CEDIC 2013

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Topics

- Freeware & Open Source
- Processing phases
- Software for image Processing
- Example of workflow
- Q&A

Definition of Freeware SW

Software classified as freeware is given in license at zero cost, completed in its features and active for an unlimited time.

Alternatively, a limited version in terms of features with the possibility of expanding them at a low cost.

A possible restriction to the license could be in terms of the entity that may use it for free (private use, commercial use, academic use, etc.)

Definition of Open Source License

With the term Open Source, it is meant a software that allows the user to even change the original code (free of charge).

The source codes are developed and improved by the collaboration of sw programmers that gather together in a community defined under the criterias of the Open Source License.

Image Processing

Considering all the different Processing methodologies for image Processing, we may however distinguish five phases

- Calibration
- Alignment
- Stack
- Contrast Enhancement
- Editing

Calibration

It is the activity of cleaning the raw frames.
To the data collected on the field we subtract some noise related to

- Thermal Noise (dark frames)
- Electronic Noise (bias frames)
- Dust, scratches or vignetting (flat frames)

Alignment

Precise overlapping of images, obtained by shifting, rotating and scaling the images

Stack

To reduce random noise which is in the frames and eliminate some unwanted signal (satellite/airplane strikes etc.).

Many algorithms are available for such purpose.

Contrast Enhancement

To highlight object's peculiar features wrt the sky background, in order to increase its contrast

This is a very important step and there are many algorthms that come handy

Editing

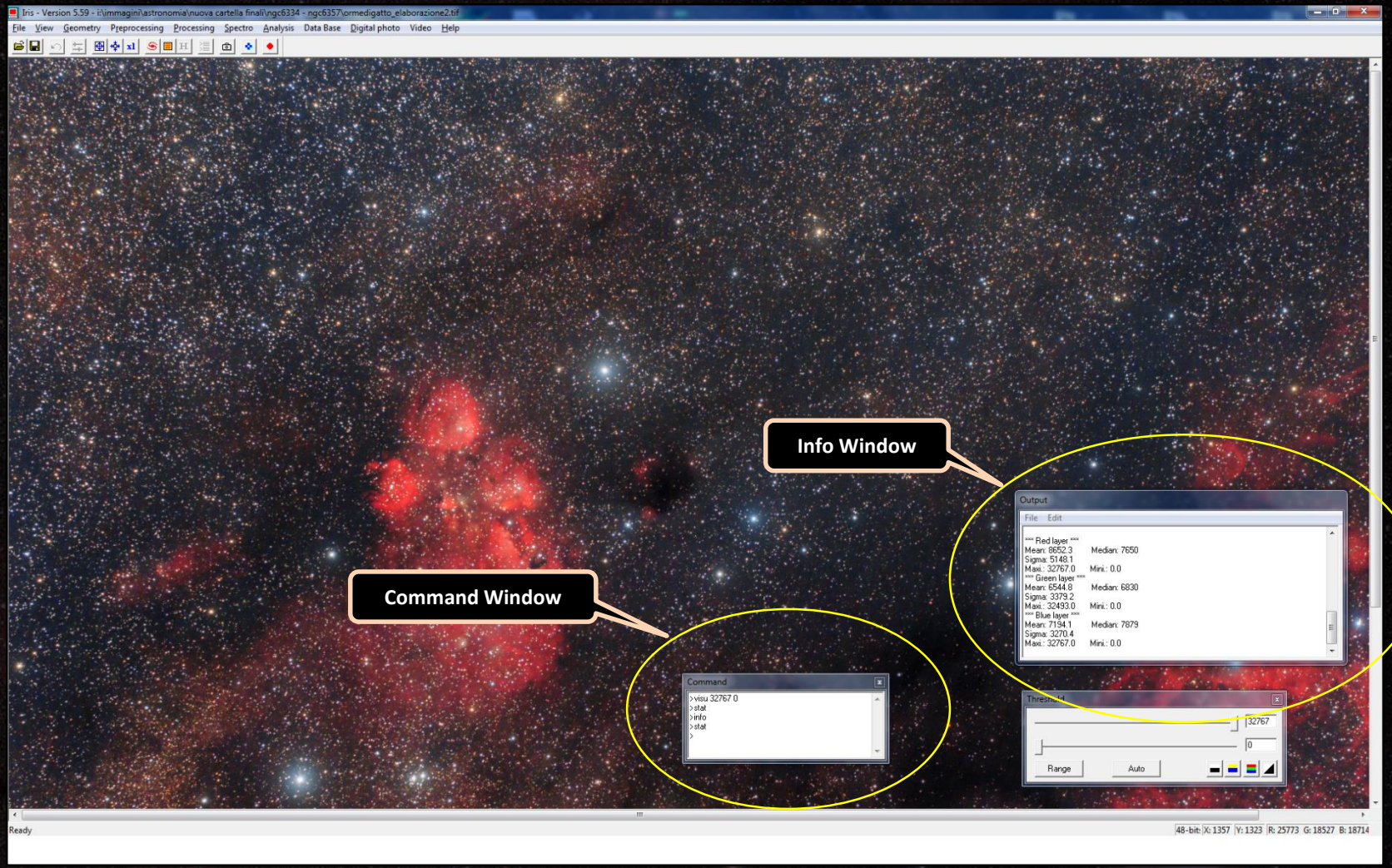
Allows to digitally erase residual unestethisms from the final image

Daylight photo editing software is normally used

Available Software..

Let’s consider some freeware/open source software

IRIS


Info Window
Command Window
Output
File Edit
Command
Threshold
Range
Auto
Ready

IRIS

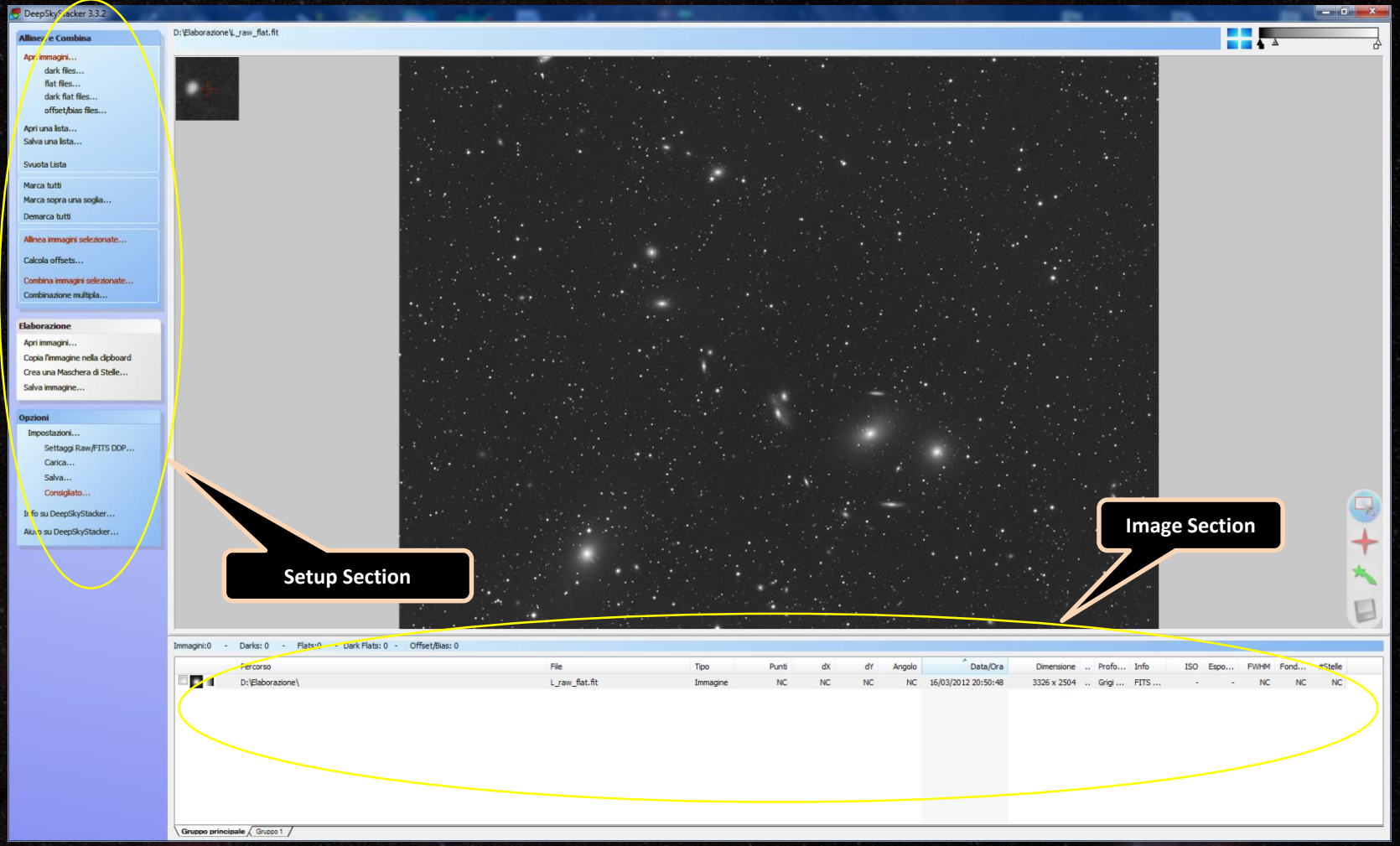
Good

- Many features
- Precise calculation

Opportunity for Improvement

- GUI
- Native file format not externally compatible

Deep Sky Stacker



Deep Sky Stacker

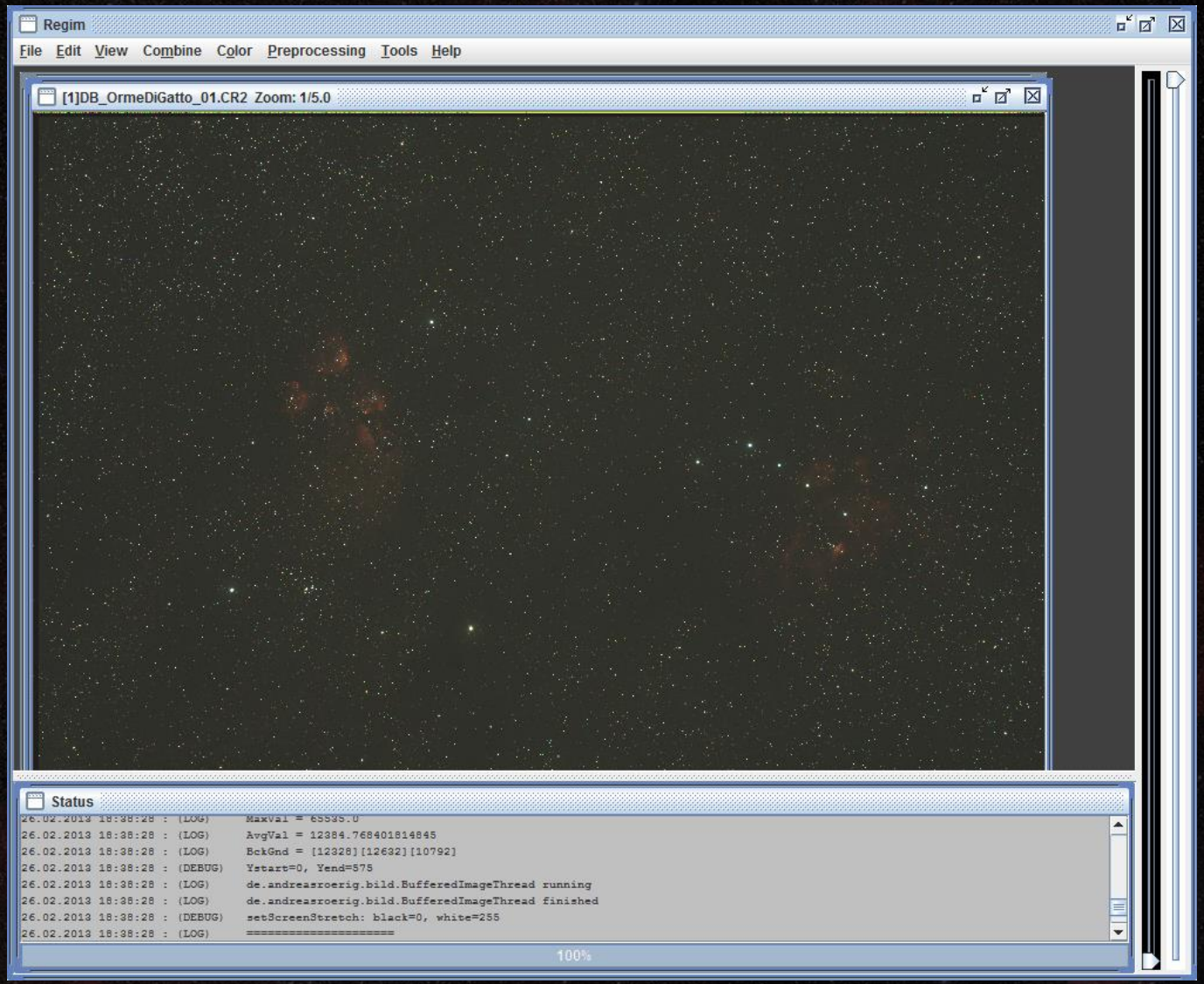
Good

- Attempt to design a better GUI
- Star ad Comet separated automatic alignment
- Monitoring of incoming frame during capture

Opportunity for Improvement

- Limited to Calibration

Regim


Regim
File Edit View Combine Color Preprocessing Tools Help
[1]DB_OrmeDiGatto_01.CR2 Zoom: 1/5.0
Status
26.02.2013 18:38:28 : (LOG) MaxVal = 65535.0
26.02.2013 18:38:28 : (LOG) AvgVal = 12384.768401814845
26.02.2013 18:38:28 : (LOG) BckGnd = [12328][12632][10792]
26.02.2013 18:38:28 : (DEBUG) Ystart=0, Yend=575
26.02.2013 18:38:28 : (LOG) de.andreasroerig.bild.BufferedImageThread running
26.02.2013 18:38:28 : (LOG) de.andreasroerig.bild.BufferedImageThread finished
26.02.2013 18:38:28 : (DEBUG) setScreenStretch: black=0, white=255
26.02.2013 18:38:28 : (LOG) ==========
100%

Regim

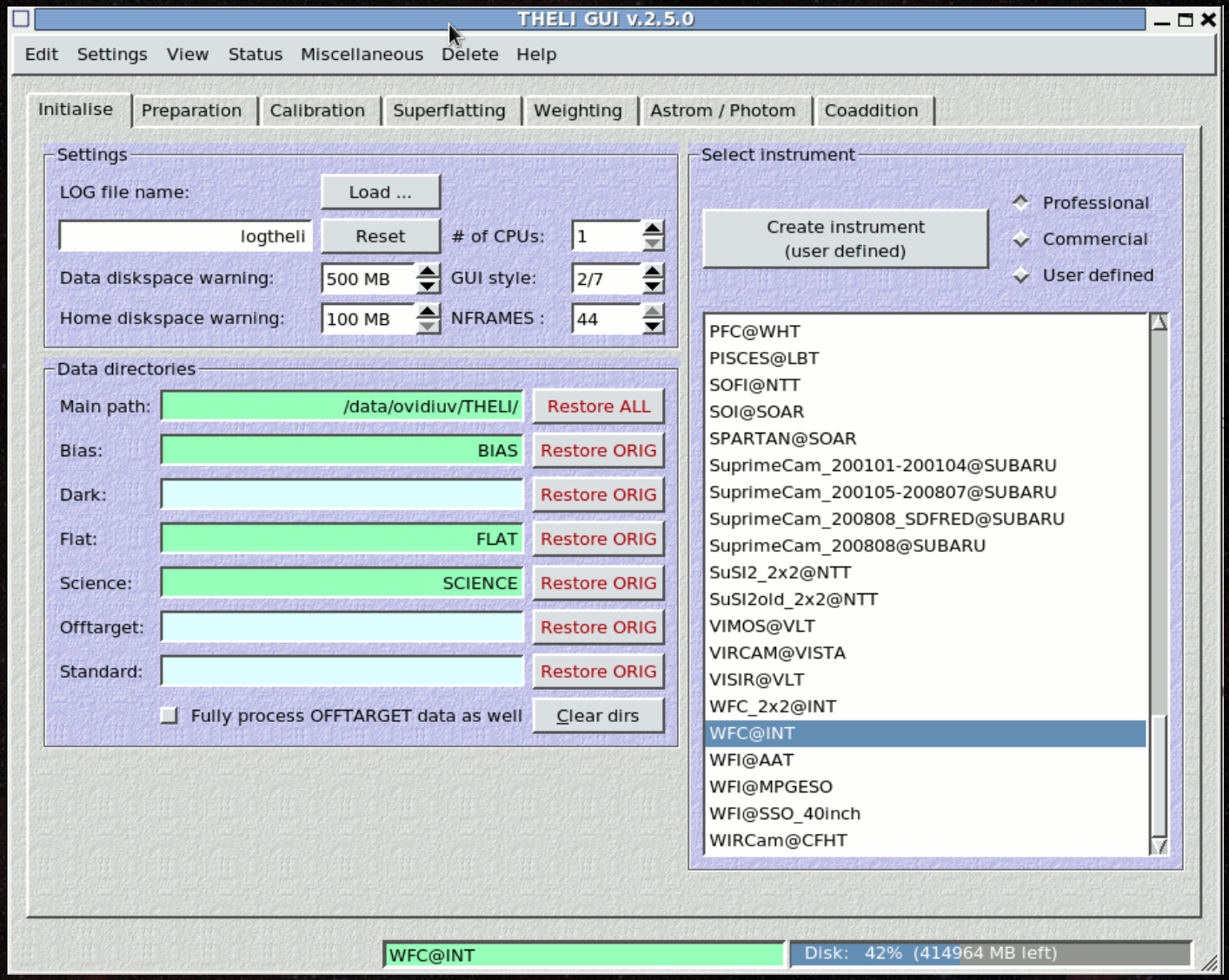
Good

- Portable on different platforms
- Simple to use
- B-V calibration, Astrometric reduction

Opportunity for Improvement

- Basically limited to calibration and stacking

Theli GUI


THELI GUI v.2.5.0
Edit Settings View Status Miscellaneous Delete Help
Initialise Preparation Calibration Superflatting Weighting Astrom / Photom Coaddition
Settings
LOG file name:
Load ...
logtheli
Reset
# of CPUs: 1
Data diskspace warning: 500 MB
GUI style: 2/7
Home diskspace warning: 100 MB
NFRAMES : 44
Data directories
Main path: /data/ovidiuv/THELI/
Restore ALL
Bias: BIAS
Restore ORIG
Dark:
Restore ORIG
Flat: FLAT
Restore ORIG
Science: SCIENCE
Restore ORIG
Offtarget:
Restore ORIG
Standard:
Restore ORIG
Fully process OFFTARGET data as well
Clear dirs
Select instrument
Create instrument (user defined)
Professional
Commercial
User defined
PFC@WHT
PISCES@LBT
SOFI@NTT
SOI@SOAR
SPARTAN@SOAR
SuprimeCam_200101-200104@SUBARU
SuprimeCam_200105-200807@SUBARU
SuprimeCam_200808_SDFRED@SUBARU
SuprimeCam_200808@SUBARU
SuSI2_2x2@NTT
SuSI2old_2x2@NTT
VIMOS@VLT
VIRCAM@VISTA
VISIR@VLT
WFC_2x2@INT
WFC@INT
WFI@AAT
WFI@MPGESO
WFI@SSO_40inch
WIRCam@CFHT
WFC@INT
Disk: 42% (414964 MB left)

Theli GUI

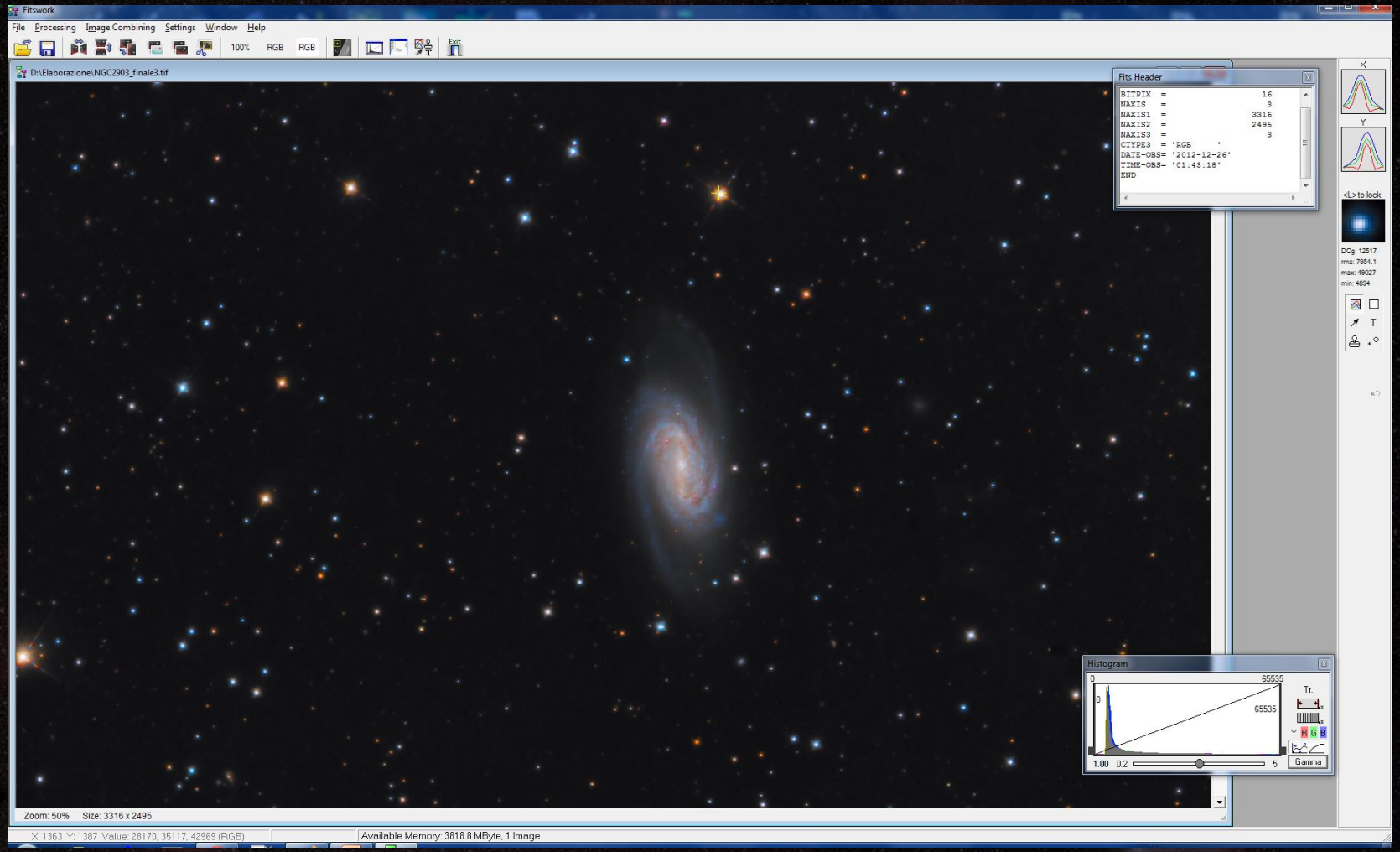
Good

- Precise frame calibration
- Used by professional astronomers

Opportunity for Improvement

- GUI not very easy to use
- User must know exactly what he is doing

Fitswork


Fitswork
File Processing Image Combining Settings Window Help
100% RGB RGB Exit
D:\Elaborazione\NGC2903_finale3.tif
Fits Header
BITPIX = 16
NAXIS = 3
NAXIS1 = 3316
NAXIS2 = 2495
NAXIS3 = 3
CTYPE3 = 'RGB '
DATE-OBS= '2012-12-26'
TIME-OBS= '01:43:18'
END
X
Y
<L> to lock
DC: 12517
rms: 7854.1
max: 49027
min: 4894
Histogram
0
65535
Tr.
Y R G B
1.00 0.2 5
Gamma
Zoom: 50% Size: 3316 x 2495
X: 1363 Y: 1387 Value: 28170, 35117, 42969 (RGB)
Available Memory: 3818.8 MByte, 1 Image

Fitswork

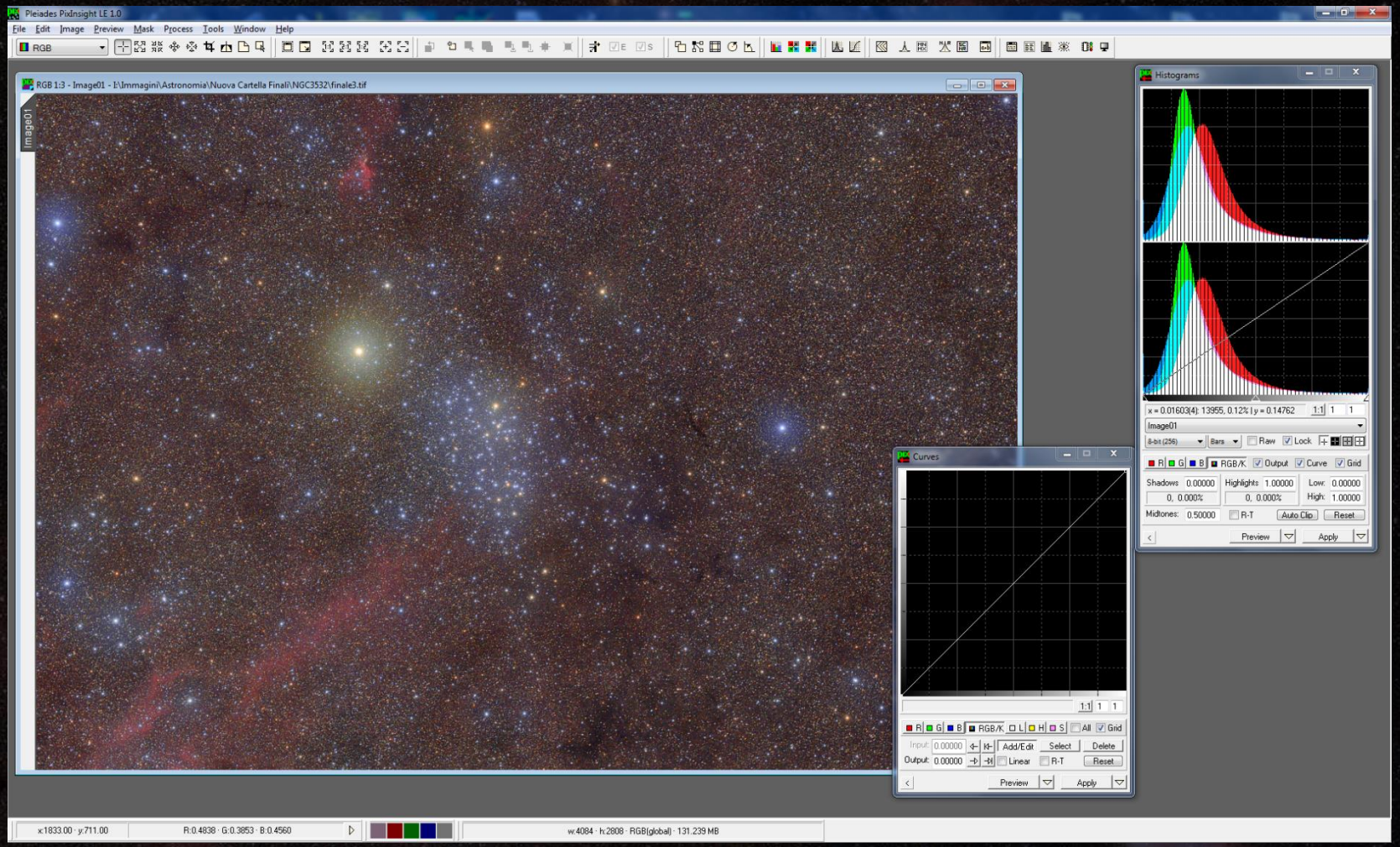
Good

- Easy to use
- Deconvolution feature

Opportunity for Improvement

- Increase processing features

PixInsight LE



Pixinsight LE

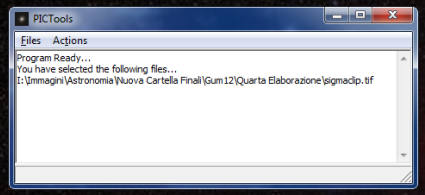
Good

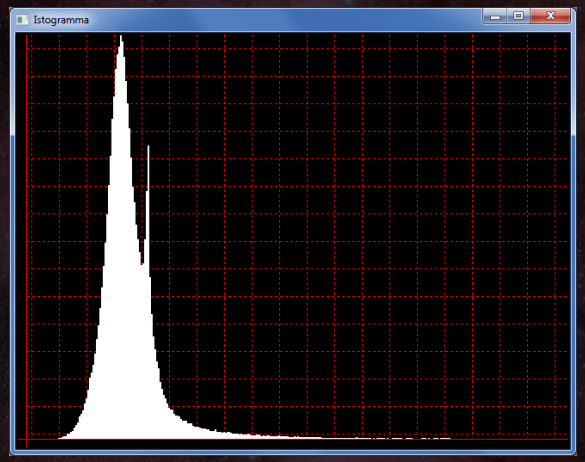
- Wavelets
- Noise reduction
- Stretch

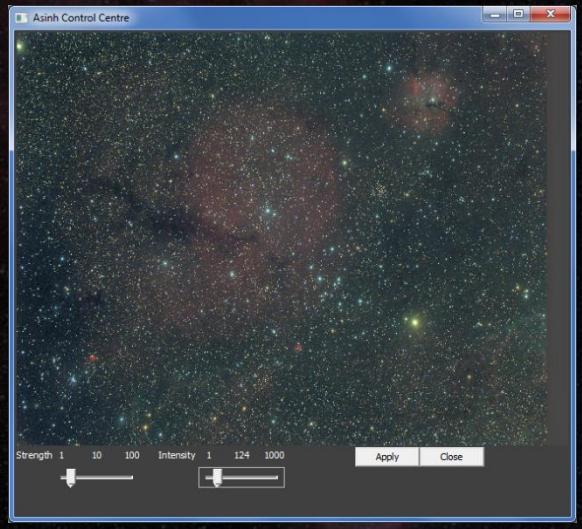
Opportunity for Improvement

- Only contrast enhancement is considered
- Not available anymore from the original website

PICTools


PICTools
Files Actions
Program Ready...
You have selected the following files...
I:\Immagini\Astronomia\Nuova Cartella Finali\Gum12\Quarta Elaborazione\sigmaclip.tif


Istogramma


Asinh Control Centre
Strength 1 10 100
Intensity 1 124 1000
Apply
Close

PICTools

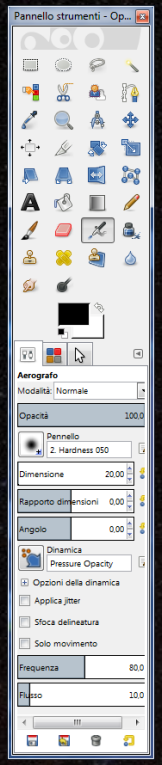
Good

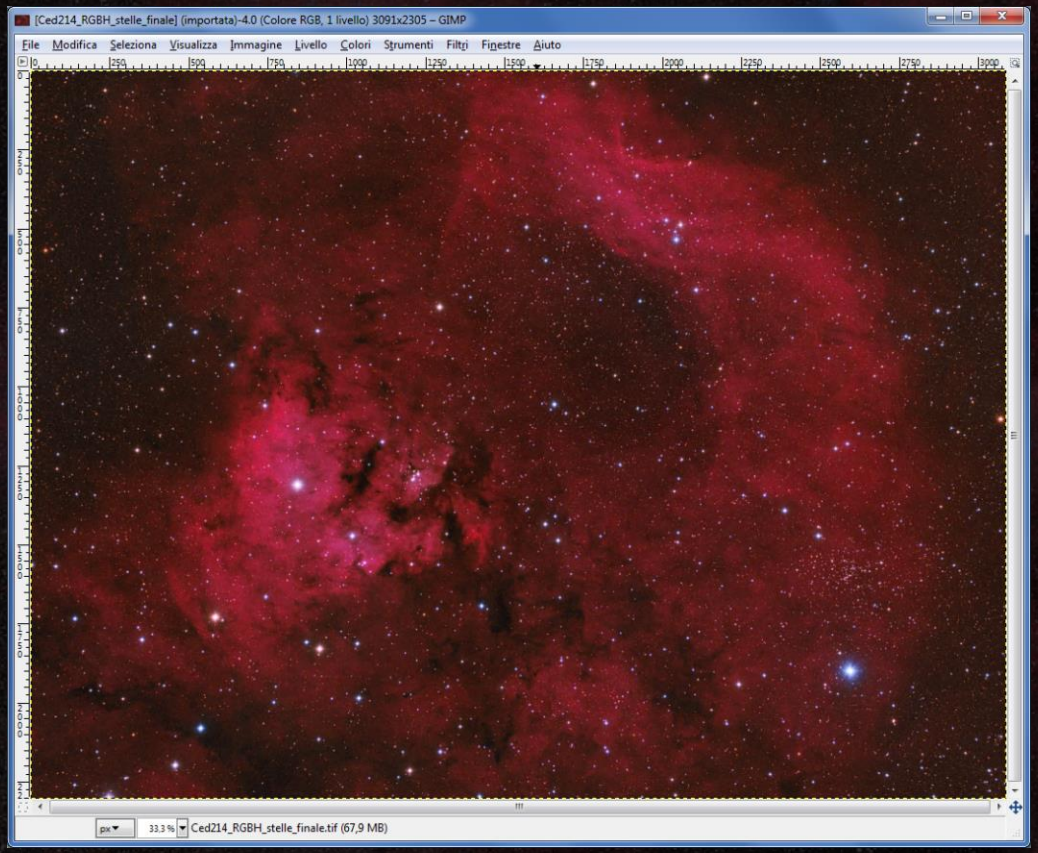
- 32-bits stack and stretch from IRIS files
- 32-bit pure ASINH stretch
- Removal of excess of green

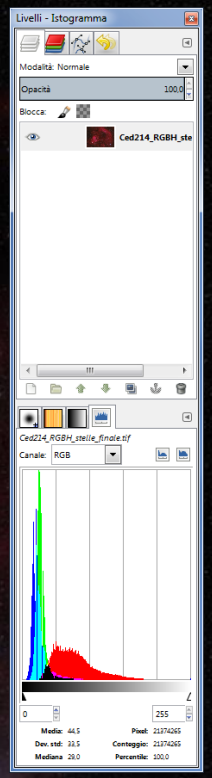
Opportunity for Improvement

- Limited functions

The GIMP


Pannello strumenti - Op...
Aerografo
Modalità: Normale
Opacità 100,0
Pennello
2. Hardness 050
Dimensione 20,00
Rapporto dimensioni 0,00
Angolo 0,00
Dinamica
Pressure Opacity
Opzioni della dinamica
Applica jitter
Sfoca delineatura
Solo movimento
Frequenza 80,0
Flusso 10,0


[Ced214_RGBH_stelle_finale] (importata)-4.0 (Colore RGB, 1 livello) 3091x2305 – GIMP
File Modifica Seleziona Visualizza Immagine Livello Colori Strumenti Filtri Finestre Aiuto
Ced214_RGBH_stelle_finale.tif (67,9 MB)


Livelli - Istogramma
Modalità: Normale
Opacità 100,0
Blocca:
Ced214_RGBH_ste
Ced214_RGBH_stelle_finale.tif
Canale: RGB

The GIMP

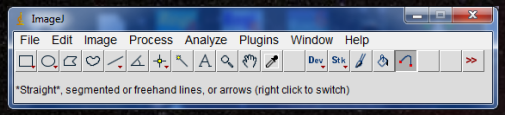
Good

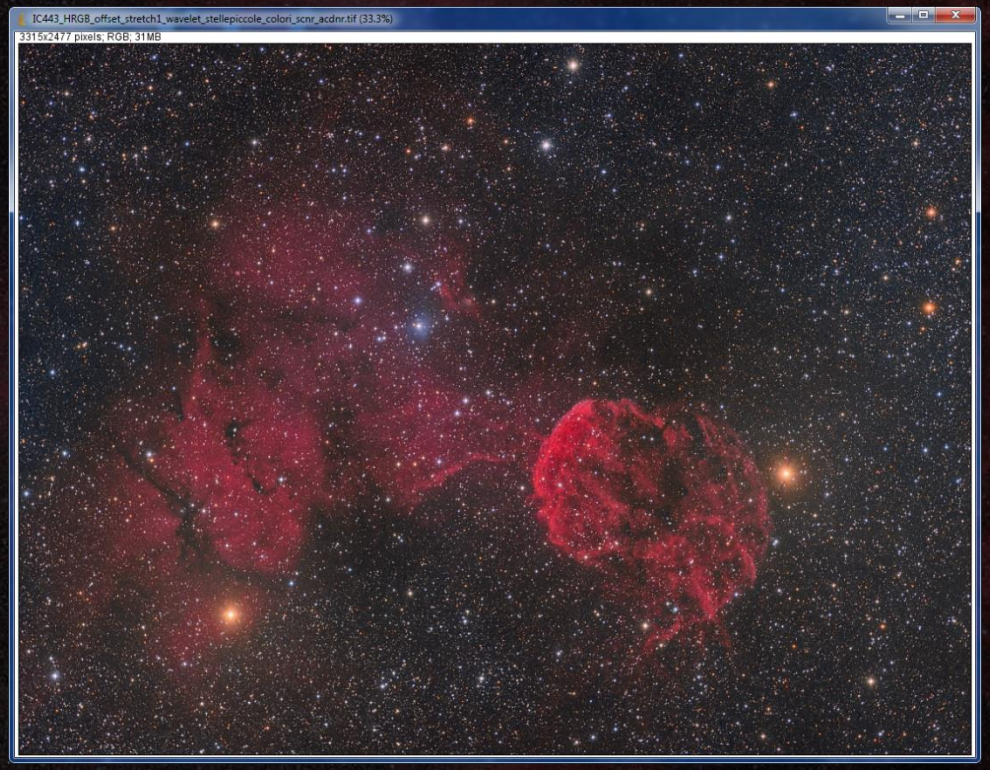
- Good GUI
- Complete set of photo editing features

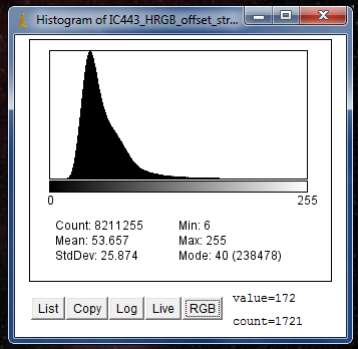
Opportunity for Improvement

- Working at 8-bit per color channel

ImageJ


ImageJ
File Edit Image Process Analyze Plugins Window Help
Straight, segmented or freehand lines, or arrows (right click to switch)


IC443_HRGB_offset_stretch1_wavelet_stellepiccole_colori_scnr_acdnr.tif (33.3%)
3315x2477 pixels; RGB; 31MB


Histogram of IC443_HRGB_offset_str...
0
255
Count: 8211255
Mean: 53.657
StdDev: 25.874
Min: 6
Max: 255
Mode: 40 (238478)
List Copy Log Live RGB
value=172
count=1721

ImageJ

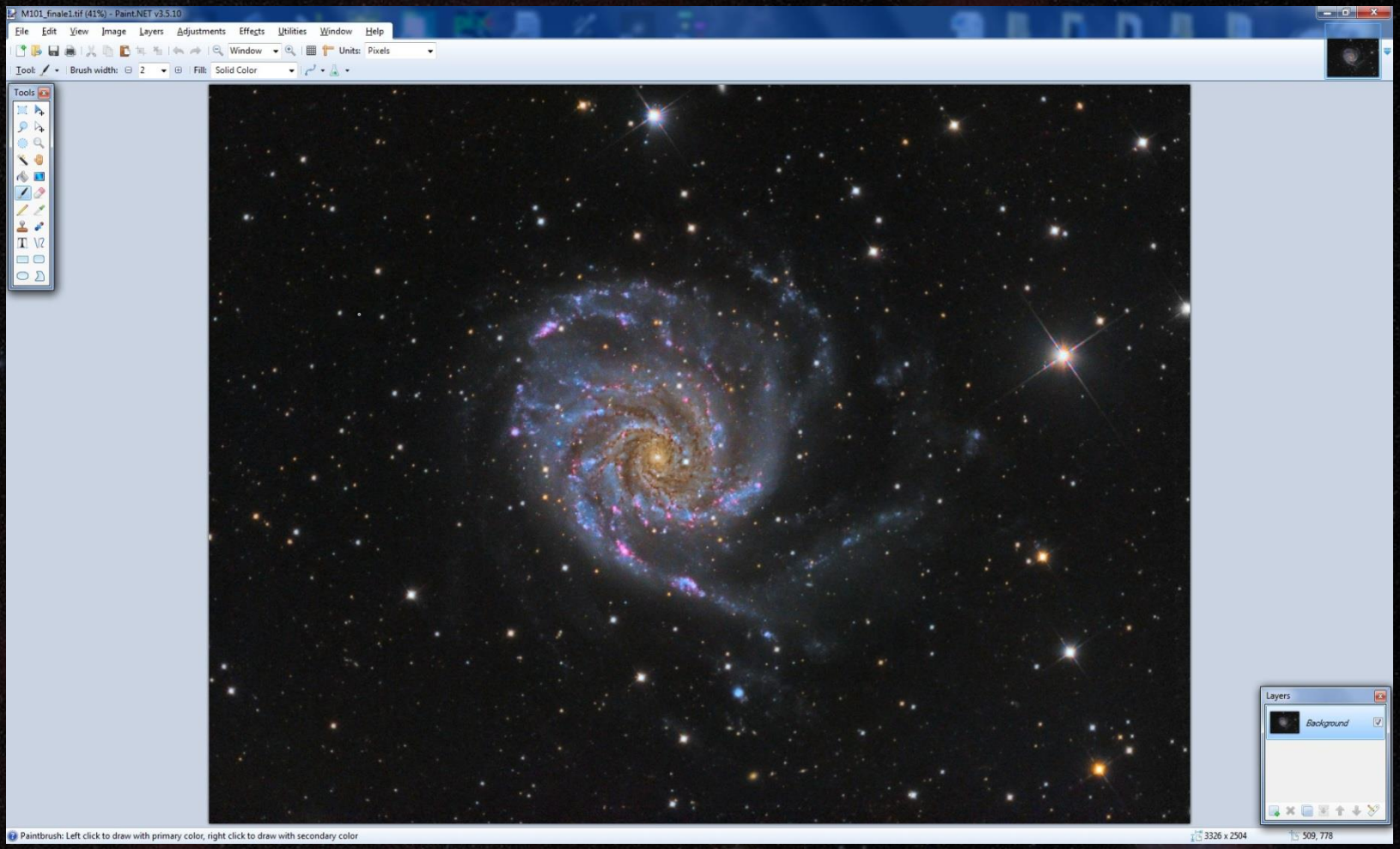
Good

- Modular and easily expandable
- Easy to write filtres and plugins to increase its power
- Portable

Opportunity for Improvement

- Bare-bone GUI
- Written in in Java

Paint.NET


M101_finale1.tif (41%) - Paint.NET v3.5.10
File Edit View Image Layers Adjustments Effects Utilities Window Help
Tools
Layers
Background
Paintbrush: Left click to draw with primary color, right click to draw with secondary color
3326 x 2504
509, 778

Paint.NET

Good

- Easy to use GUI
- Works with layers

Opportunity for Improvement

- Levels/Curves adjustments
- Better resilience

Let's put all together…

Which are the free software to use?

Evaluated Software

Name	Author or POC	License	Calibration	Alignment	Stack	Contrast Enh.	Photo Editing
IRIS	Christian Buil	Freeware	Yes	Yes	Yes	Yes	No
Deep Sky Stacker	Luc Coiffier	Freeware	Yes	Yes	Yes	No	No
Regim	Andreas Roerig	Freeware	Yes	Yes	Yes	No	No
THELI GUI	Mischa Schirmer	Open Source	Yes	Yes	Yes	No	No
Fitswork	Jens Dierks	Freeware	Yes	Yes	Yes	Yes	No
PixInsight LE	Pleiades Astrophoto	Freeware	No	No	No	Yes	No
PICTools	Nicola Montecchiari	Open Source	No	No	Yes	Yes	No
GIMP	The GIMP Team	Open Source	No	No	No	Yes	Yes
ImageJ	The ImageJ Group	Open Source	No	No	No	Yes	Yes

Summing up…

All programs described have got interesting features

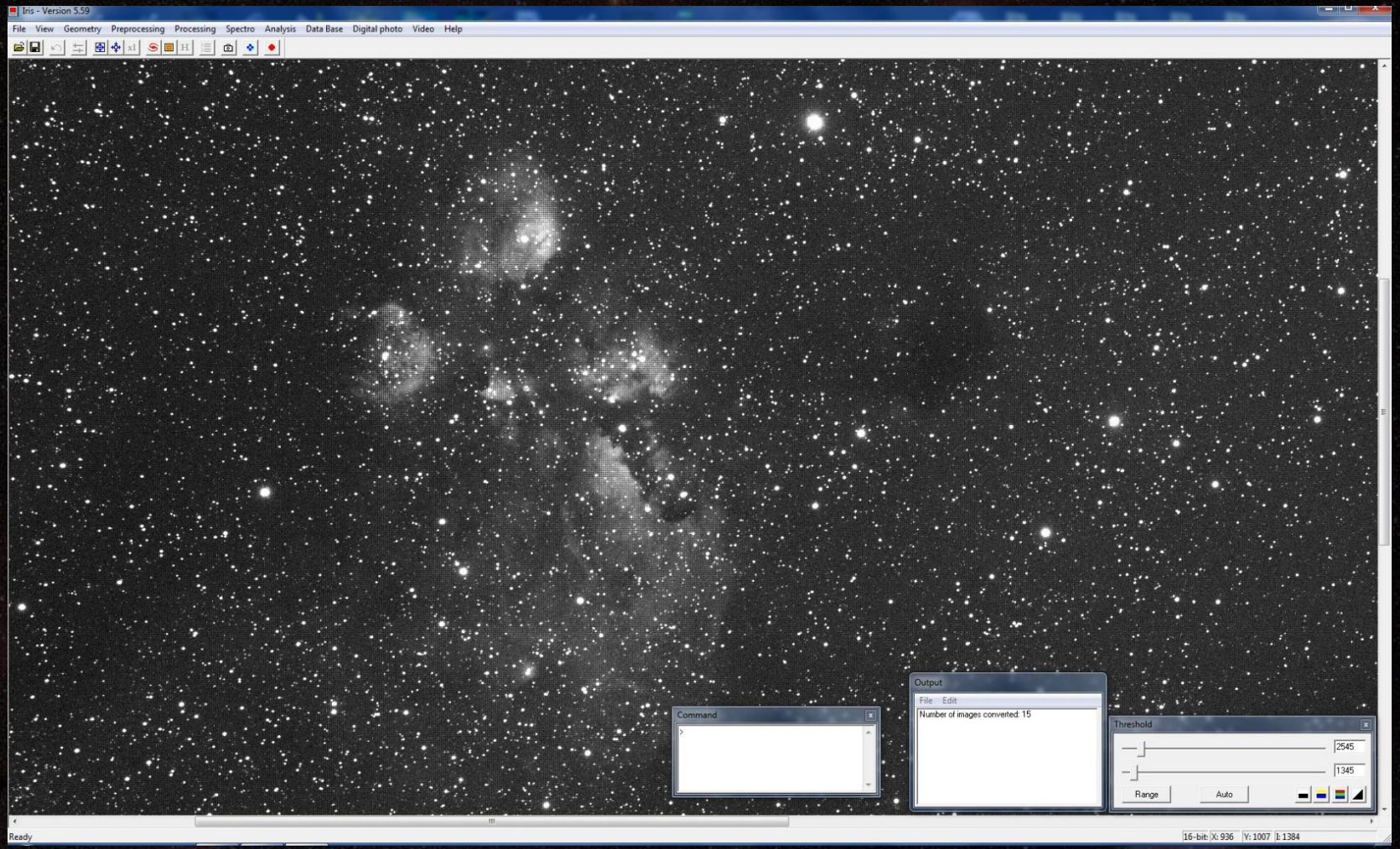
The choice of the right one depends on our needs and skills

Carefully analyze what the world of Freeware/Open Source provides in terms of features

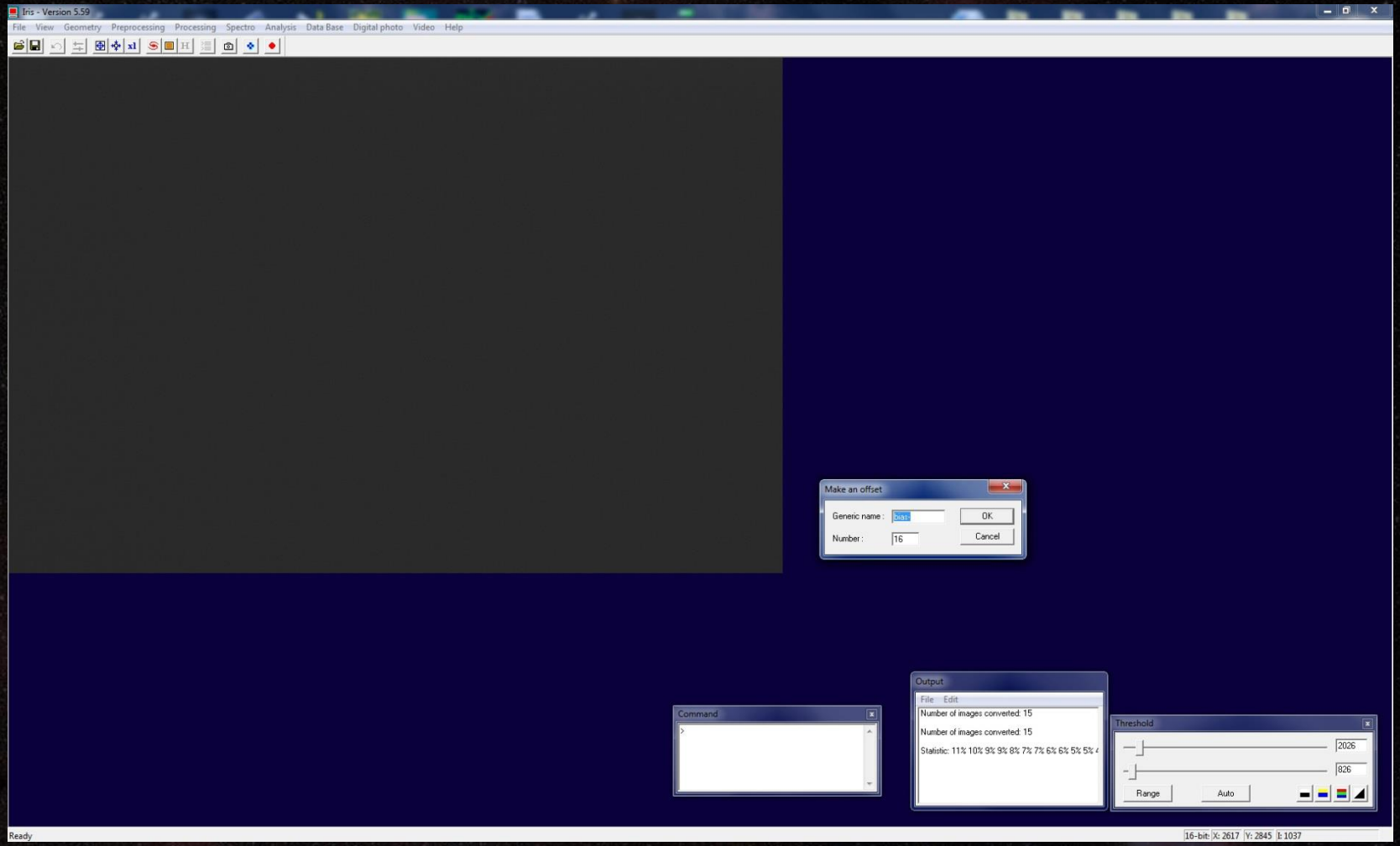
Example

Step by step image processing of NGC6334-NGC6357, shot in Namibia with a Canon DSLR and a Takahashi FSQ85ED.

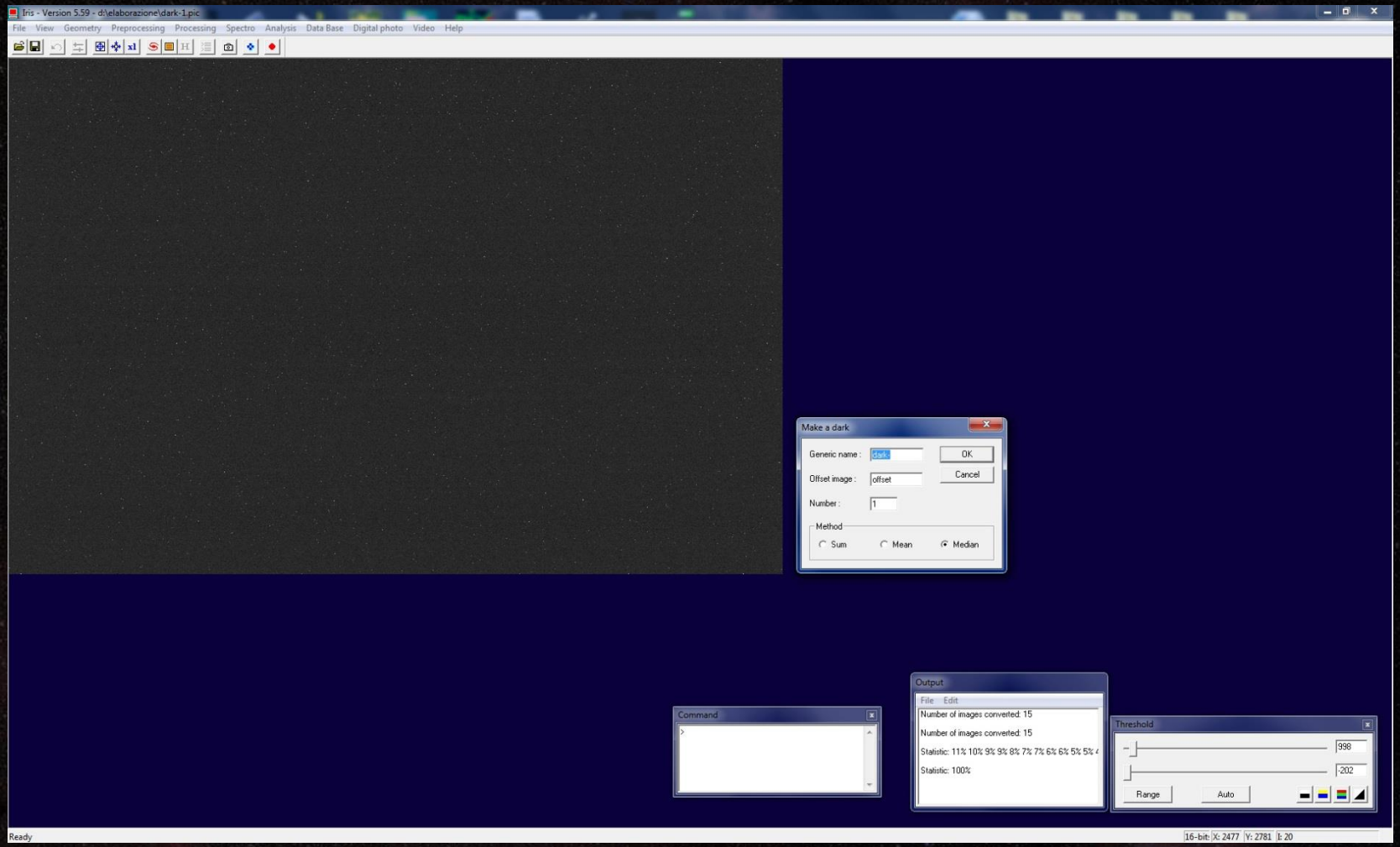
Raw to CFA conversion - IRIS



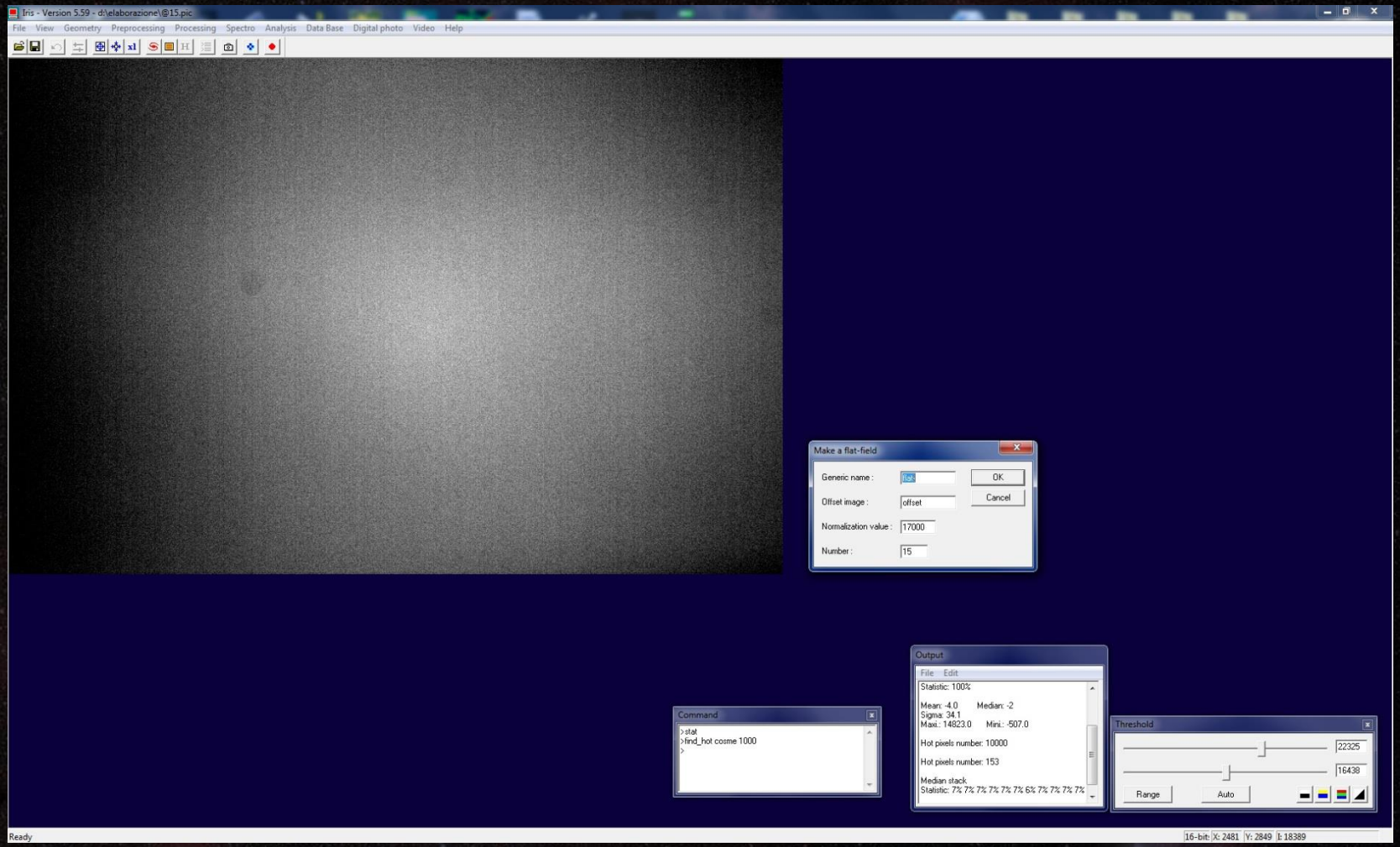
Master Bias - IRIS



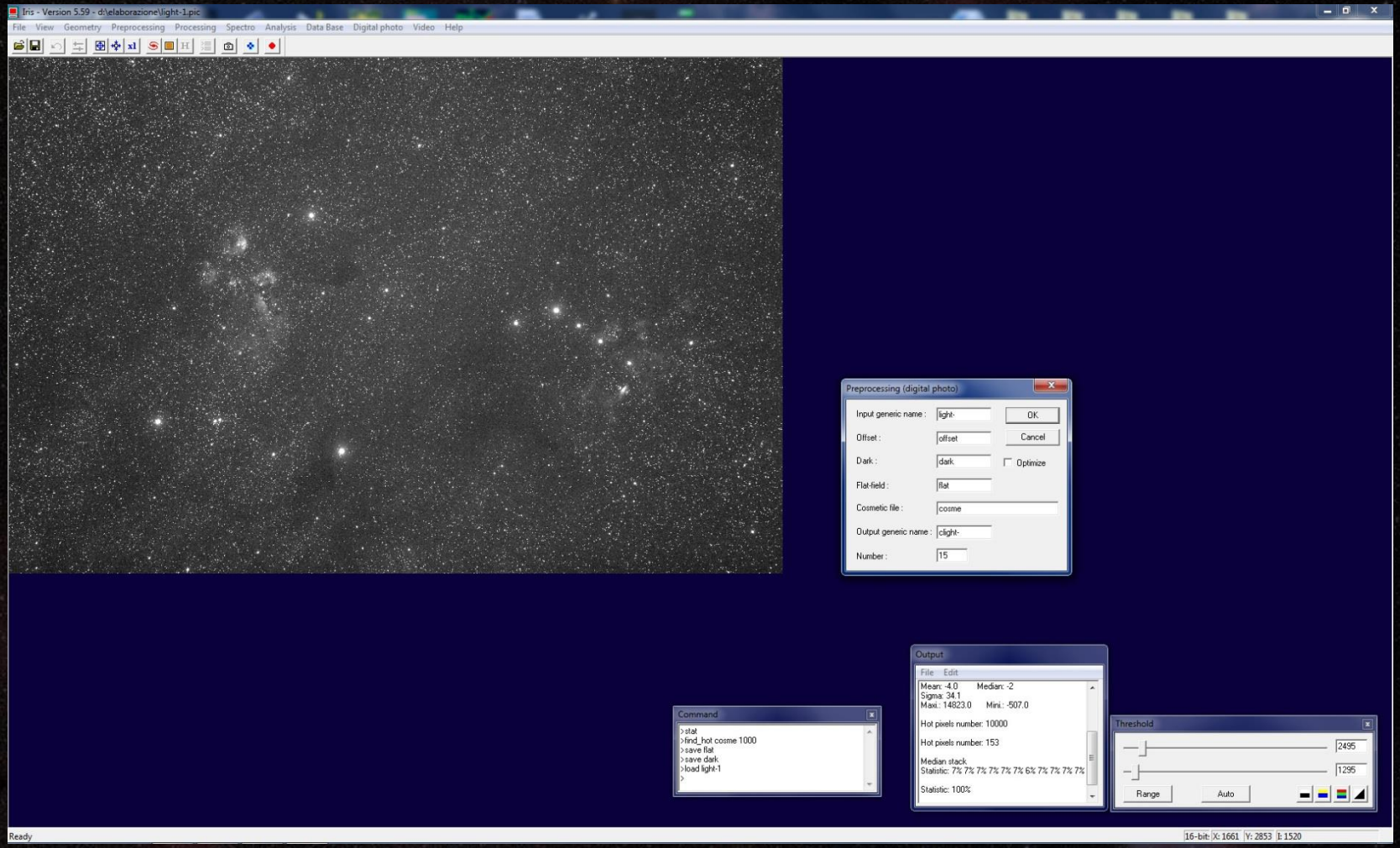
Master Dark - IRIS



Master Flat - IRIS



Calibration - IRIS



CFA to RGB conversion - IRIS

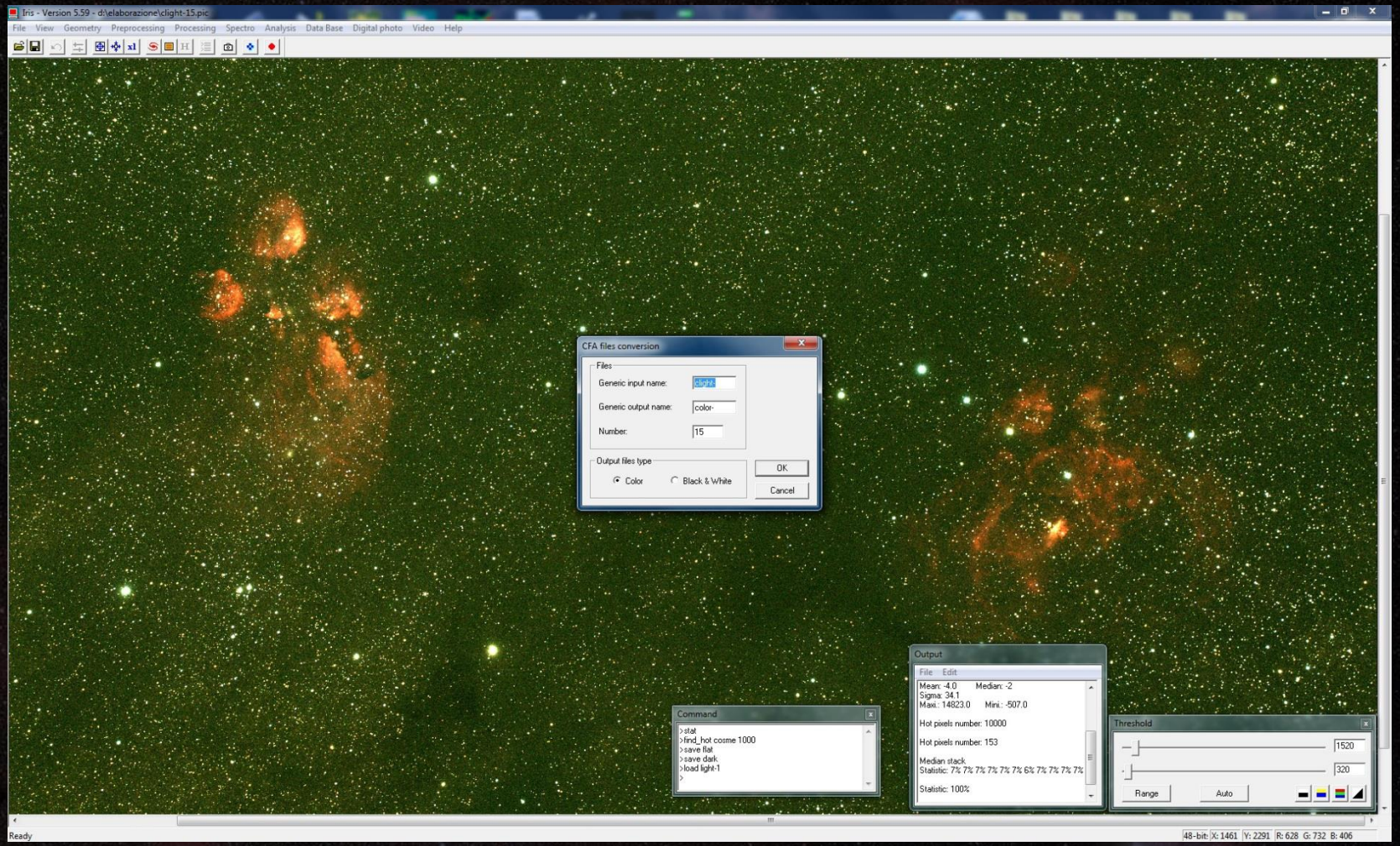
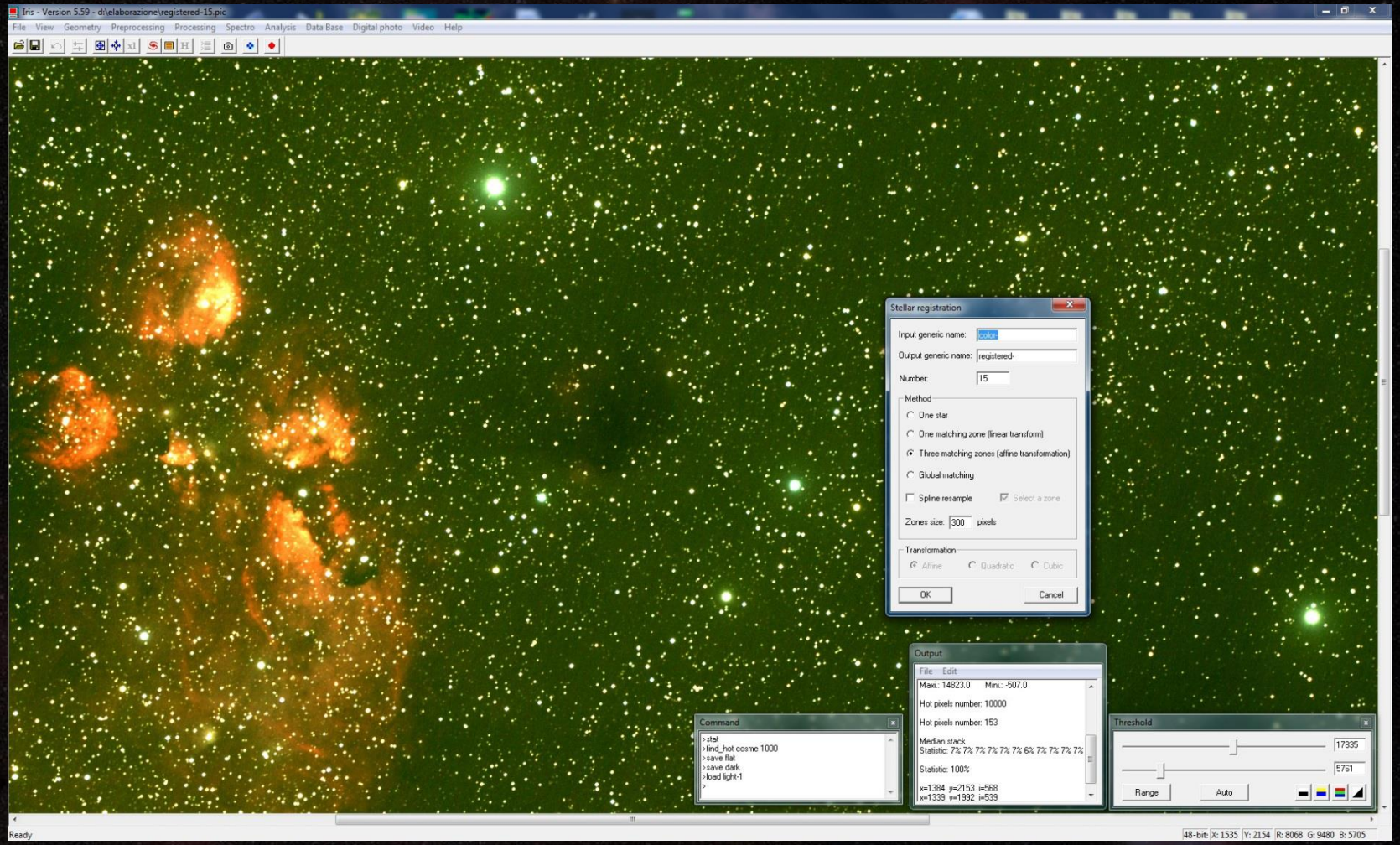


Image Registration - IRIS



Normalisation - IRIS

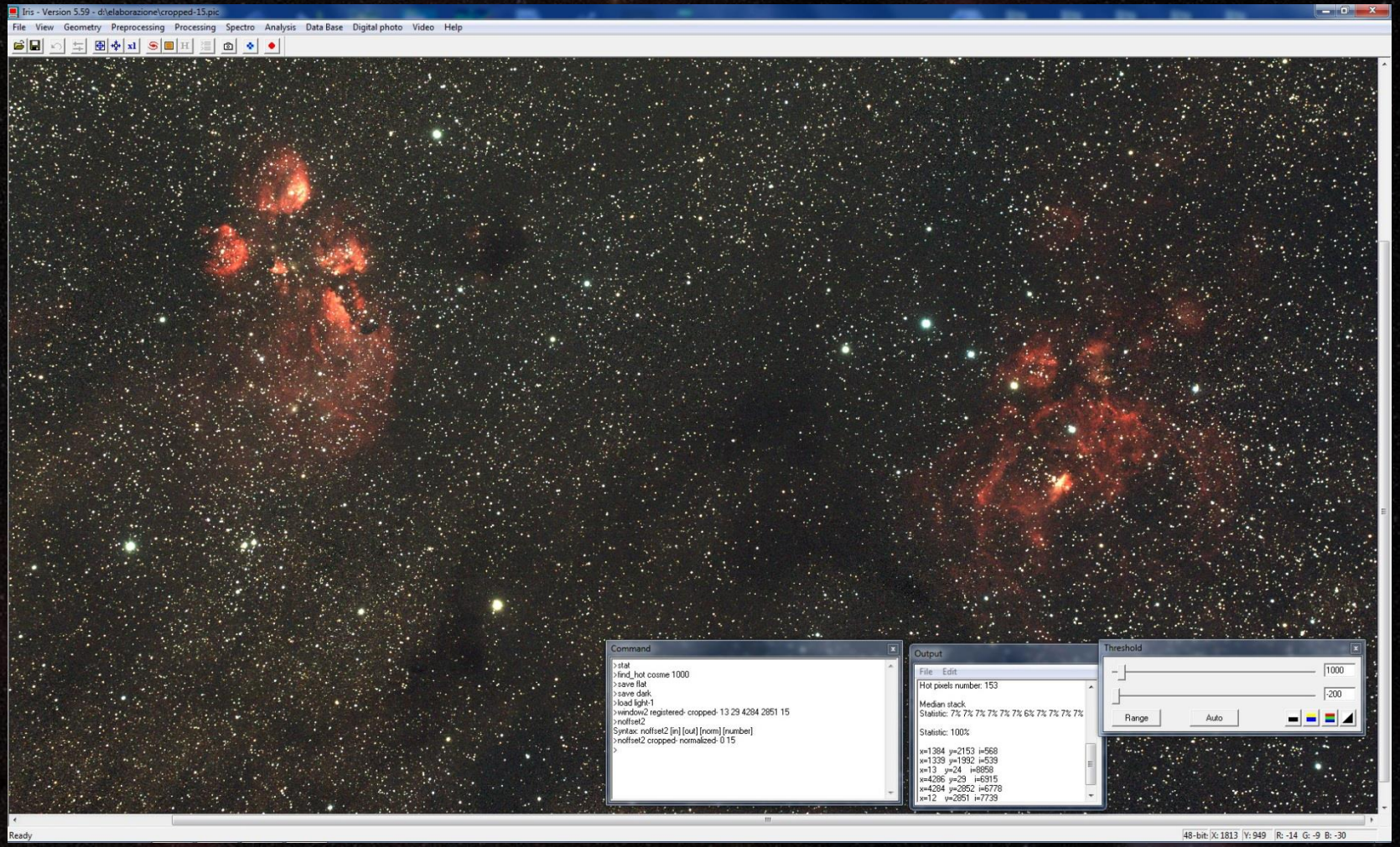
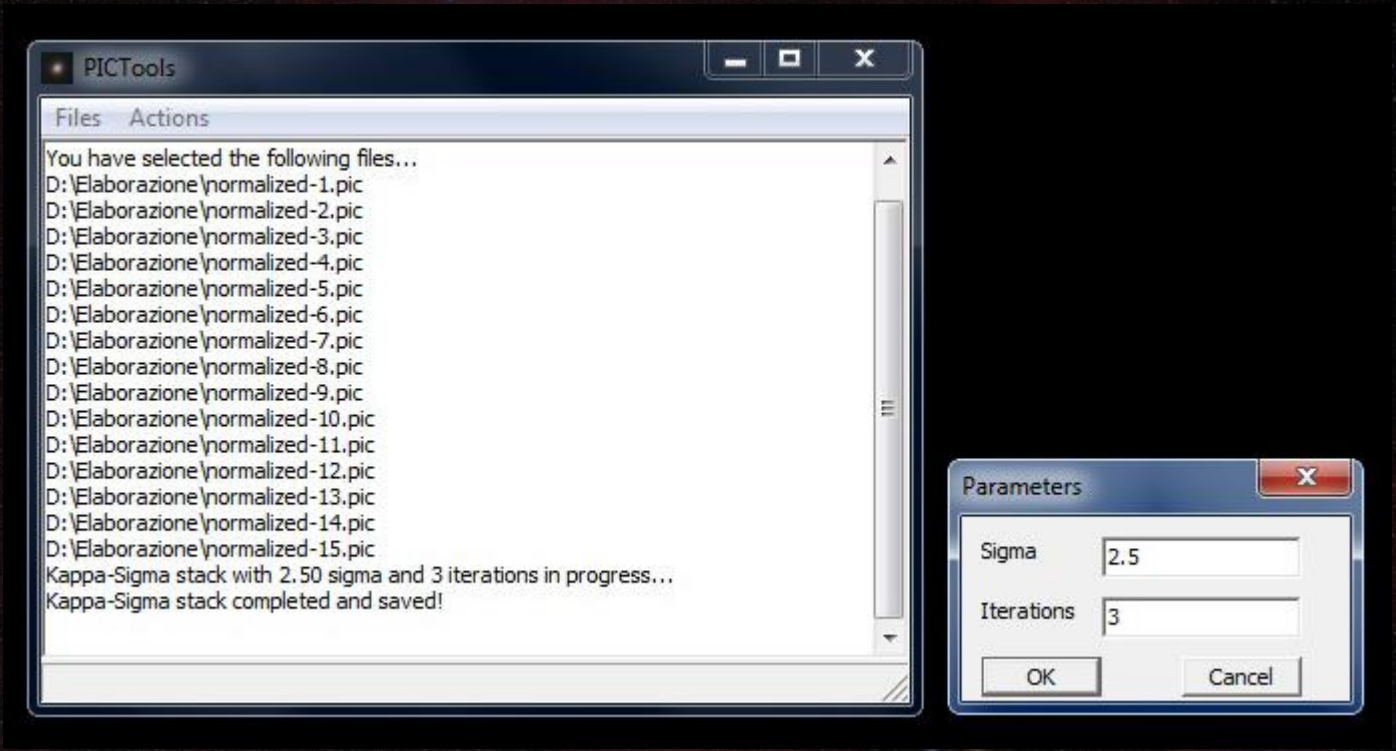
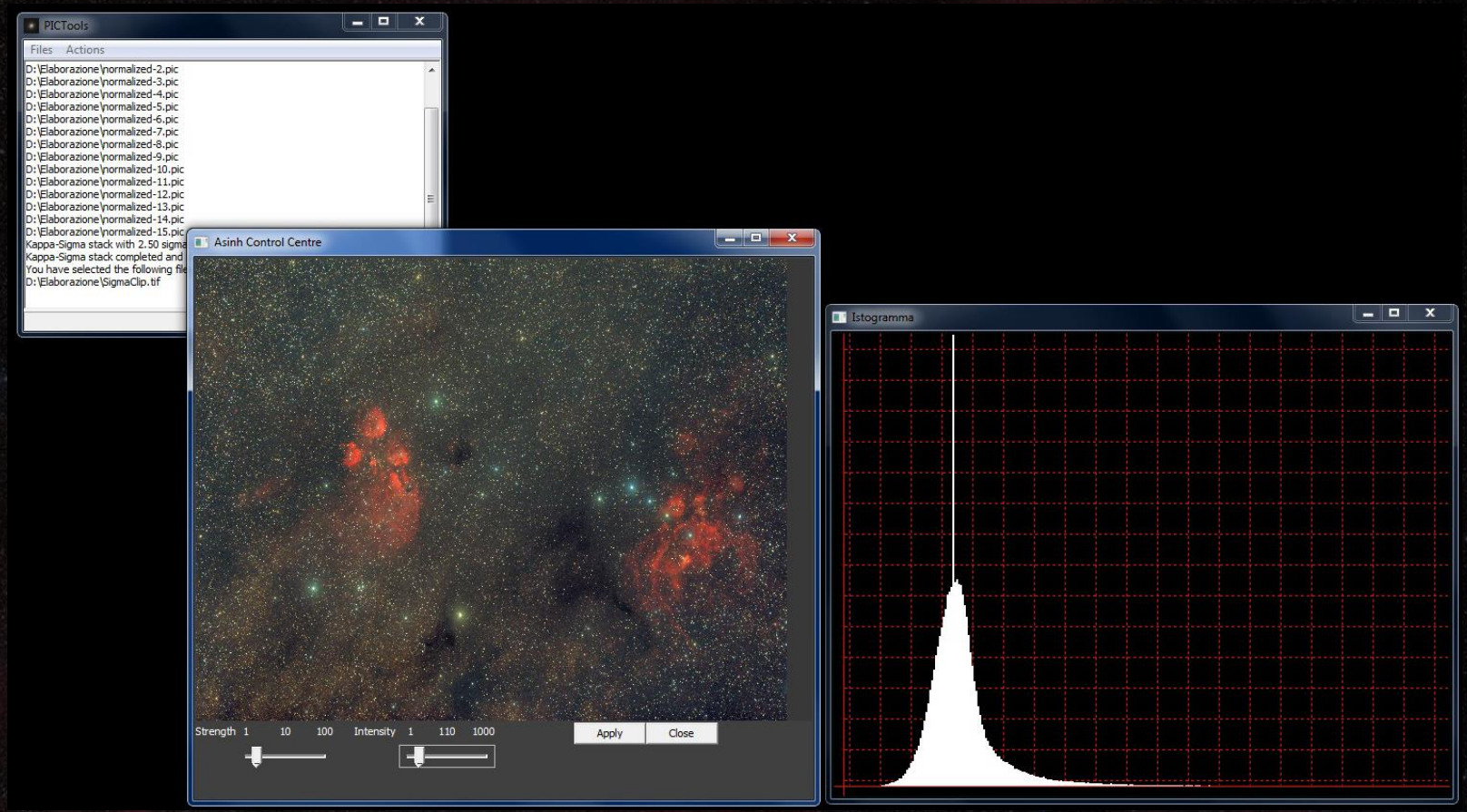


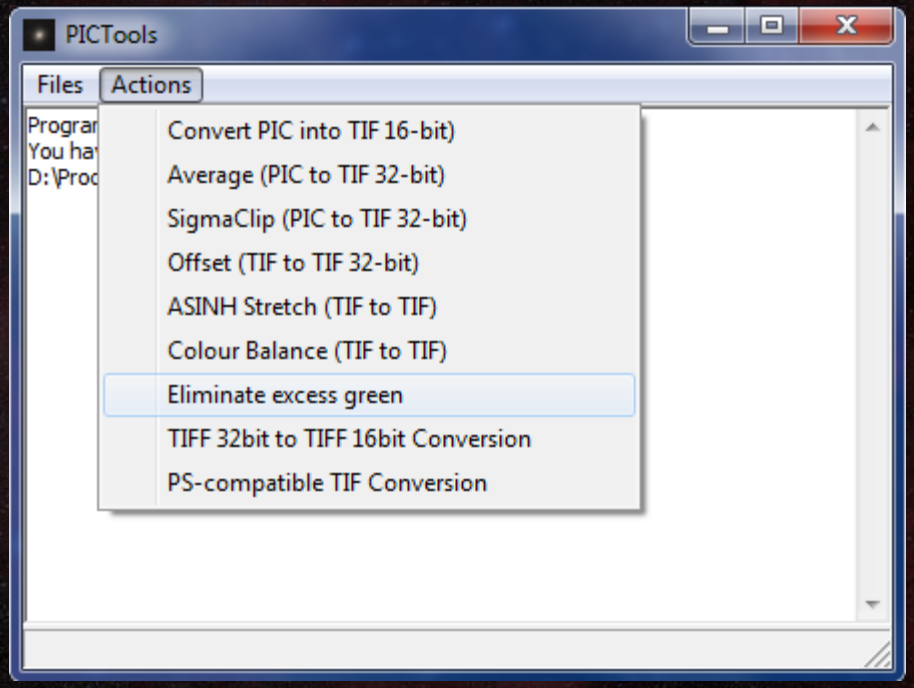
Image Stack - PICTools



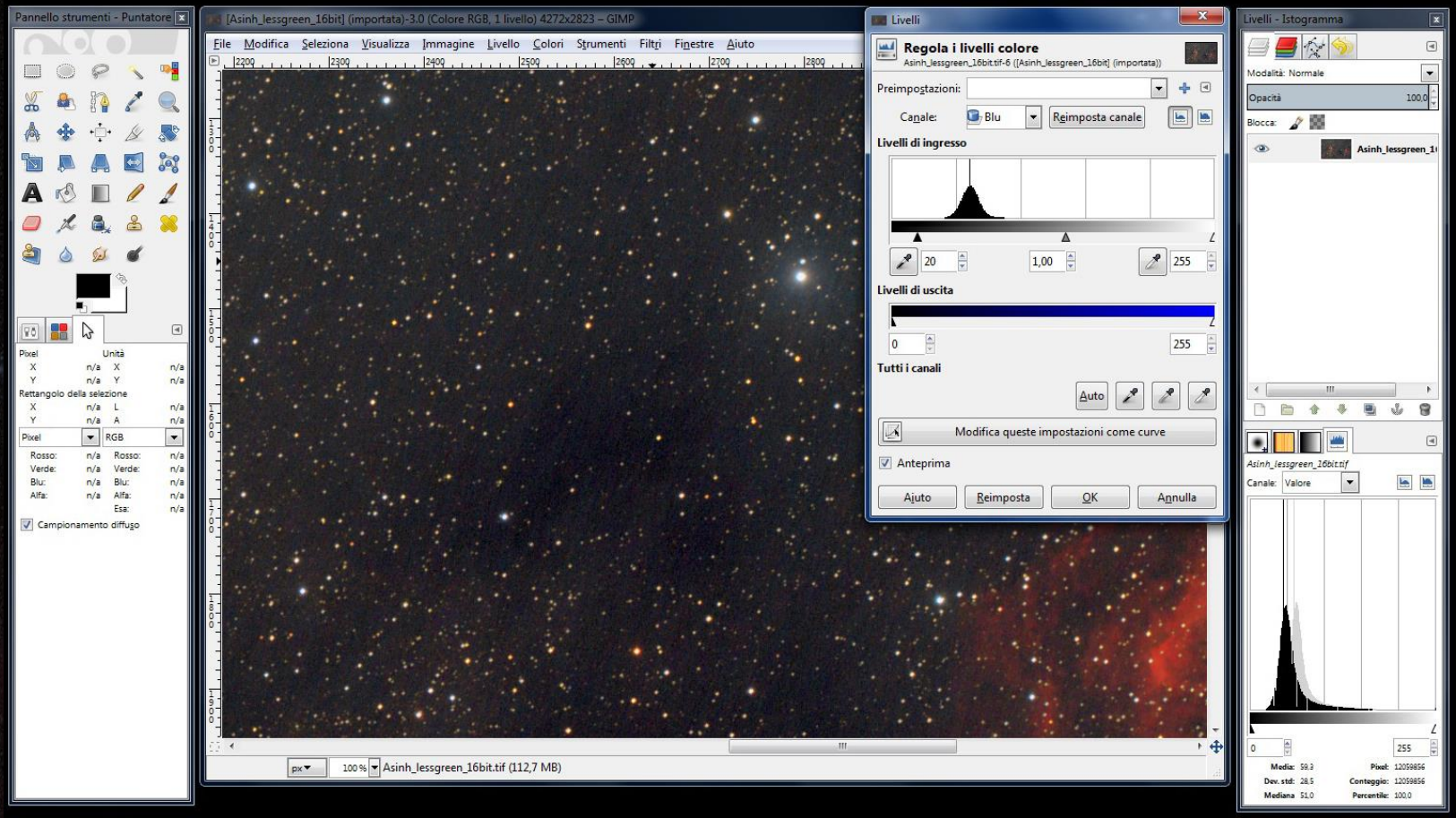
Asinh Stretch - PICTools



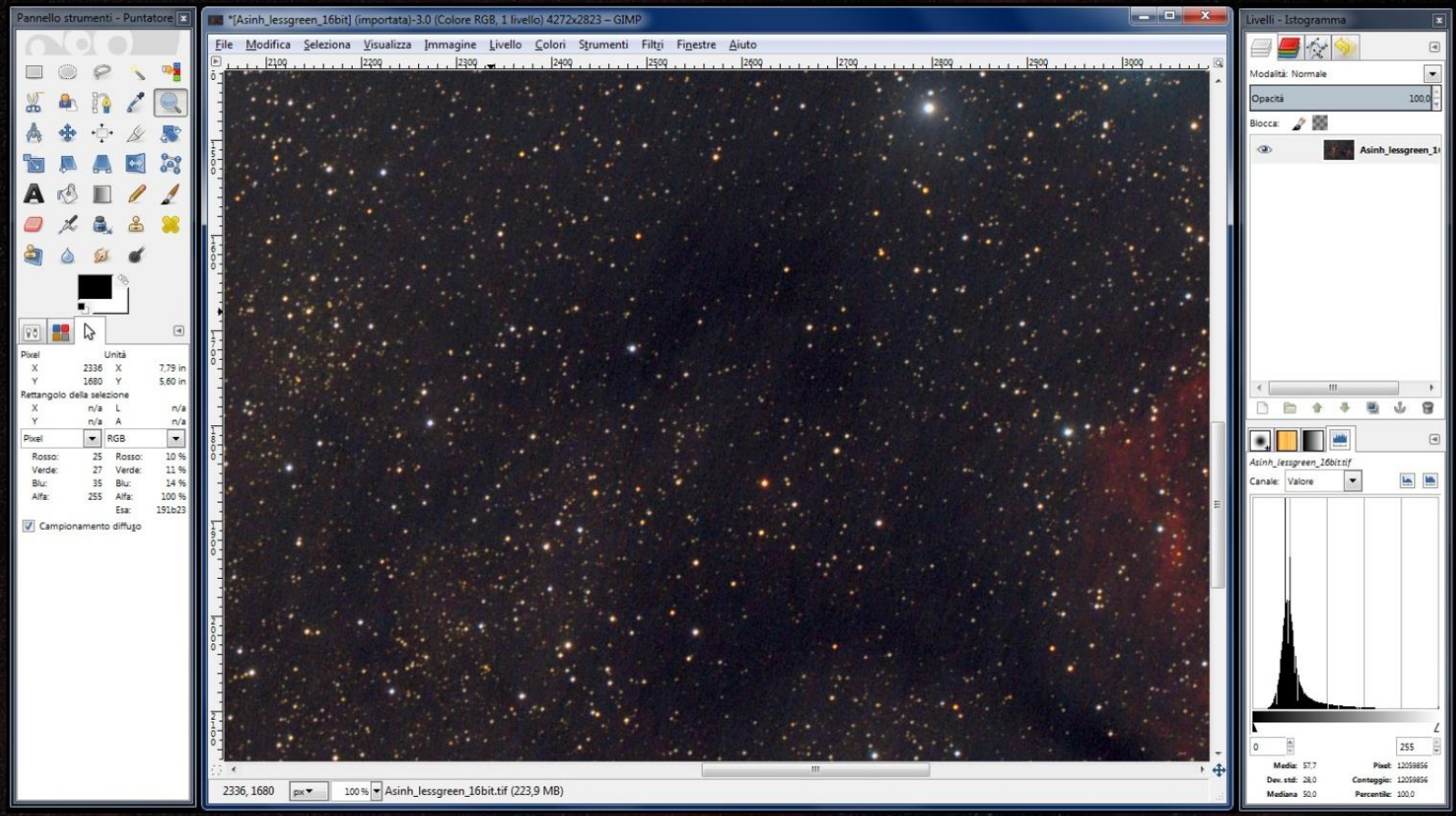
Excess green removal - PICTools



Levels- GIMP

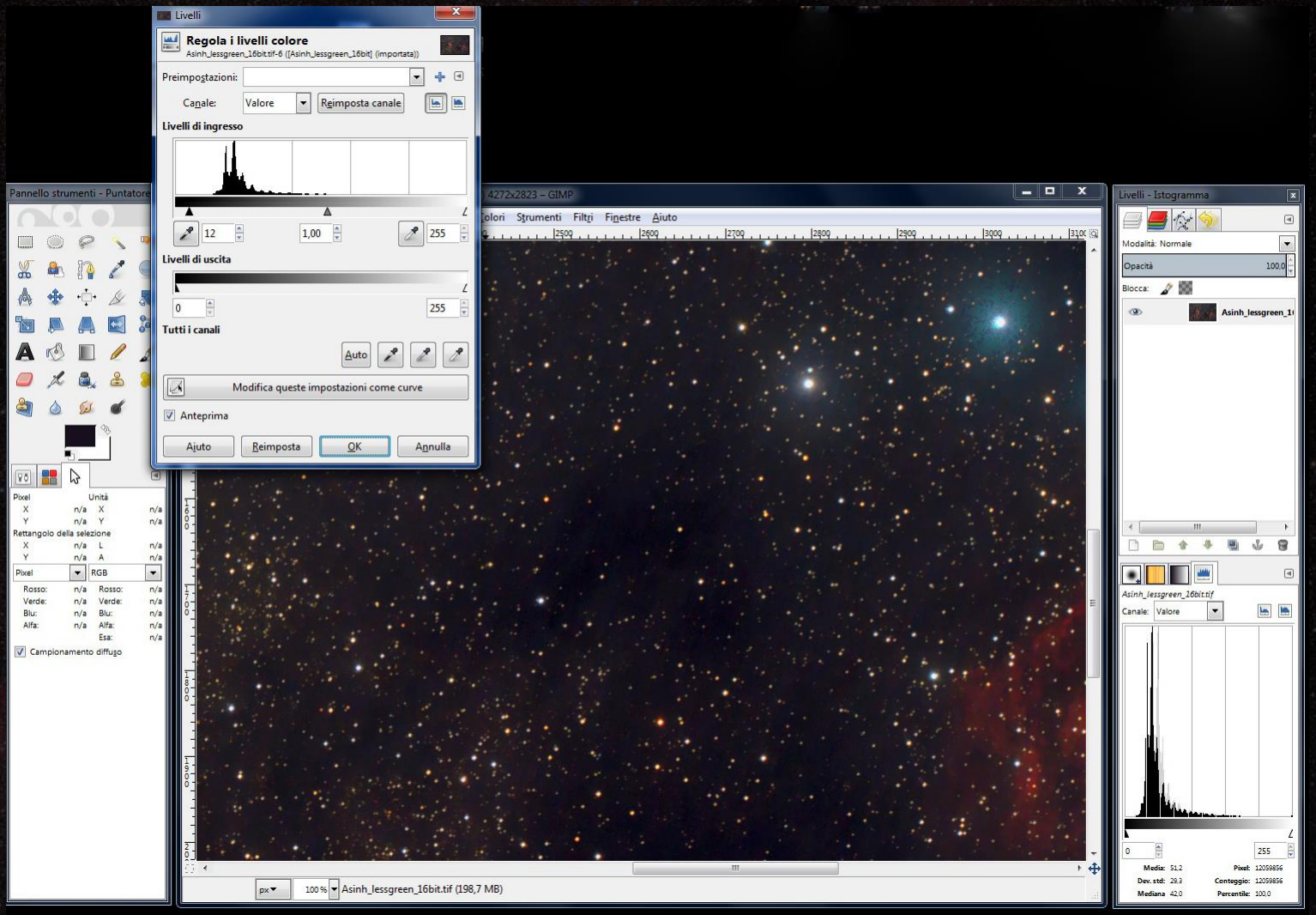

Pannello strumenti - Puntatore
[Asinh_lessgreen_16bit] (importata)-3.0 (Colore RGB, 1 livello) 4272x2823 – GIMP
File Modifica Seleziona Visualizza Immagine Livello Colori Strumenti Filtri Finestre Aiuto
Asinh_lessgreen_16bit.tif (112,7 MB)
Livelli
Regola i livelli colore
Asinh_lessgreen_16bit.tif-6 ([Asinh_lessgreen_16bit] (importata))
Preimpostazioni:
Canale: Blu
Reimposta canale
Livelli di ingresso
Livelli di uscita
Tutti i canali
Auto
Modifica queste impostazioni come curve
Anteprima
Aiuto
Reimposta
OK
Annulla
Livelli - Istogramma
Modalità: Normale
Opacità
Blocca:
Canale: Valore

Denoise (before) - GIMP

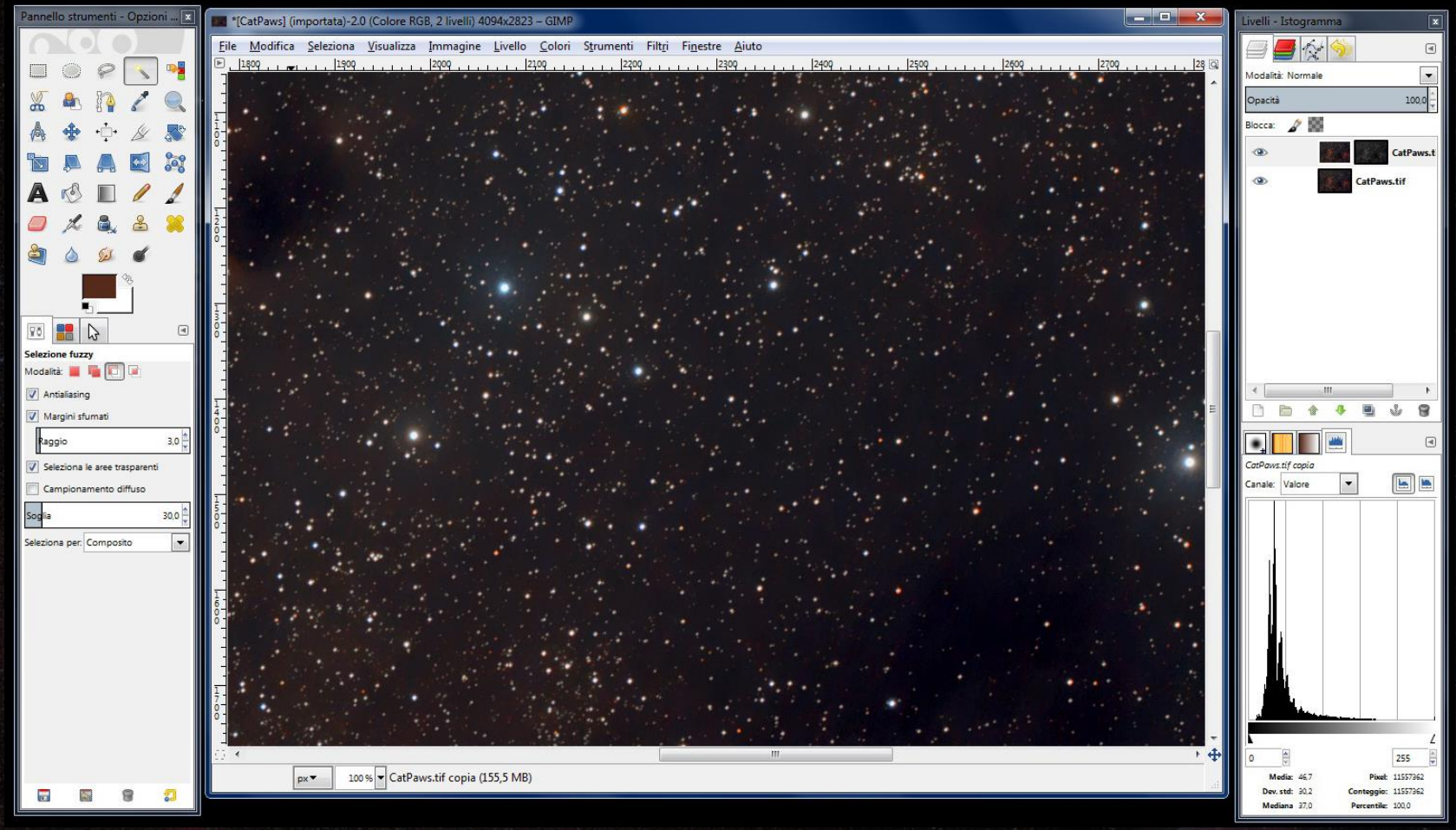


Denoise (after) - GIMP

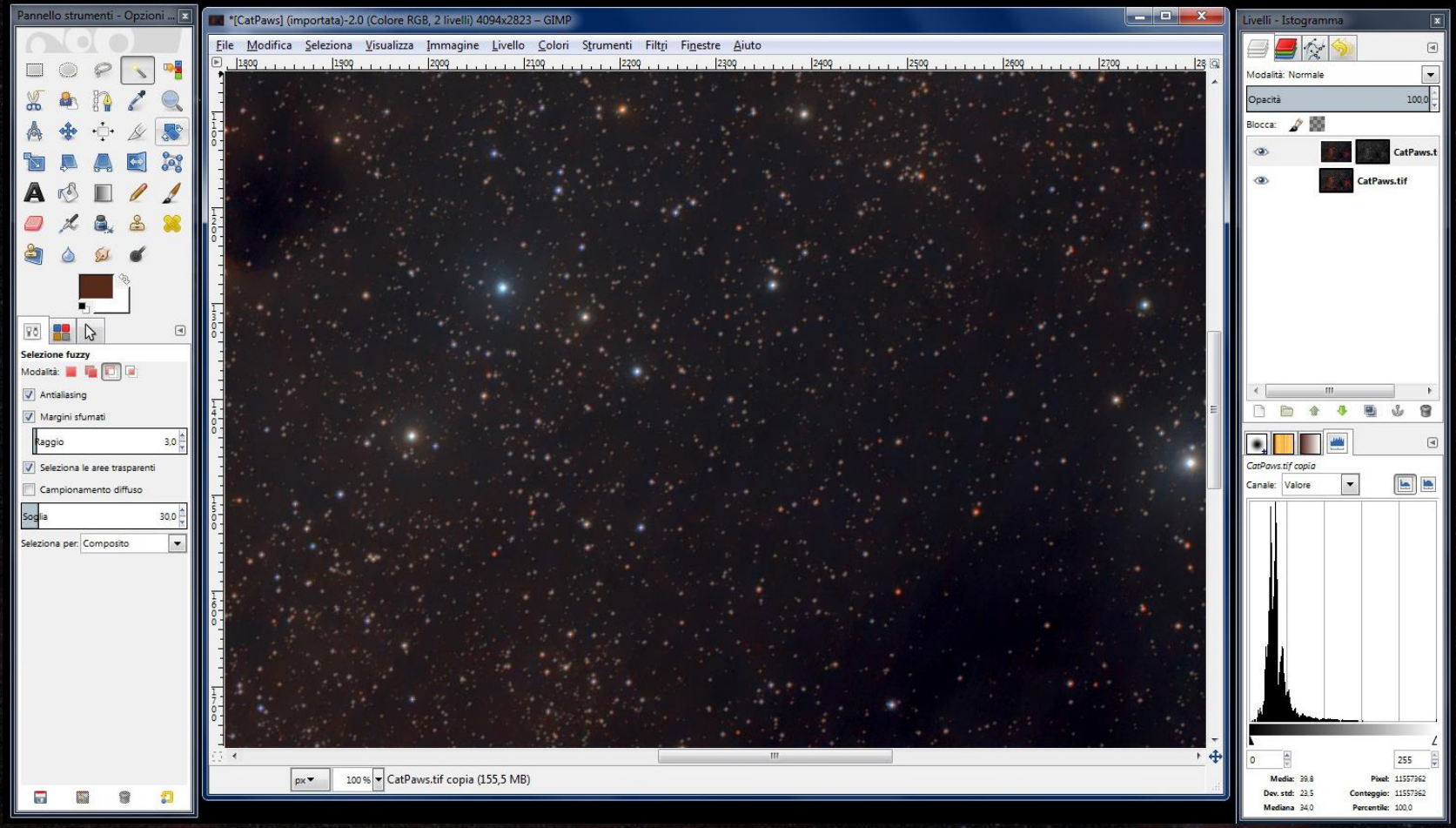
Levels (again) - GIMP



Star Size (before) - GIMP



Star Size (after) - GIMP



Final Image - GIMP

Other features

- Deconvolution, wavelets (IRIS, Fitswork)

- Mosaics/Geometrical distortions (IRIS)

Links to the aforementioned software

Name	Link
IRIS	http://www.astrosurf.com/buil/us/iris/iris.htm
Deep Sky Stacker	http://deepskystacker.free.fr/english/index.html
Regim	http://www.andreasroerig.de/regim/regim_e.htm
THELI GUI	http://www.astro.uni-bonn.de/theli/gui/index.html
Fitswork	http://www.fitswork.de/software/softw_en.php
PixInsight LE	N/A
PICTools	http://www.skymonsters.net/software.php
GIMP	http://www.gimp.org/downloads/
ImageJ	http://rsbweb.nih.gov/ij/download.html

Future enhancements

PICTools	- DDP - Better histogram - FITS compatibility
Regim	- Batch file conversion (ex: from FITS to TIFF and vice-versa) - Support for newer DSLR cameras - A photometry module
ImageJ	- Bilateral filtering - Better 16bit/channel support
GIMP	- 16-bit per channel support (due sometimes in 2013)
THELI	- Improved debayering algorithm - Mixing broad and narrow band images - Automated reduction of data sets

www.skymonsters.net

omega.centauri@gmail.com

It’s there and it’s free!
Go and get it now!

Thank you for your attention!