Canon EOS 300d astrophotography

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Astrophotography with a digital SLR camera

- **Main equipment**
  - Vixen 4" achromatic refractor
    - Focal length: 1000mm
    - Focal ratio: f/9.8
  - Vixen GP equatorial mount
  - Vixen Skysensor 2000 PC
  - Laptop PC
- **Main software**
  - DSLR Focus, MaxDSLR, Photoshop

Astrophotography with a digital SLR camera

- **Camera**
  - Canon EOS 300D digital SLR (body)
    - CMOS sensor size: 22.7x15.1 mm
    - Pixel size: 7.4x7.4 microns
    - 6.3 megapixel resolution (3072x2048)
    - 12 bit per color channel R,G,B (RAW format)
    - Weight body plus battery and CF card: 649 gr
  - Canon EF 24-85mm f/3.5-4.5 USM lens
    - Weight: 380 gr

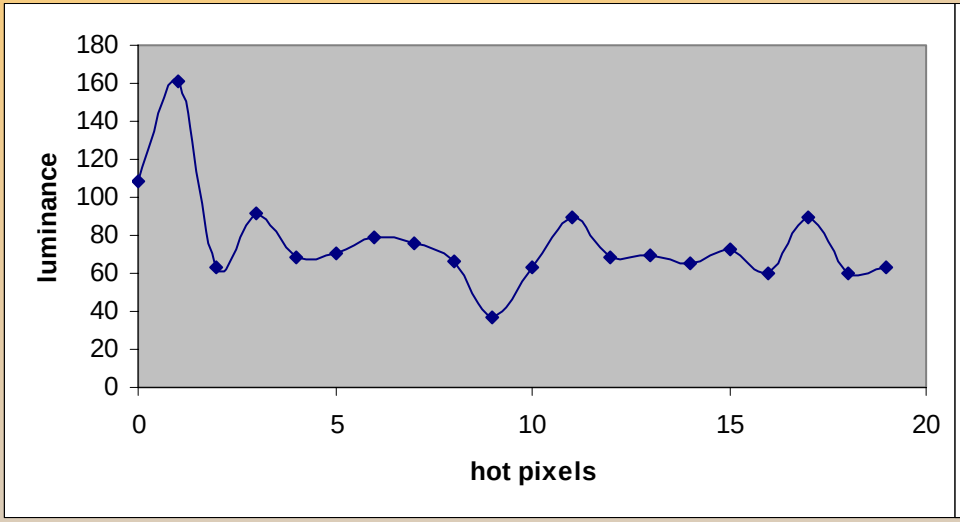
Astrophotography with a digital SLR camera

- **Pros for the 300D**
  - Big CMOS sensor 23x15mm, with low noise
  - High resolution: 3072x2048 active pixels
  - Shutter speeds: 1/4000-30sec plus BULB mode
  - ISO speeds: 100-200-400-800-1600
  - Lightweight
  - Widely useable with all Canon compatible lenses
  - Can be used for regular photography

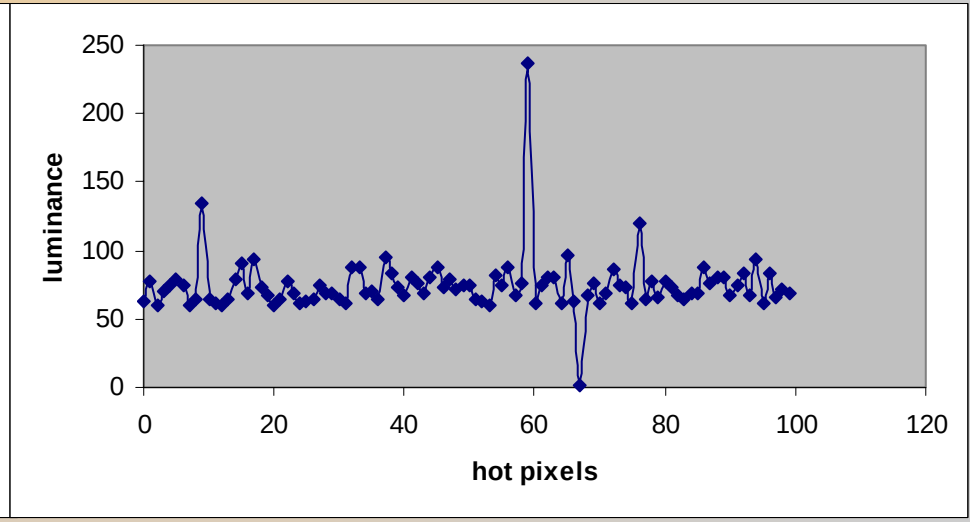
Cons for the 300D

- Low response to H-alpha due to IR-cut filter of CMOS sensor
- 12 bit per color channel R,G,B (RAW format) instead of 16 bit for most astronomical CCDs
- No mirror lock up
- No cooling possible: better operation during cold ambient
- No multiple exposure mode
- Optical viewfinder provides low magnification
- LCD monitor no live preview

✶ Hot pixels comparison



1 frame: 30 sec – ISO 800



1 frame: 15 min – ISO 800

Program used: Dead/hot Pixel Test (c) Michael Salzlechner

Threshold for hot pixels=60, Threshold for dead pixels=250

Astrophotography with a digital SLR camera

- **Russian Firmware Hack**
  - Custom Functions
    - Mirror lock up
  - ISO speed 3200

Canon EOS 300D → Canon EOS 10D

Astrophotography with a digital SLR camera

- **Canon EOS 300D modification**
  - Removal of CMOS sensor IR-cut filter
    - Increased H-alpha sensitivity
    - Uncalibration
      (White balance, Auto focus, Manual focus)
  - Plans for Peltier cooling

- **Useful accessories**
  - AC adapter kit ACK-E2
  - RS-60 E3 remote control
  - Battery pack BG-E1
  - Angle finder C

- **Astrophotography tips**
  - Balanced, cooled system
  - Steady mount (no vibrations)
  - Skysensor adjustments (PEC,backlash)
  - Polar alignment (star drift method)
  - Good seeing
  - Preferably dark sky
  - Object in high altitude for better results
  - Less optical elements - more image quality
  - Filters to reduce chromatic aberration (achromatic refractors)

Astrophotography with a digital SLR camera

- **Astrophotography methods**
  - Tripod
  - Piggy-back
  - Prime focus
  - Eyepiece projection
- **Typical camera settings**
  - Auto Rotate: off
  - Image quality RAW, ISO range 400-800
  - Mode: Manual
  - Manual Focus to infinity (piggy-back)
  - Mirror lockup enabled (planets) & self timer enabled

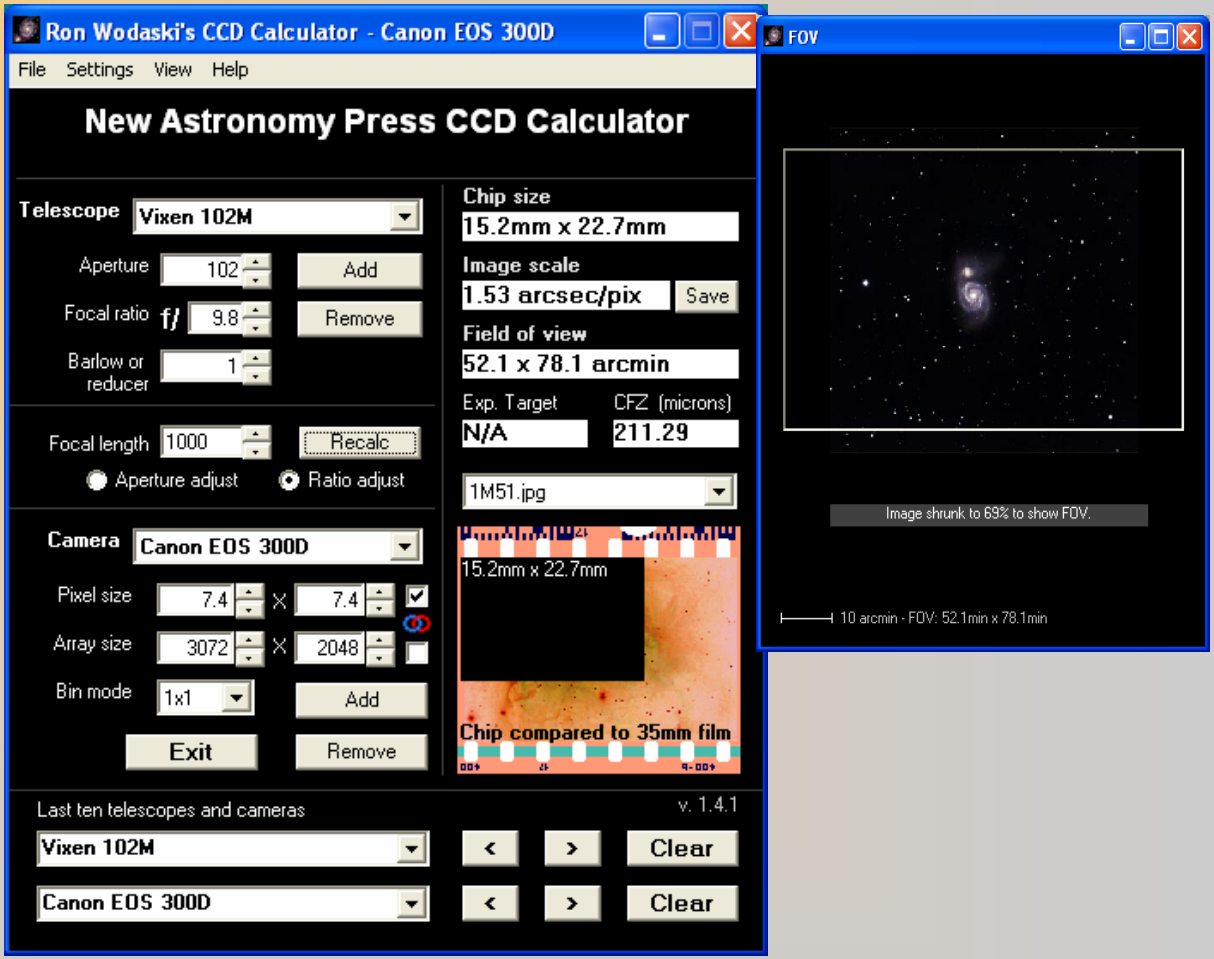
Astrophotography with a digital SLR camera

✶ Calculations

- Image scale
- Field of view
- Chip size

Ideal Image scale:

- 2"/pixel (DSO)
- 0.5"/pixel (planets)



Astrophotography with a digital SLR camera

- **Tripod astrophotography**
  - Star trails
  - Solar scenes (sunset, sunrise, eclipses)
  - Lunar scenes (moonset, moonrise, eclipses)
  - Wide field (Milky Way, Constellations)

Astrophotography with a digital SLR camera

- **Piggy-back astrophotography**
  - Bright deep sky objects
  - Wide field (Milky Way, Constellations)

Astrophotography with a digital SLR camera

- **Recommended Canon lenses for piggy-back astrophotography**
  - Wide angle
    - EF 15mm f/2.8 Fisheye
  - Normal
    - EF 50mm f/1.4 USM
  - Tele photo
    - EF 100mm f/2 USM
    - EF 200mm f/2.8 L II USM
    - EF 300mm f/4.0 L USM

(remember **digital factor**=1.6)

- **Prime focus astrophotography**
  - Deep sky objects
  - Multiple stars
  - Sun (disc, sunspots, eclipses)
  - Moon (disc, eclipses) & planets

Astrophotography with a digital SLR camera

- **Eyepiece projection astrophotography (w/wo Barlow lens)**
  - Planets
  - Sun
  - Moon

- **Piggy-back astrophotography example**

Orion sword

Location: Tripotama Achaias

Date: 06/11/2005

Astrophotography with a digital SLR camera

- **Equipment preparation**
  - Scope in horizontal position, cooled & balanced
  - Skysensor setup (location, time, mount mode)
  - Polar alignment (star drift method)
  - 3-star alignment with Skysensor
  - Perform GOTO star Alnitak
  - Center star Alnitak in the scope field of view (illuminated reticle eyepiece)

Astrophotography with a digital SLR camera

- **Camera preparation**
  - Camera battery fully charged
  - Camera mounted piggy-back
  - Manual Focus set to infinity
  - Camera connected to the laptop (USB port)
  - DSLR Focus started – camera connected
  - Bulb mode selected
  - Image RAW format selected
  - Serial cable for long exposures enabled (USB port)
  - Test shots to adjust focus and camera exposure settings (ISO, Tv, Av)

Astrophotography with a digital SLR camera

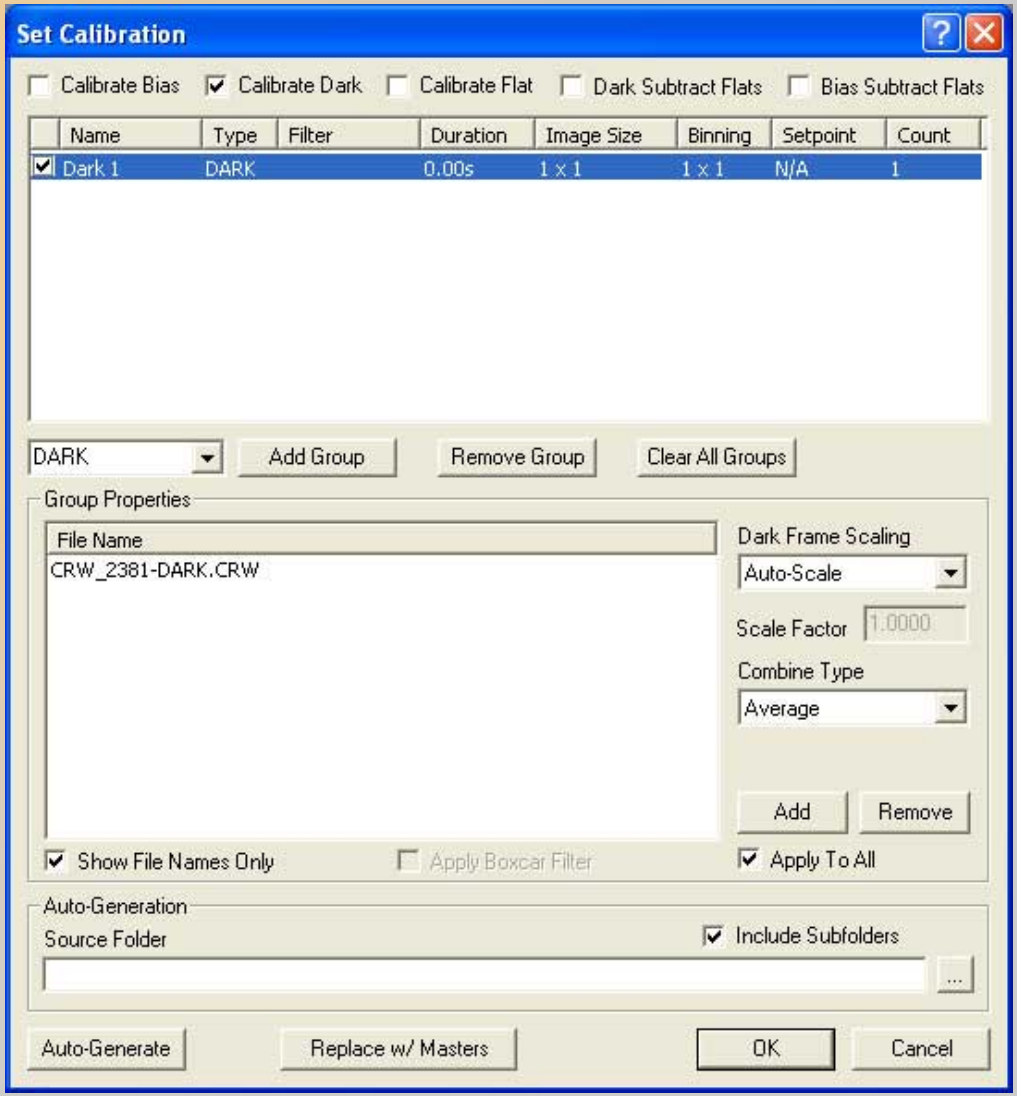
- Image capture
  - 3 frames x10 min ISO 800
  - 1 dark frame x10 min ISO 800
- Problems encountered
  - Dew in camera lens and scope lens
  - Some light pollution

Astrophotography with a digital SLR camera

– Image processing

MaxDSLR

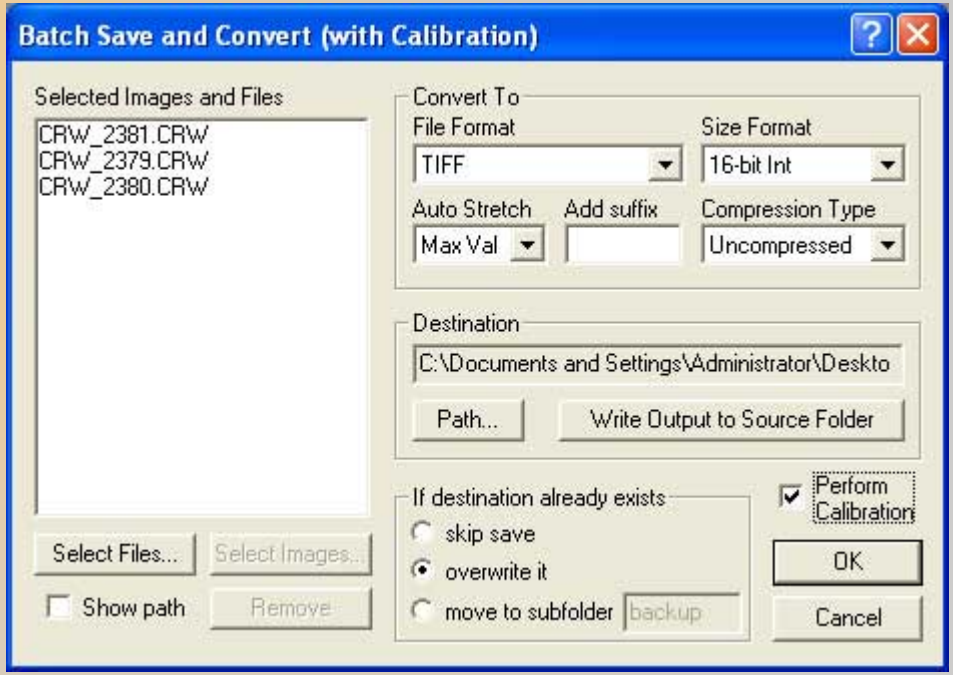
- Set Calibration (Dark frame)



Astrophotography with a digital SLR camera

MaxDSLR

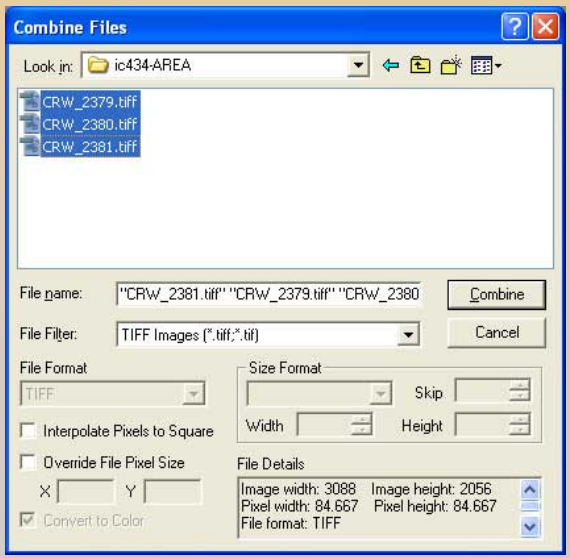
- Camera Raw Images calibrated and converted to TIFF 16-bit format

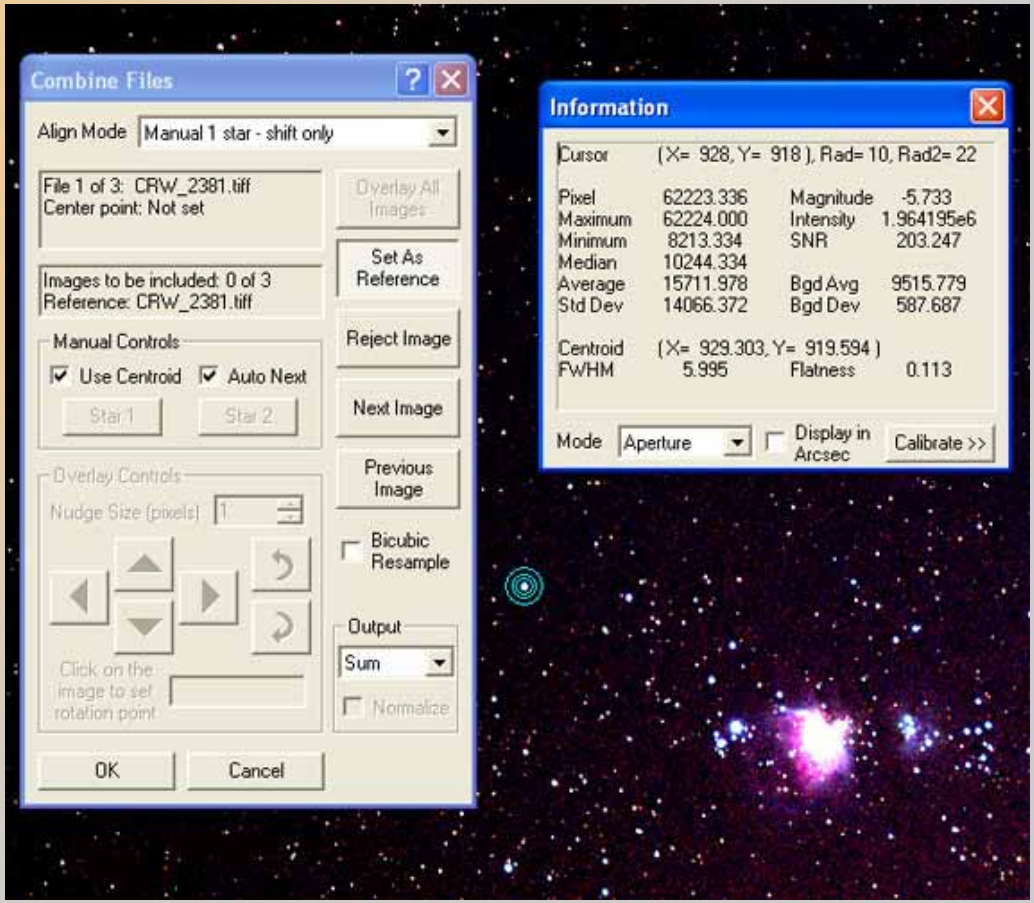


Astrophotography with a digital SLR camera

MaxDSLR

- Combine TIFF images (align mode selected)

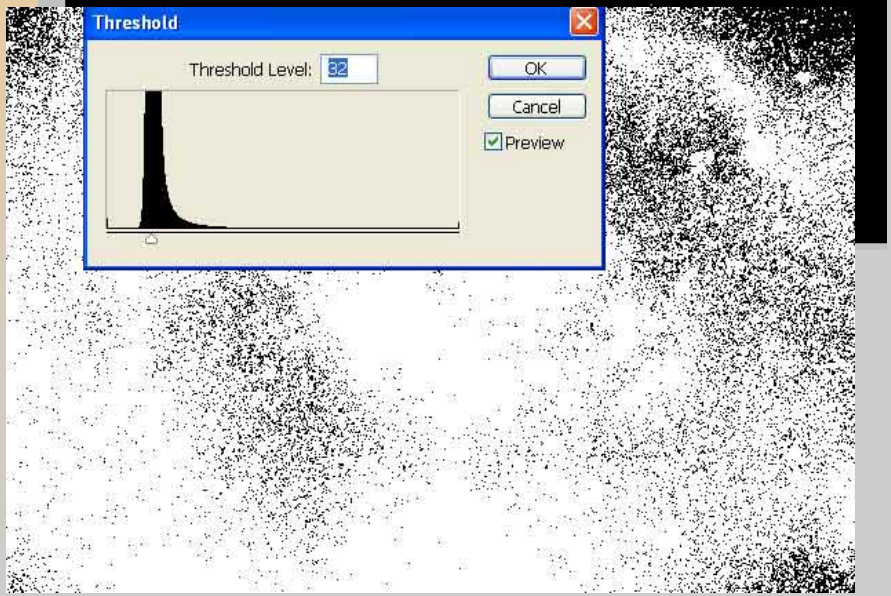




Astrophotography with a digital SLR camera

Photoshop

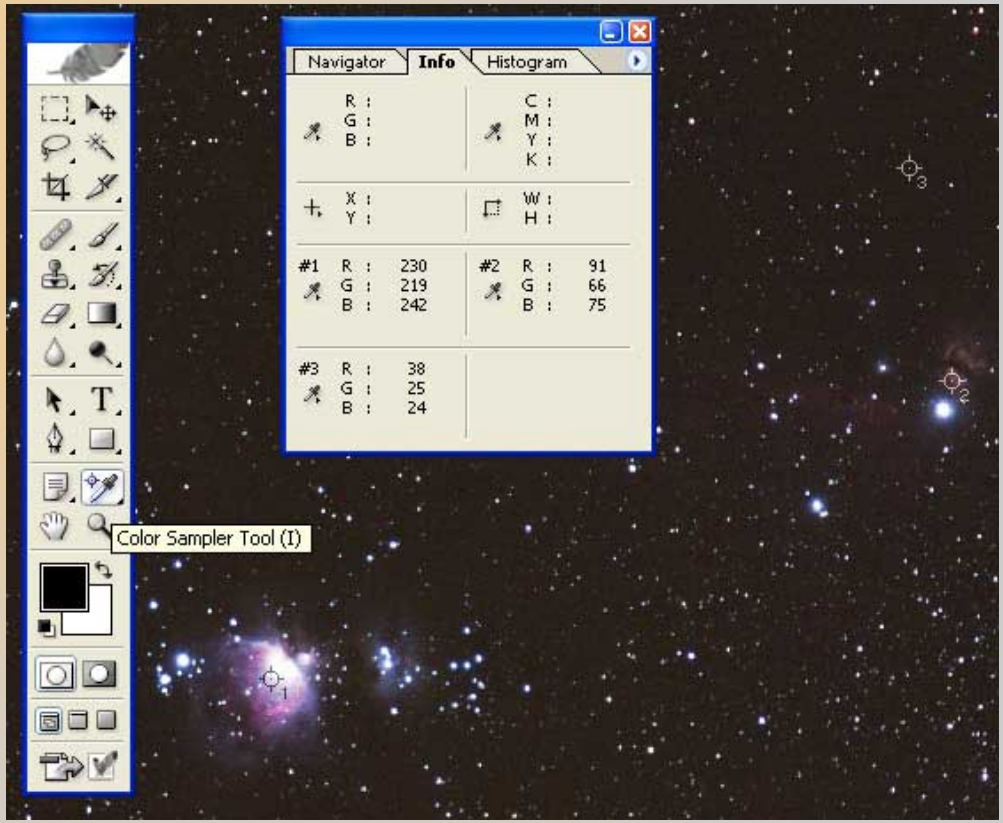
- Find white/black points (threshold adjustment) in the result image



Astrophotography with a digital SLR camera

Photoshop

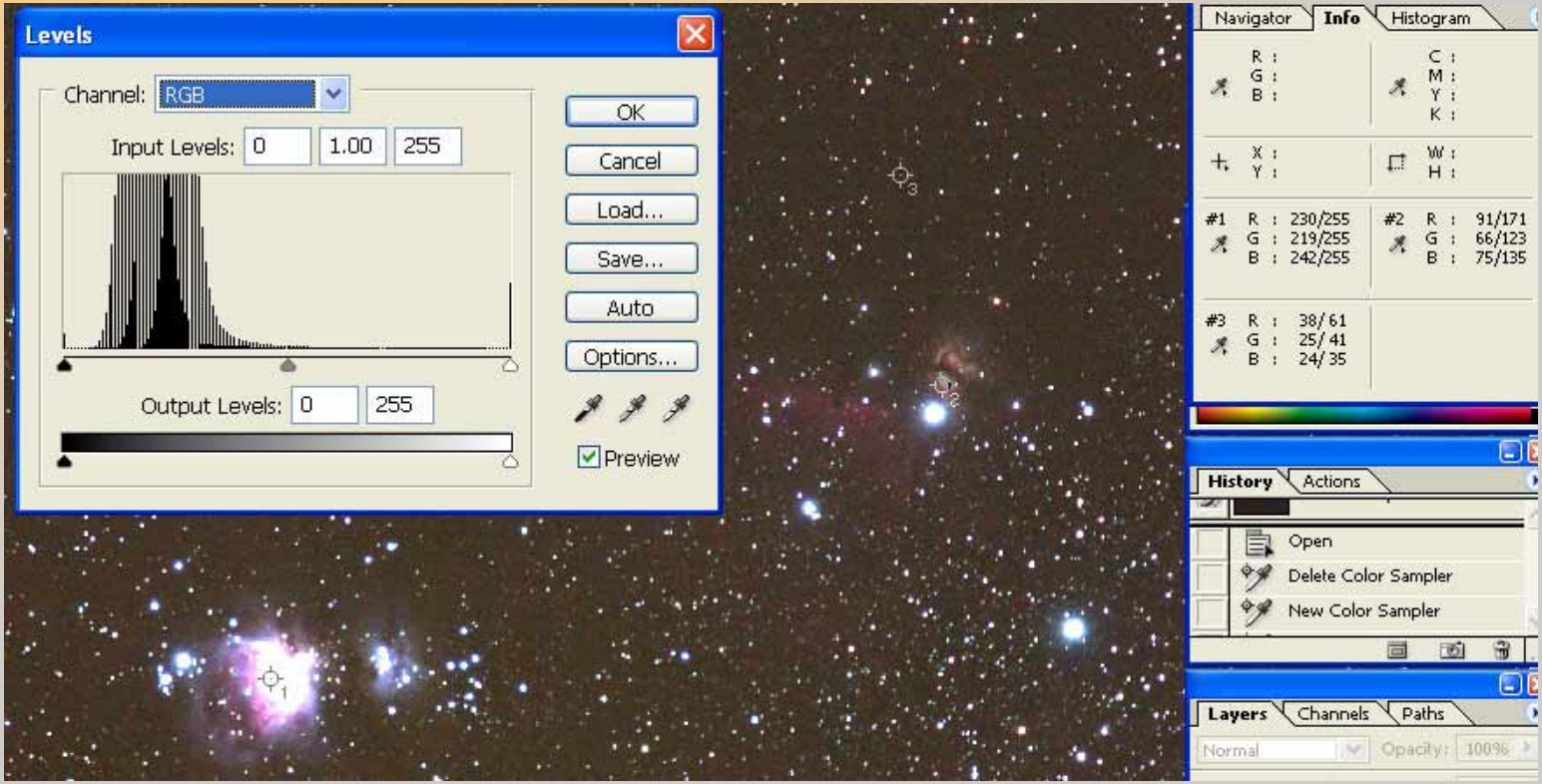
- Select black/white points (Color sample tool)



Astrophotography with a digital SLR camera

Photoshop

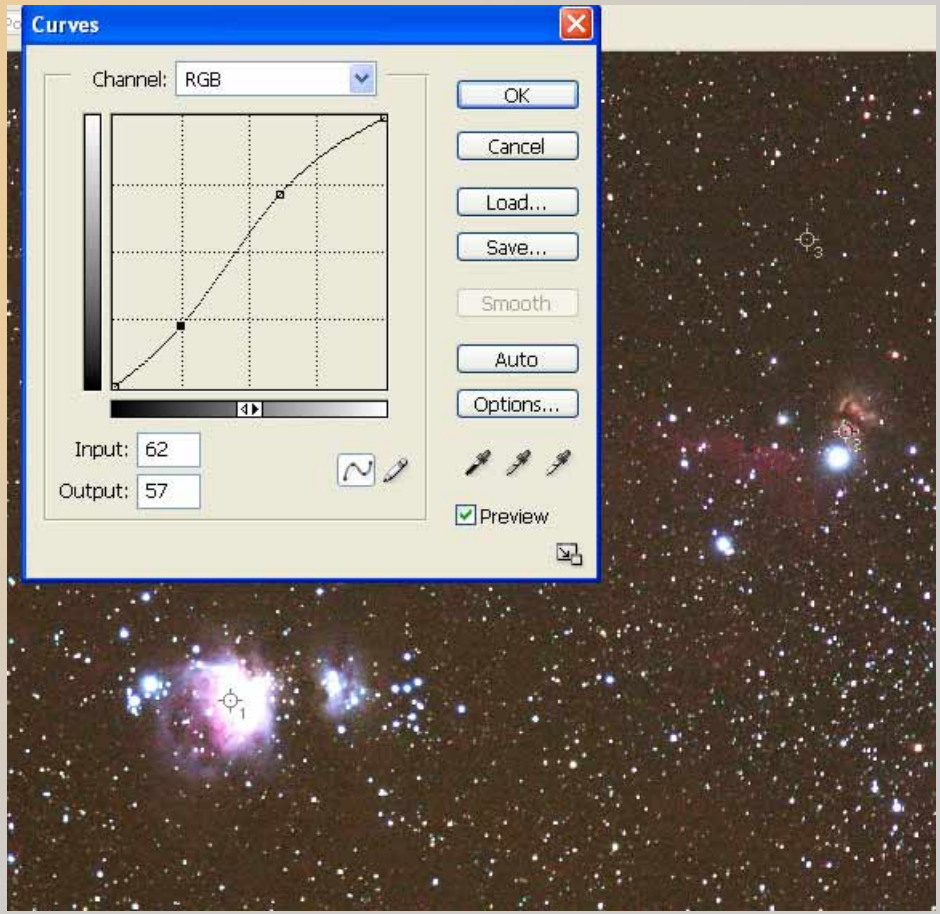
- Correct image black/white points with Levels (R,G,B channels)
- Adjust brightness with midtones



Astrophotography with a digital SLR camera

Photoshop

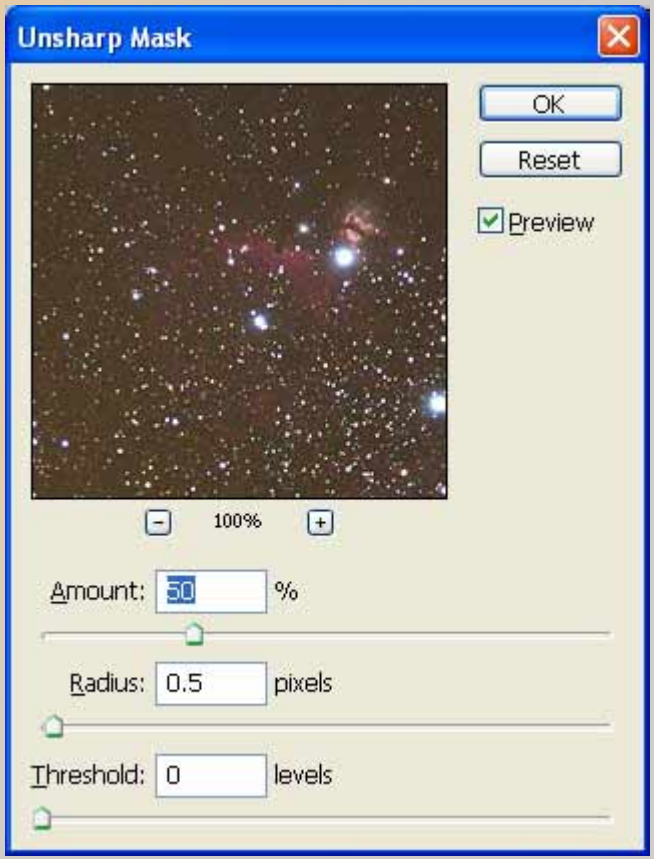
- Enhance image brightness & contrast with Curves (R,G,B channels)



Astrophotography with a digital SLR camera

Photoshop

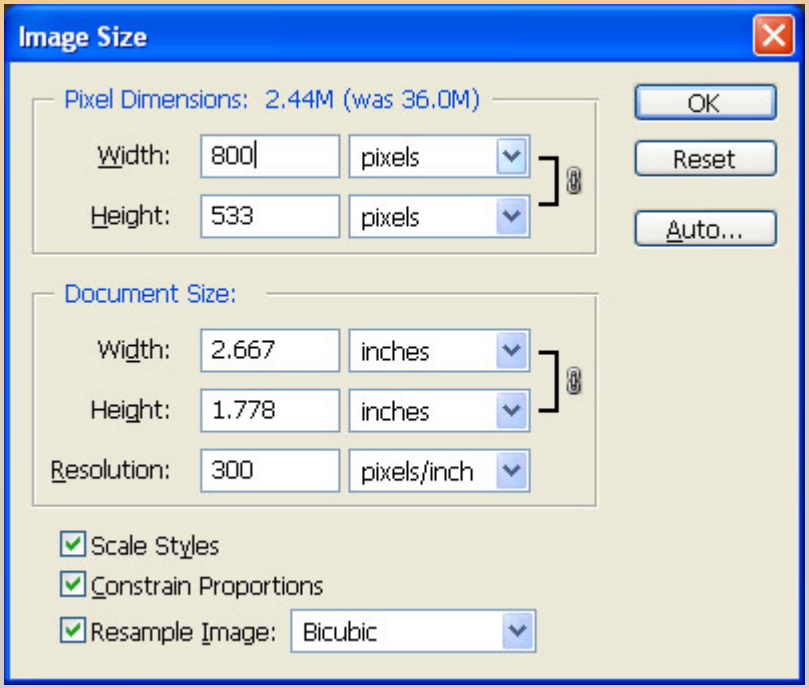
- Enhance image details with Unsharp Mask filter

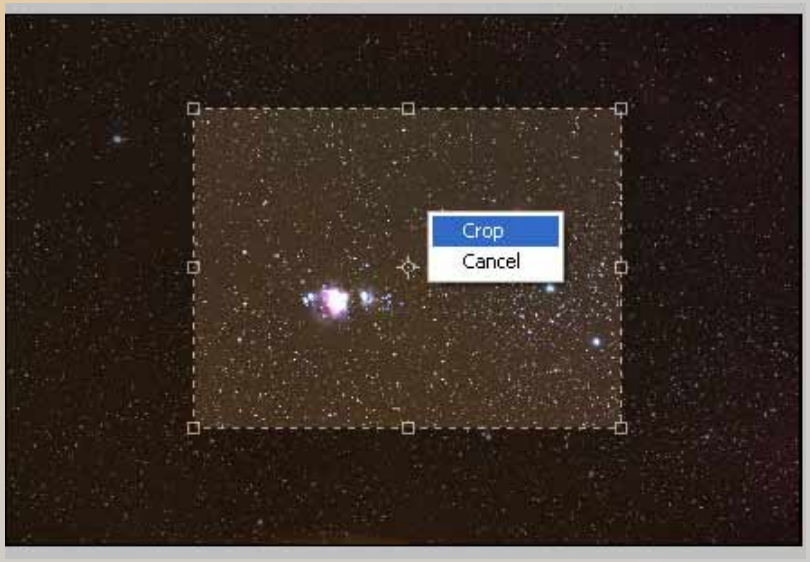


Astrophotography with a digital SLR camera

Photoshop

- Resize/crop image and save it for the web (jpg format)





Astrophotography with a digital SLR camera

Image Comparison

Before

After

Astrophotography with a digital SLR camera

– Useful links

- Astrophotography guide for EOS digital
  http://www.canon.co.jp/Imaging/astro/index-e.html
- Canon EOS 300D modification
  http://ghonis2.ho8.com/rebelmodnew.html
- Russian FW hack for the 300D
  http://satinfo.narod.ru/en/
- Photoshop for astrophotographers
  http://www.astropix.com/PFA/PFA.HTM
- DSLR Focus
  http://www.dslrfocus.com/
- MaxDSLR
  http://www.cyanogen.com/products/maxdslr_main.htm

Astrophotography with a digital SLR camera

Thank you very much!!!

Clear skies!!!