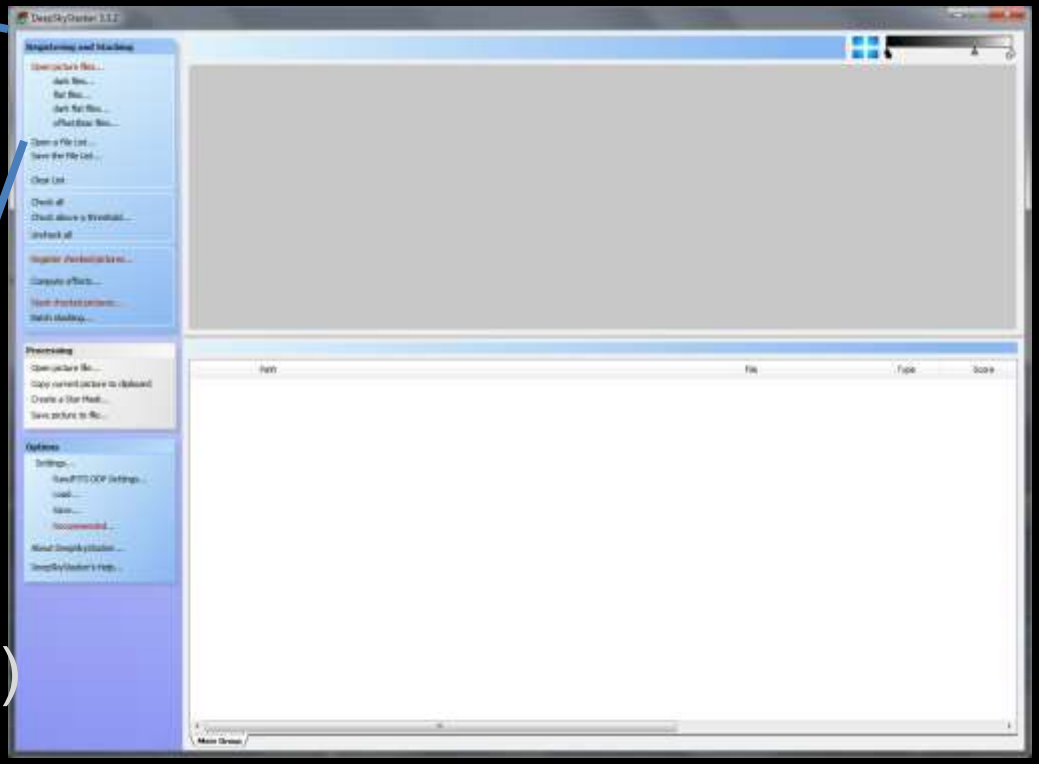
- ❑ Cover Scope
- ❑ Set BYE
- ❑ Start Sequence

Backyard EOS (BYE) Settings

DSLR Astroimaging - Tutorial

3. Processing Image – Align and Stack

Deep Sky Stacker



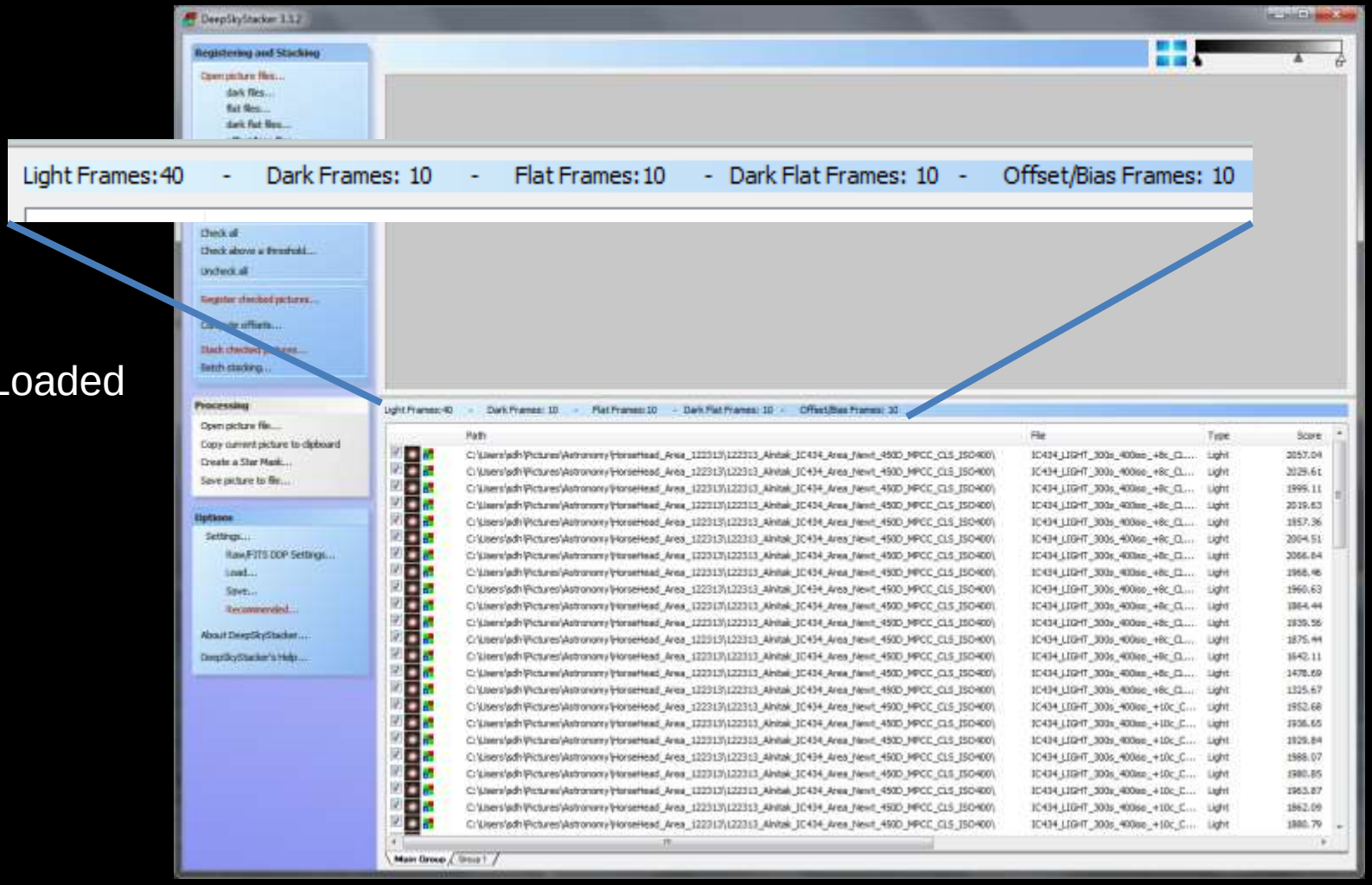
Click here to load:
Lights (Open picture files…)
Darks (dark files…)
Flat Lights (flat files…)
Flat Darks (dark flat files…)
Bias (offset/bias files…)

Align / Register: Moves images around so that features line up (translate & rotate).
Stack: Combines images to increase Signal to Noise ratio (SNR).

DSLR Astroimaging - Tutorial

3. Processing Image – Align and Stack (cont'd)

Deep Sky Stacker



All Files Loaded

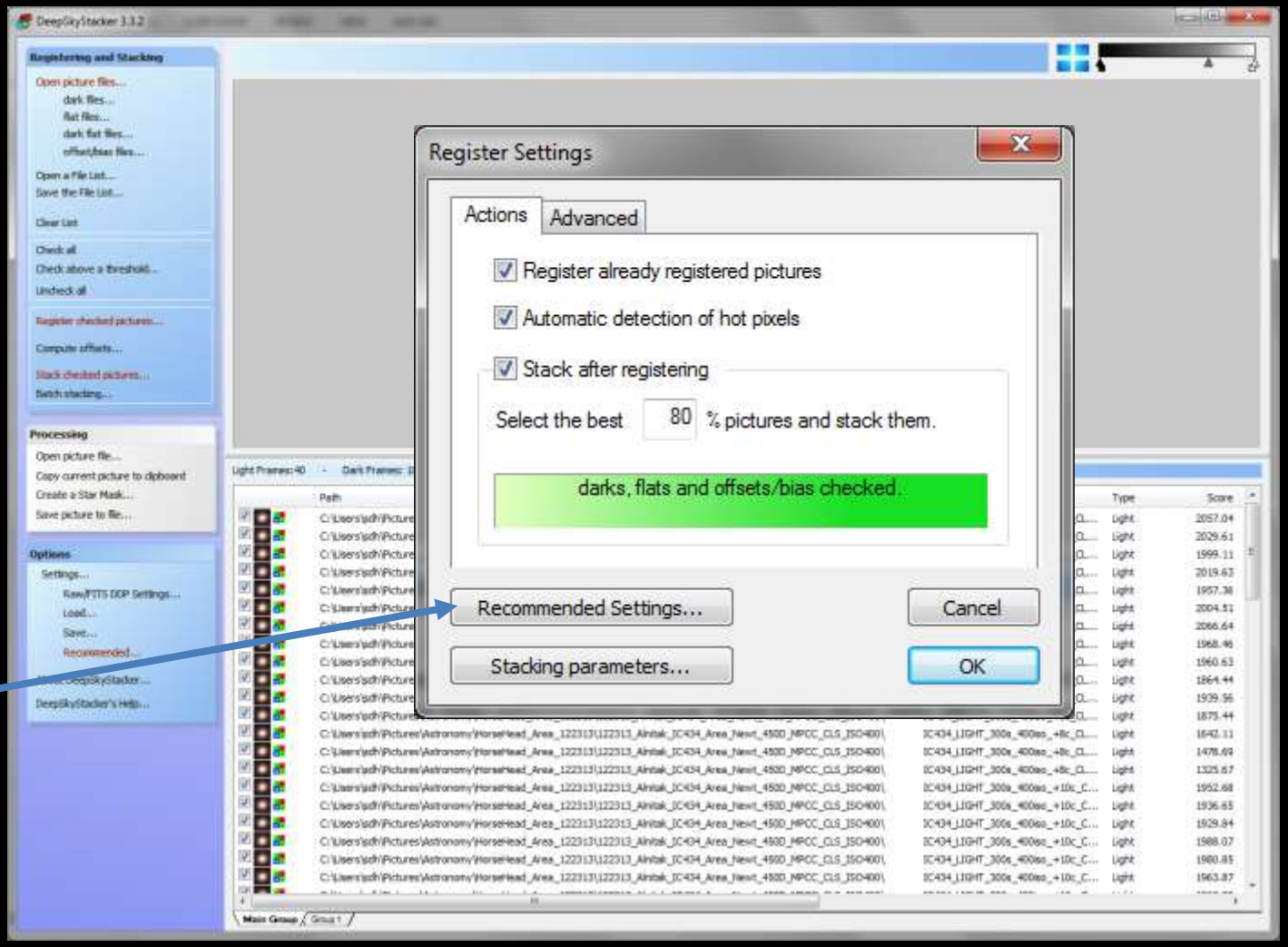
DSLR Astroimaging - Tutorial

3. Processing Image – Align and Stack (cont'd)

Deep Sky Stacker

Click:
Register checked pictures

Click:
Recommend Settings

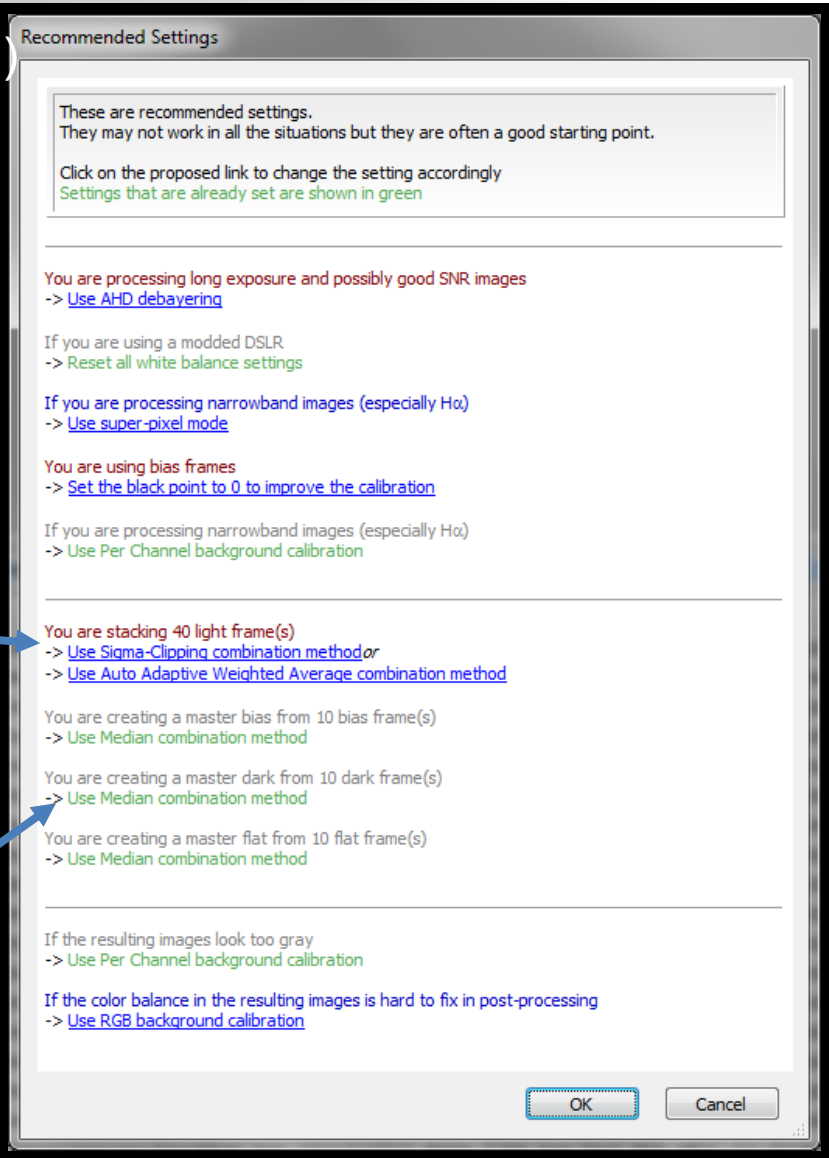


DSLR Astroimaging - Tutorial

3. Processing Image – Align and Stack (cont'd)

Blue: Recommend Changing to These Settings

Green: Recommended Settings Have Been Selected

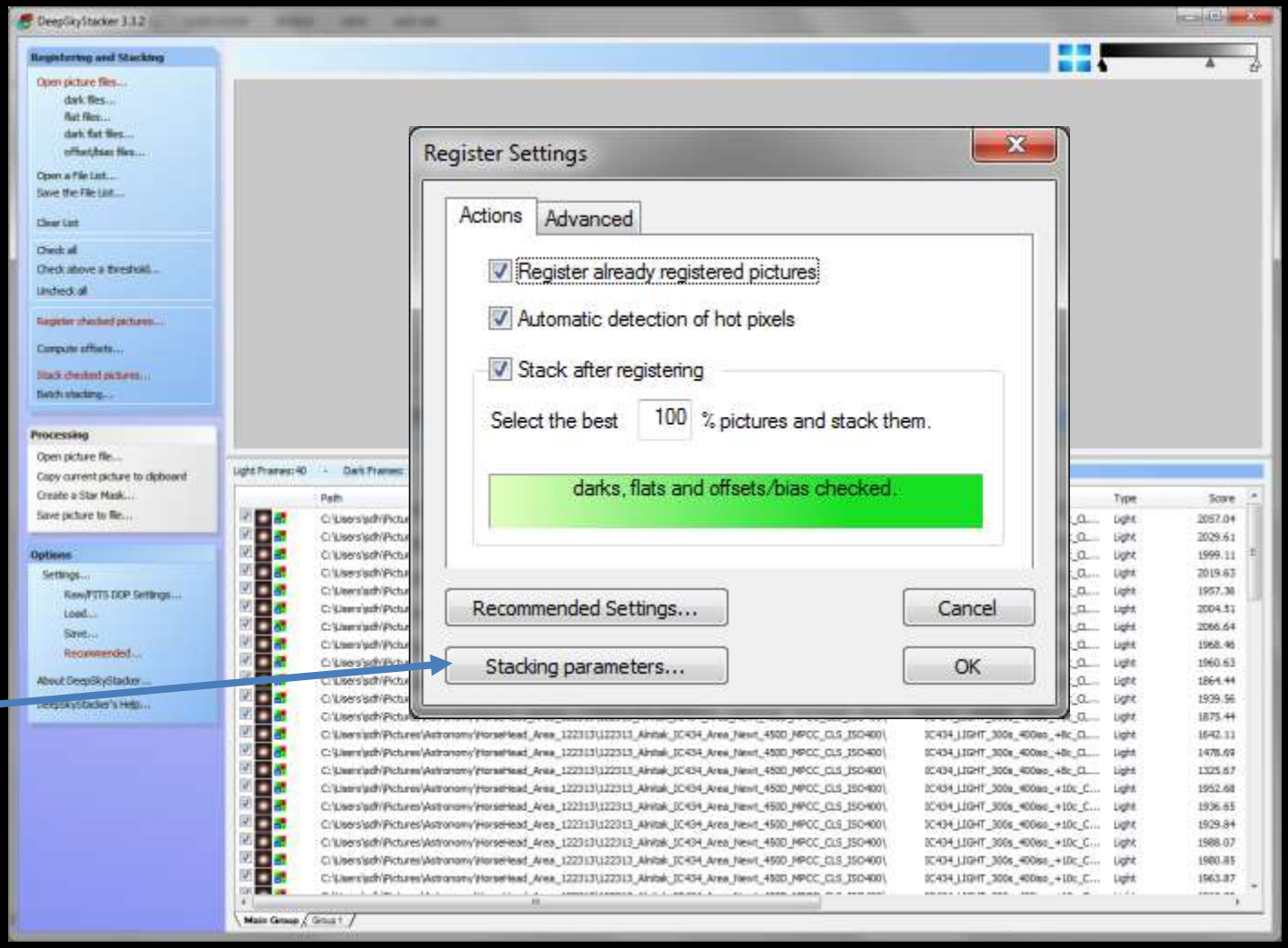


DSLR Astroimaging - Tutorial

3. Processing Image – Align and Stack (cont'd)

Deep Sky Stacker

Click:
Stacking
Parameters



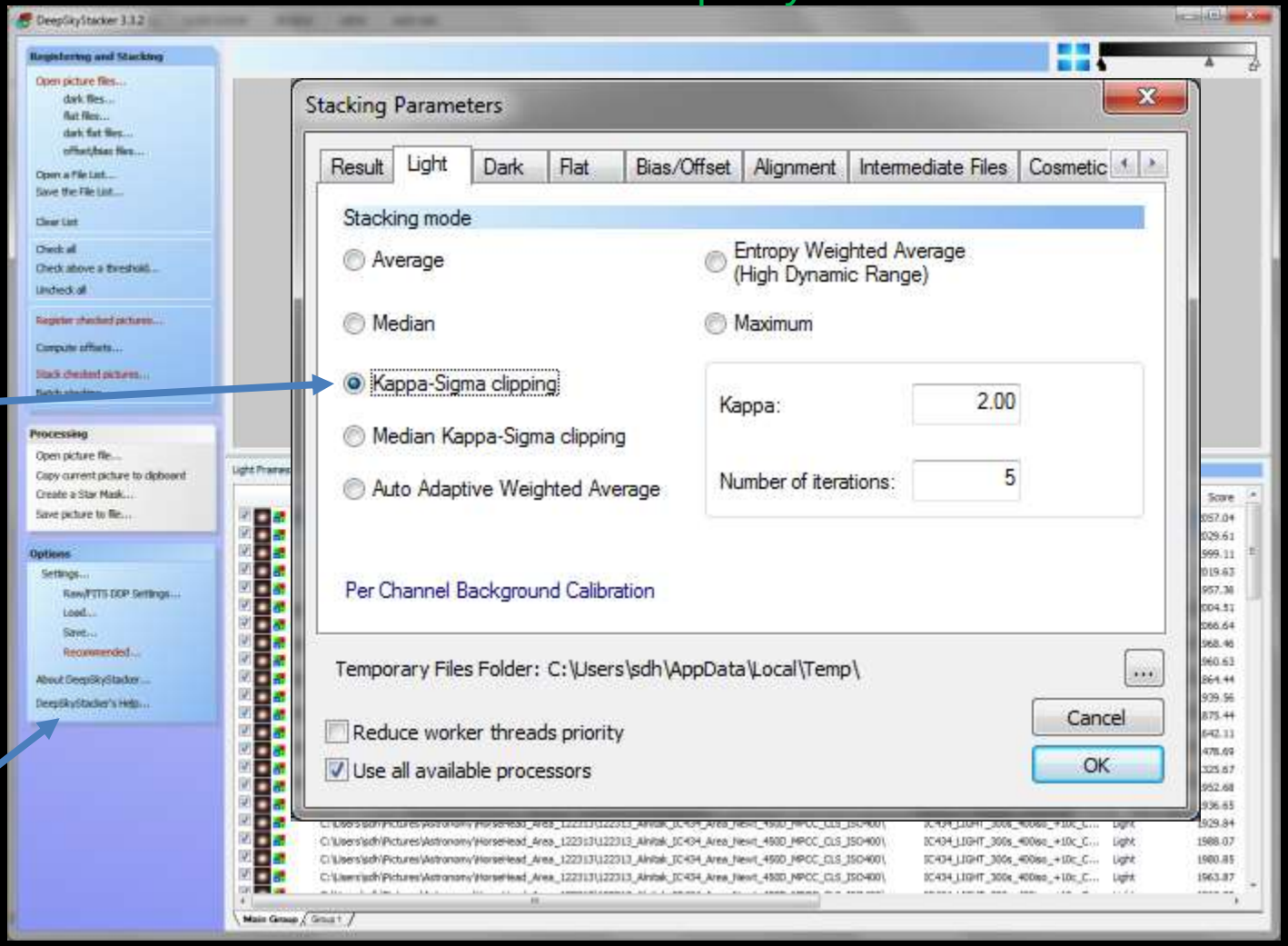
DSLR Astroimaging - Tutorial

3. Processing Image – Align and Stack (cont'd)

Deep Sky Stacker

Select Desired Changes For:
Lights
Darks
Flat
Bias
Etc.

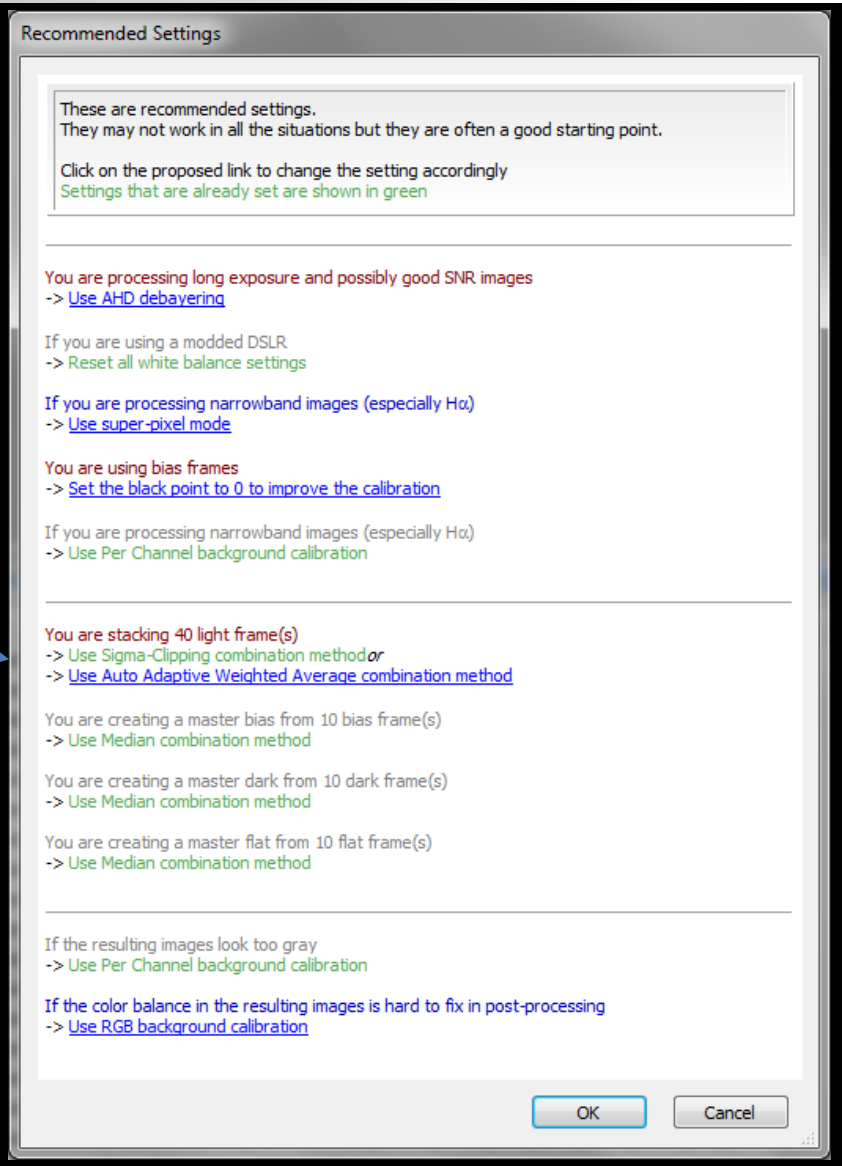
DSS has help files to aid in understand settings



DSLR Astroimaging - Tutorial

3. Processing Image – Align and Stack (cont'd)

Now 'light frames' stacking shows a GREEN selection

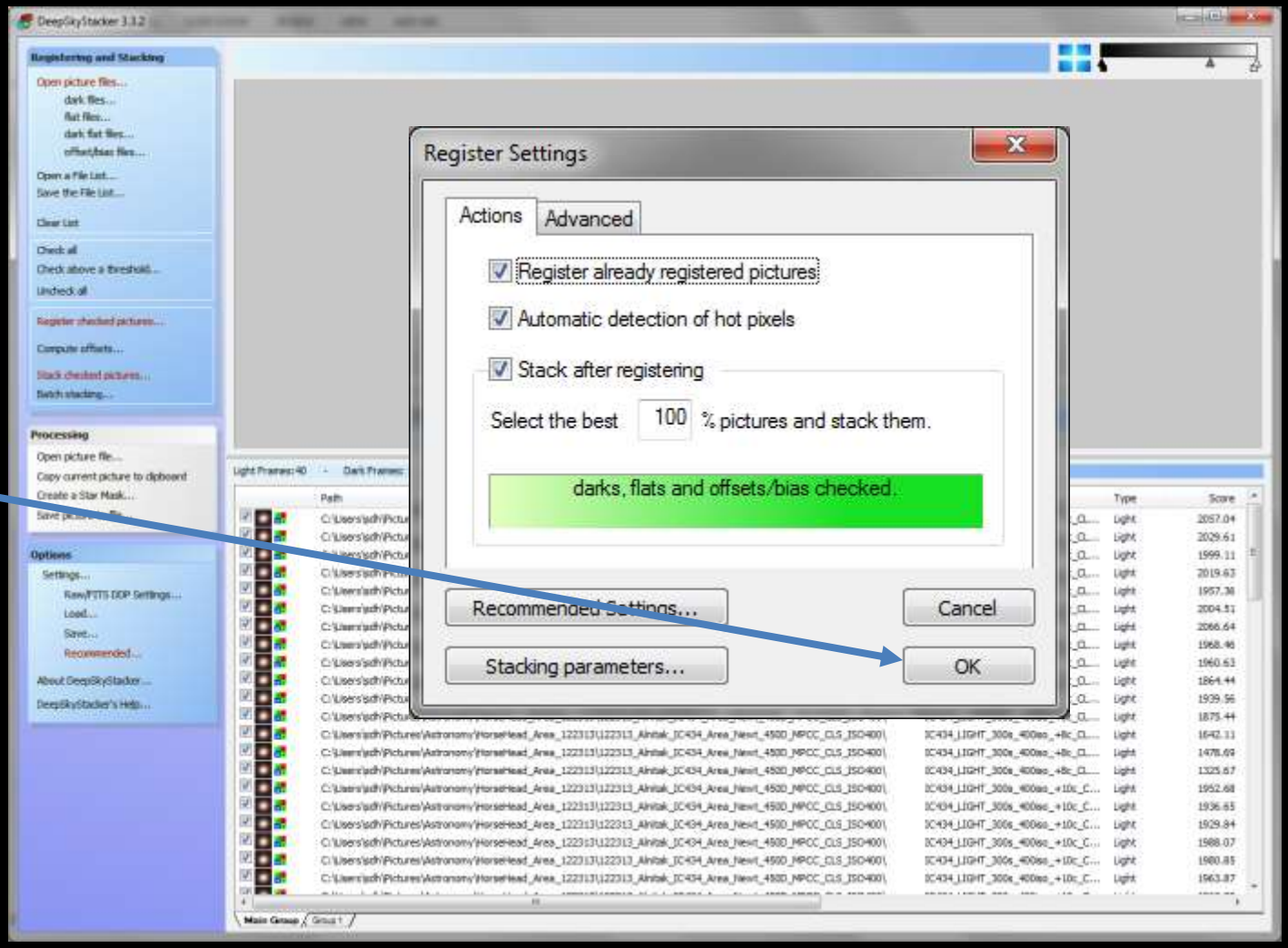


DSLR Astroimaging - Tutorial

3. Processing Image – Align and Stack (cont'd)

Deep Sky Stacker

Start Align & Stack: Click OK



DSLR Astroimaging - Tutorial

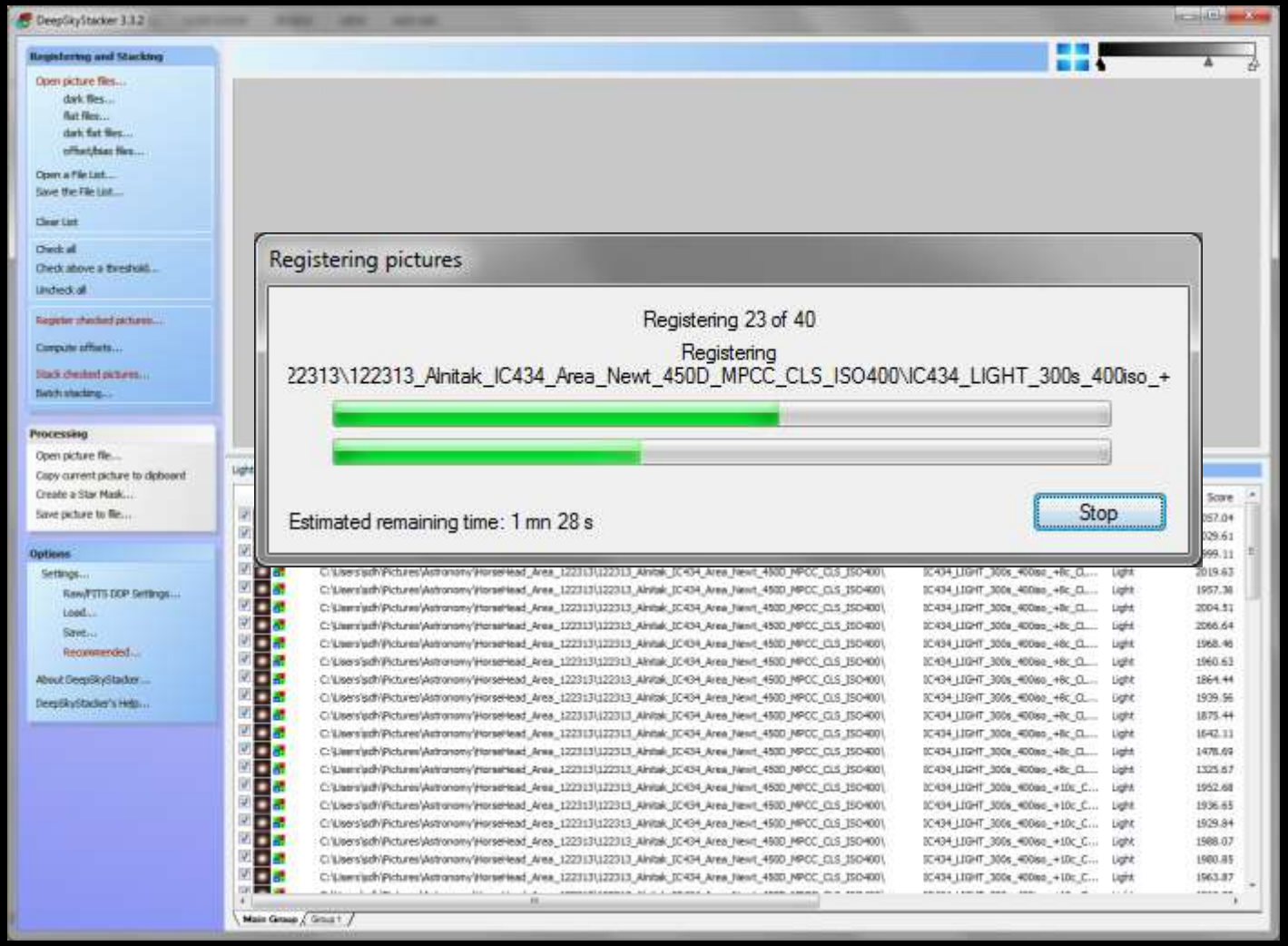
3. Processing Image – Align and Stack (cont'd)

Deep Sky Stacker

Procesing Images

Can Take a Long Time

Approx. 20 minutes on my laptop



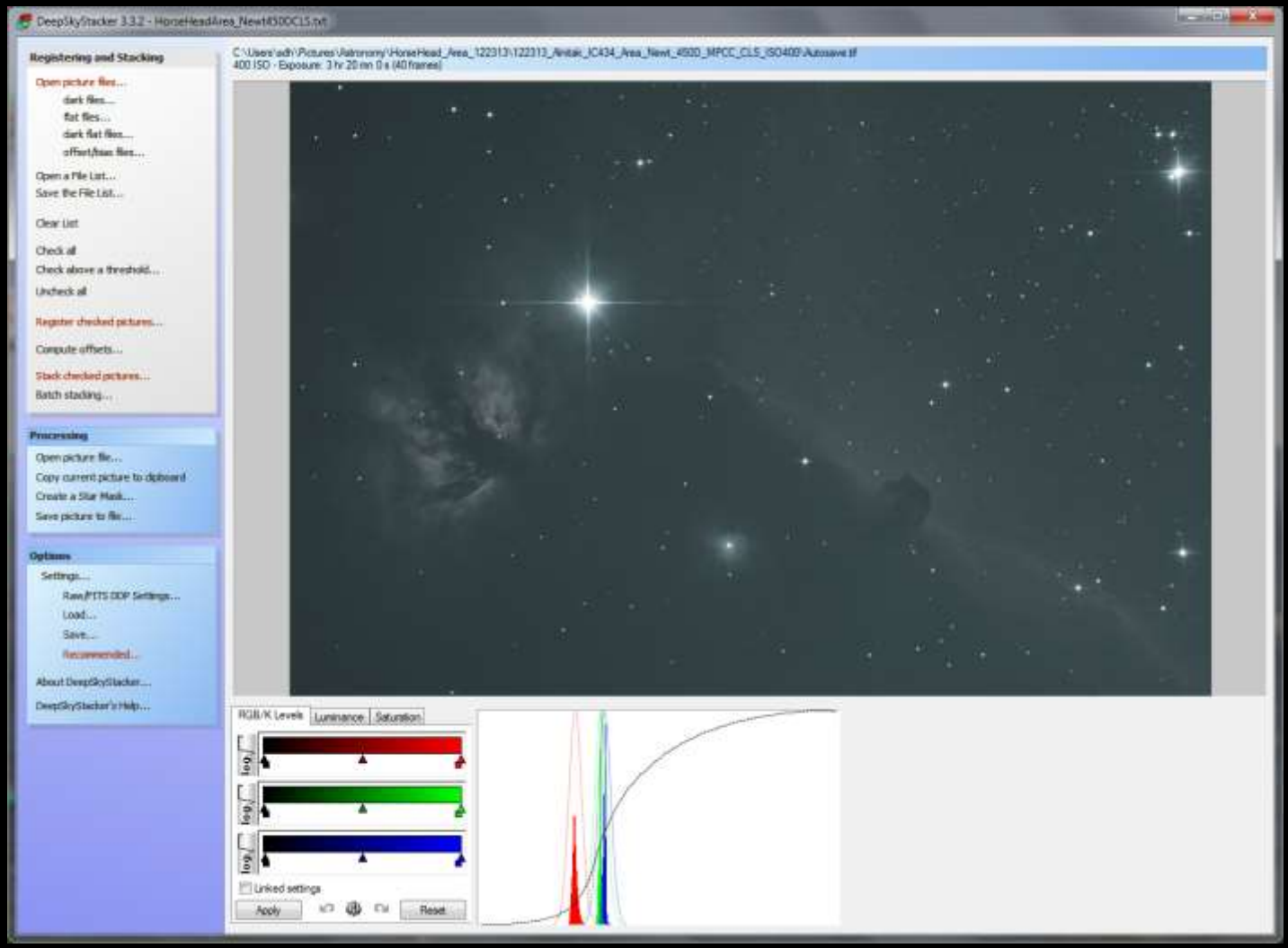
DSLR Astroimaging - Tutorial

3. Processing Image – Align and Stack (cont'd)

Deep Sky Stacker

Displays a version of the aligned and stacked image.

Saves file: Autosave.tif 32bits per color, 116MBytes



DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing

To go from here to ==========➔ here

We will use: 1) Photoshop Levels, 2) Photoshop Curves, 3) Photoshop Dust & Scratches

Note – Different images require different processing steps

Some other common additional steps: Gradient Correction, Other Noise Reduction

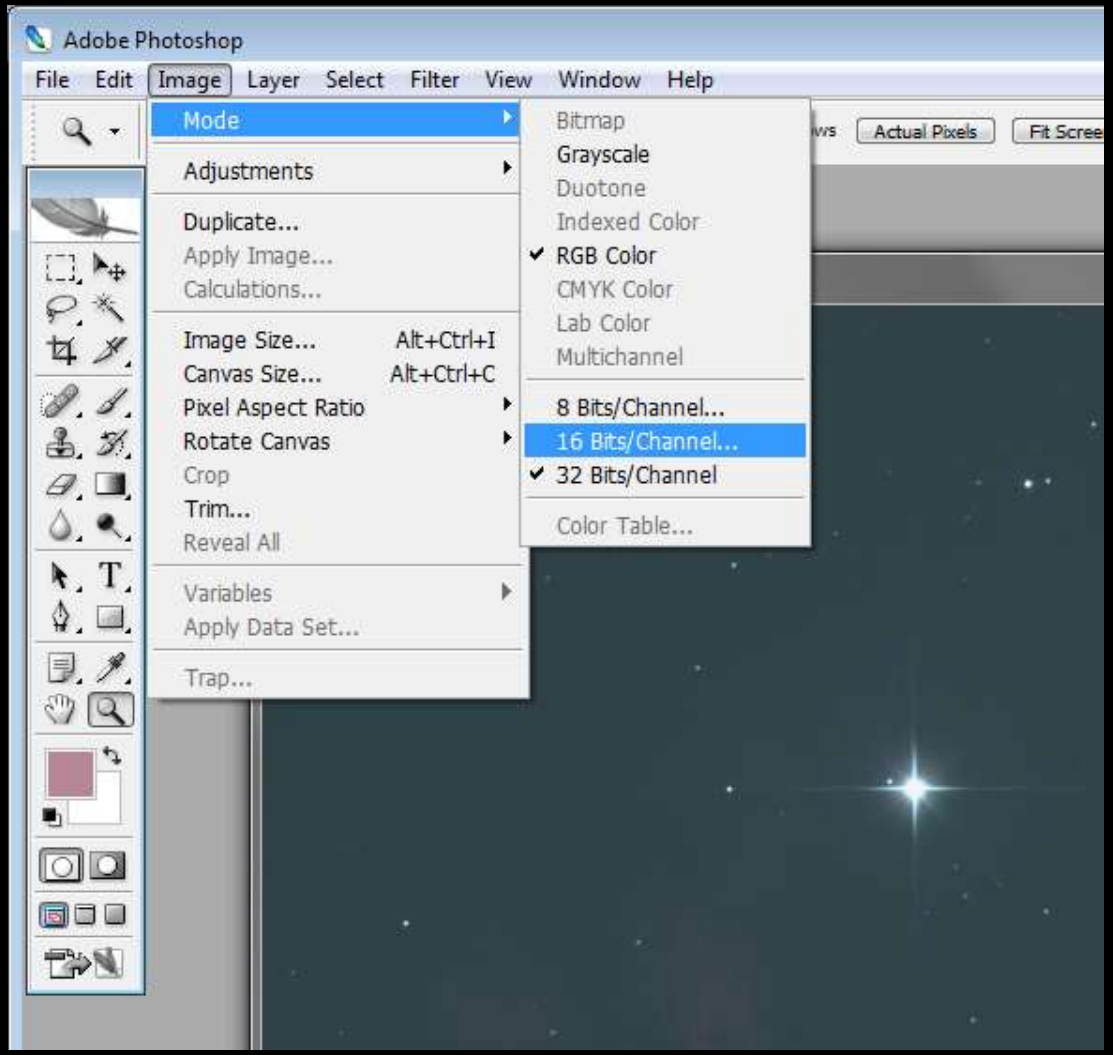
DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

Photoshop

Step 1: Convert from 32 bits per color to 16 bits per color

[Required to use PS functions]

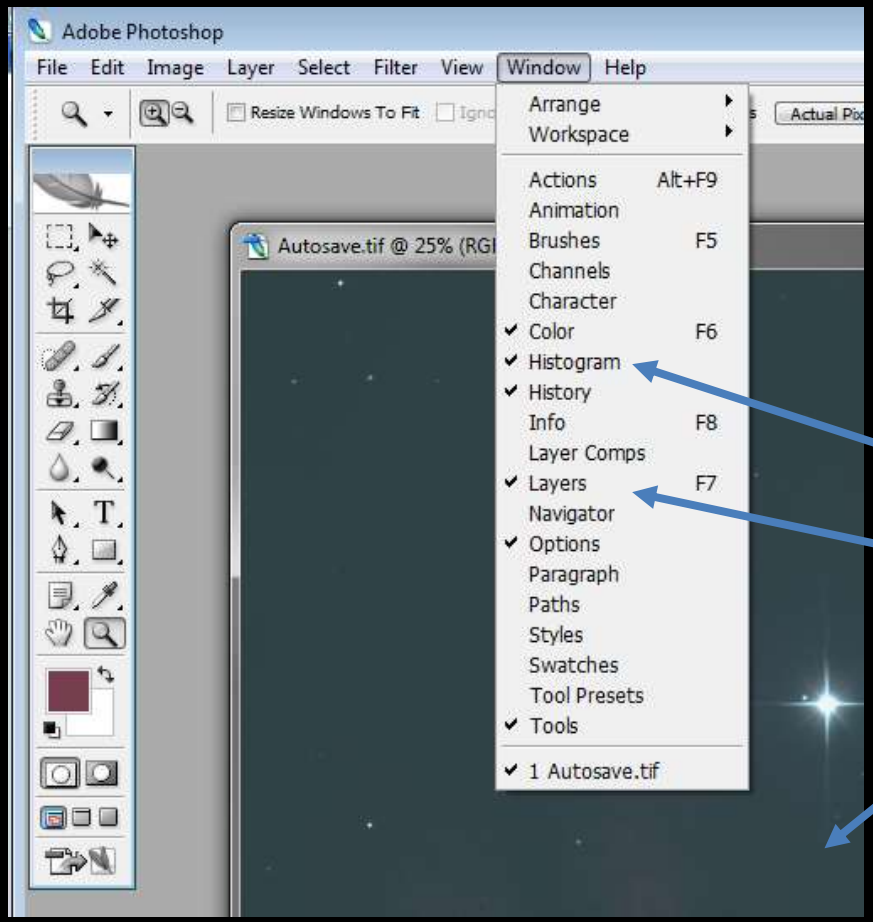


S. Douglas Holland

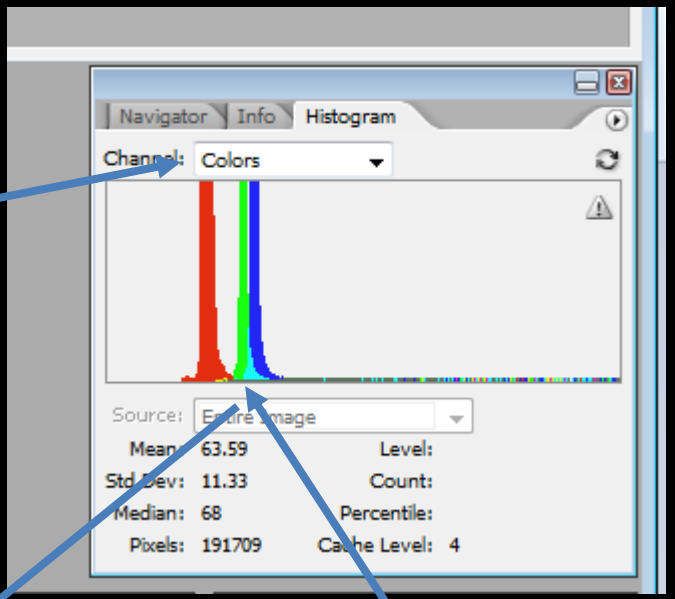
DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd) Photoshop

Step 2 – Need to balance R,G,B channels – First activate Histogram & Layers



Set to Colors



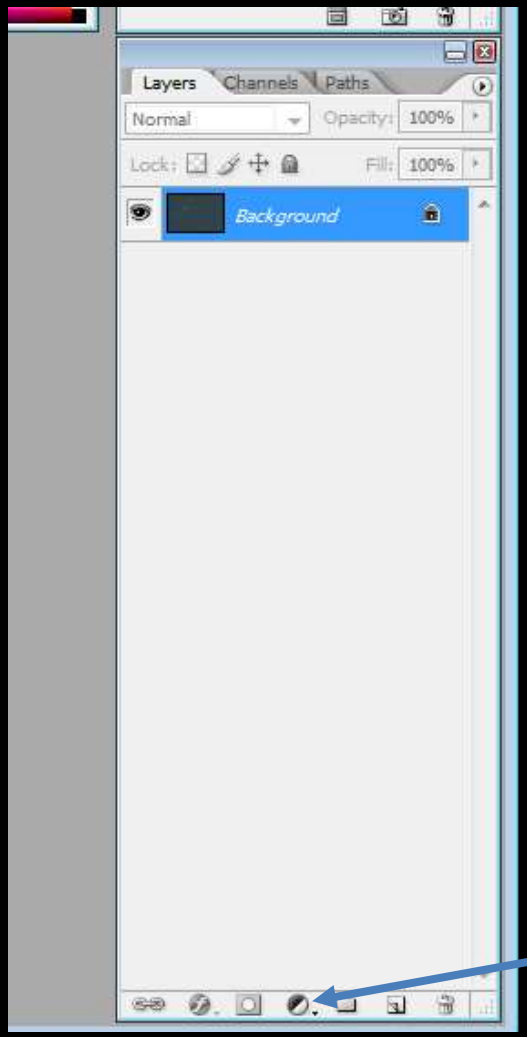
R,G,B channels unbalanced

Note – Greenish Blue tint

DSLR Astroimaging - Tutorial

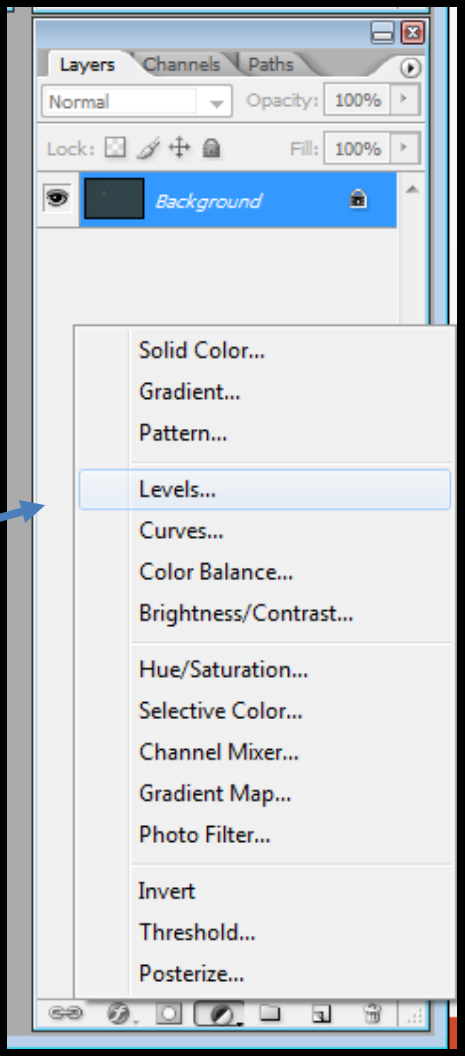
3. Processing Image – Post Processing (cont'd)

Photoshop



Create Adjustment Layer

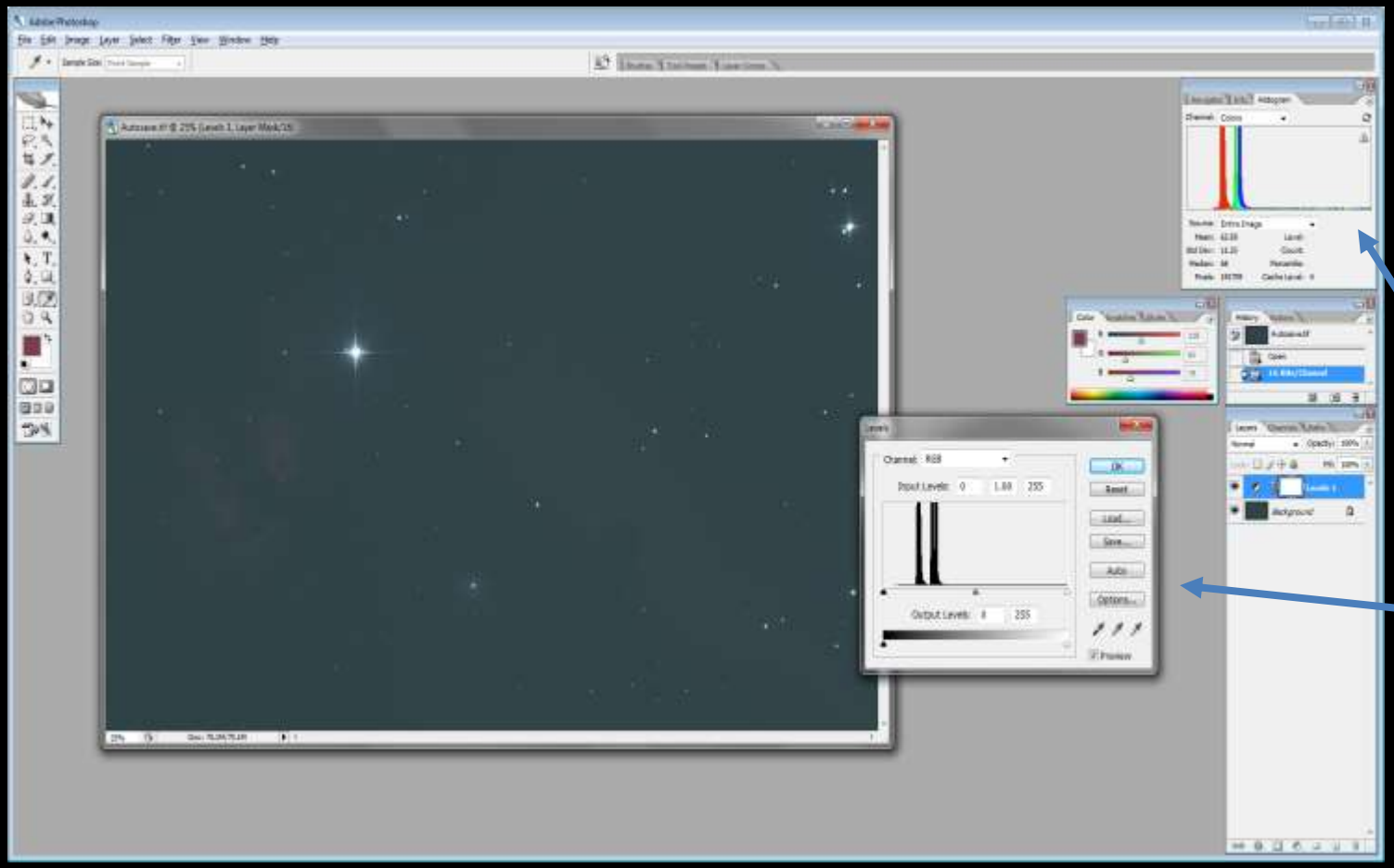
Select Levels



DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

Photoshop

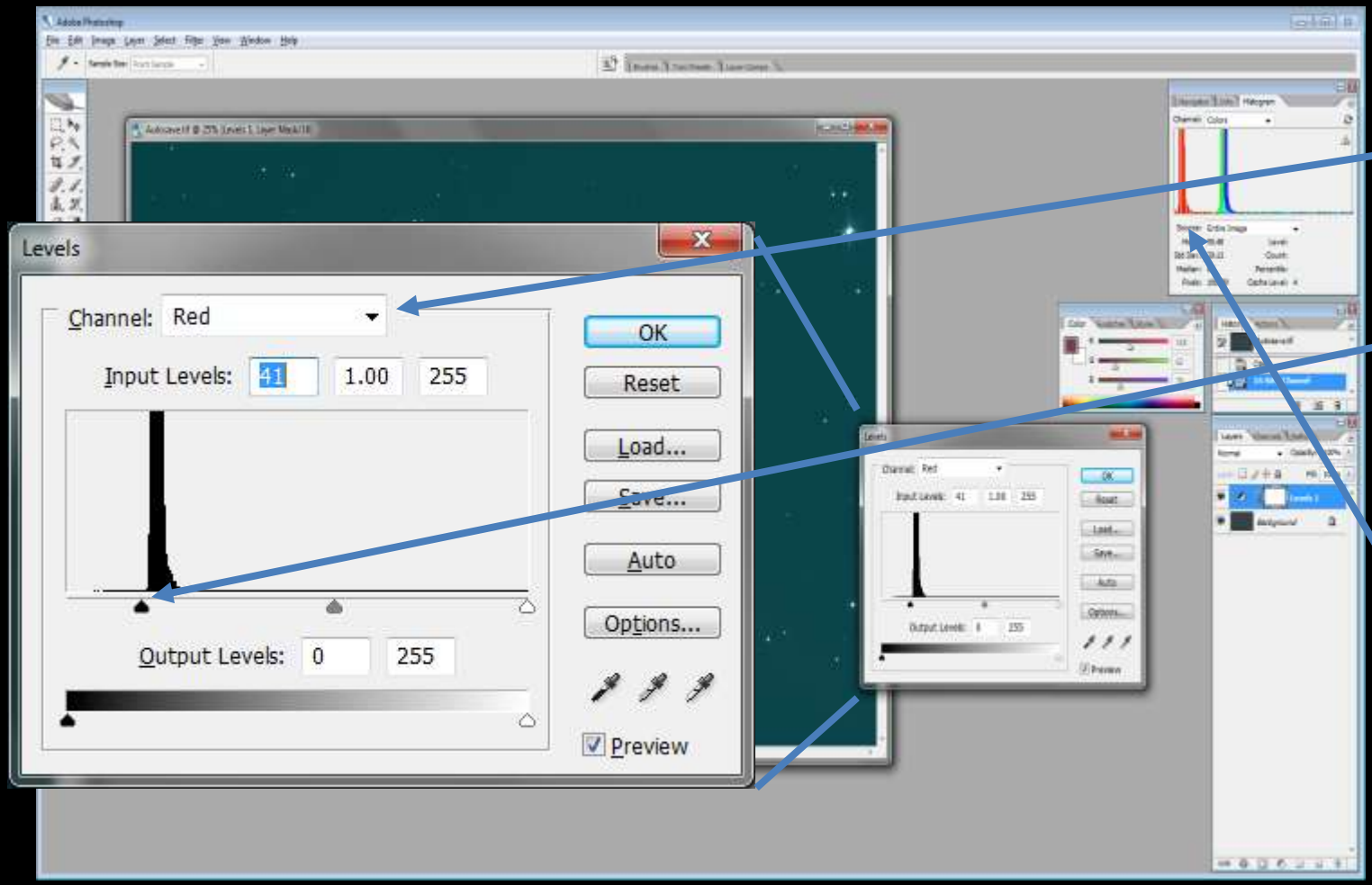


Levels Adjust
Results shown
on Histogram

DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

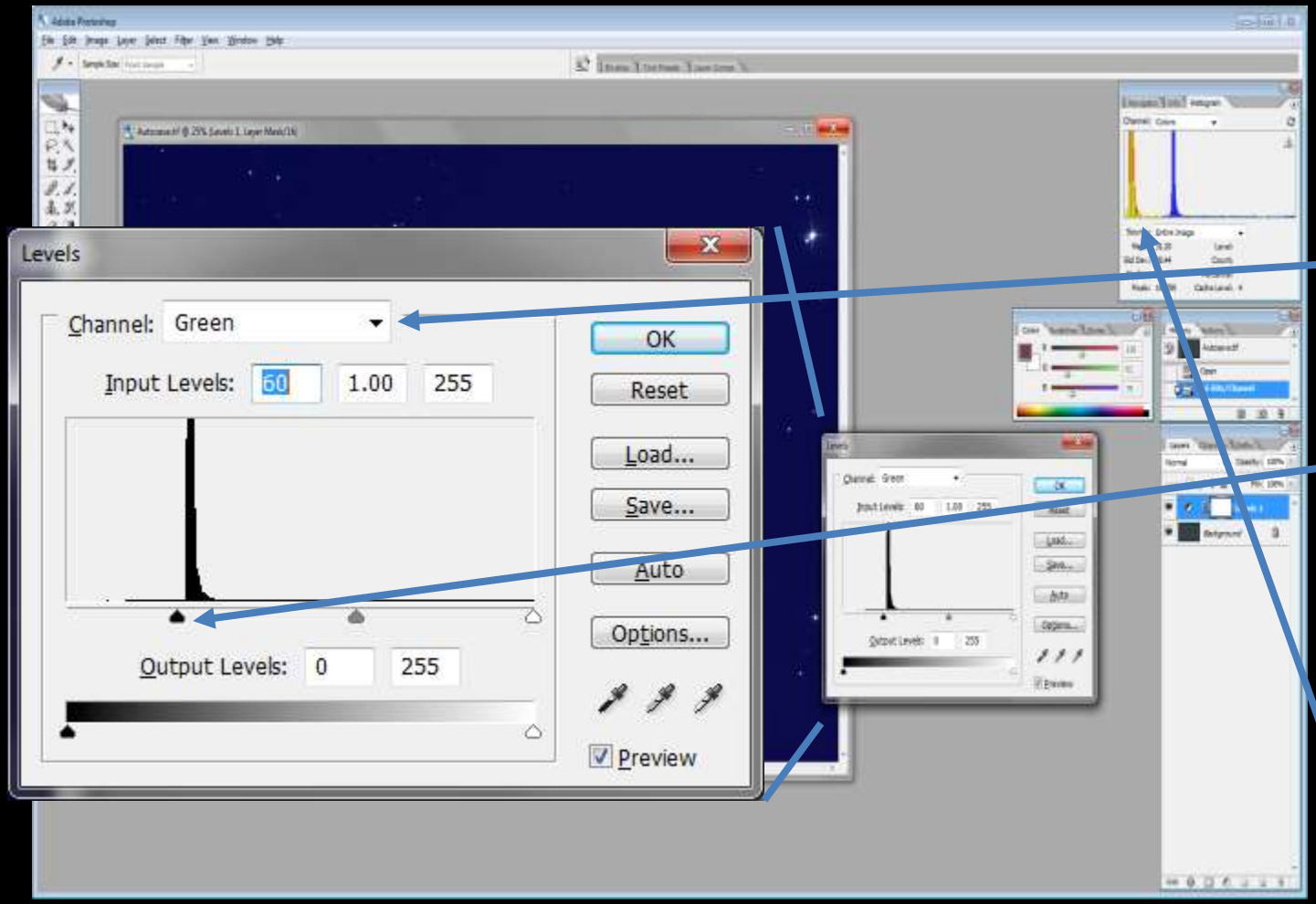
Photoshop



DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

Photoshop



Repeat for Green

Select Green

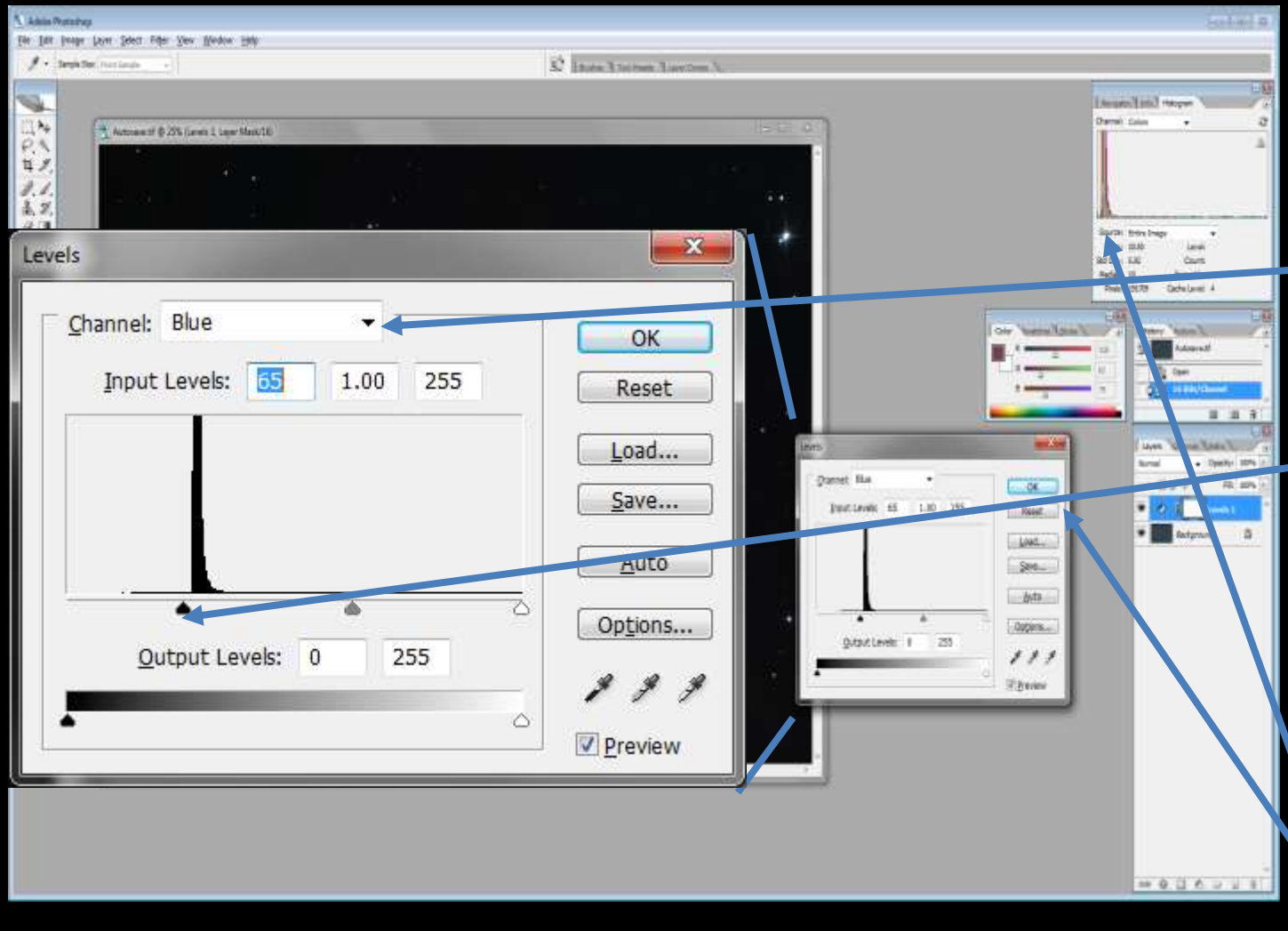
Move
Black Point

Note
Effect on
Histogram:
Red & Green
overlapping

DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

Photoshop



Repeat for Blue

Select Blue

Move Black Point

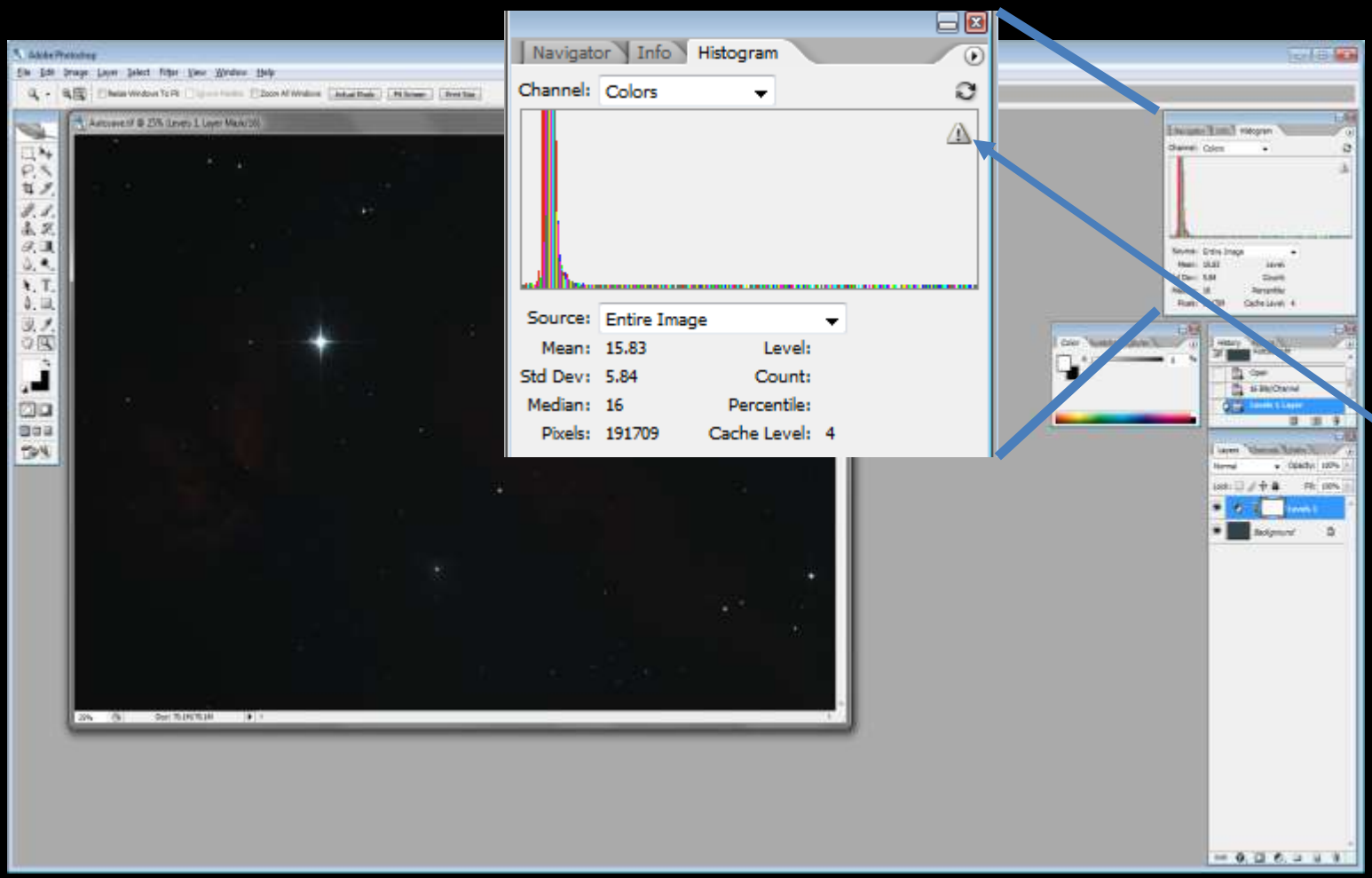
Note Effect on Histogram: R,G,B overlapping

OK

DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

Photoshop



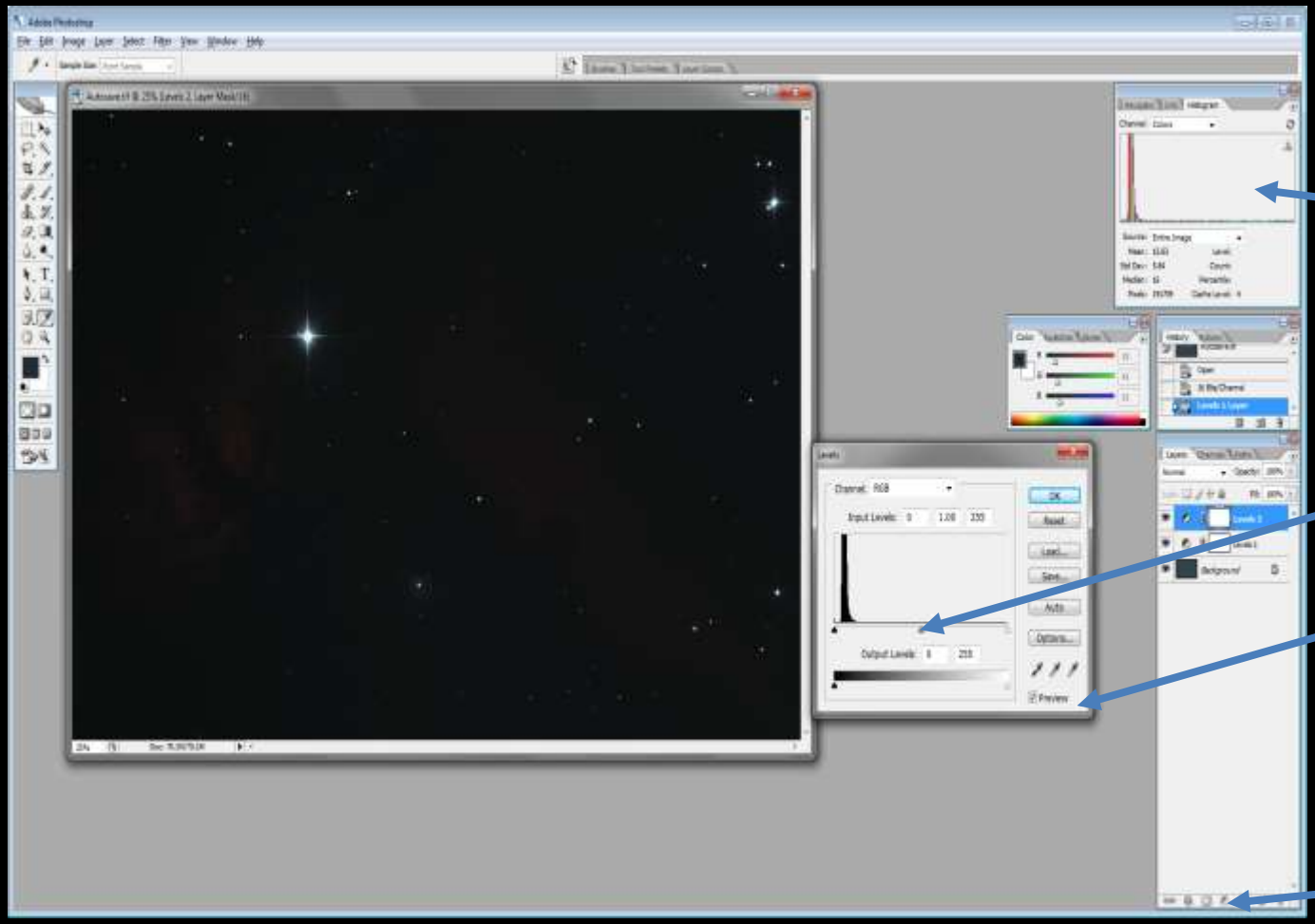
Click here to update histogram and image with uncached data

DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

Photoshop

Step 3 – Stretch data, re-balance channels



Monitor histogram

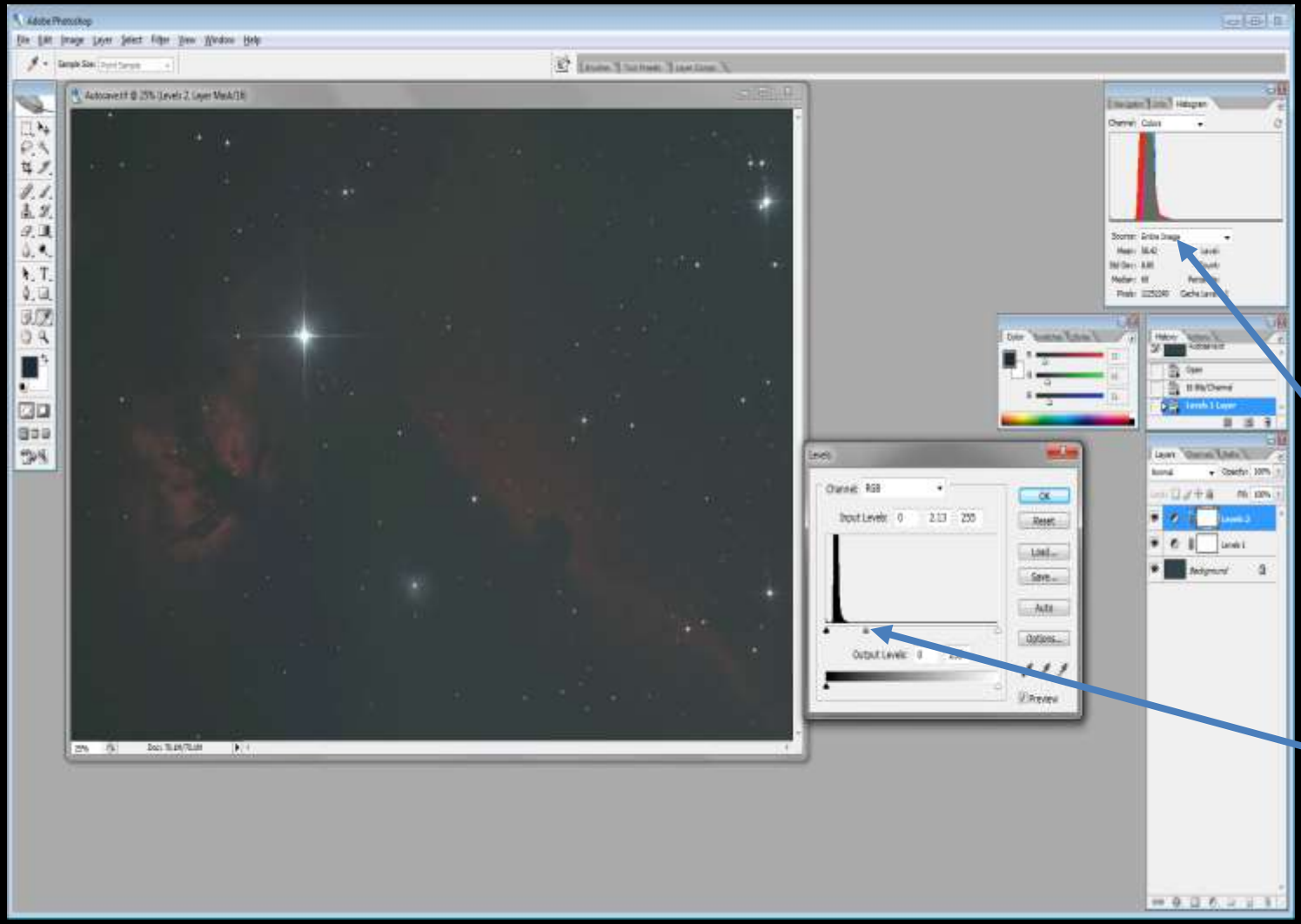
Adjust mid slider to stretch data

Create another Levels Adjustment Layer

DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

Photoshop



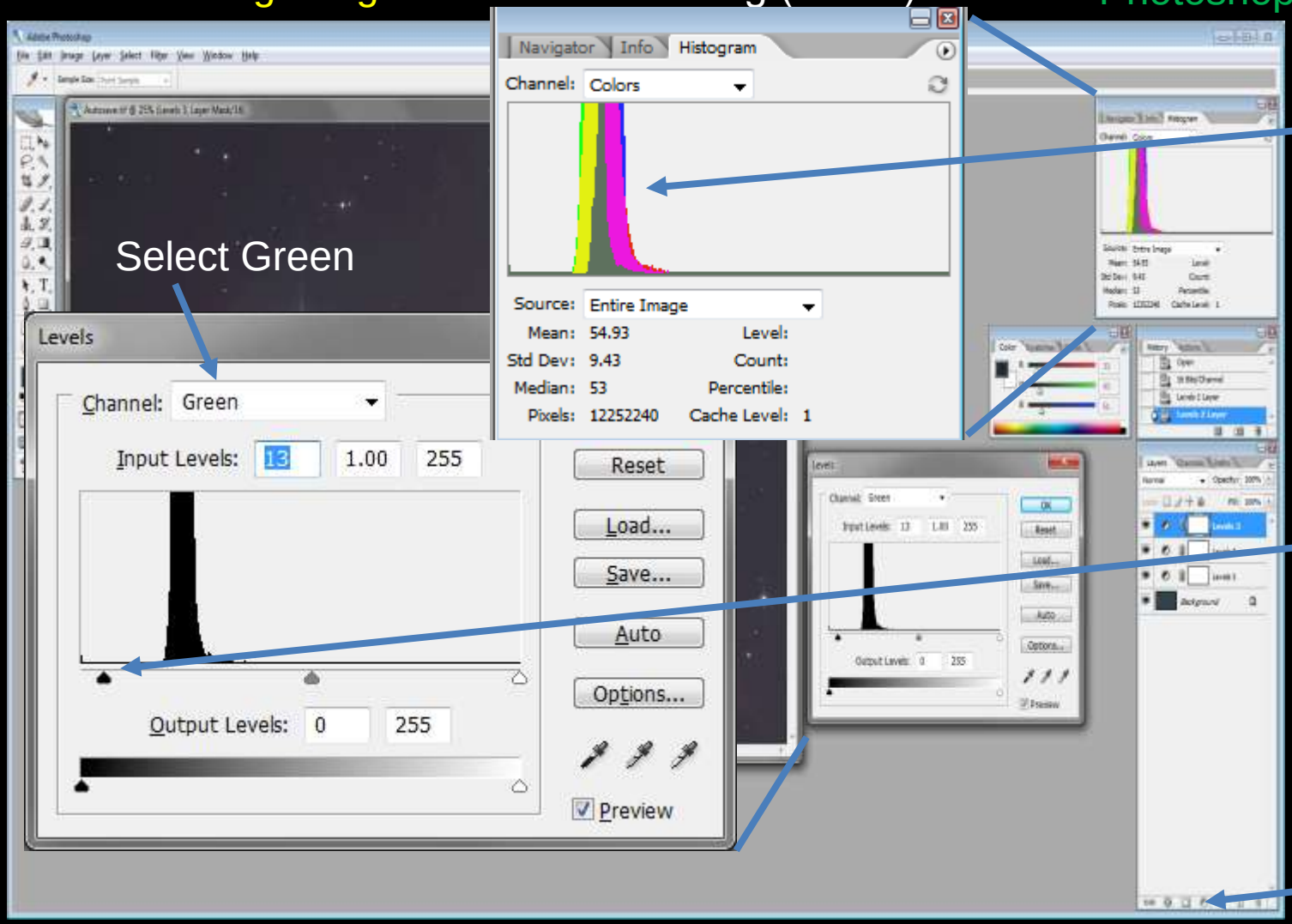
Histogram stretched but channels not balanced

Slider moved to left

DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

Photoshop



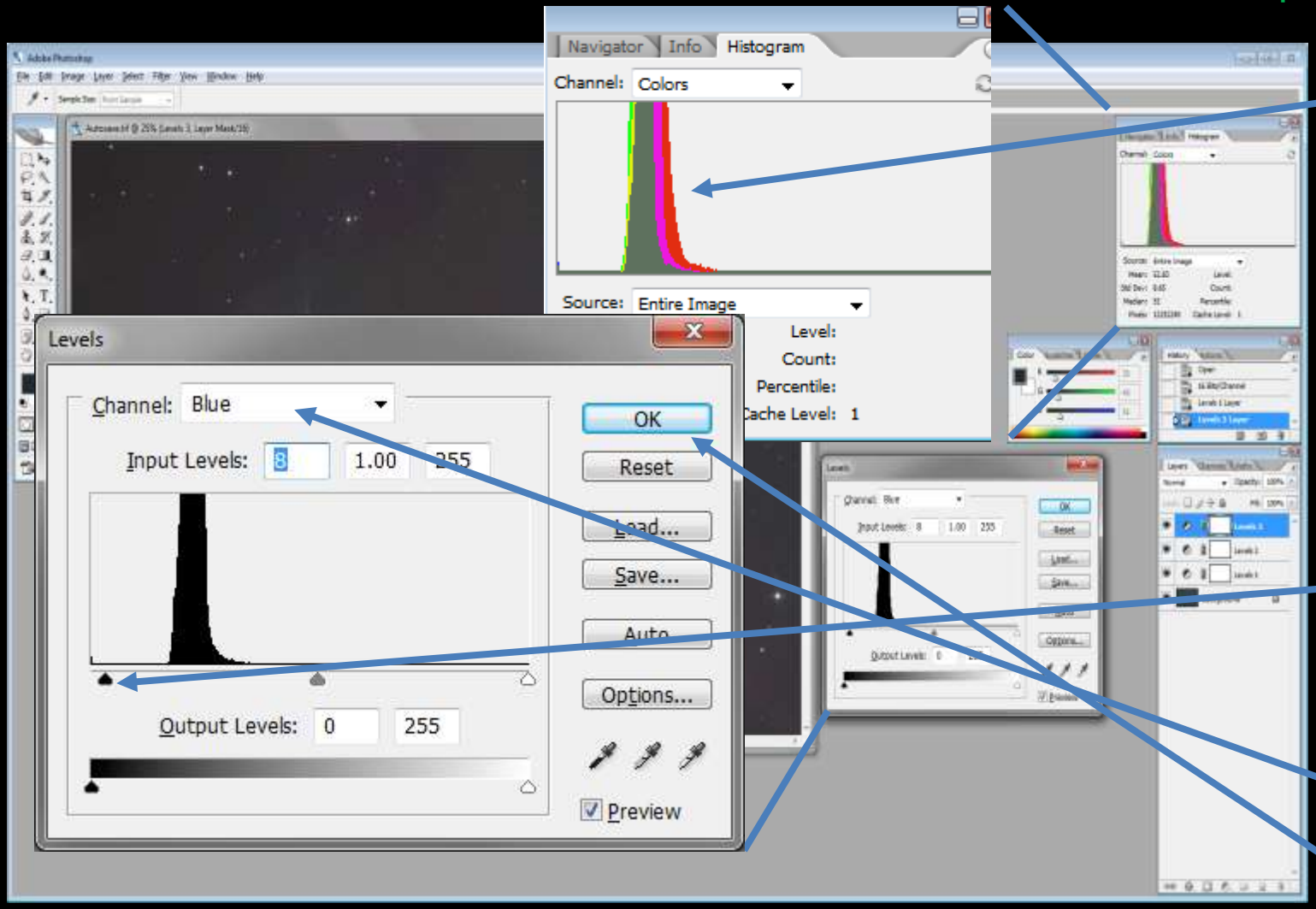
Move black point slider to make green match red

Create another Levels Adjustment Layer

DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

Photoshop



Move black point slider to make blue match red & green

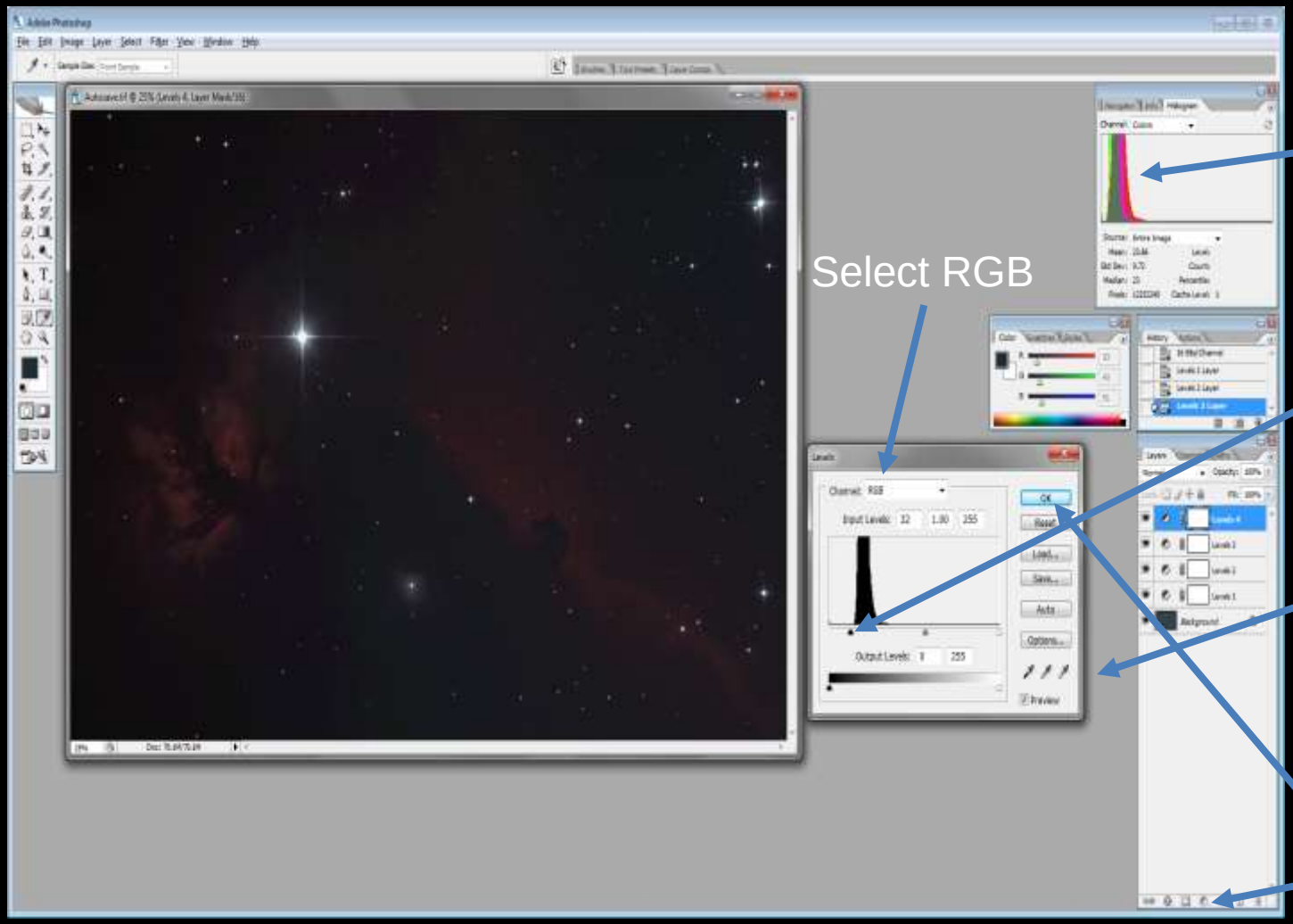
Select Blue

OK

DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

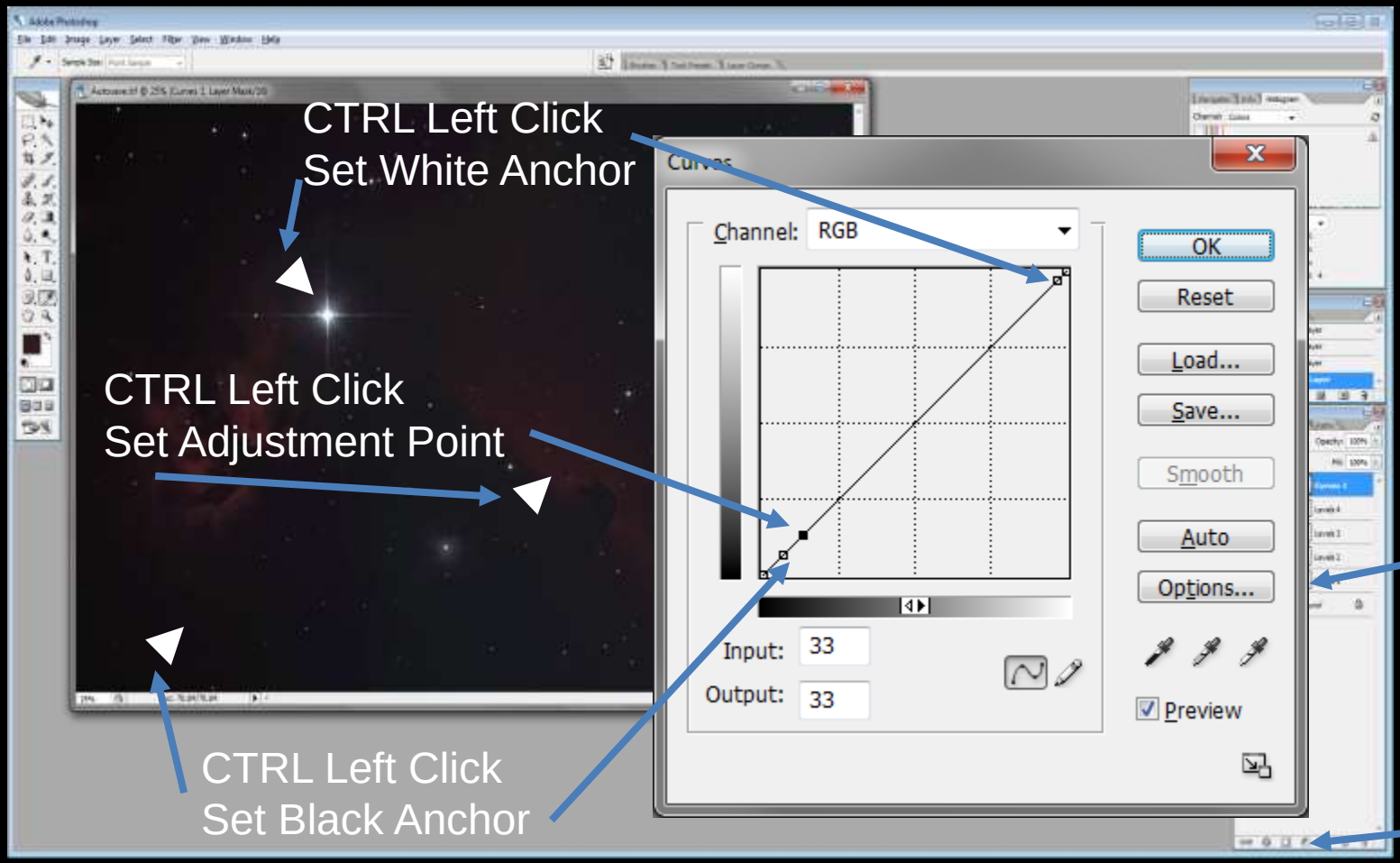
Photoshop



DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

Photoshop



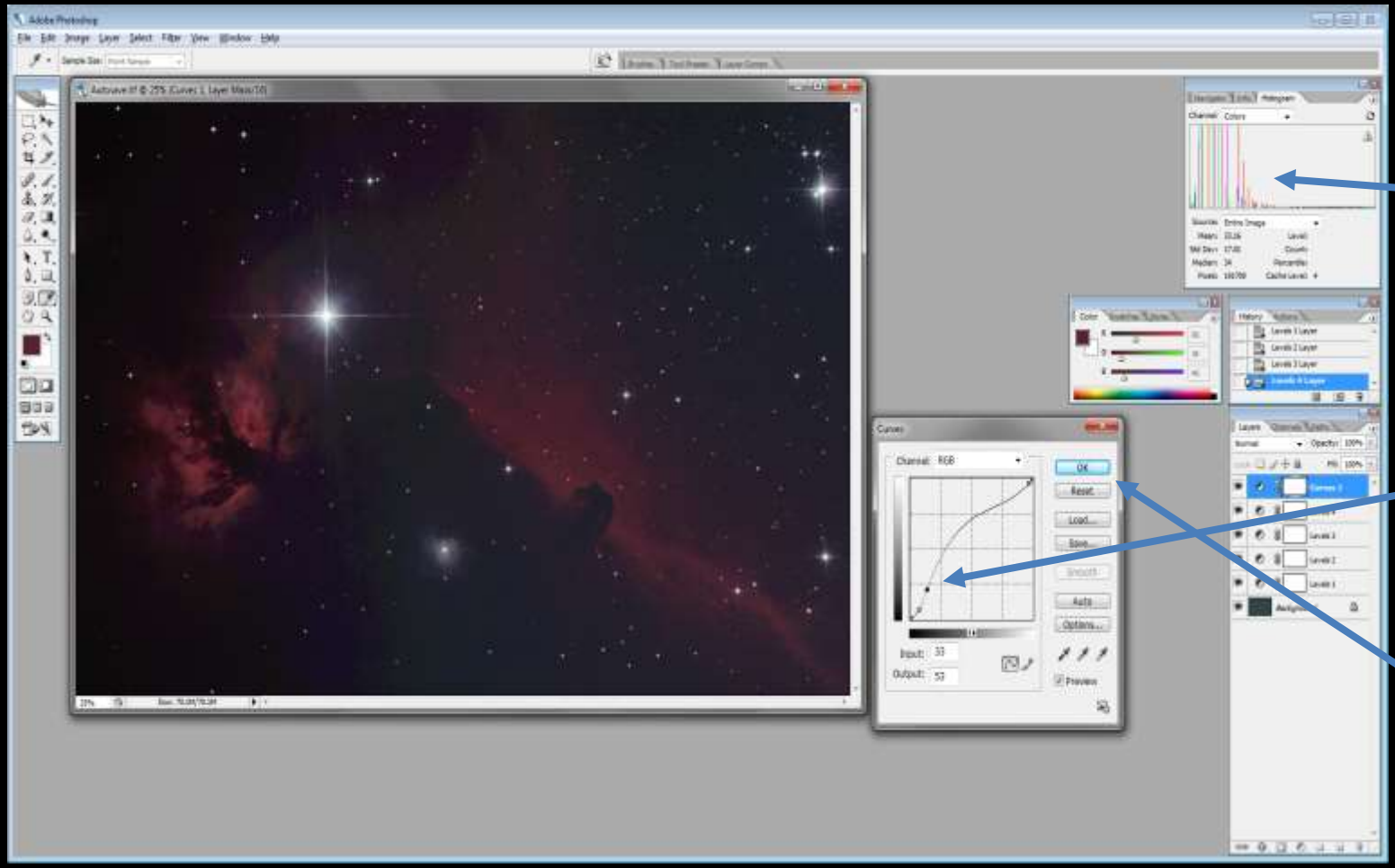
Bring nebula level up

Create Curves Adjustment Layer

DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

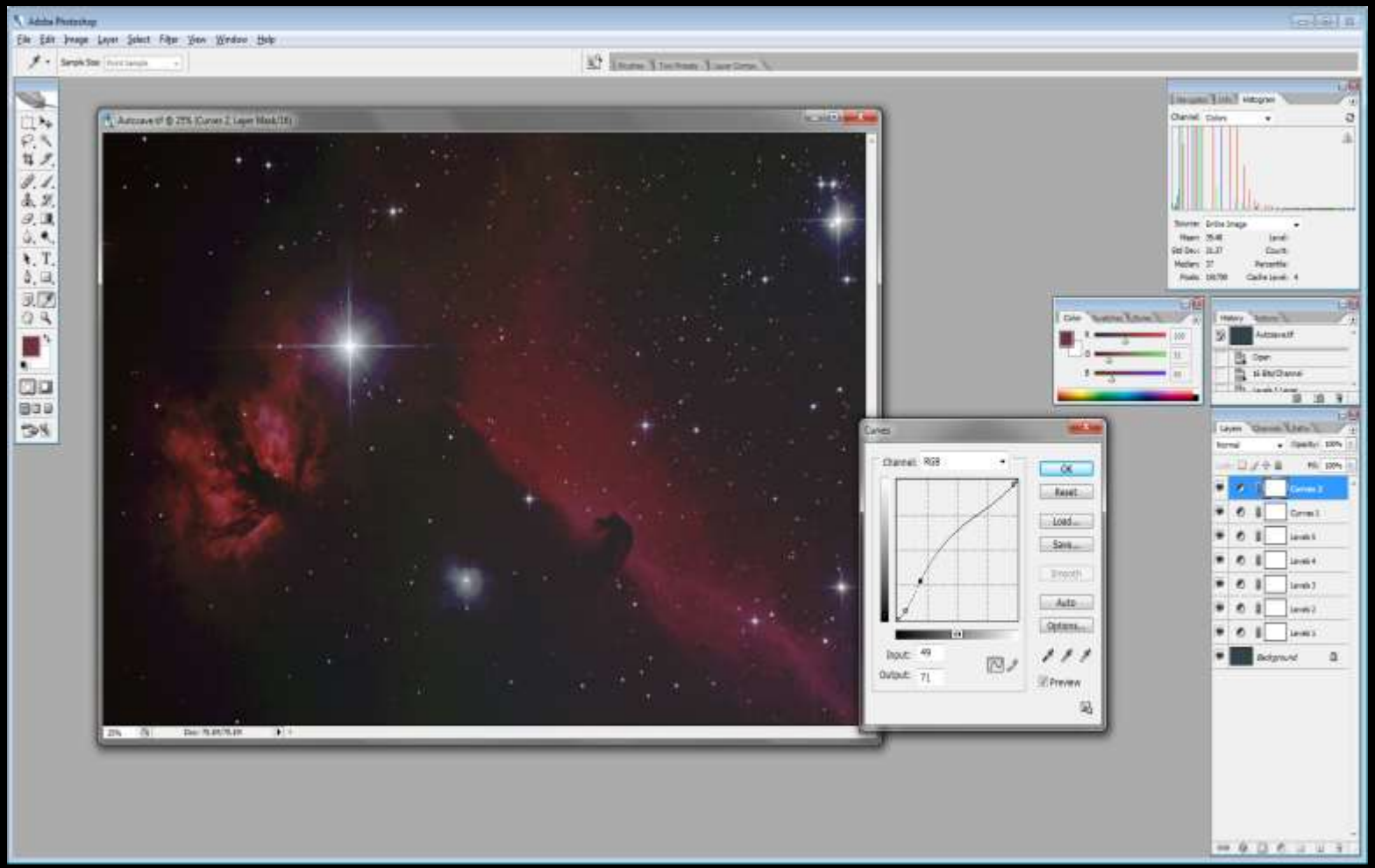
Photoshop



DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

Photoshop

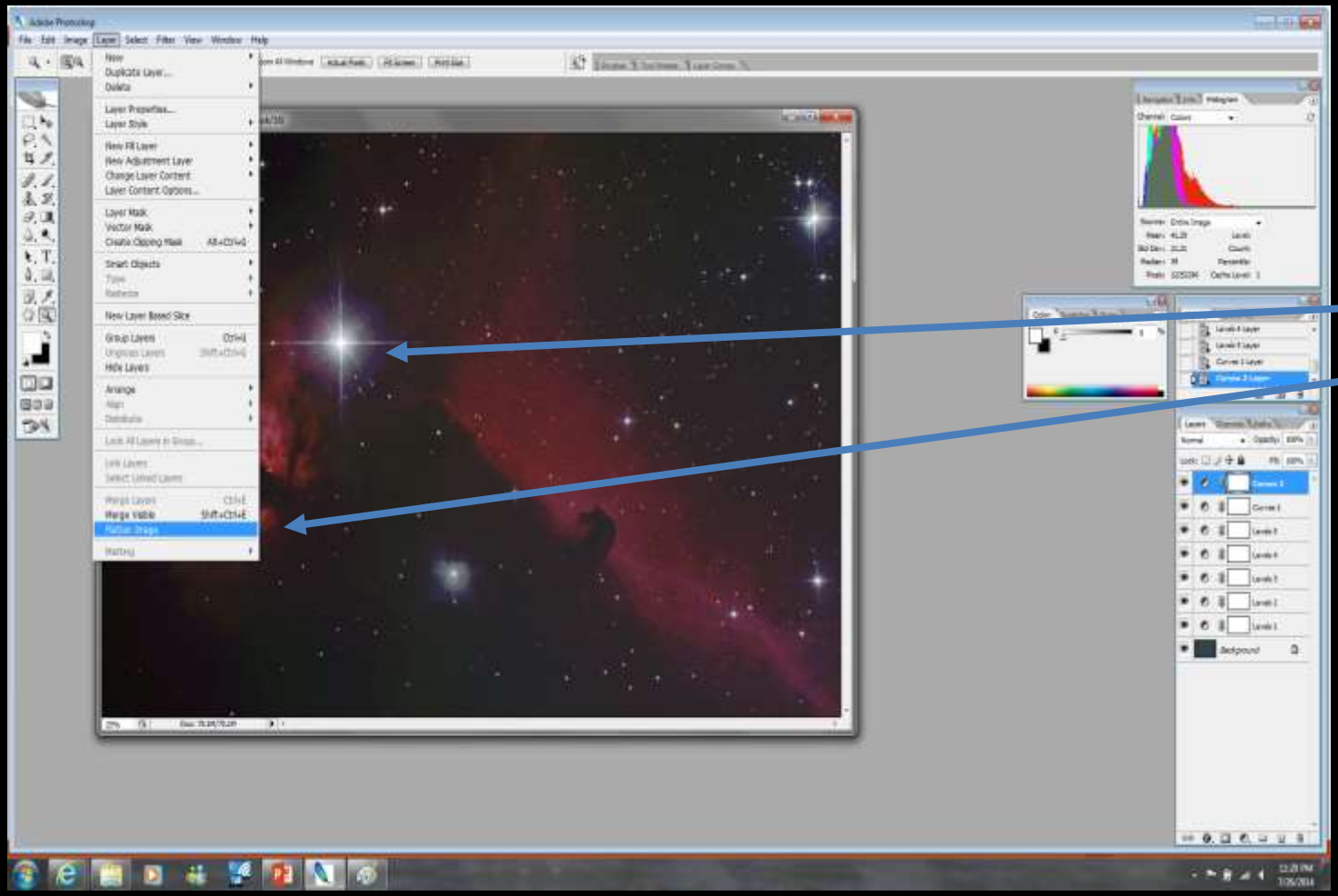


Repeat last step

DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

Photoshop

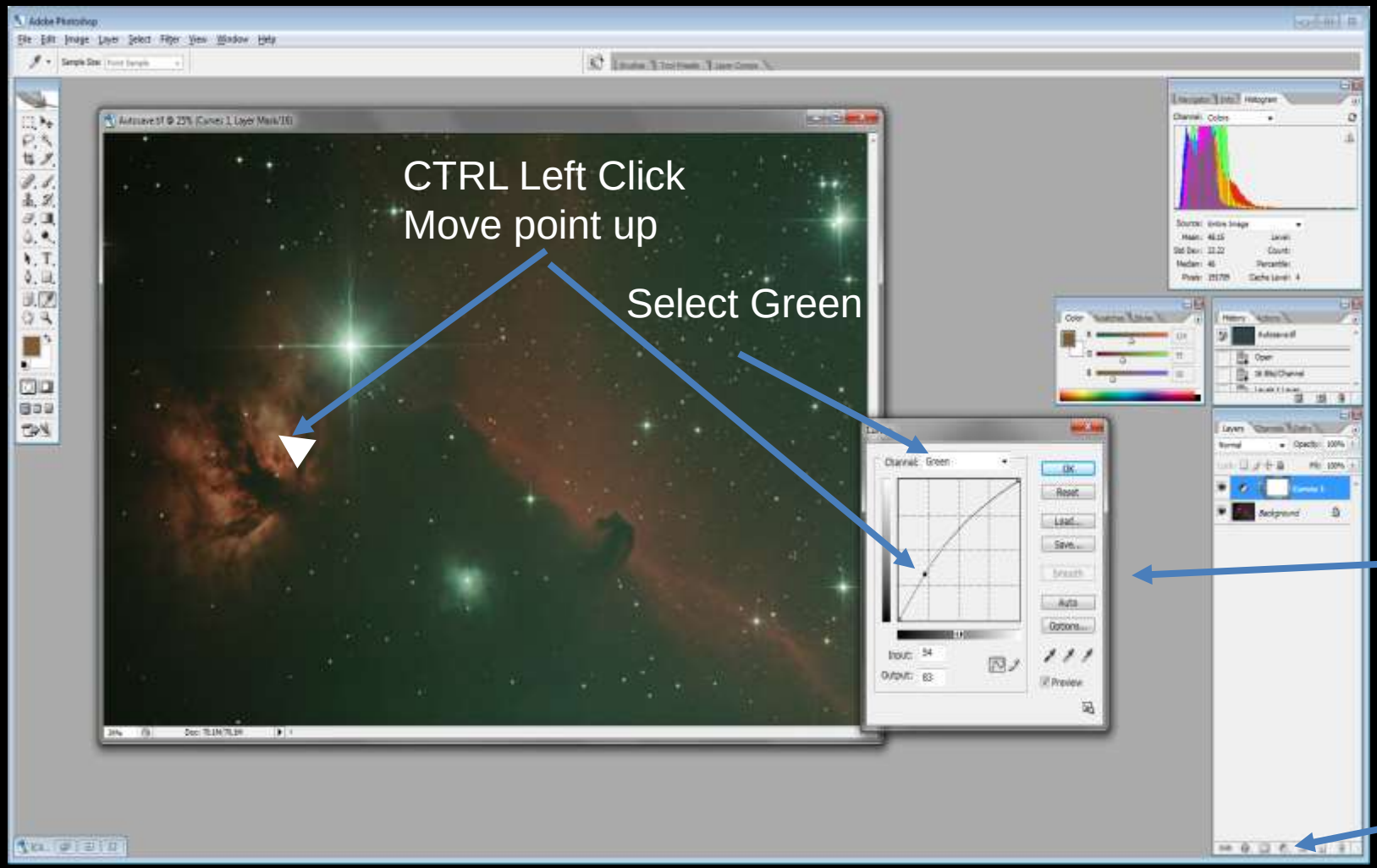


When excessive contouring, flatten Image

DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

Photoshop



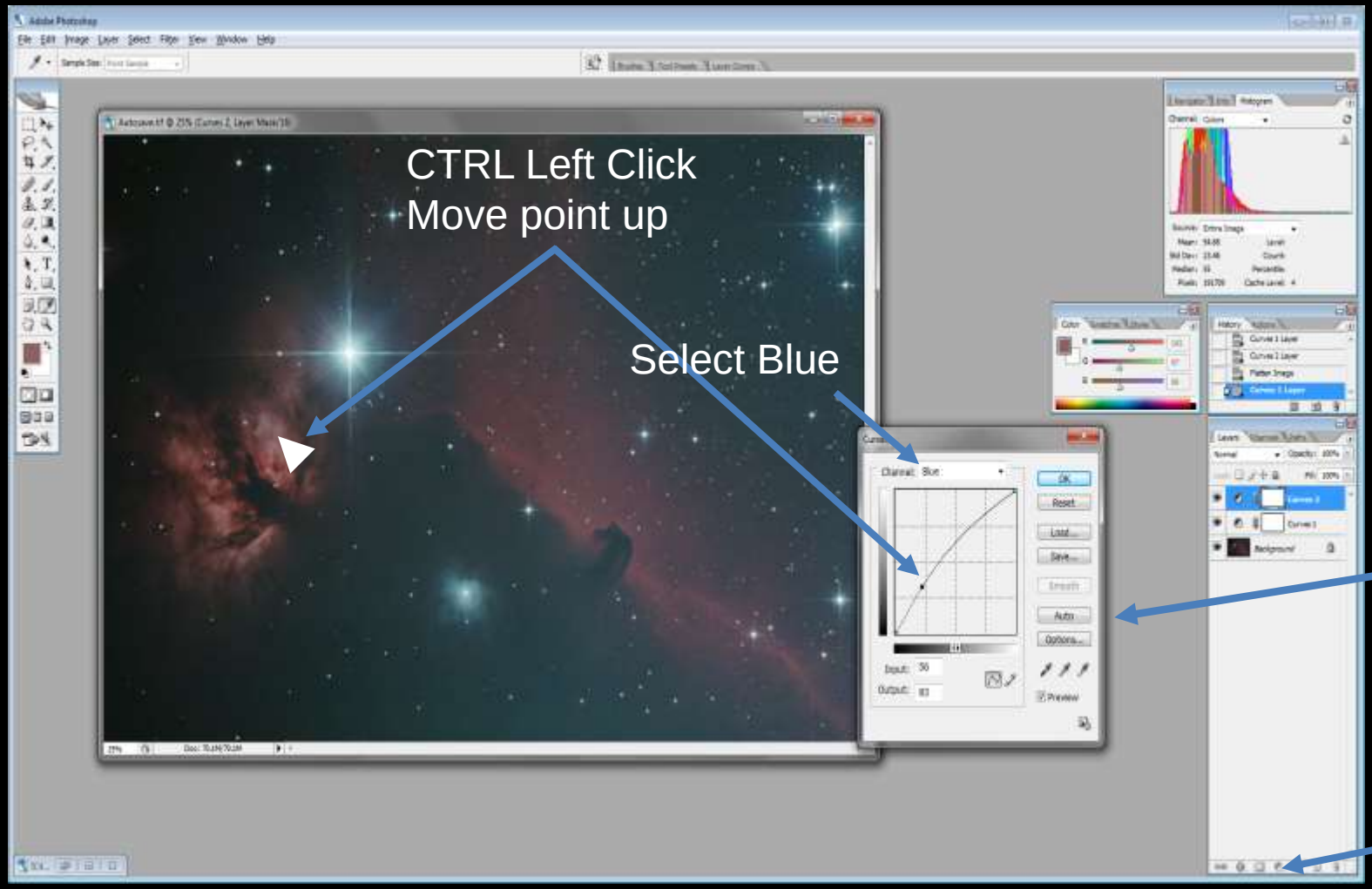
Adjust Green & Blue to match Red

Create another Curves Adjustment Layer

DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

Photoshop



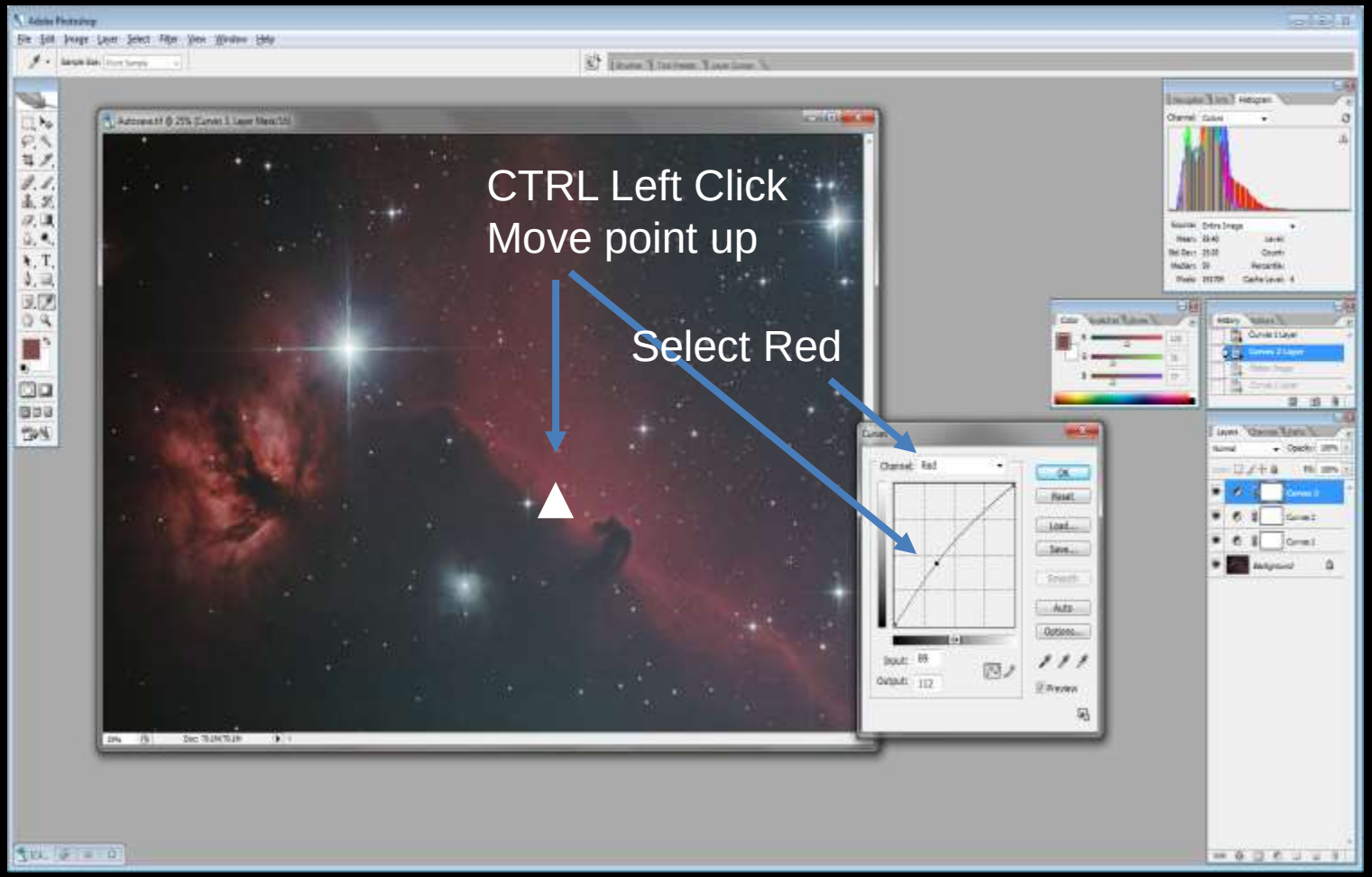
Adjust Green & Blue to match Red

Create another Curves Adjustment Layer

DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

Photoshop



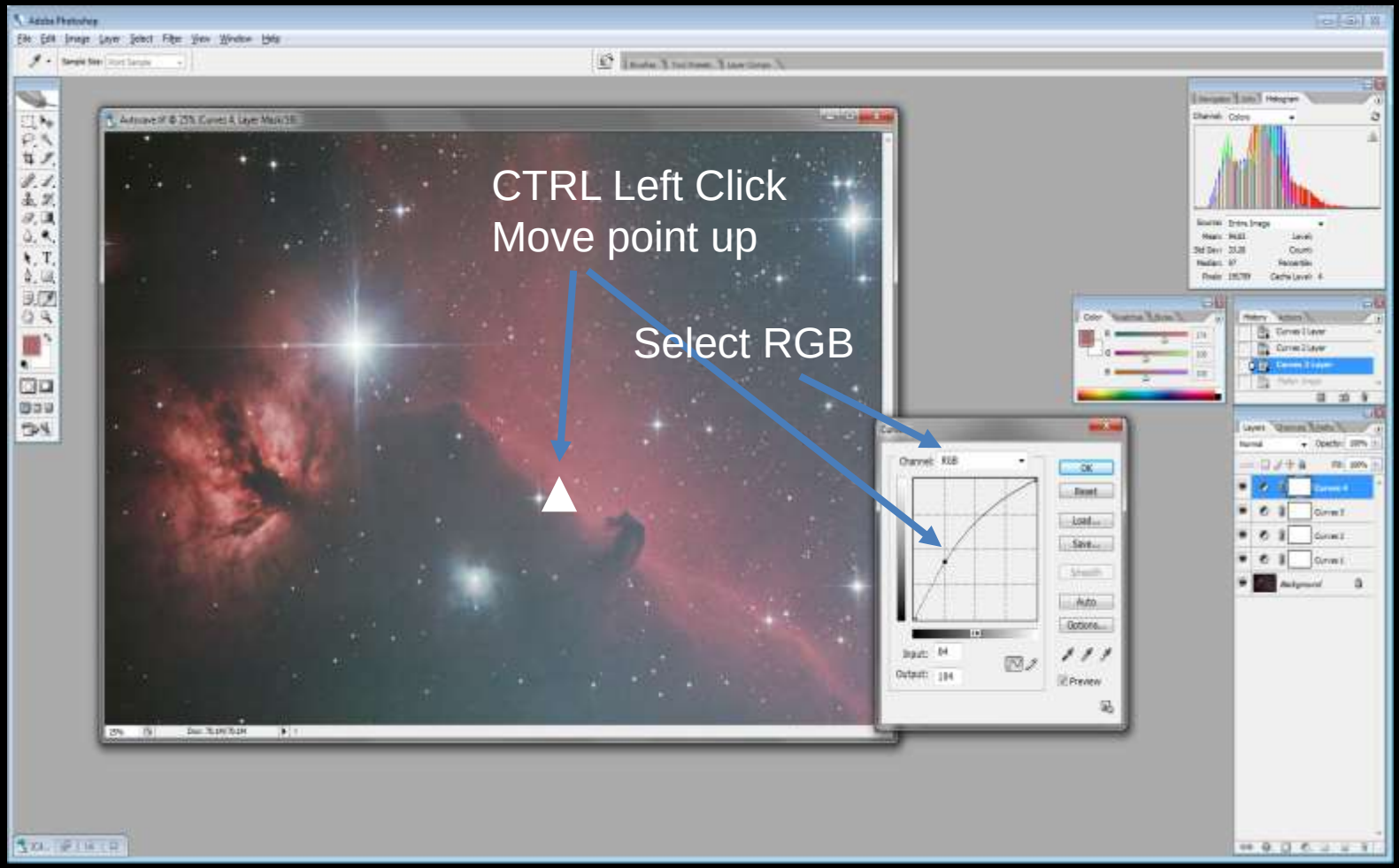
Bring Red up to accentuate the nebula

Create another Curves Adjustment Layer

DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

Photoshop



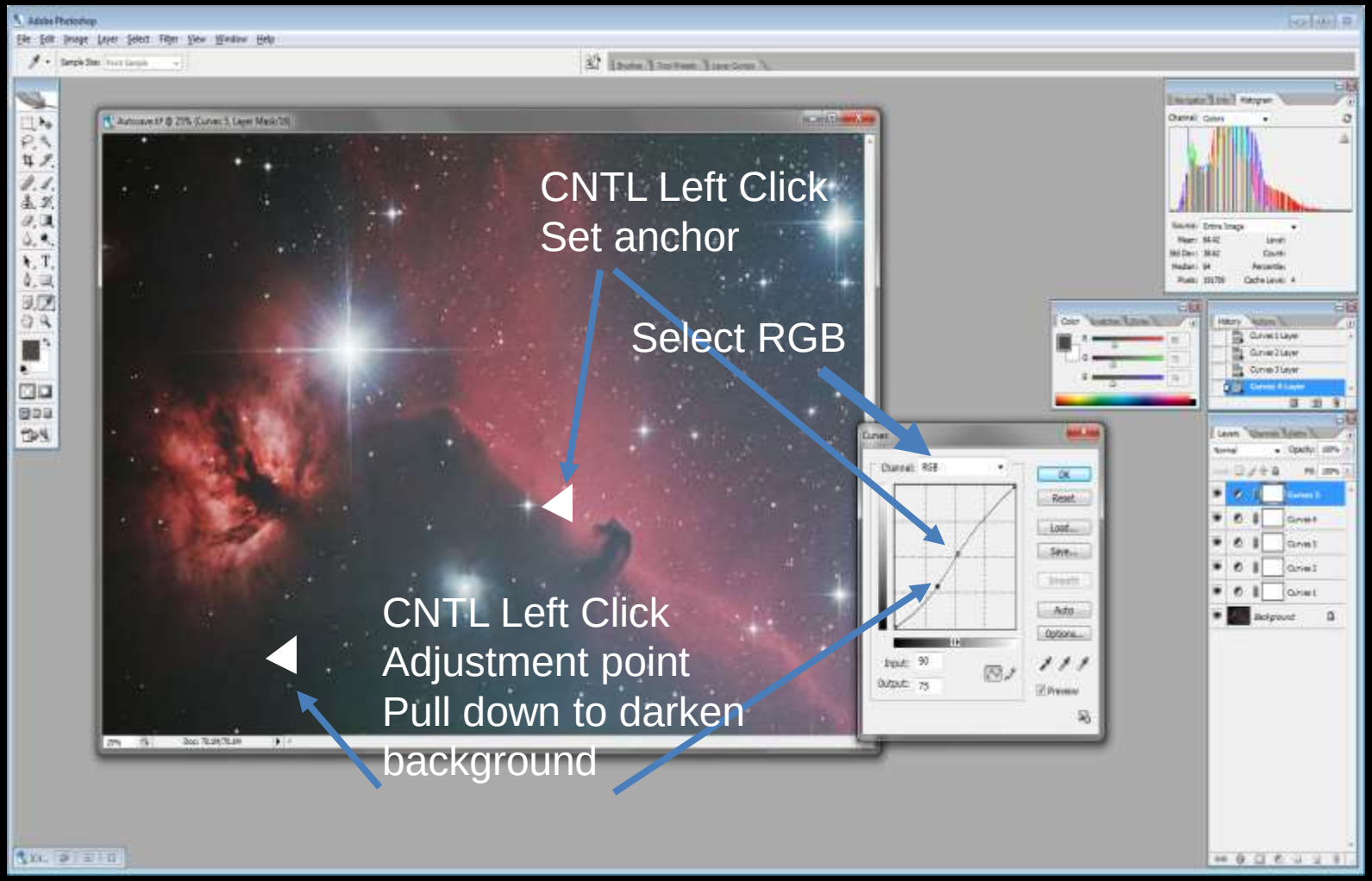
Brighten entire image

Create another Curves Adjustment Layer

DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

Photoshop



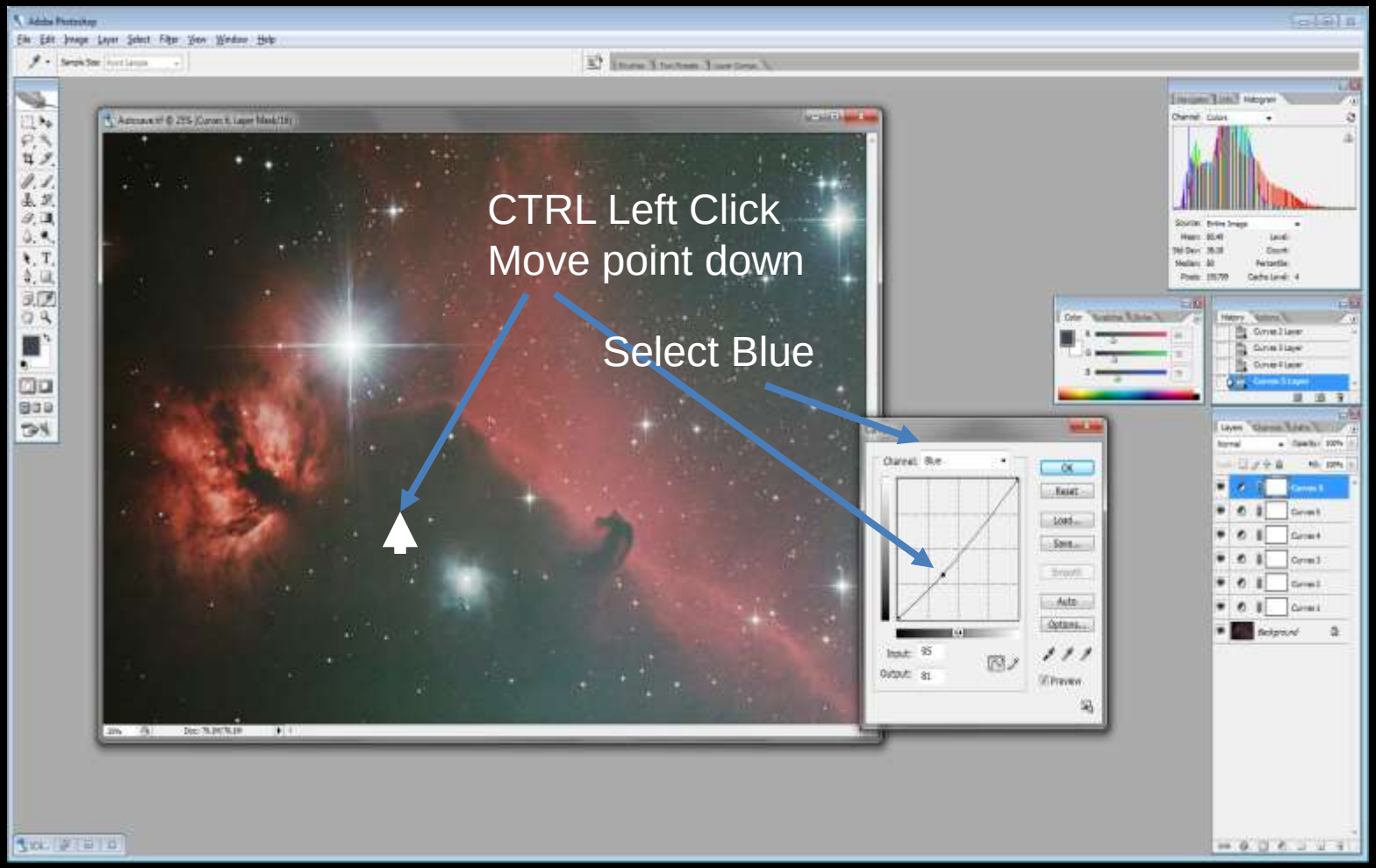
Darken background while retaining nebula

Create another Curves Adjustment Layer

DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

Photoshop



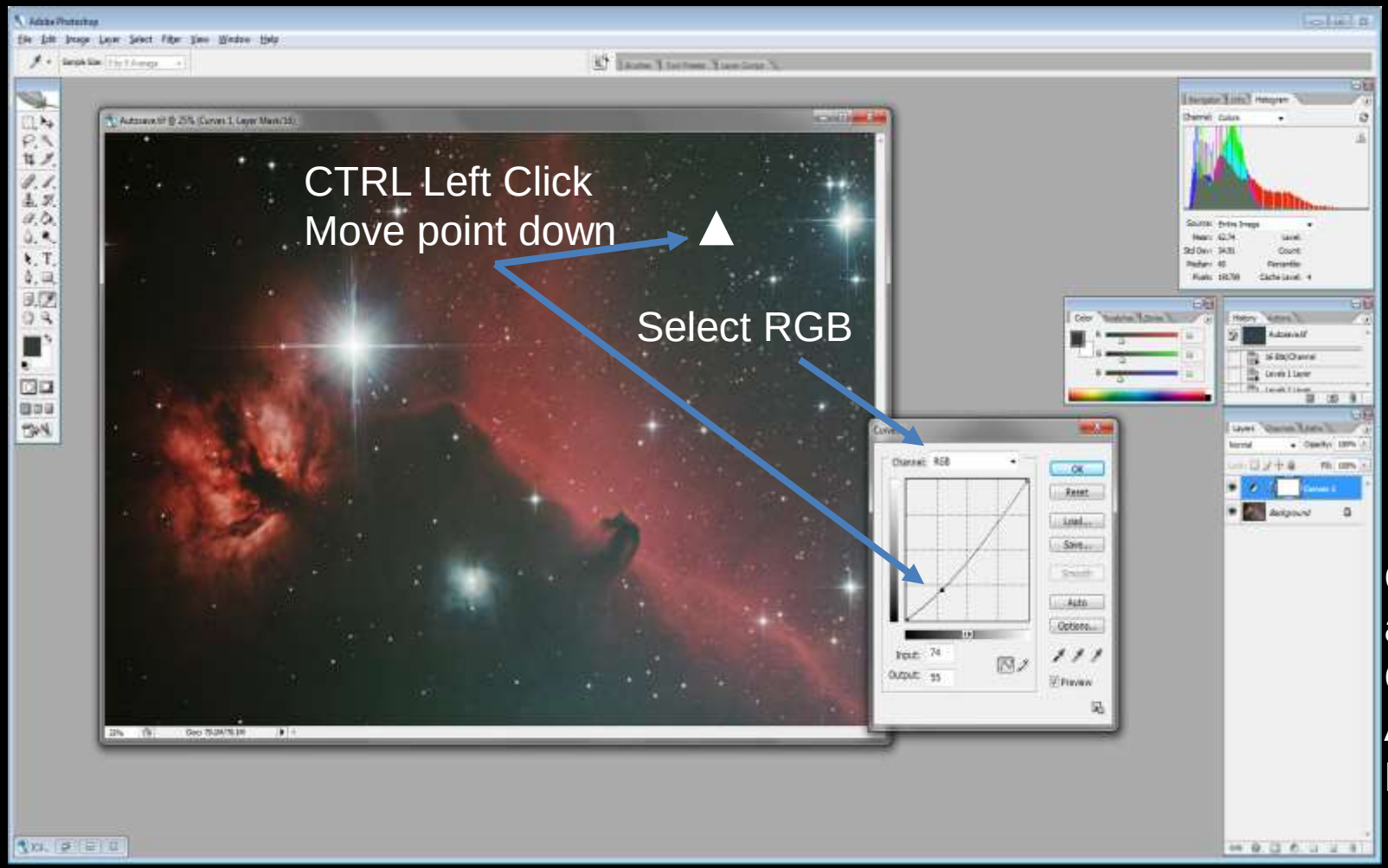
Decrease background blue

Create another Curves Adjustment Layer

DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

Photoshop



Darken background

Flatten layers

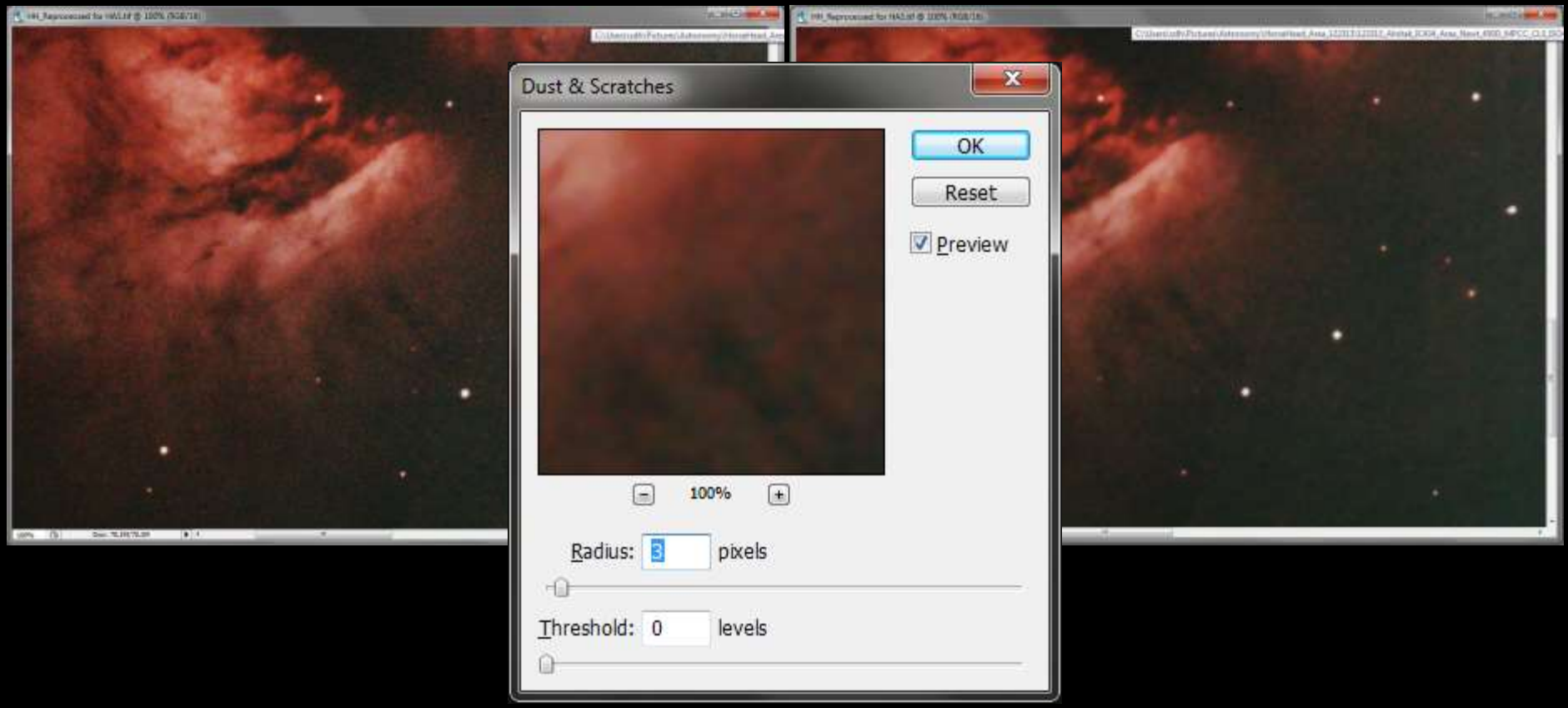
Create another Curves Adjustment Layer

DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

Photoshop

Step 4: Improve noise and take edge off stars



Filter => Noise => Dust & Scratches => Radius = 3

DSLR Astroimaging - Tutorial

3. Processing Image – Post Processing (cont'd)

Photoshop

Finished Product

S. Douglas Holland

DSLR Astroimaging - Tutorial

4. References

- DSLR Astrophotography by Michael A. Covington
- The Handbook of Astronomical Image Processing by Richard Berry and James Burnell
  - Best book to understand theory of image calibration, comes with AIP4WIN software
- The 100 Best Astrophotography Targets by Ruben Kier
- Photoshop Astronomy by R. Scott Ireland
- Telescopes, Eyepieces, Astrographs by Smith, Ceragioli & Berry
  - Tells the pros and cons of different telescope designs

➢ Visit my web page:

- www.holland-observatory.net
- The presentation posted under 'Astrophotography => Technique'