Astro Pixel Processor

drs. E.M.W.P. Haverkamp (Mabula)

overzicht

- introductie
- waarom Astro Pixel Processor (APP)?
- wat is APP?
- gebruikers interface

overzicht

- data reductie en nabewerking
- beta team
- slot

introductie

- Mabula?
- opleiding
- publicatie
- werk carrière
- en toen...

introductie - Mabula?

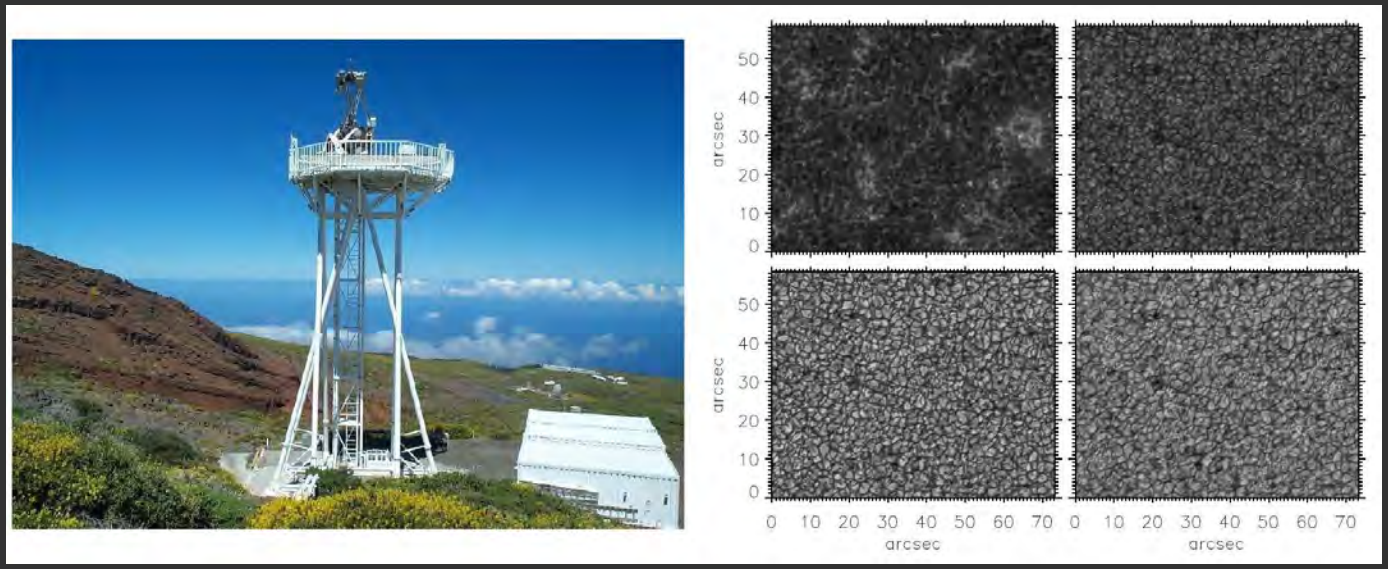
Mabula Haverkamp

10 april 1977, Ndala (Tanzania)

introductie - opleiding

drs. Sterrenkunde, Universiteit Utrecht 2004

Solar magnetic fluxtubes diagnosed from isolated internetwork bright points - An analysis of Dutch Open Telescope observations



introductie - publicatie

Astronomy & Astrophysics, AA 441, 1183-1190 (2005)

A&A 441, 1183-1190 (2005)
DOI: 10.1051/0004-6361:20053373

DOT tomography of the solar atmosphere

IV. Magnetic patches in internetwork areas

A. G. de Wijn[1], R. J. Rutten[1,2], E. M. W. P. Haverkamp[1] and P. Sütterlin[1]

[1] Sterrekundig Instituut, Utrecht University, Postbus 80 000, 3508 TA Utrecht, The Netherlands
e-mail: [A.G.deWijn;R.J.Rutten]@astro.uu.nl
[2] Institute of Theoretical Astrophysics, Oslo University, PO Box 1029 Blindern, 0315 Oslo, Norway

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Abstract

We use G-band and Ca II H image sequences from the Dutch Open Telescope (DOT) to study magnetic elements that appear as bright points in internetwork parts of the quiet solar photosphere and chromosphere. We find that many of these bright points appear recurrently with varying intensity and horizontal motion within longer-lived magnetic patches. We develop an algorithm for detection of the patches and find that all patches identified last much longer than the granulation. The patches outline cell patterns on mesogranular scales, indicating that magnetic flux tubes are advected by granular flows to mesogranular boundaries. Statistical analysis of the emergence and disappearance of the patches points to an average patch lifetime as long as 530 ± 50 min (about nine hours), which suggests that the magnetic elements constituting strong internetwork fields are not generated by a local turbulent dynamo.

introductie - werk carrière

- Market Maker bij Curvalue, 2005-2009
- Middleware consultant voor Axxius BV, 2010-2011
- en toen... 2011-2016

introductie - en toen...

Sterke gezondheids problemen...

Na 2 jaar ziekte, diagnose: Chronische Sarcoïdose

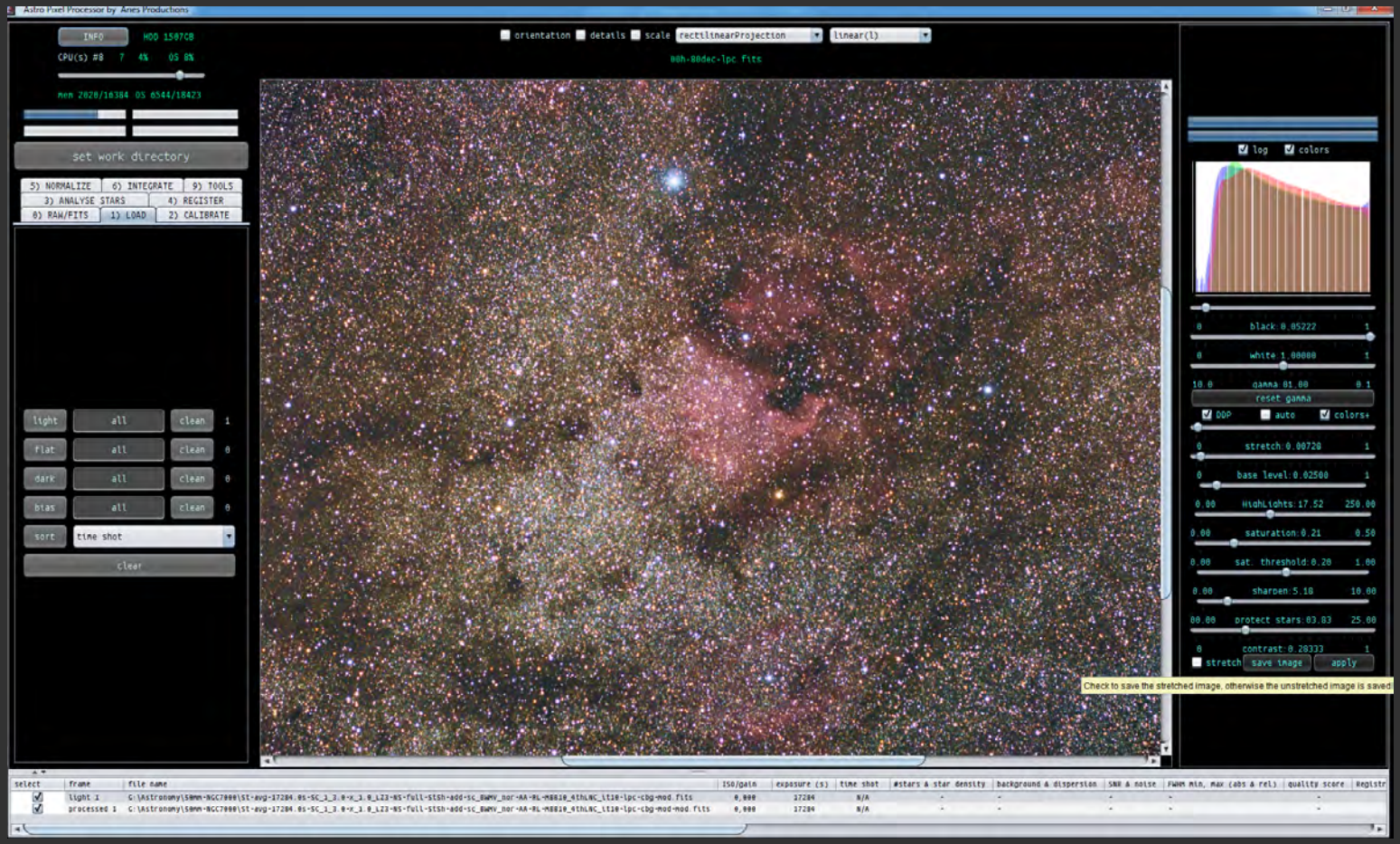
Geen arbeids mogelijkheden vanwege de beperkingen

Astro Pixel Processor?

jASS - java Align Stack Stretch?
Deep Space Integrator?

geniale ingeving van Rob Musquetier!

waarom Astro Pixel Processor?



waarom Astro Pixel Processor?

- eigen reïntegratie
  - kennis en vaardigheden op peil houden
  - niet overgeven aan de ziekte
- sterrenkunde achtergrond
  - kennis van het onderwerp
  - analytisch/wiskundig programmeren
- geadvanceerde techniek eenvoudig toe te passen

waarom Astro Pixel Processor?

- middleware/ict achtergrond
- wat gebeurd er met mijn data?
- wetenschappelijk verantwoord
- iets moois maken
- heel erg leuk!

wat is APP?

Astro Pixel Processor by Aries Productions
INFO
HDD 670GB
set work directory
5) NORMALIZE
6) INTEGRATE
9) TOOLS
3) ANALYSE STARS
4) REGISTER
0) RAW/FITS
1) LOAD
2) CALIBRATE
light
flat
dark
bias
sort
time shot
clear
orientation
details
scale
rectilinearProjection
linear(l)
log
colors
reset gamma
stretch
apply

wat is APP?

compleet programma voor ver-/bewerking van Deep Sky opnames

- data calibratie middels bias, darks, flats & Bad Pixel Mapping
- analyseren van sterren, vorm en grootte
- registreren/uitlijnen van opnames, regulier en mozaïeken

wat is APP?

compleet programma voor ver-/bewerking van Deep Sky opnames

- data normalisatie
- data integratie/stacken
- nabewerkings tools

gebruikers interface

gebruikers interface

- informatie hardware bronnen
- controle paneel
- opname informatie
- opname venster
- histogram en opname filter

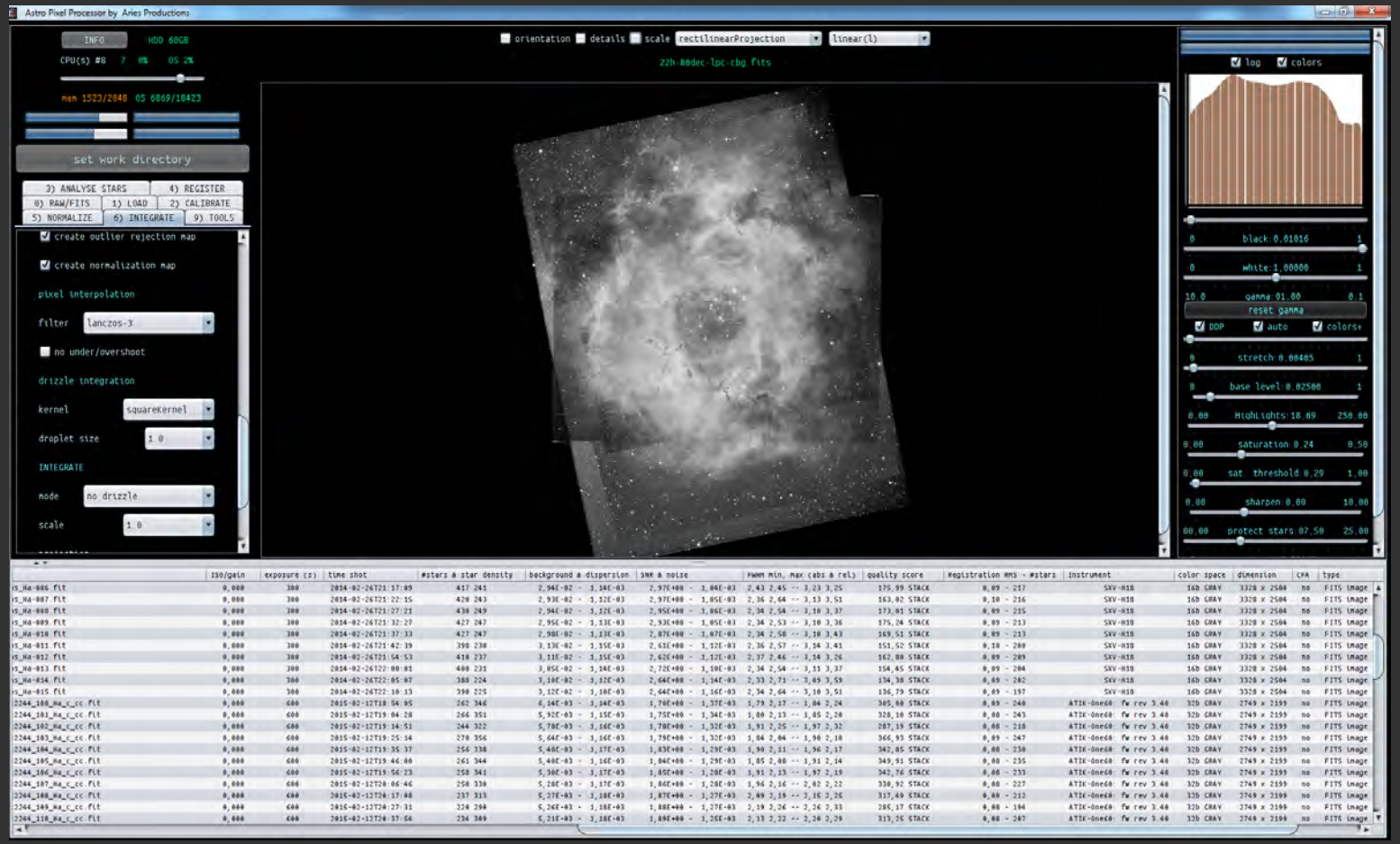
informatie hardware bronnen

informatie hardware bronnen

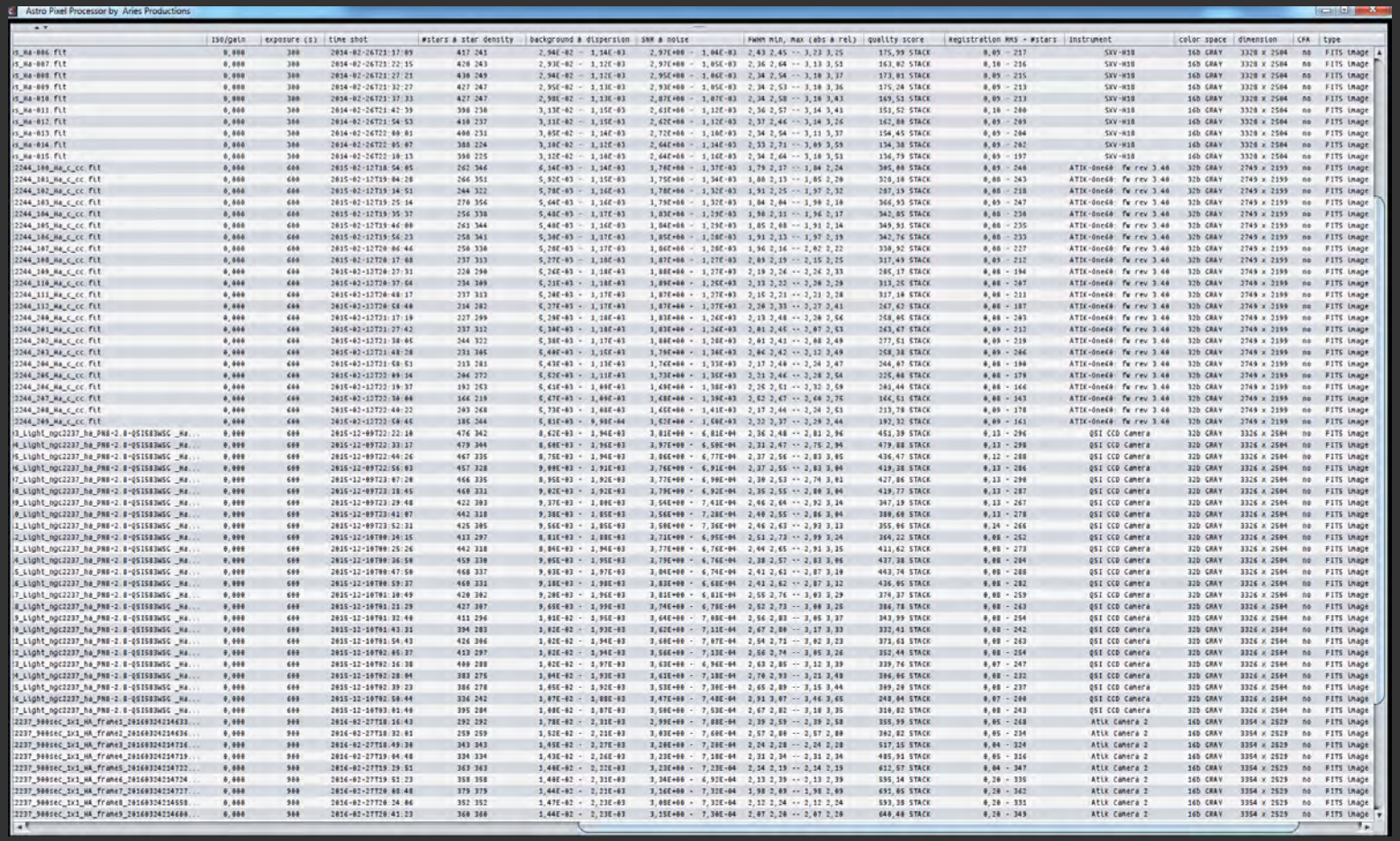
- licentie informatie
- HDD ruimte
- CPU(s), APP & OS
- geheugen, APP & OS
- voortgang indicatoren

controle paneel

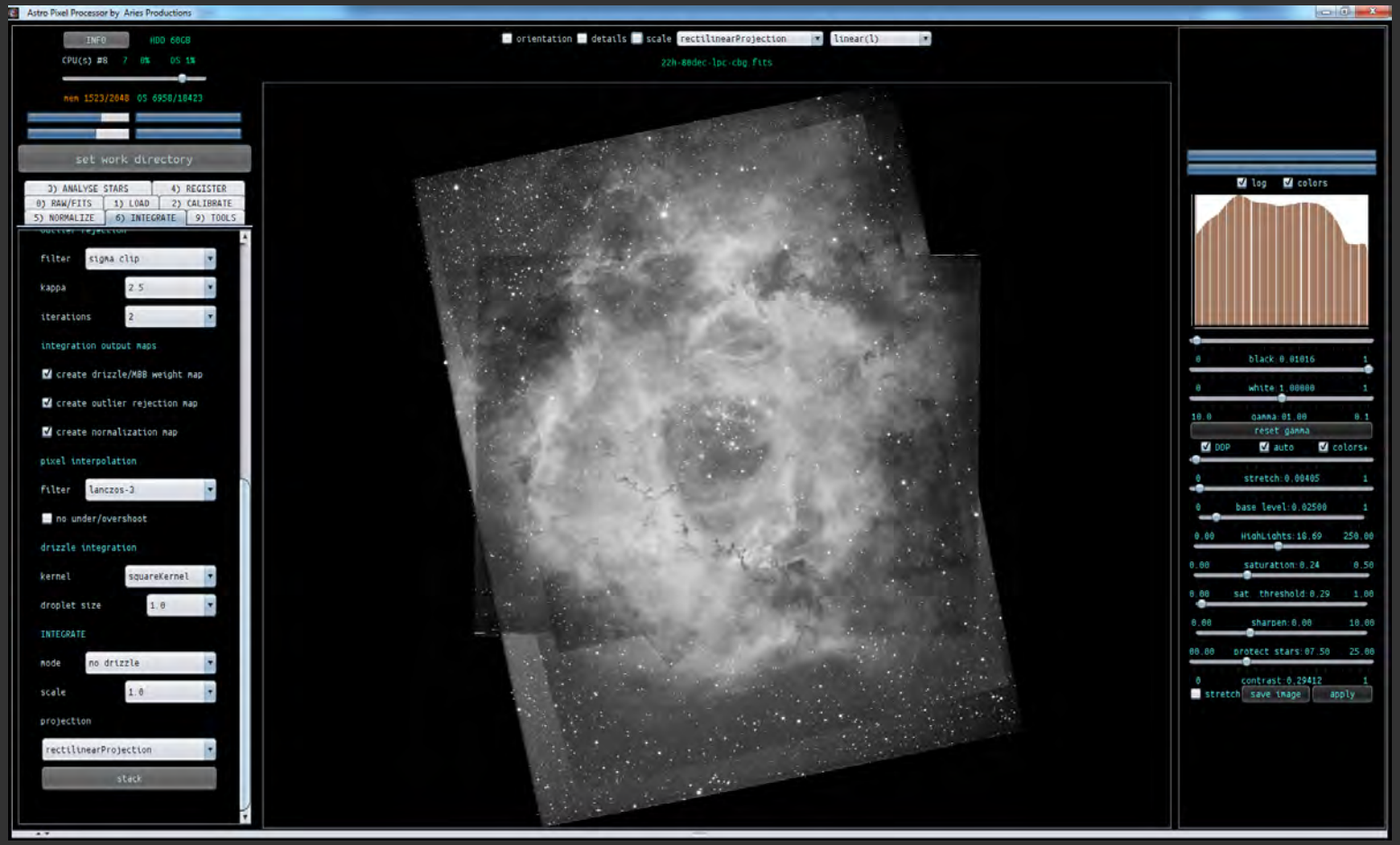
opname informatie



opname informatie



opname informatie

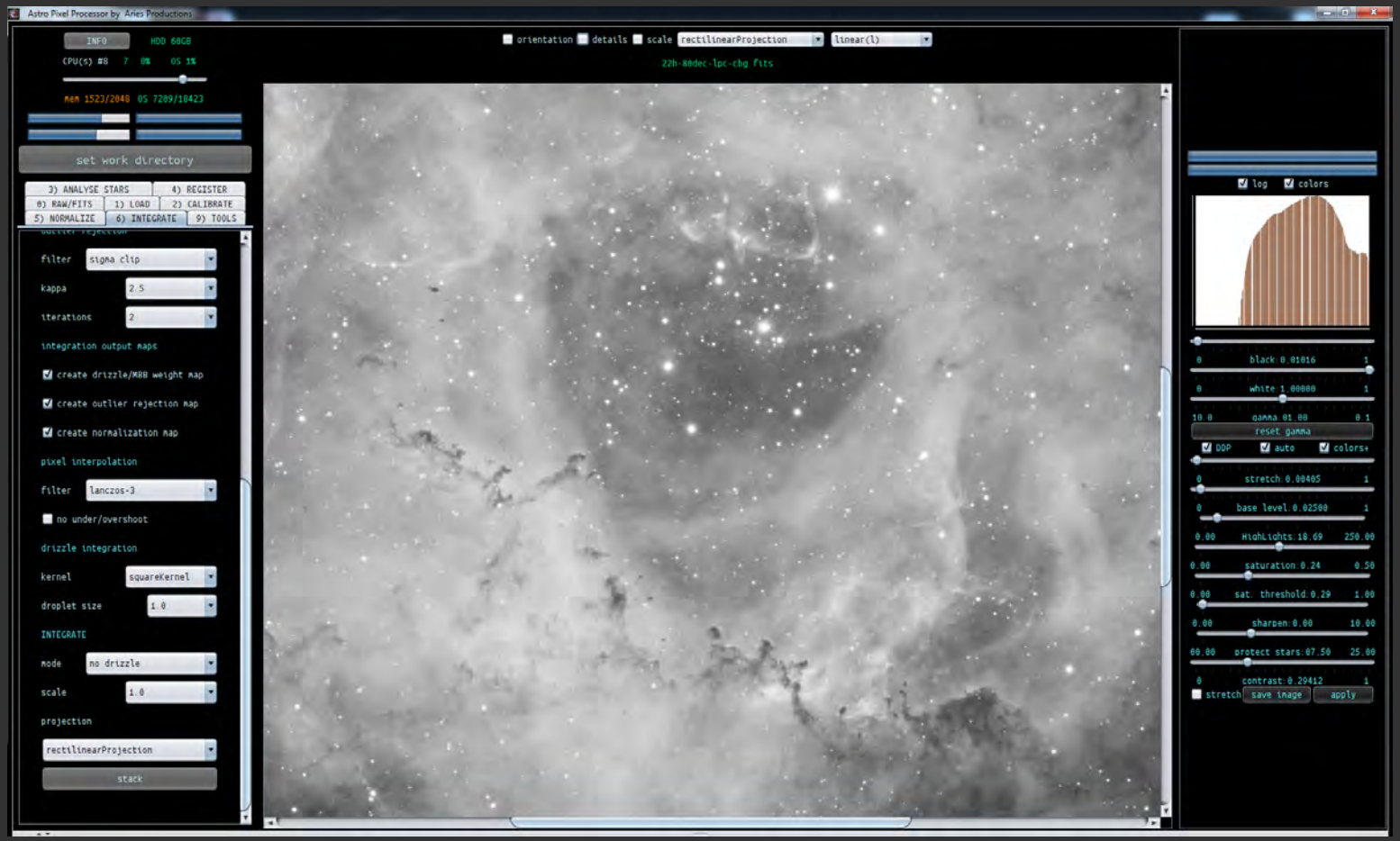


Astroforum.nl Forumpower

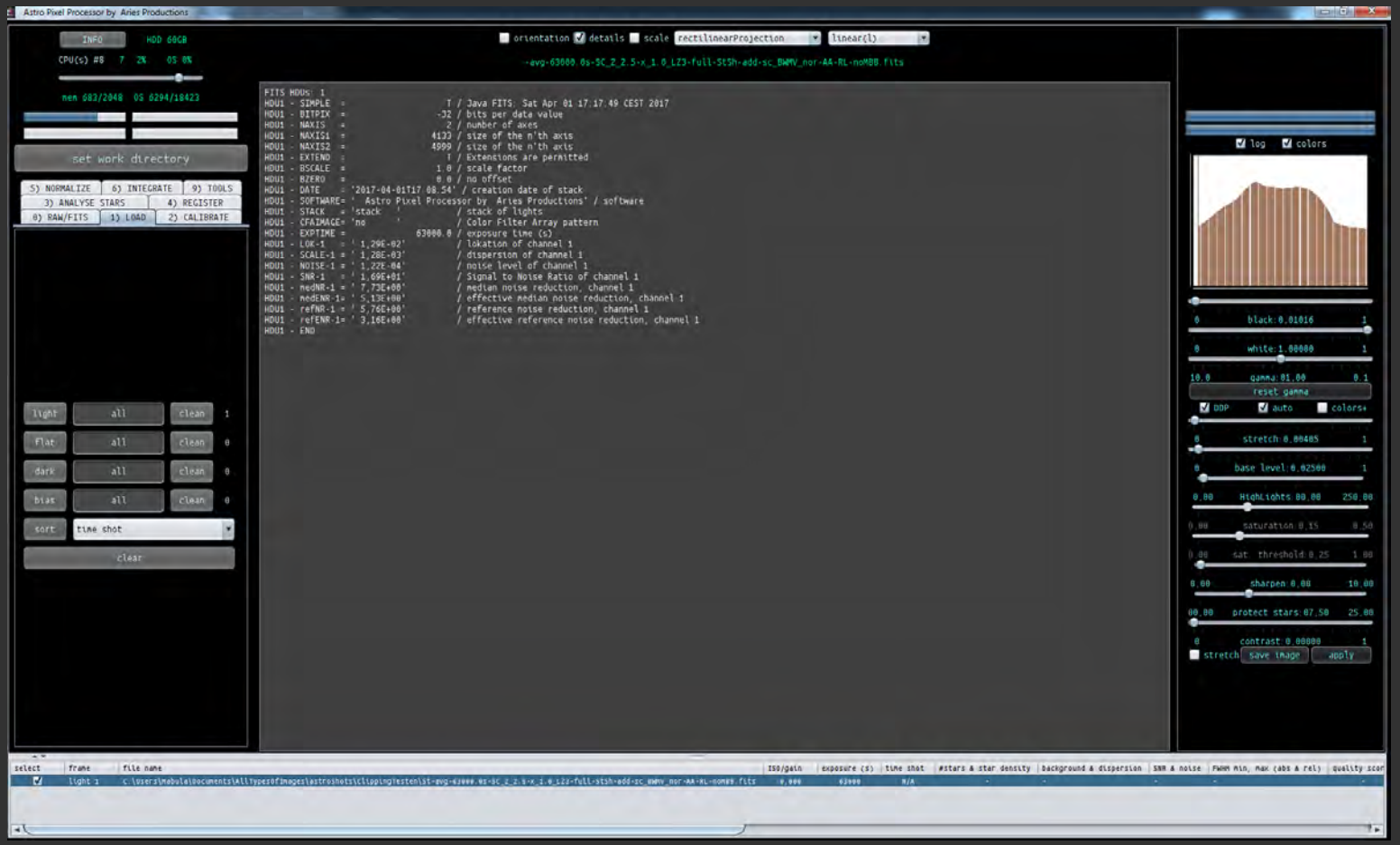
Rosette H-alpha data credits:

- Irving Pieters
- Michael van Doorn
- André van der Hoeven
- Rob Musquetier
- Ruud de Vries

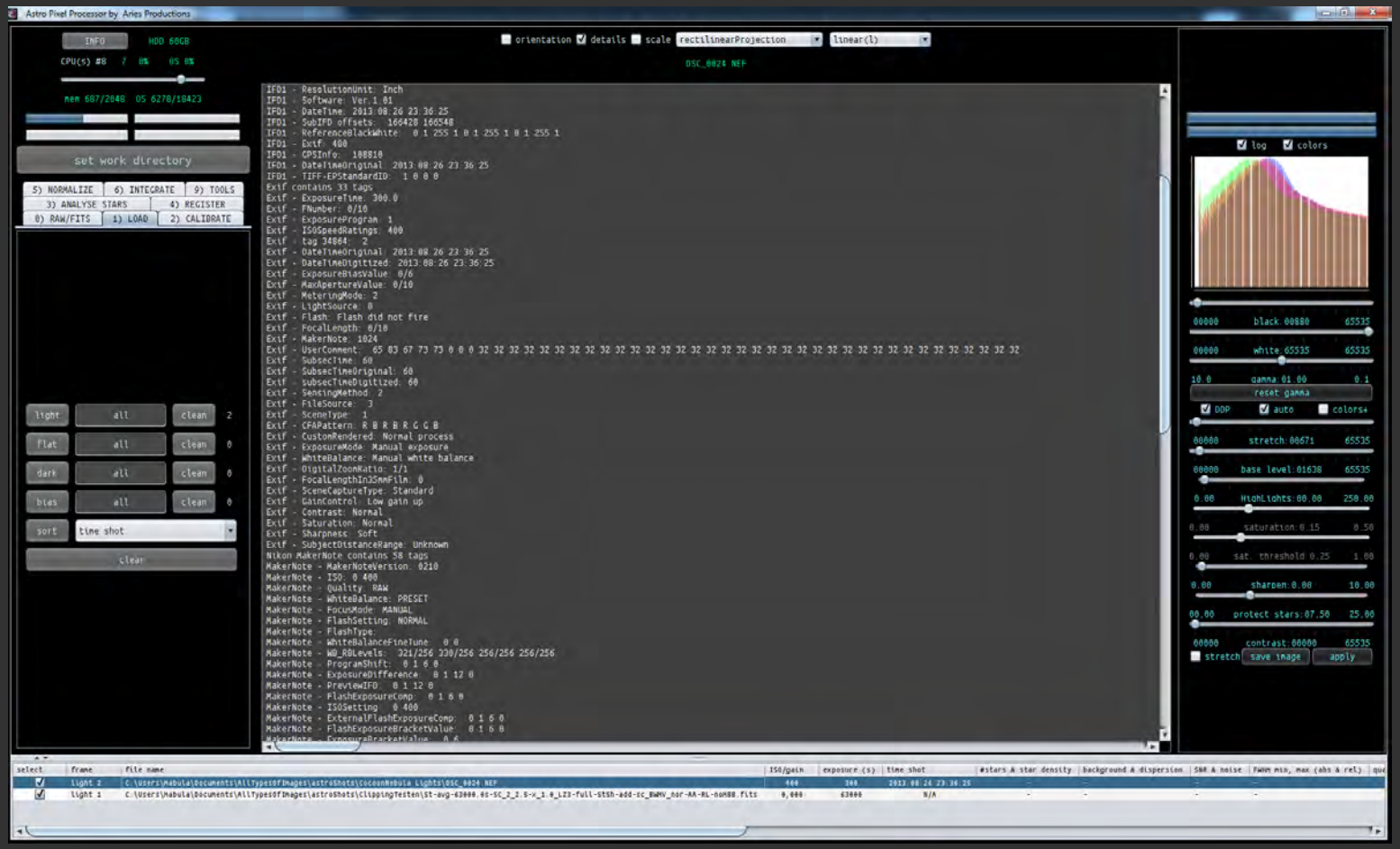
opname venster - opname



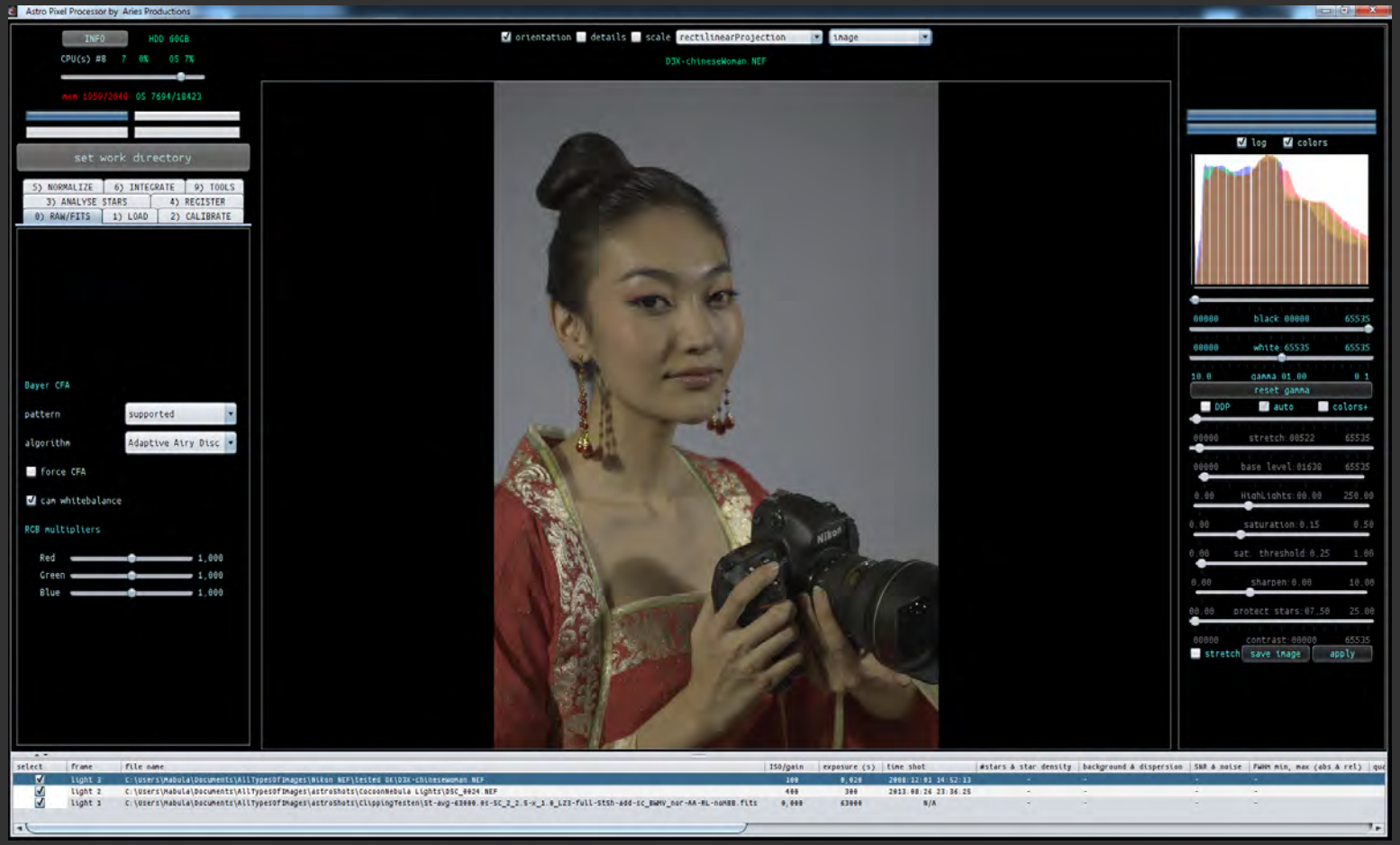
opname venster - meta data



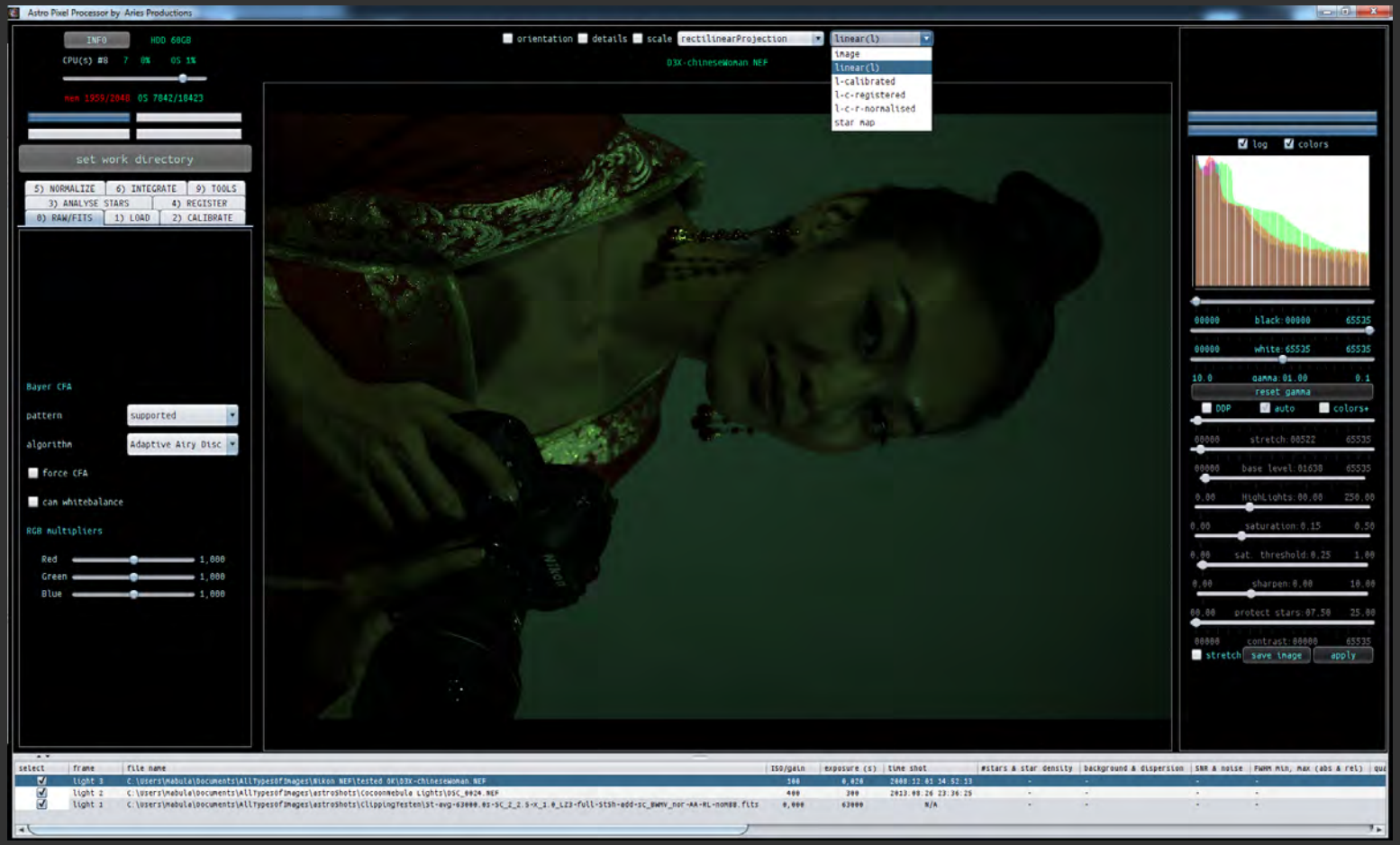
opname venster - meta data



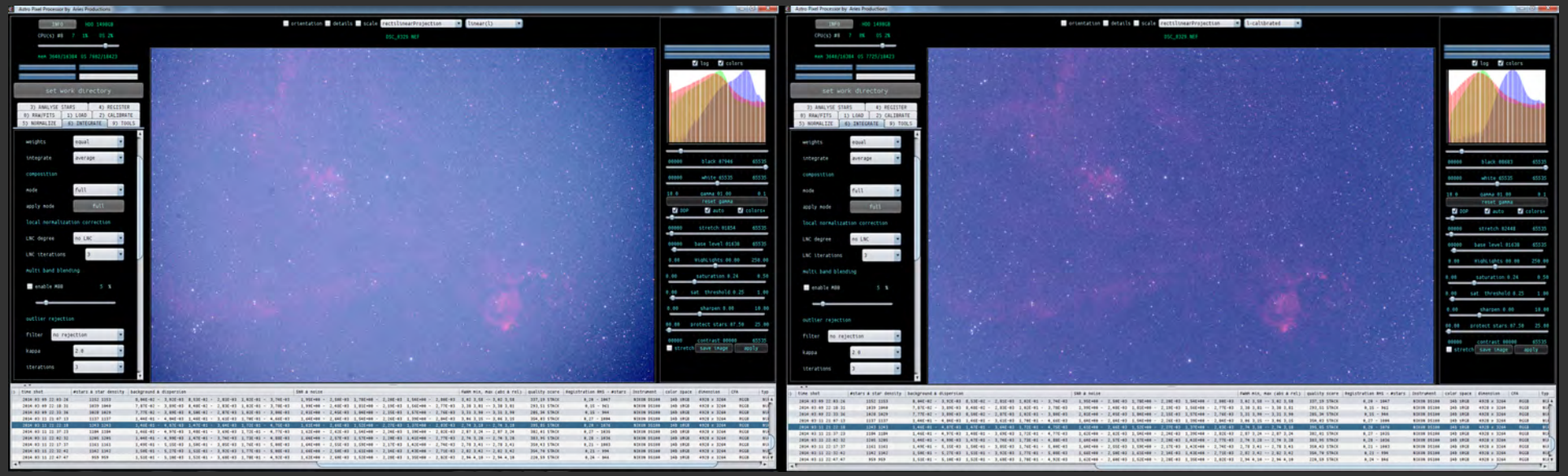
opname venster - image mode



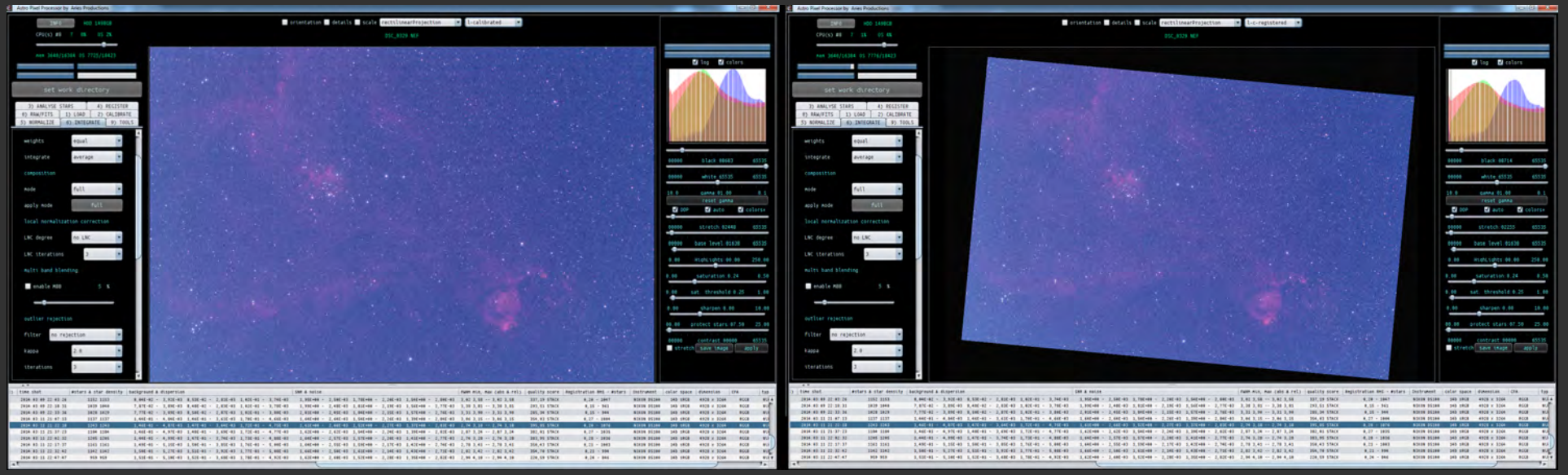
opname venster - linear mode



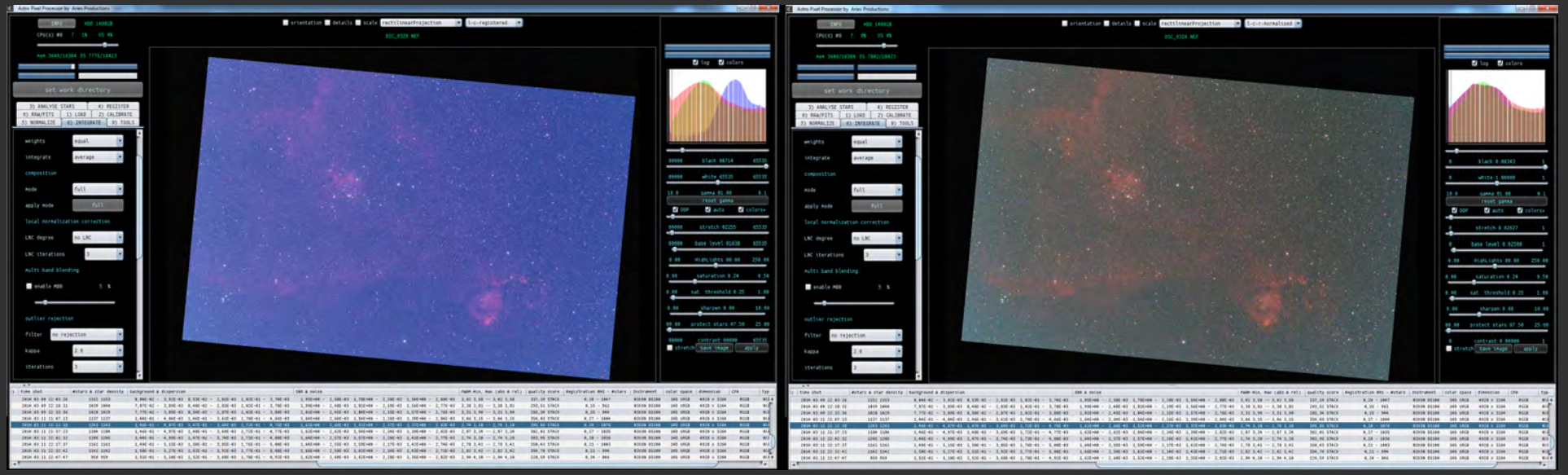
opname venster - linear & calibrated mode



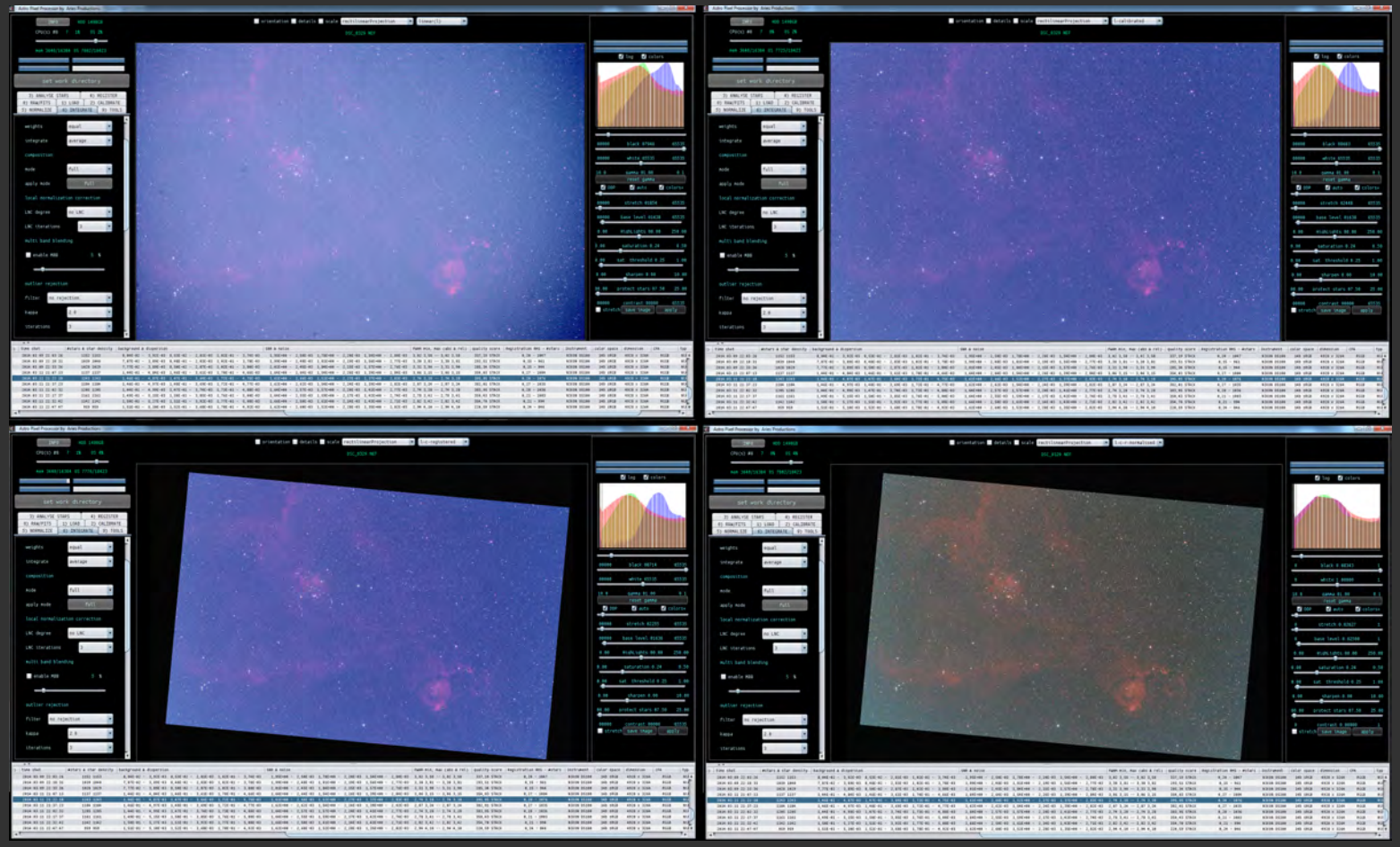
opname venster - calibrated & registered mode



opname venster - registered & normalized mode



opname venster - linear to normalized mode



histogram en opname filter - Orion data

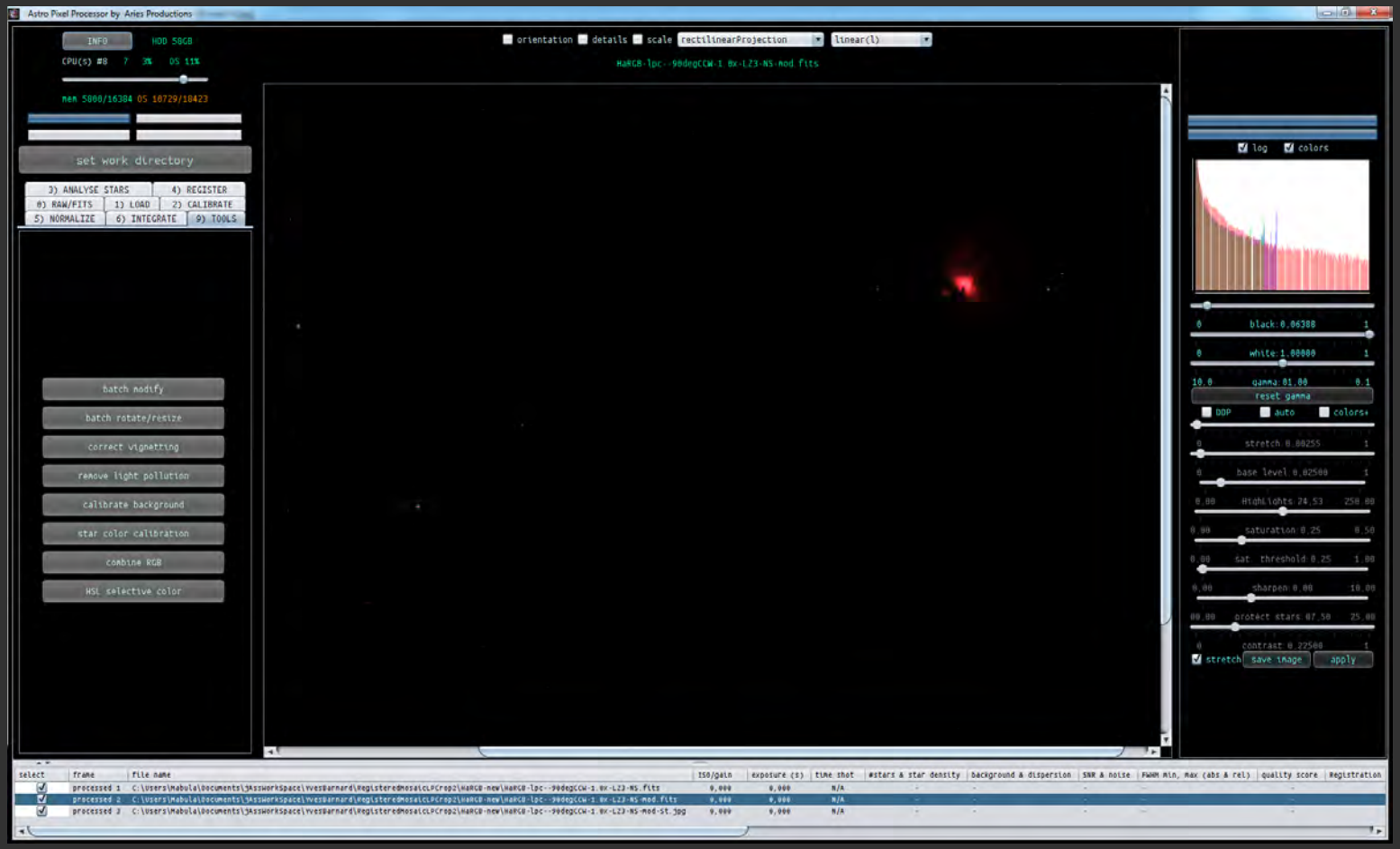
Yves van den Broek

M42 uit Barnard's Loop HaRGB

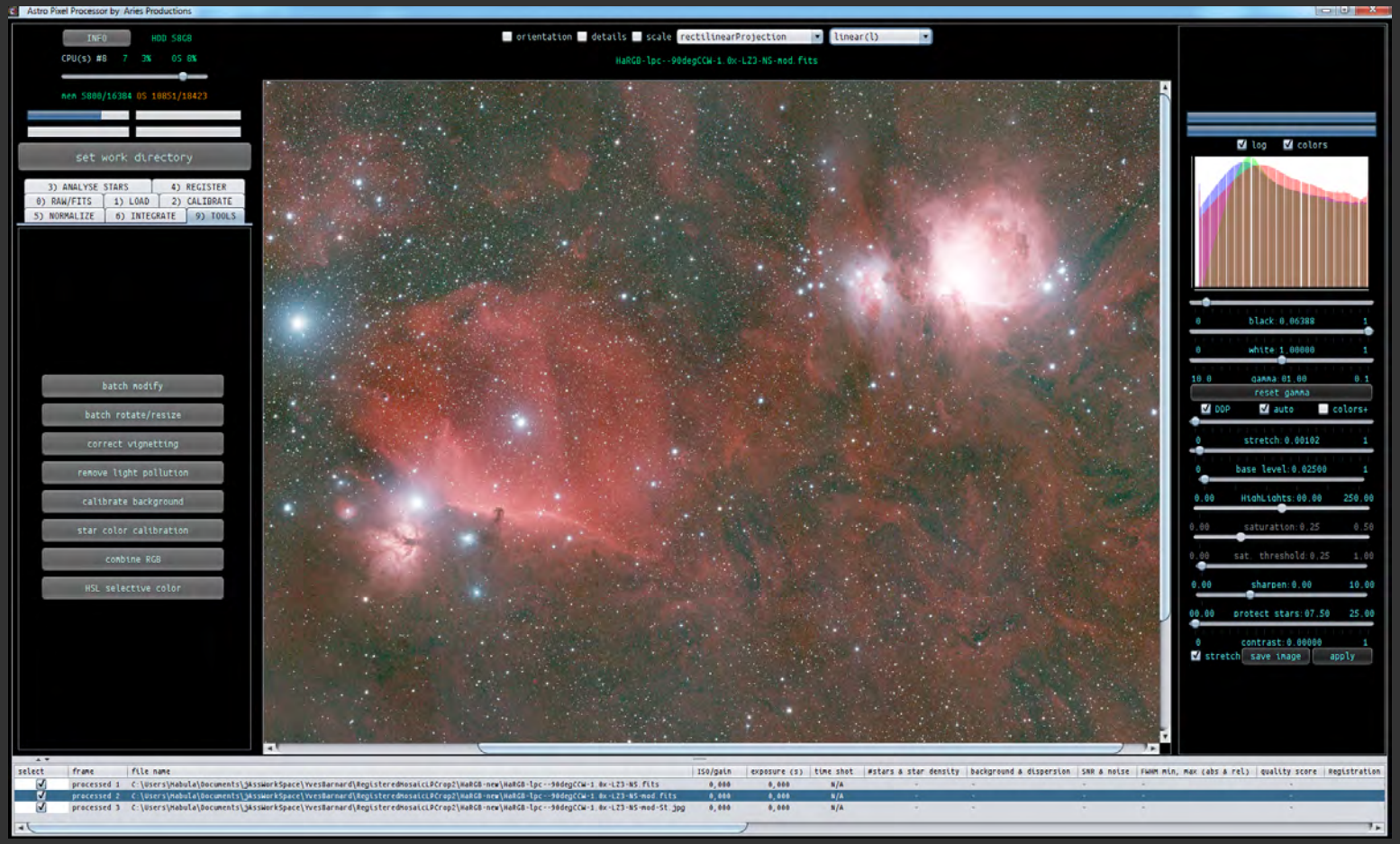
44 uur belichting

RGB - Nikon D810a
H-alpha - Nikon D600 mono cooled

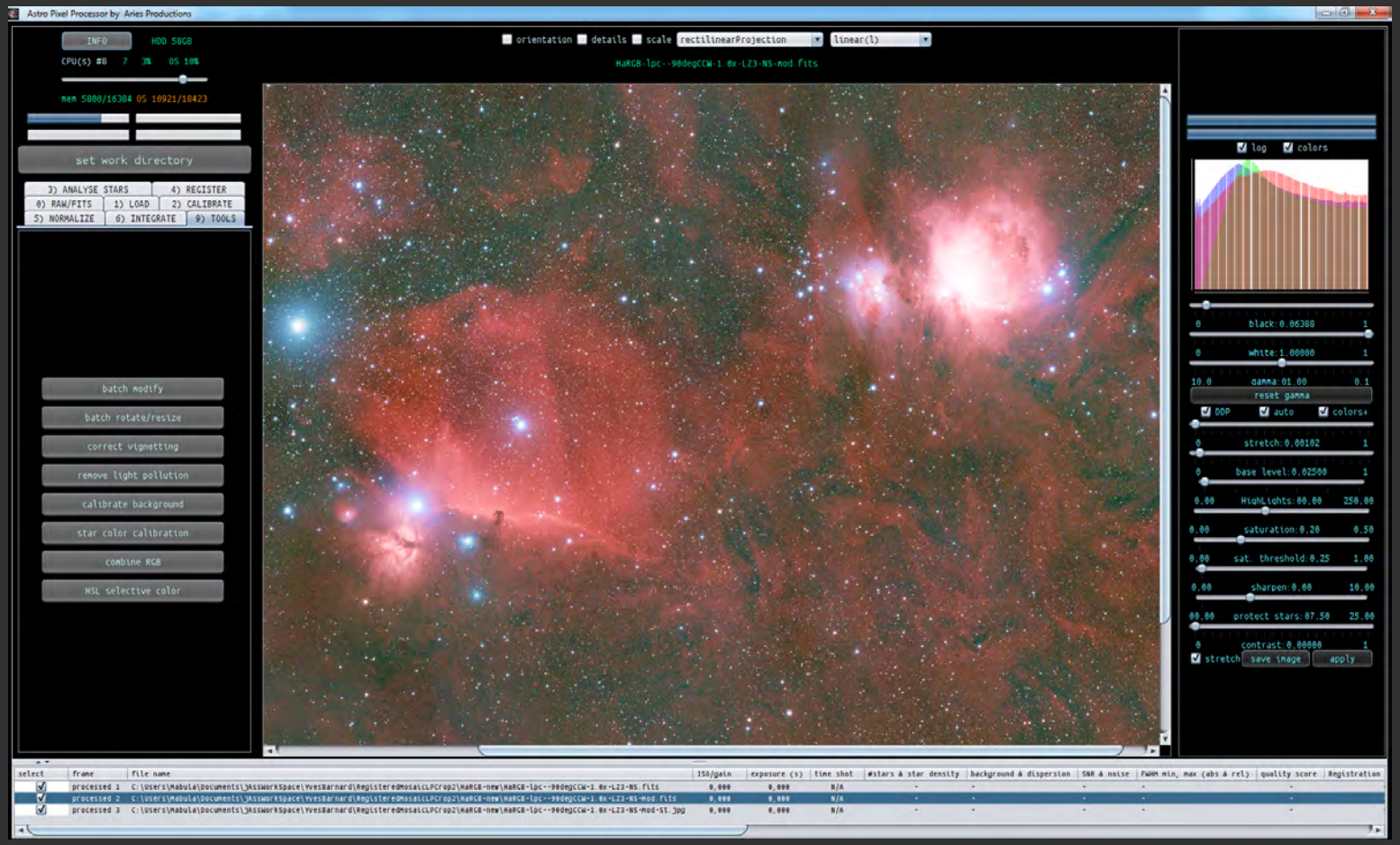
histogram en opname filter - black point



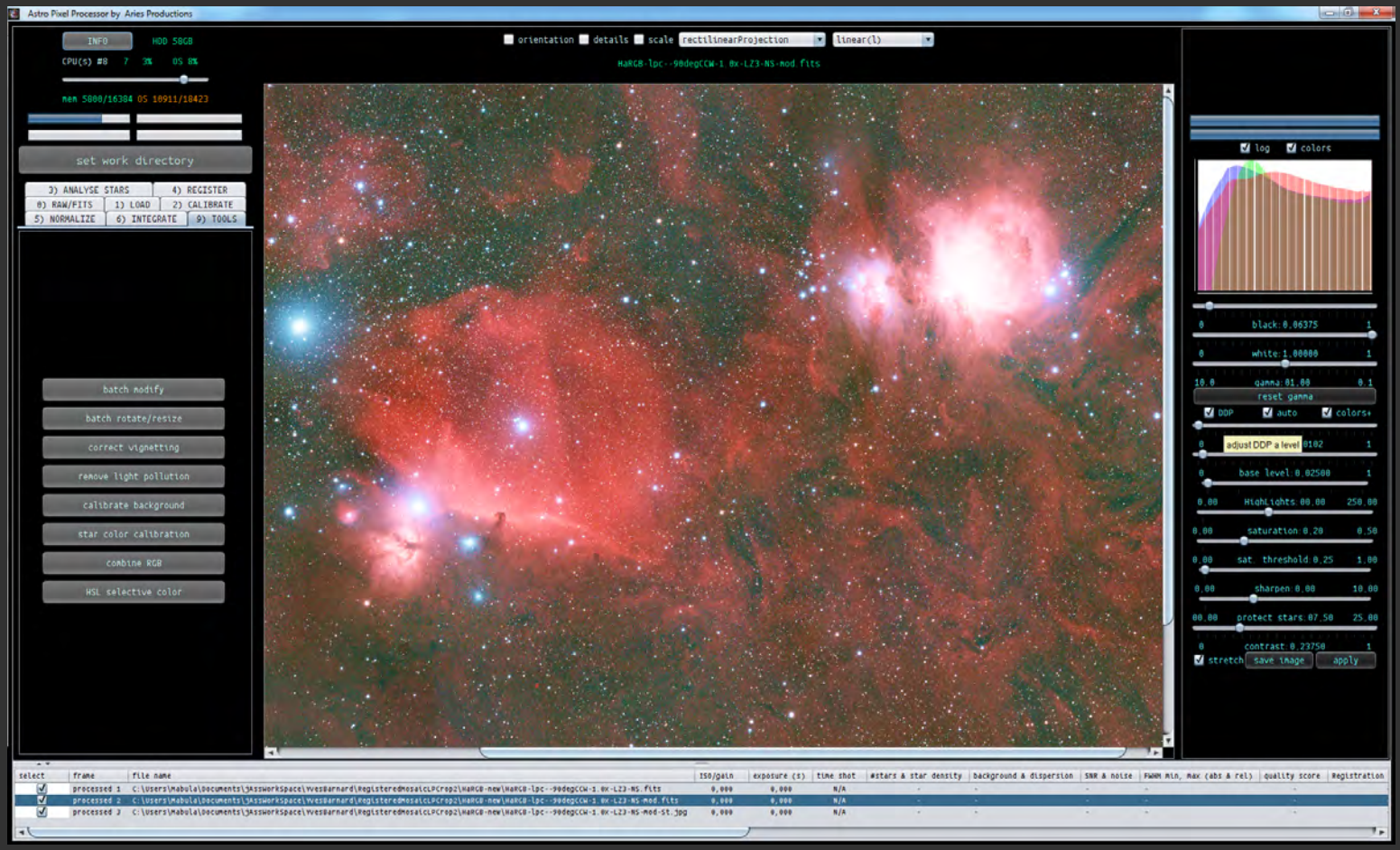
histogram en opname filter - auto DDP



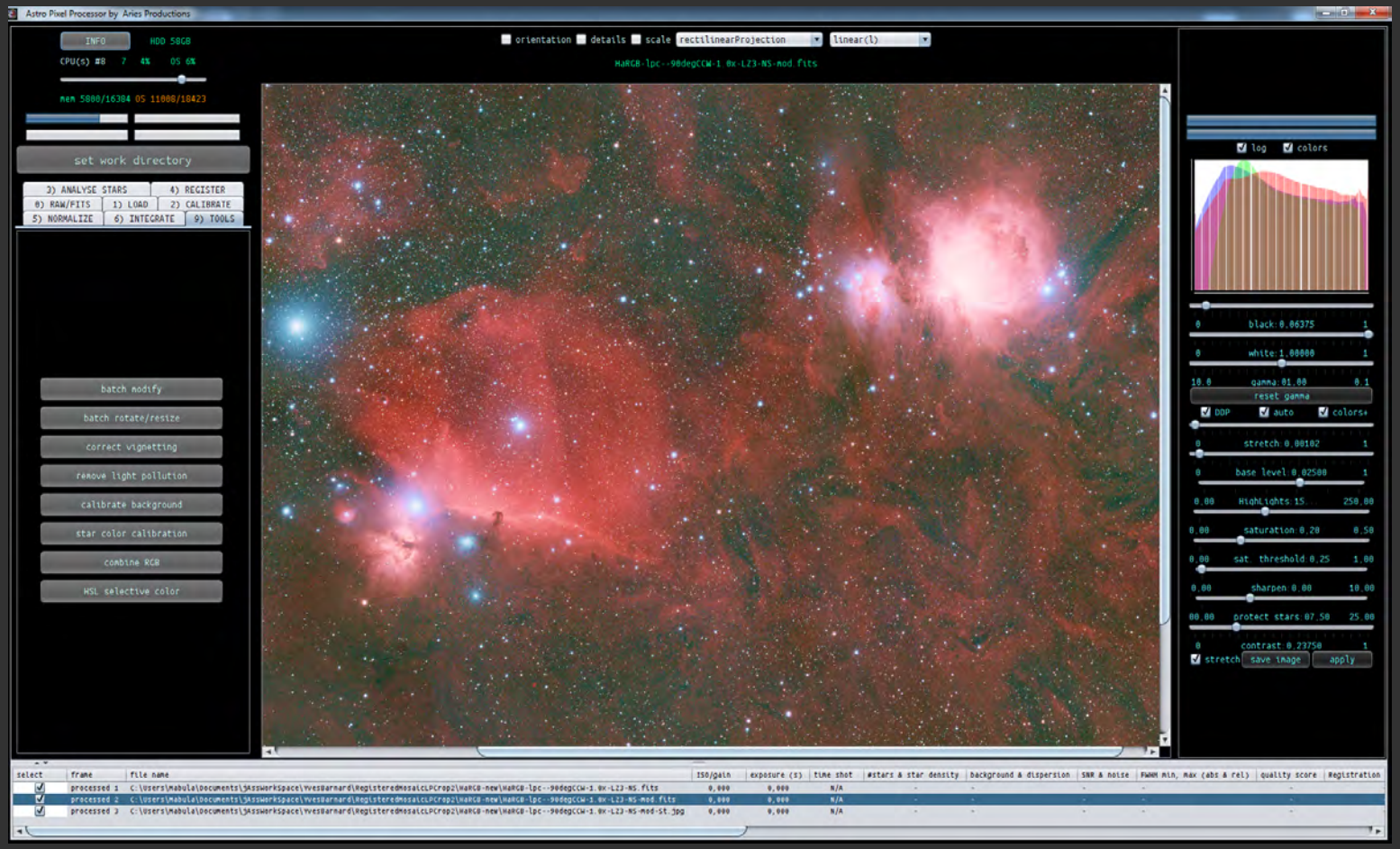
histogram en opname filter - saturatie



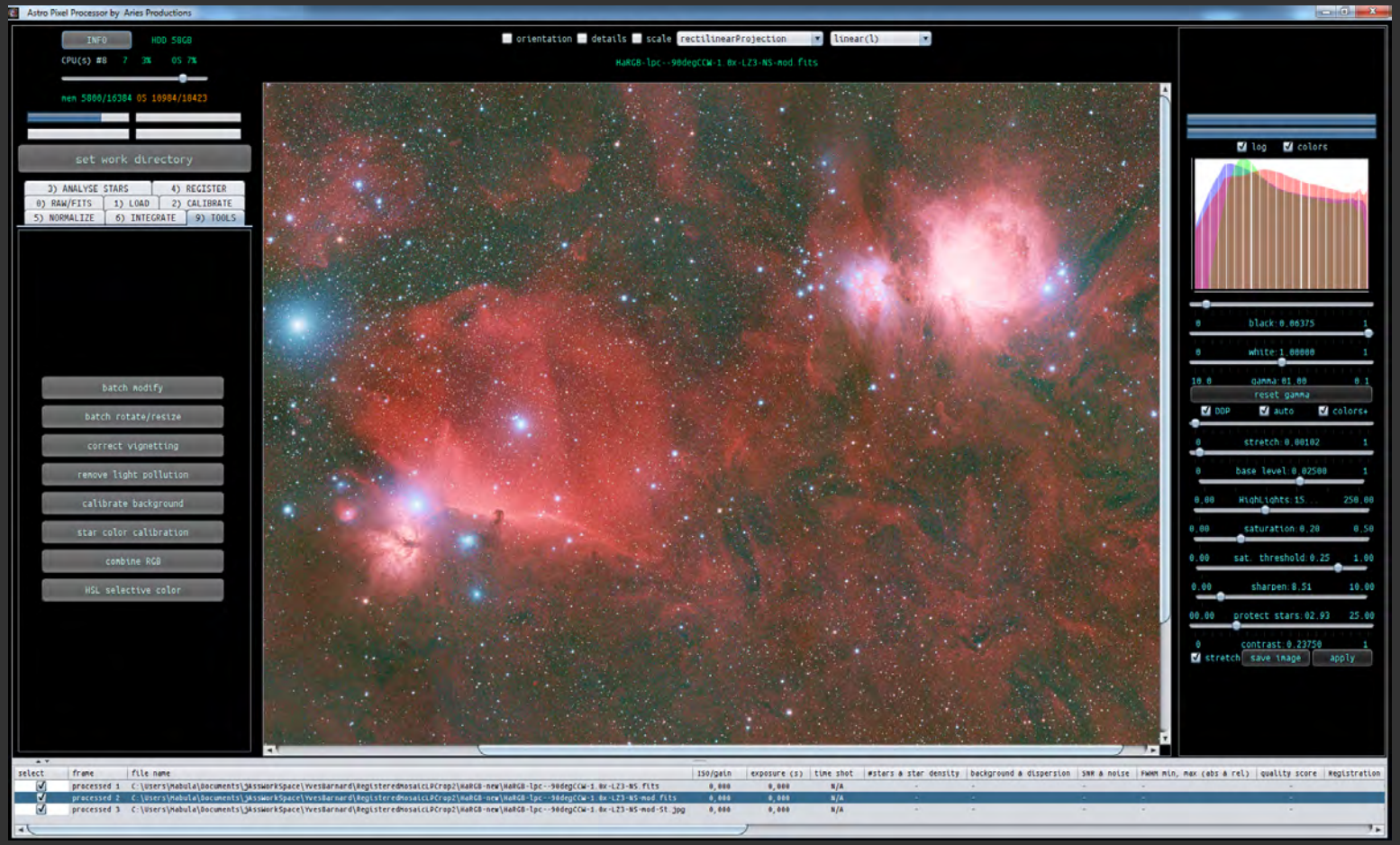
histogram en opname filter - contrast



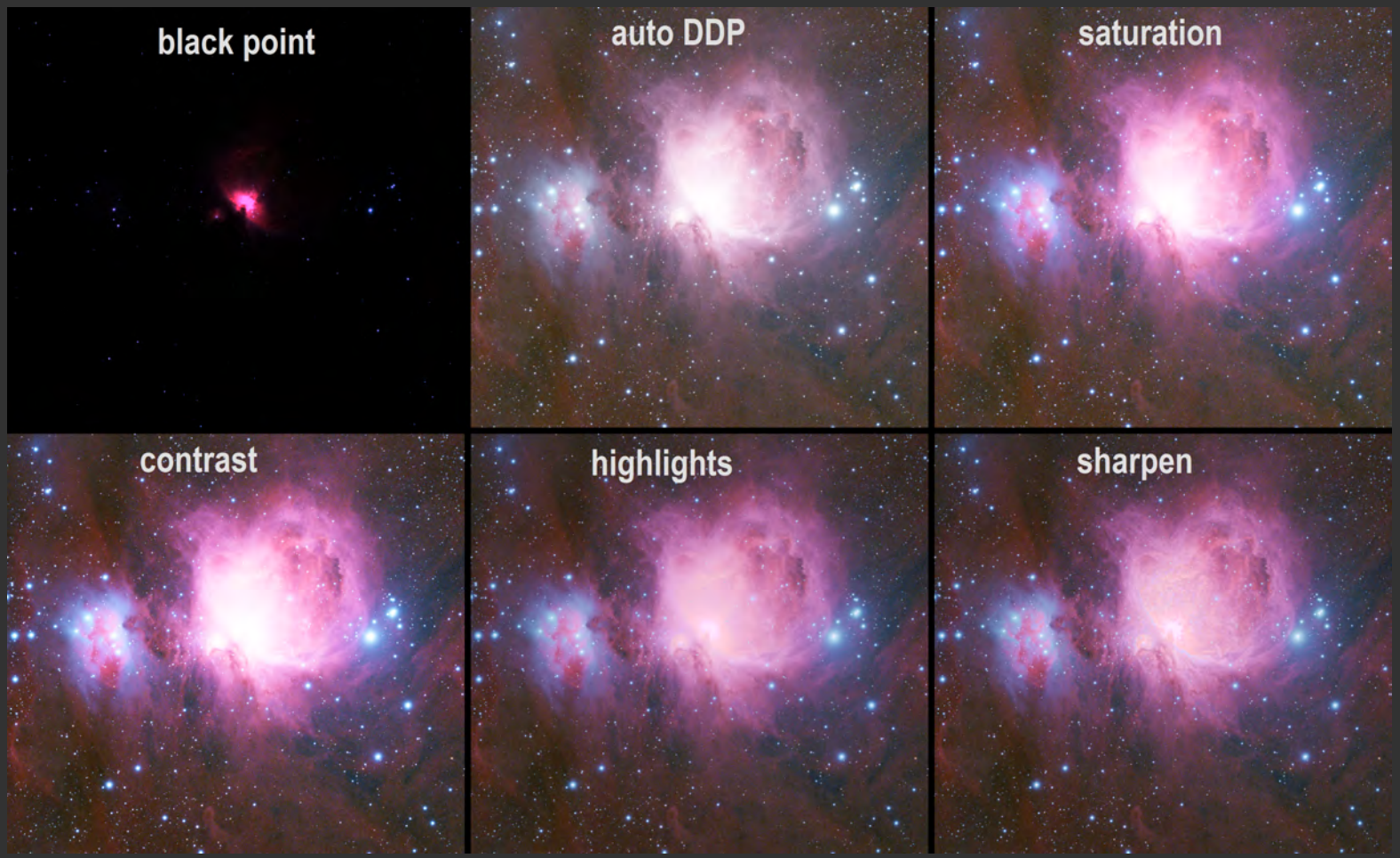
histogram en opname filter - highlights



histogram en opname filter - sharpen



histogram en opname filter - overzicht



histogram en opname filter - opslaan afbeelding

- gestretcht/niet-gestretcht
- 32/16/8 bits uncompressed TIFF
- 8 bits JPG met kwaliteitskeuze
- 64/32/16/8 bits FITS
- TIFF & JPG met ICC profiel

data integratie en nabewerking

- 0) RAW/FITS
- 1) LOAD
- 2) CALIBRATE
- 3) ANALYSE STARS

data integratie en nabewerking

- 4) REGISTER
- 5) NORMALIZE
- 6) INTEGRATE
- 9) TOOLS

0) RAW/FITS

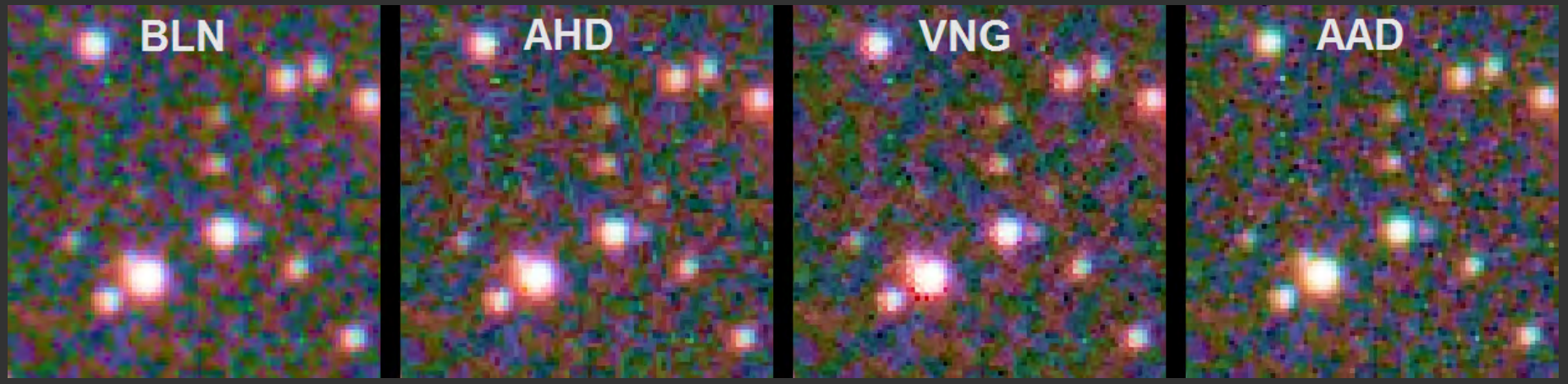
- Bayer CFA patroon (RGGB)
- Bayer CFA algoritme (AAD)
- camera witbalans
- RGB factoren
- forceer CFA interpretatie

CFA debayer algoritmes

- geen interpolatie
- bilinear
- adaptive edge
- adaptive airy disc
- super pixel

Adaptive Airy Disc - AAD

zelf ontwikkeld algoritme
voor onze sterrenfoto's



Adaptive Airy Disc - AAD

vergeleken met AHD & VNG

- beste resolutie
- minder artefacten, achtergrond/sterren
- minder chromatische ruis in achtergrond
- echt ronde sterren
- betere kleuren na achtergrond/sterkleur calibratie

CFA debayer algoritmes - smalband

- hydrogen alpha
- hydrogen beta
- Sulfur II
- Oxygen III
- Nitrogen II

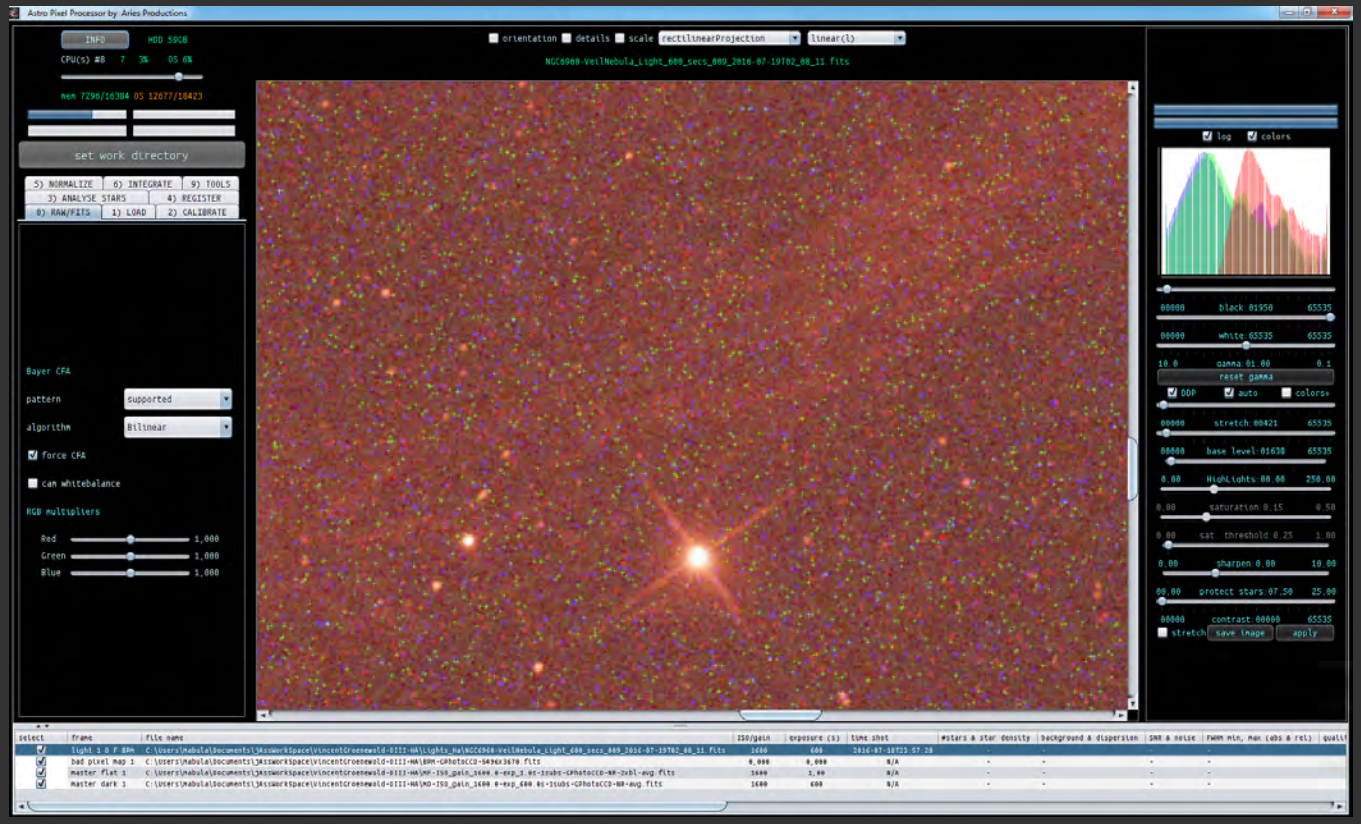
Hydrogen alpha debayer?

Veel voordelen!

- sterke versimpeling van verwerking
- behoud van resolutie (geen superpixel/split channel)
- stervormen blijven intact
- betere registratie als gevolg
- geen noise injectie van mogelijk opschalen

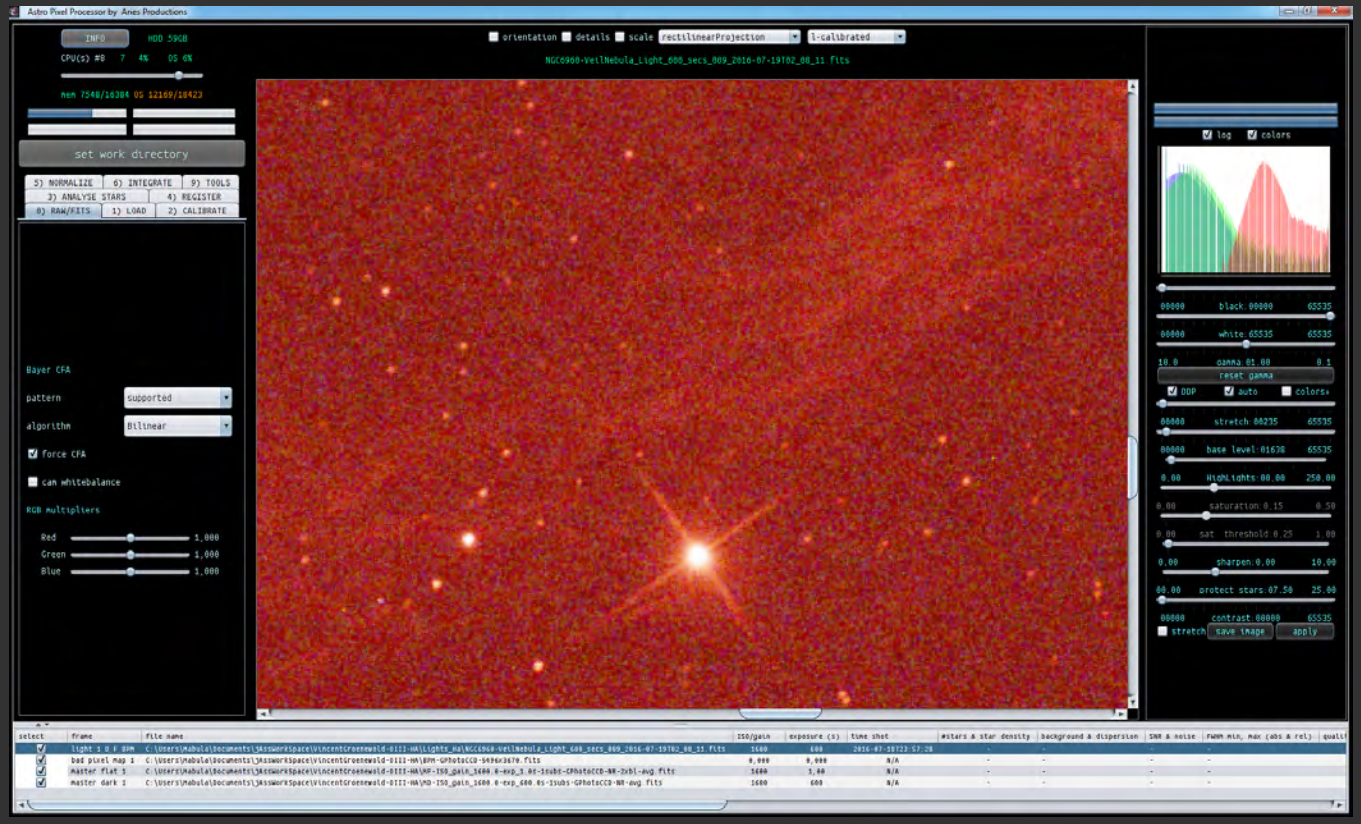
Hydrogen alpha debayer?

Voorbeeld - Veil Nebula, Vincent Groenewold, Canon 6D



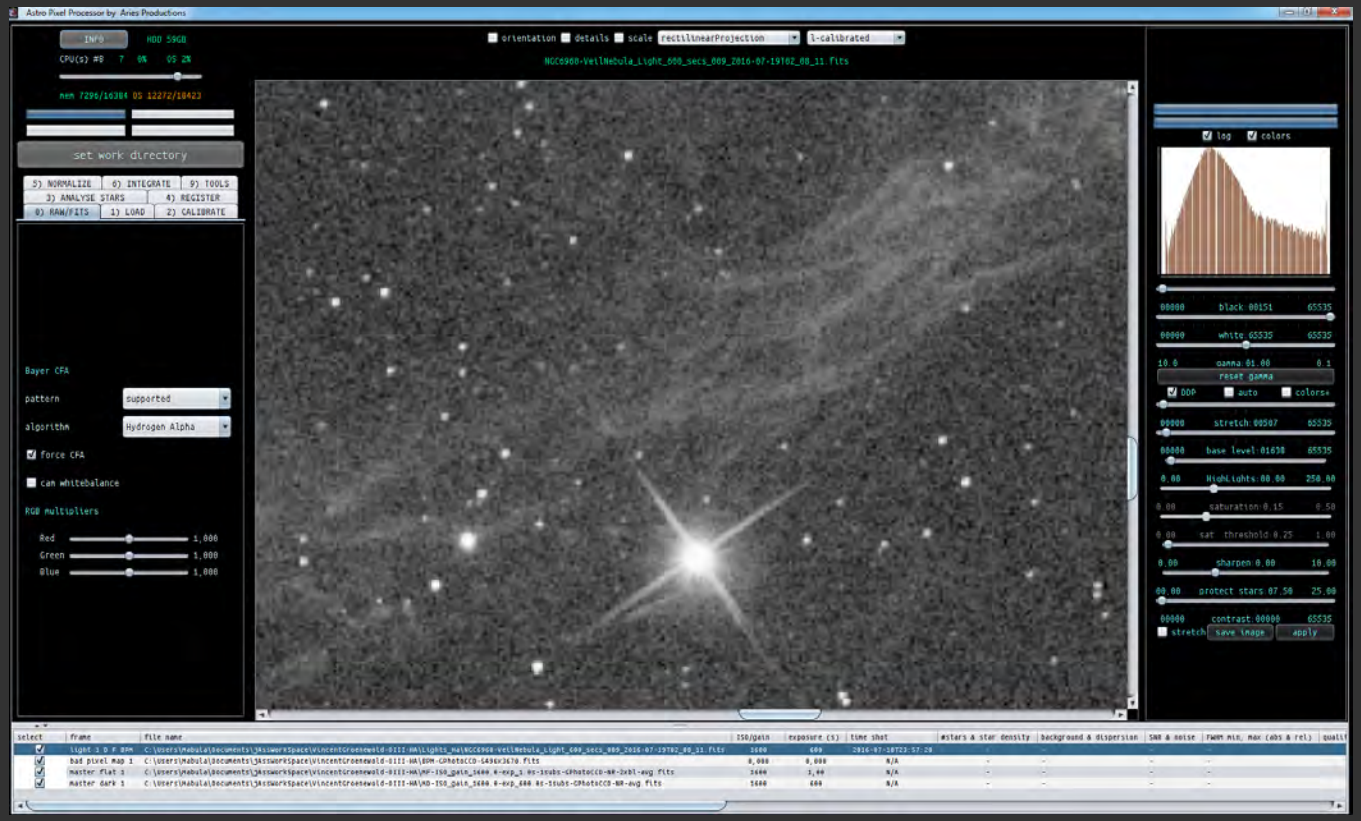
Hydrogen alpha debayer?

Voorbeeld - Veil Nebula, Vincent Groenewold

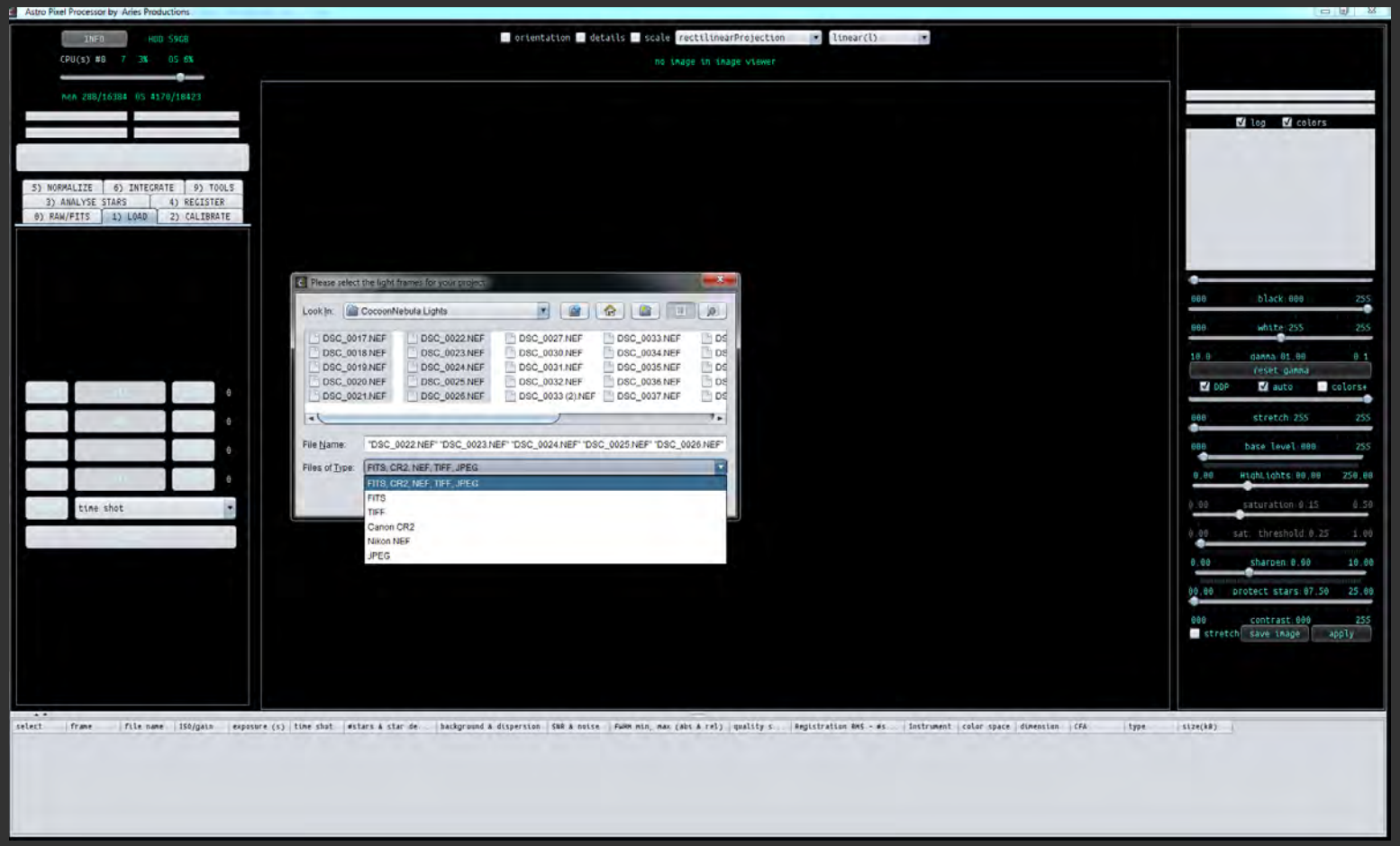


Hydrogen alpha debayer?

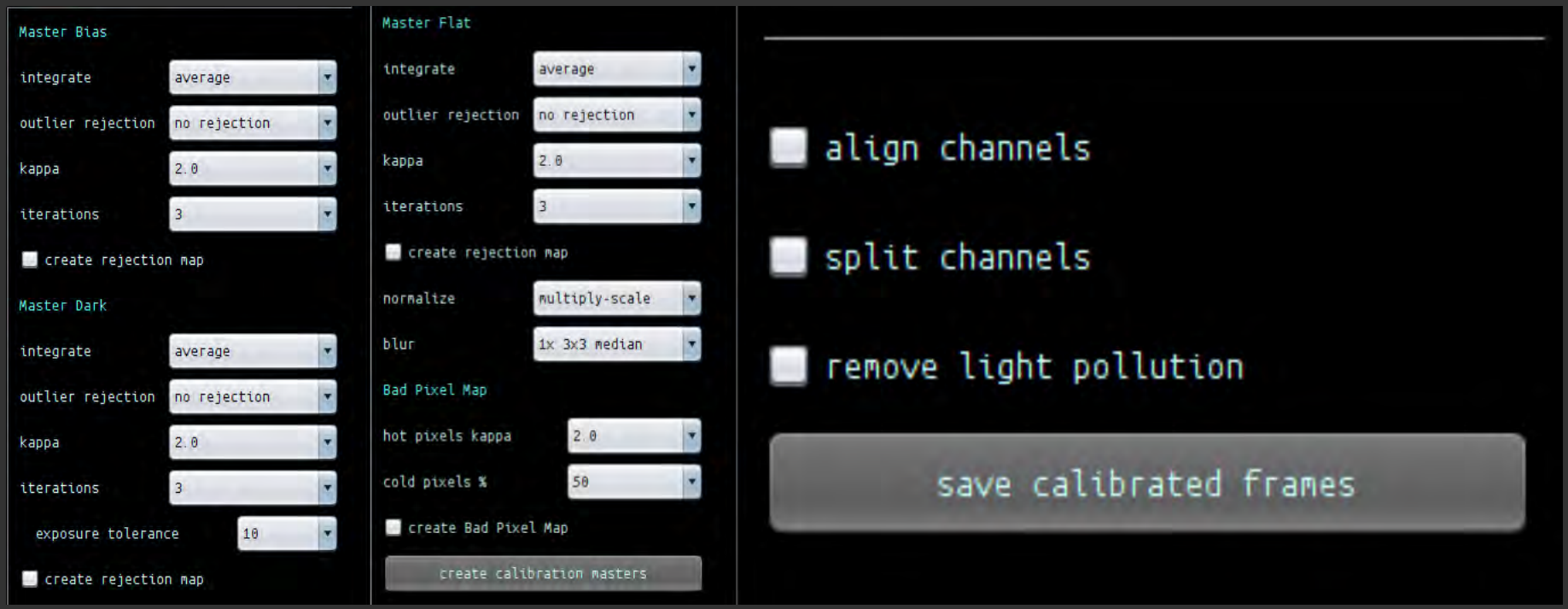
Voorbeeld - Veil Nebula, Vincent Groenewold



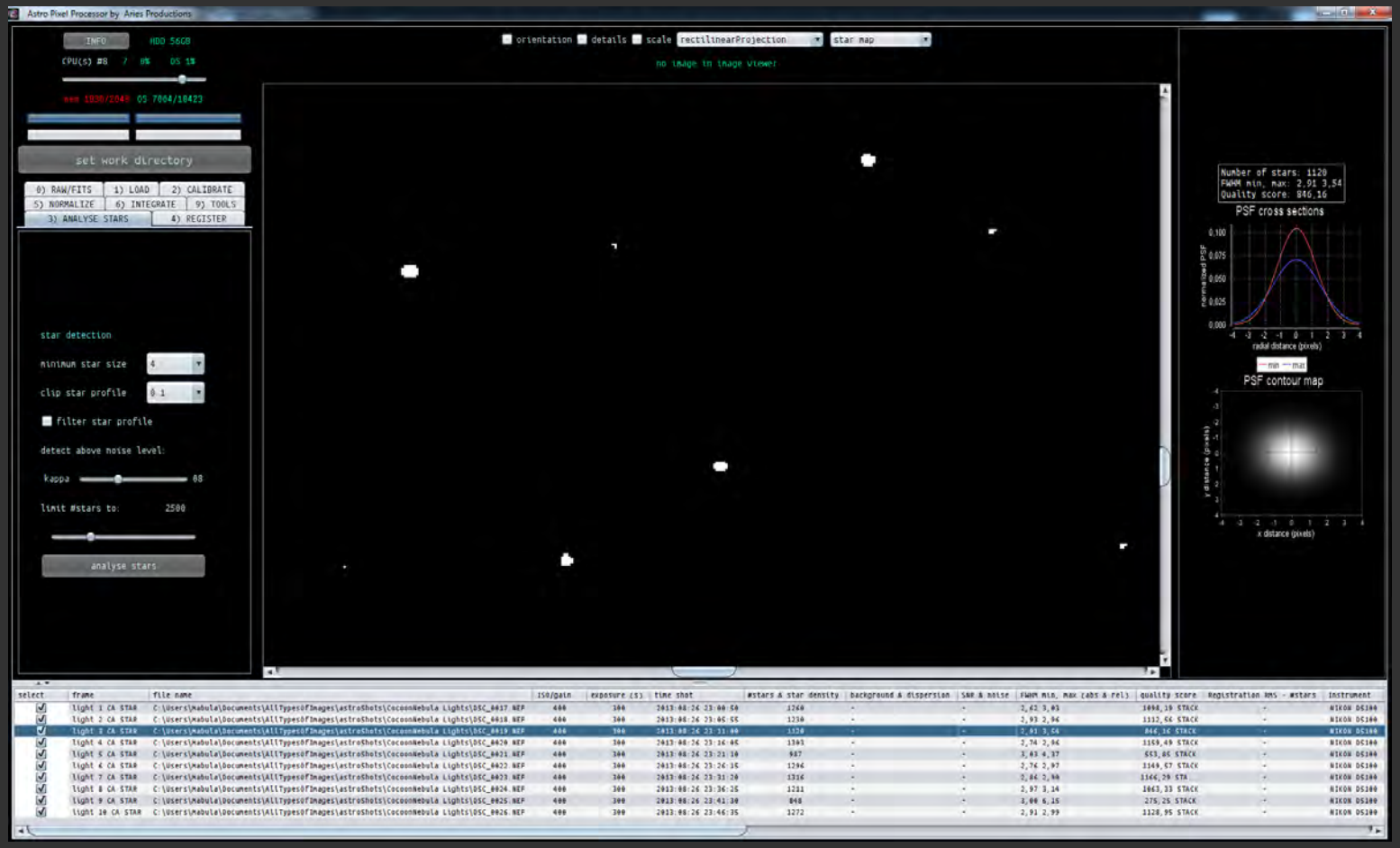
1) LOAD


Astro Pixel Processor by Aries Productions
INFO
HDD 59GB
orientation
details
scale
rectilinearProjection
linear(1)
no image in image viewer
5) NORMALIZE
6) INTEGRATE
9) TOOLS
3) ANALYSE STARS
4) REGISTER
0) RAW/FITS
1) LOAD
2) CALIBRATE
time shot
log
colors
black 000
white 255
gamma 01.00
reset gamma
DDP
auto
colors+
stretch 255
base level 000
highlights 00.00
saturation 0.15
sat. threshold 0.25
sharpen 0.00
protect stars 07.50
contrast 000
stretch
save image
apply
Please select the light frames for your project
Look In:
CocoonNebula Lights
DSC_0017.NEF
DSC_0018.NEF
DSC_0019.NEF
DSC_0020.NEF
DSC_0021.NEF
DSC_0022.NEF
DSC_0023.NEF
DSC_0024.NEF
DSC_0025.NEF
DSC_0026.NEF
DSC_0027.NEF
DSC_0030.NEF
DSC_0031.NEF
DSC_0032.NEF
DSC_0033 (2).NEF
DSC_0033.NEF
DSC_0034.NEF
DSC_0035.NEF
DSC_0036.NEF
DSC_0037.NEF
File Name:
"DSC_0022.NEF" "DSC_0023.NEF" "DSC_0024.NEF" "DSC_0025.NEF" "DSC_0026.NEF"
Files of Type:
FITS, CR2, NEF, TIFF, JPEG
FITS
TIFF
Canon CR2
Nikon NEF
JPEG

2) CALIBRATE

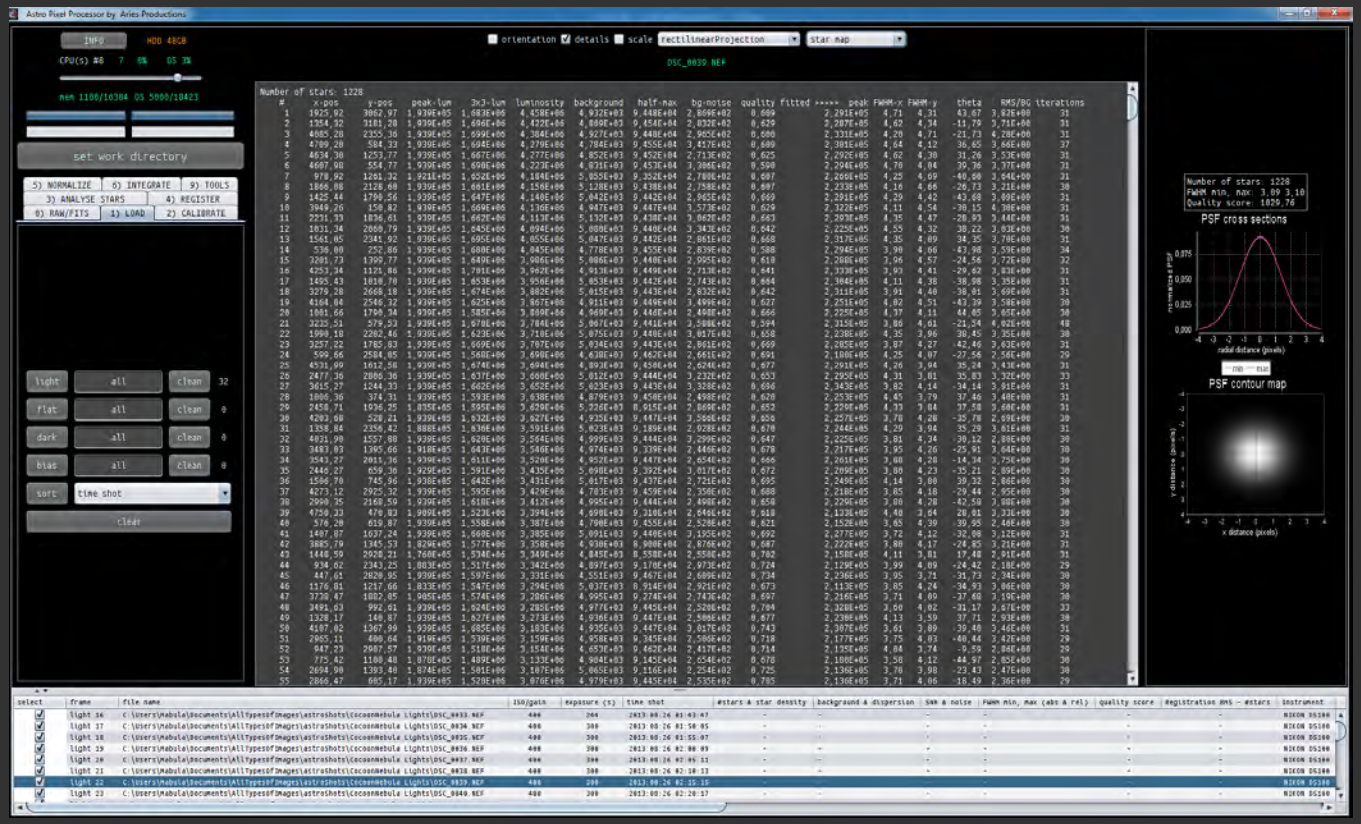

Master Bias
integrate
average
outlier rejection
no rejection
kappa
2.0
iterations
3
create rejection map
Master Dark
integrate
average
outlier rejection
no rejection
kappa
2.0
iterations
3
exposure tolerance
10
create rejection map
Master Flat
integrate
average
outlier rejection
no rejection
kappa
2.0
iterations
3
create rejection map
normalize
multiply-scale
blur
1x 3x3 median
Bad Pixel Map
hot pixels kappa
2.0
cold pixels %
50
create Bad Pixel Map
create calibration masters
align channels
split channels
remove light pollution
save calibrated frames

3) ANALYSE STARS



3) ANALYSE STARS

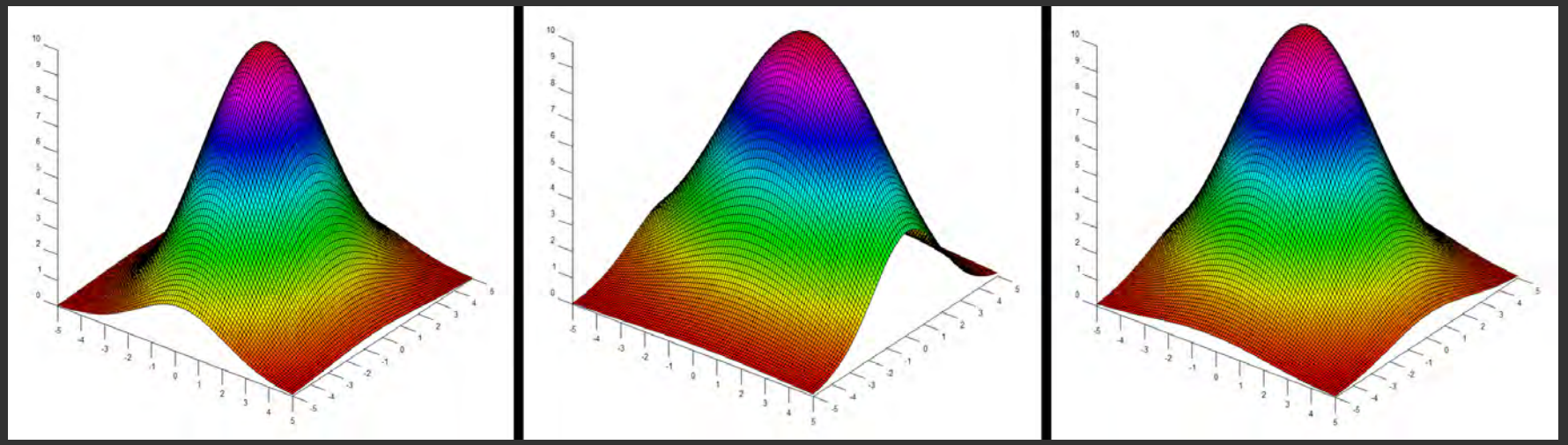
ster lokaties: Intensity Weighted Centroiding (IWC)



3) ANALYSE STARS

general 2D elliptical Gaussian model

$$I(x,y) = I_0 \exp(-(A(x-x_0)^2 - 2B(x-x_0)(y-y_0) + C(y-y_0)^2)) \quad (1)$$



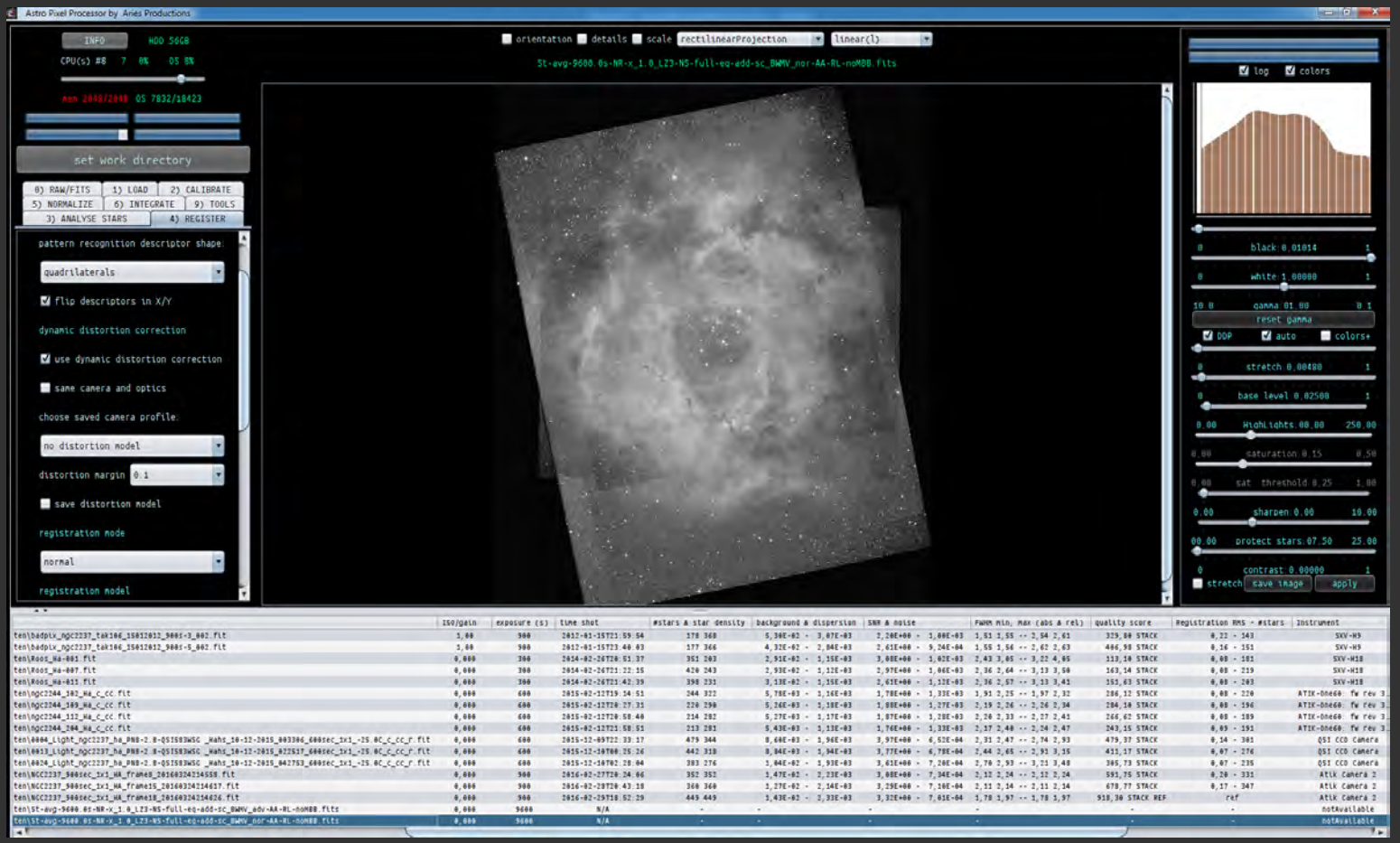
4) REGISTER

- patroon herkenning 3-,4-,5-hoeken
- tranparante flip in X/Y
- optische vervorming correctie (pincushion, barrel)
- N-view i.p.v. 2-view oplossing

4) REGISTER

- bewaren camera + optiek profiel
- normaal en mozaïek modus
- camera calibratie (focal length, principal point)
- rectilinear & equirectangular projections

4) REGISTER - flip X/Y



4) REGISTER - optische vervorming correctie (DDC)

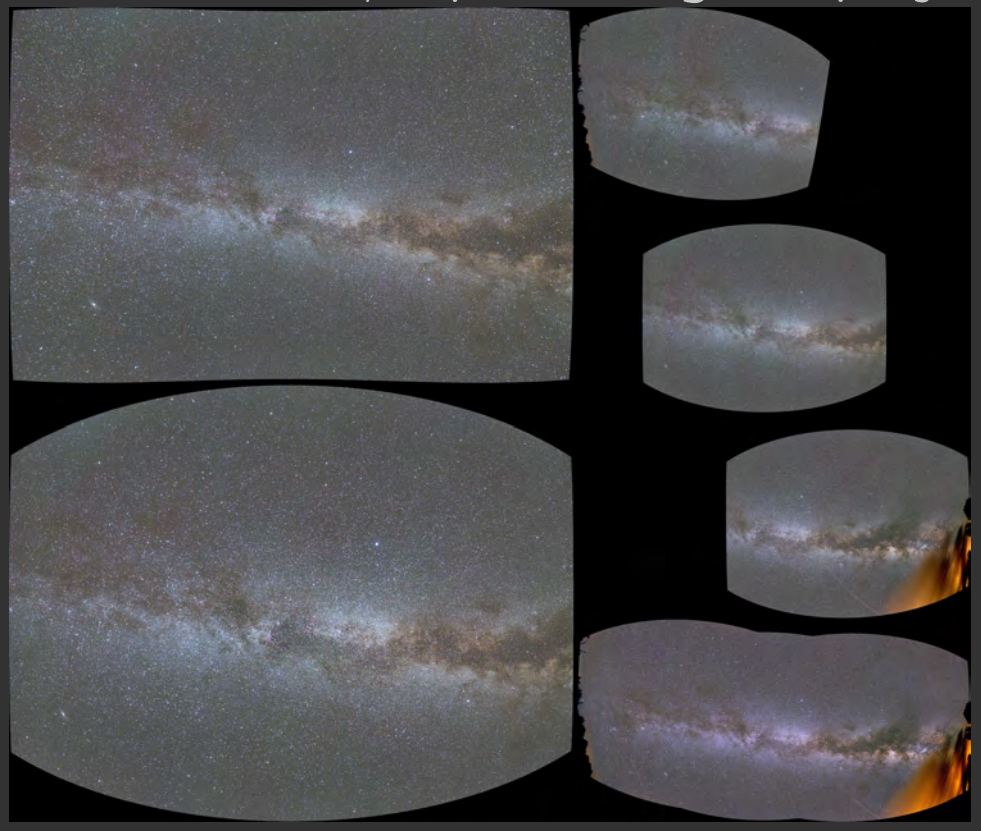
Ralph Wagter - 180 graden mozaïek
Canon EOS 6D & Samyang 14mm f/2.8

4) REGISTER - optische vervorming correctie (DDC)

Ralph Wagter - 180 graden mozaïek
Canon EOS 6D & Samyang 14mm f/2.8

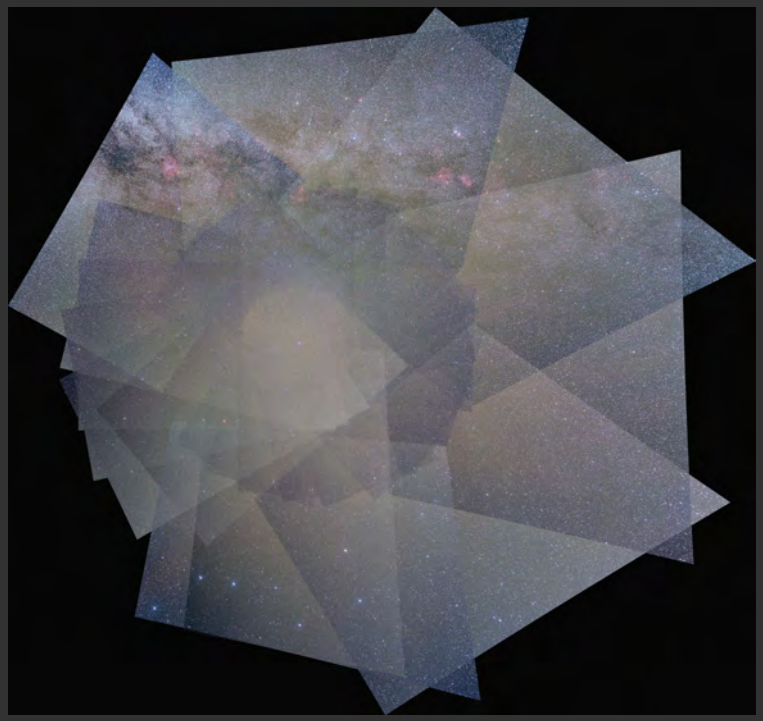
4) REGISTER - camera calibratie

big Field Of View, equirectangular projection



4) REGISTER - N-view oplossing

Scott Rosen 30 paneel mozaïek
Canon 450D & 6D, 50mm f/1.8 Olympus Zuiko



5) NORMALIZE

data normalisatie ?

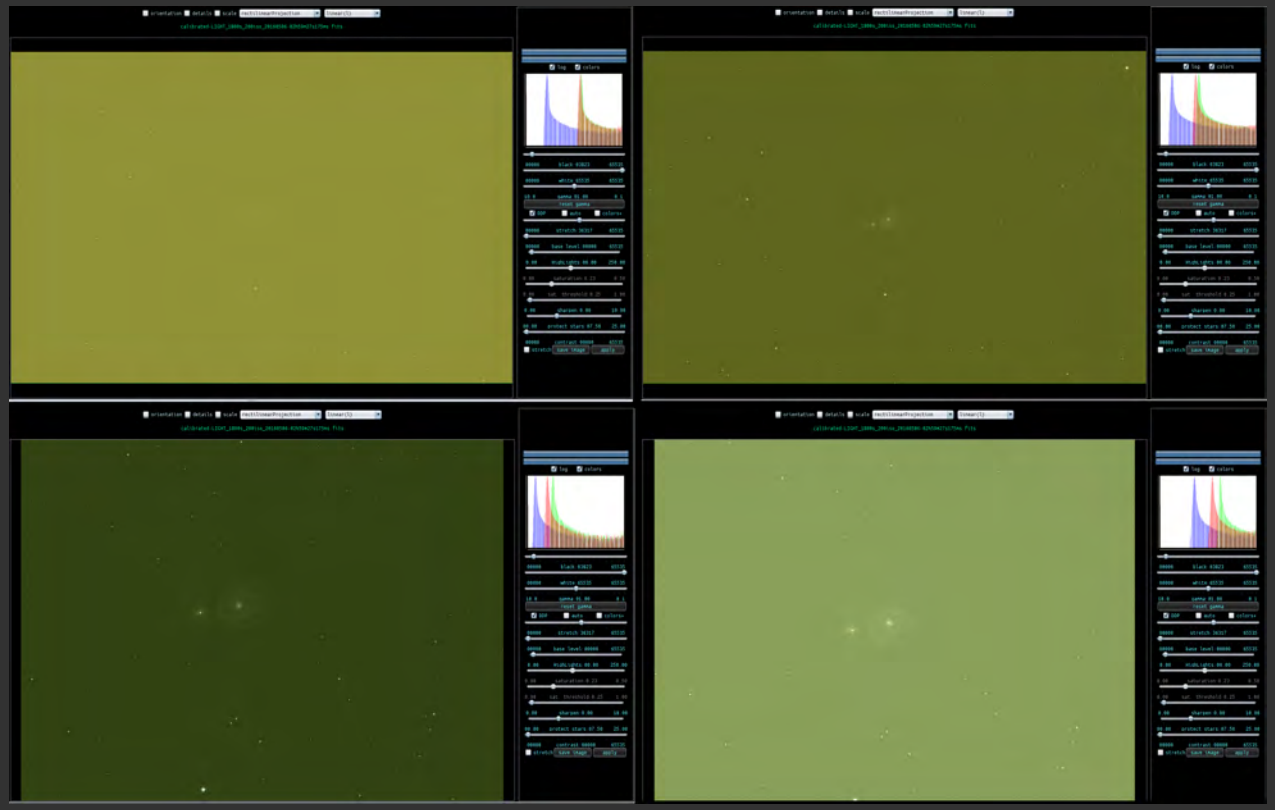
M51, the Whirlpool Galaxy
iso: 320
exposure: 900s, 1800s
focal length = 575mm, 816mm
Nikon D5100 BCF, Takahashi TSA102

5) NORMALIZE - M51, the Whirl Pool Galaxy

background & dispersion					
3,52E-01	4,08E-03	3,59E-01	4,18E-03	1,43E-01	2,54E-03
2,21E-01	3,23E-03	2,40E-01	3,40E-03	1,04E-01	2,16E-03
1,36E-01	2,48E-03	1,63E-01	2,70E-03	8,62E-02	2,00E-03
3,37E-01	3,95E-03	4,06E-01	4,39E-03	2,13E-01	3,16E-03

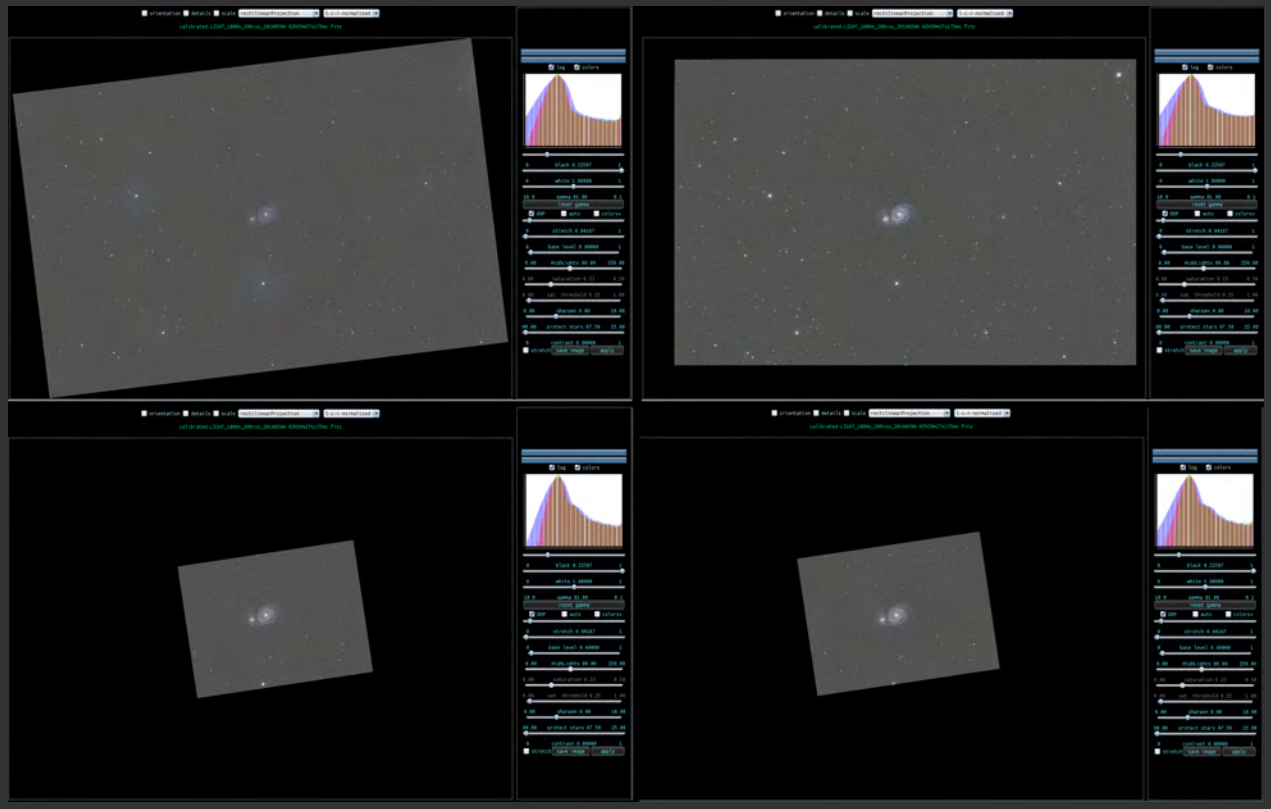
5) NORMALIZE - M51, the Whirl Pool Galaxy

VOOR



5) NORMALIZE - M51, the Whirl Pool Galaxy

NA



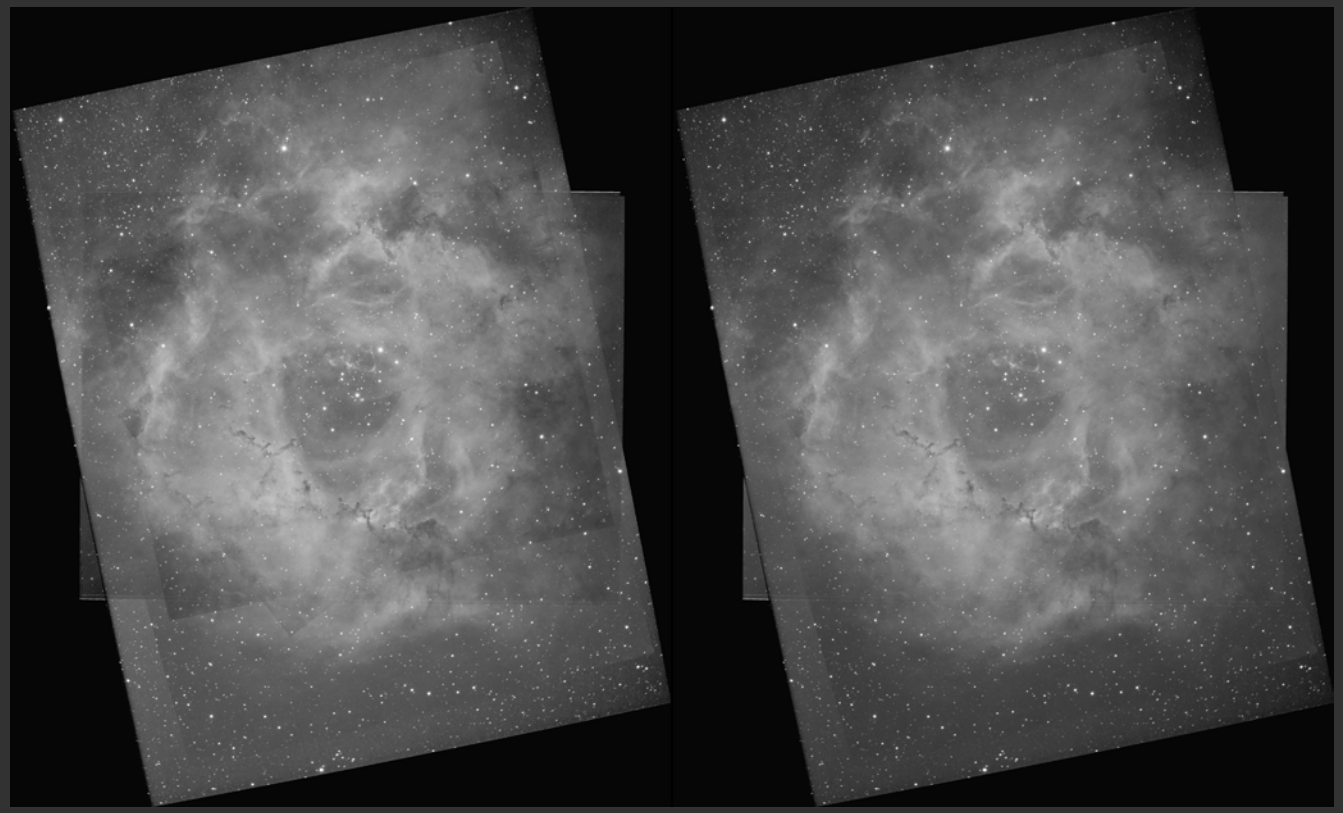
5) NORMALIZE

data normalisatie voor integratie

- opnames worden statistisch vergelijkbaar
- verbetering outlier rejection
- verbetering average/median
- ruis omlaag, SNR omhoog
- verschillende telescopen / camera's / sessies

5) NORMALIZE

advanced mode



6) INTEGRATE

data integratie / stacken

- gewichten
- compositie
- Local Normalization Correction (LNC)
- Multi-Band Blending (MBB)

6) INTEGRATE

data integratie / stacken

- outlier rejection filters
- output maps
- pixel interpolatie

6) INTEGRATE

data integratie / stacken

- schaal
- drizzle
- projectie

6) INTEGRATE - gewichten

- ster vorm/dichtheid
- ruis
- SNR (onbetrouwbaar !)
- kwaliteit
- belichtingstijd

6) INTEGRATE - compositie

- full
- reference
- crop

6) INTEGRATE - Local Normalization Correction

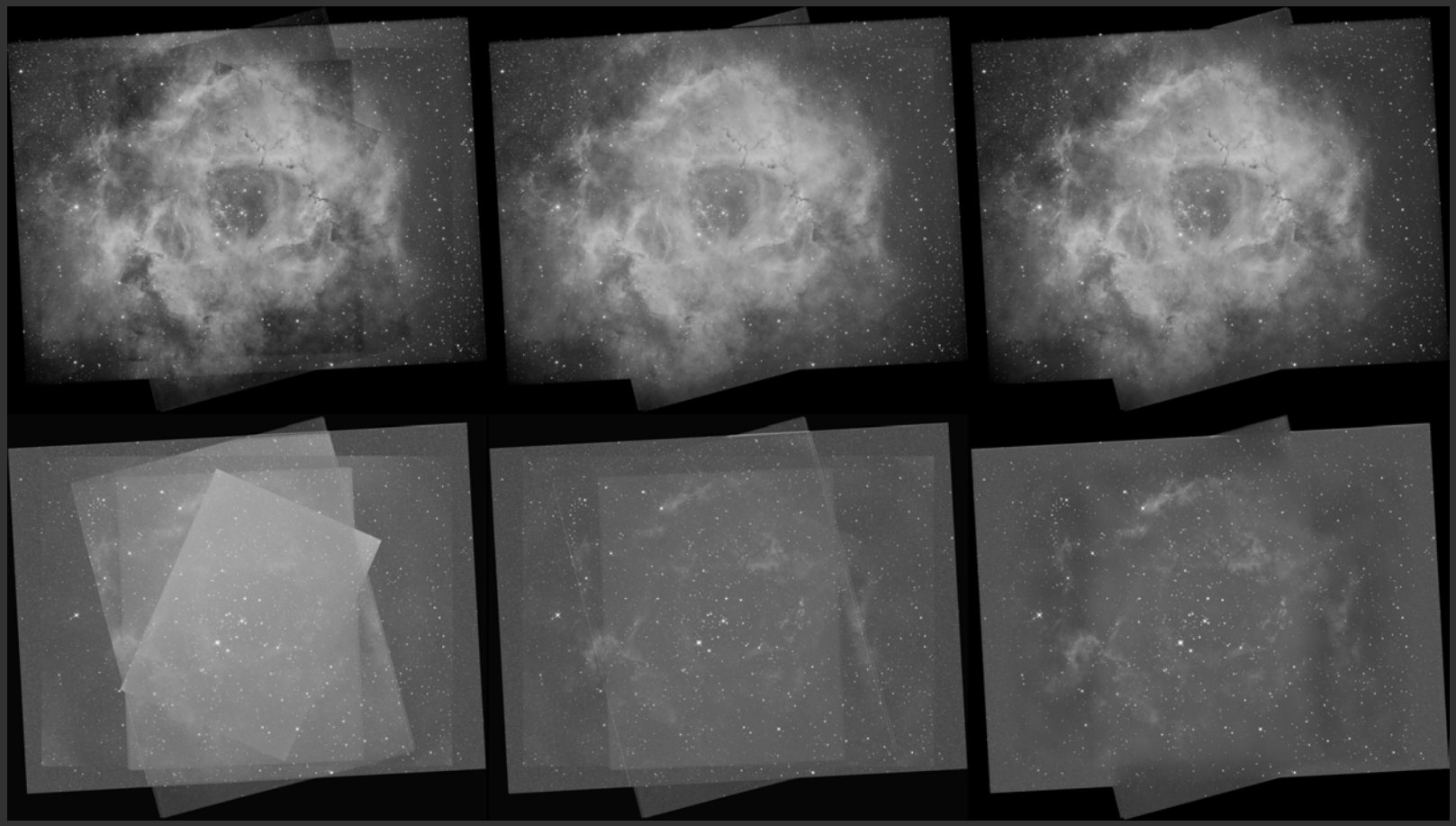
uniek & vernieuwend concept

- corrigeert alle lagen
- 1st-8th degree bivariate polynomial
- stabiele lineaire kleinste kwadraten oplossing
- correcties lokaal in alle lagen
- optimale normalisatie over hele beeldveld

6) INTEGRATE - Multi-Band Blending

- verwijderd naden mozaïeken
- reduceert stack artefacten
- gewicht randen opnames

6) INTEGRATE - LNC + MBB

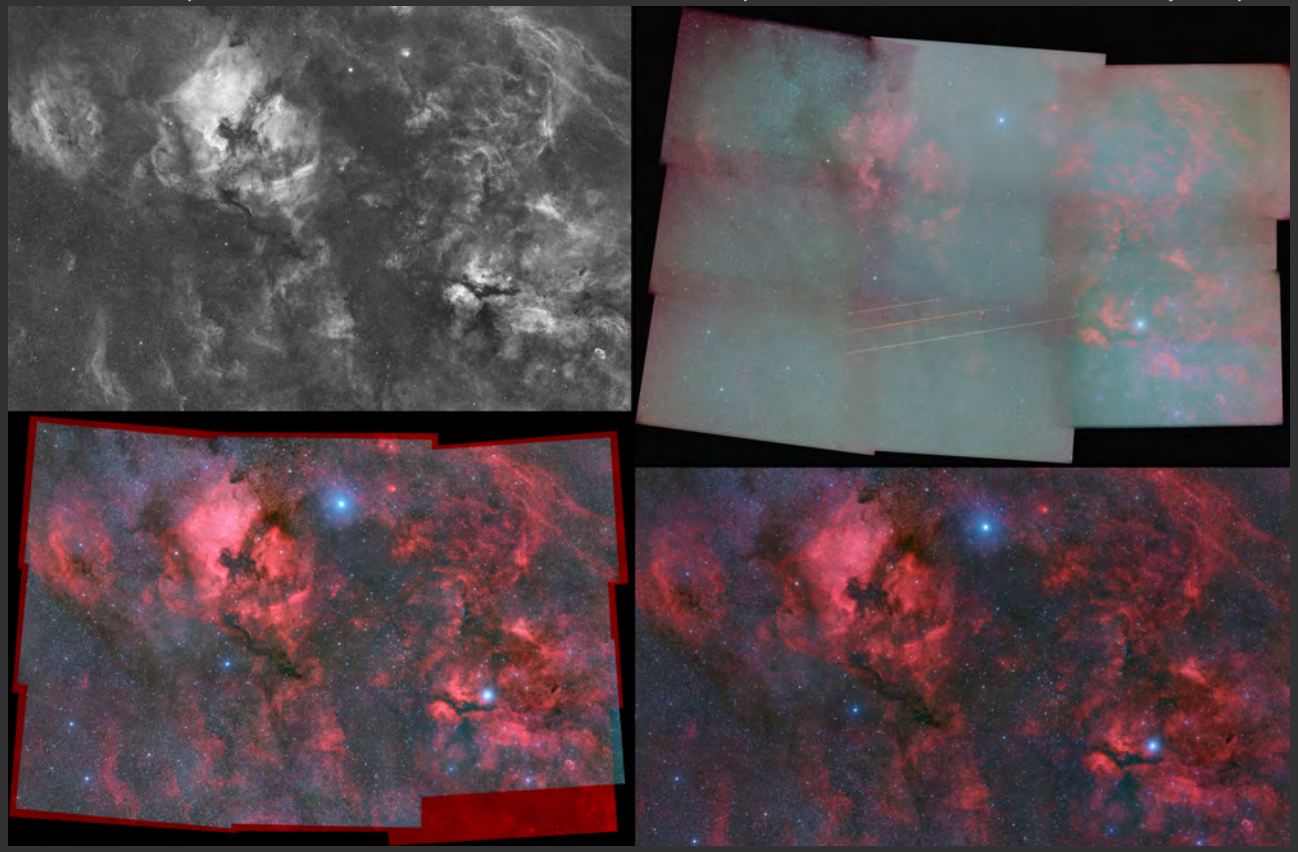


6) INTEGRATE - LNC + MBB

Yves van den Broek - Barnard's Loop
Nikon D810a, WO Star 71 apo

6) INTEGRATE - LNC + MBB + DDC

Yves van den Broek - North America to Crescent
Nikon D810a, D600 mono cooled, WO Star 71 apo, 9 panel



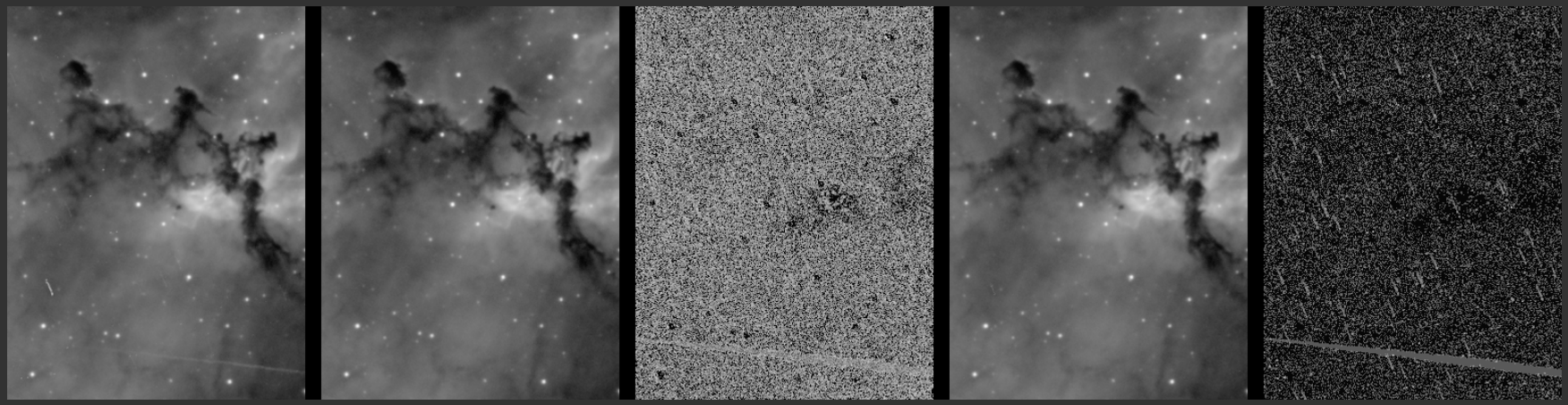
6) INTEGRATE - outlier rejection filters

- sigma clipping
- winsorized sigma clipping (fouten)
- linear fit clipping (overbodig door LNC?)

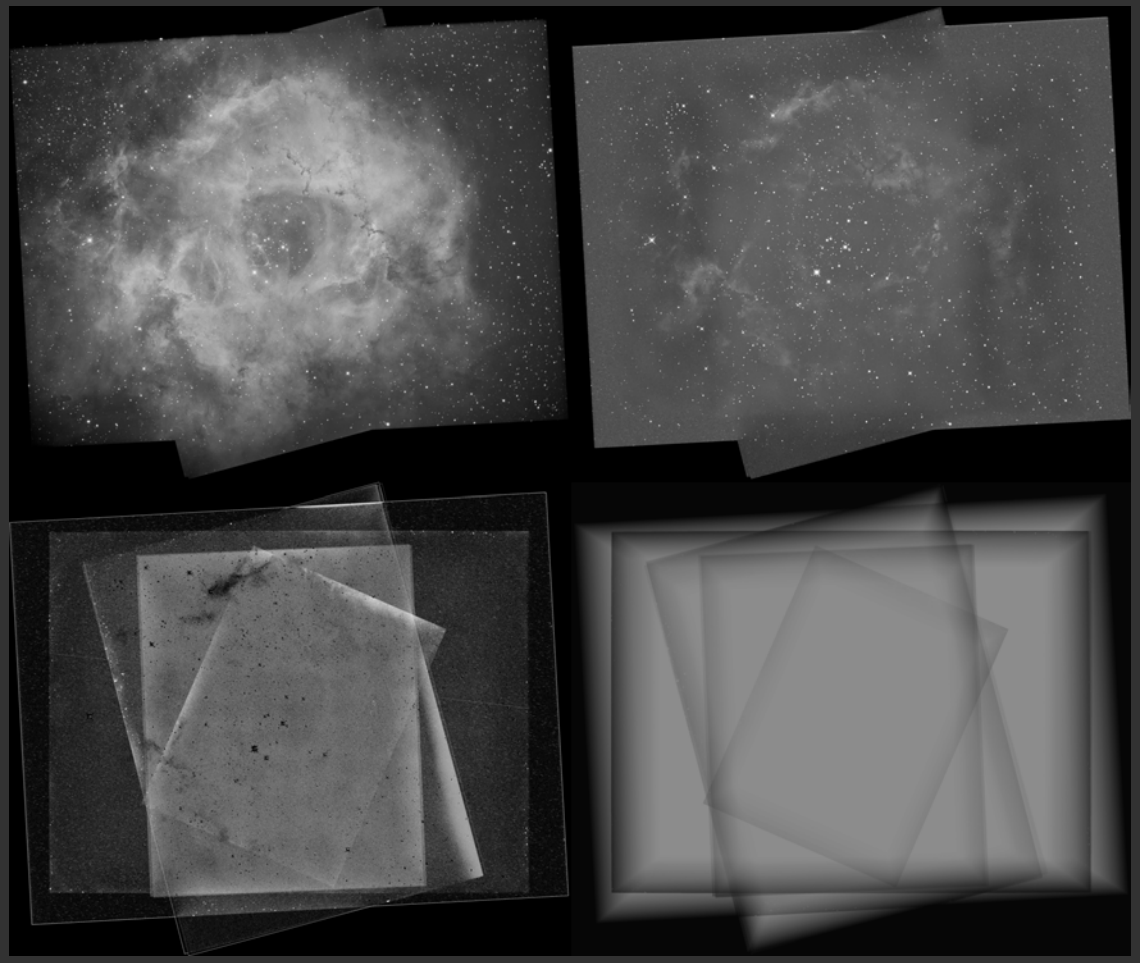
6) INTEGRATE - outlier rejection filters

- laatste hulpmiddel (BPM, dither)

- conservatief toepassen



6) INTEGRATE - output maps

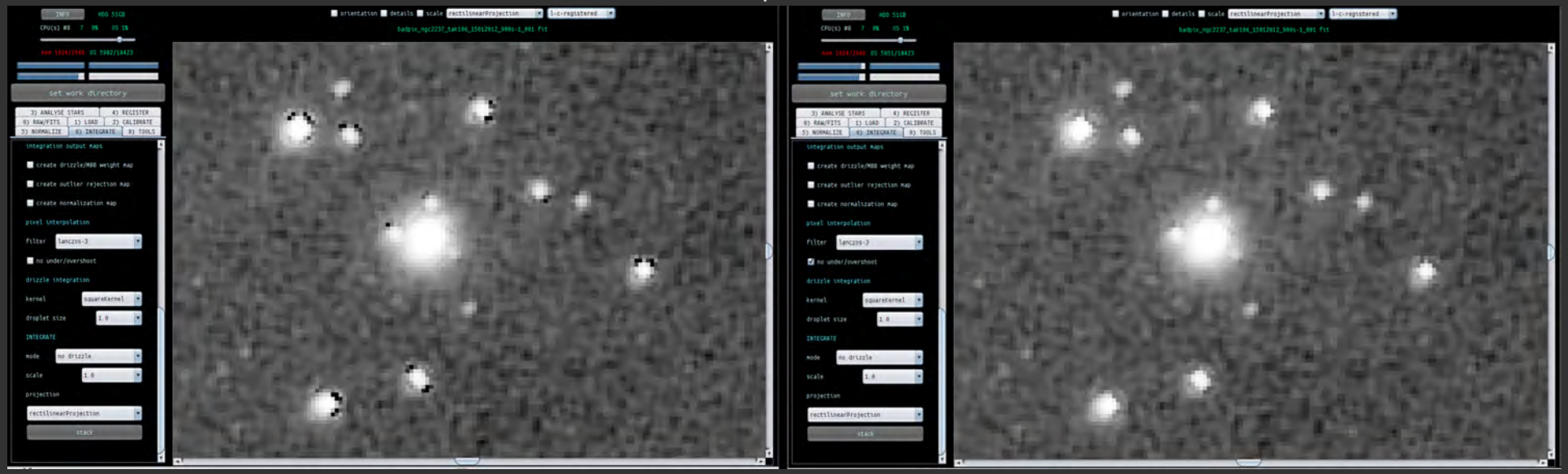


6) INTEGRATE - pixel interpolatie

- nearest neighbour
- bilinear
- Cubic B-spline, Mitchell Netravali, Catmull-Rom spline
- Lanczos 3,4,5
- no under/overshoot

6) INTEGRATE - pixel interpolatie

no under/overshoot



6) INTEGRATE - drizzle

voorwaardes: dithering, undersampled, ruis vs. resolutie

- schaalvergroting 1.0 - 3.0
- druppel keuze 0.1 - 3.0 (?)
- kernels: point, square, tophat, gauss
- bayer drizzle
- precisie 0.04 pixel

6) INTEGRATE - drizzle

Scott Rosen - Canon EOS 450D, 50mm f/1.8 Olympus Zuiko

9) TOOLS

lineaire data verwerking !

- batch modify
  - crop/uncrop
  - undebayer
  - metadata
  - add, multiply

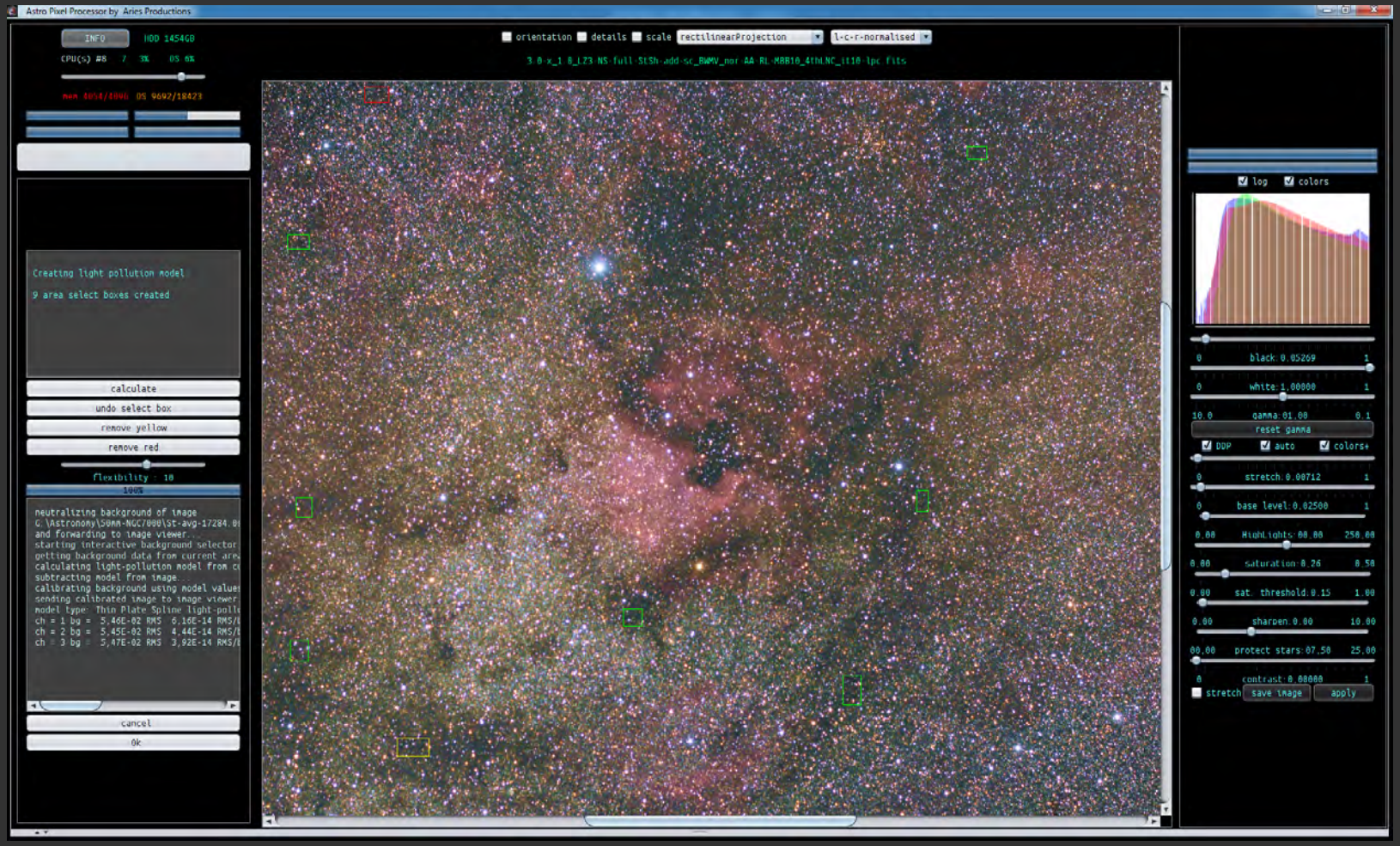
9) TOOLS

- batch rotate/resize
- correct vignetting (Kang Weiss models, artificial masterflat)
- remove light pollution
- calibrate background

9) TOOLS

- star color calibration
- combine RGB (LRGB, SII-Ha-OIII, ..)
- HSL selective color

9) TOOLS - remove LP



9) TOOLS - example

Kees Scherer - NGC2174, Monkeyhead Nebula

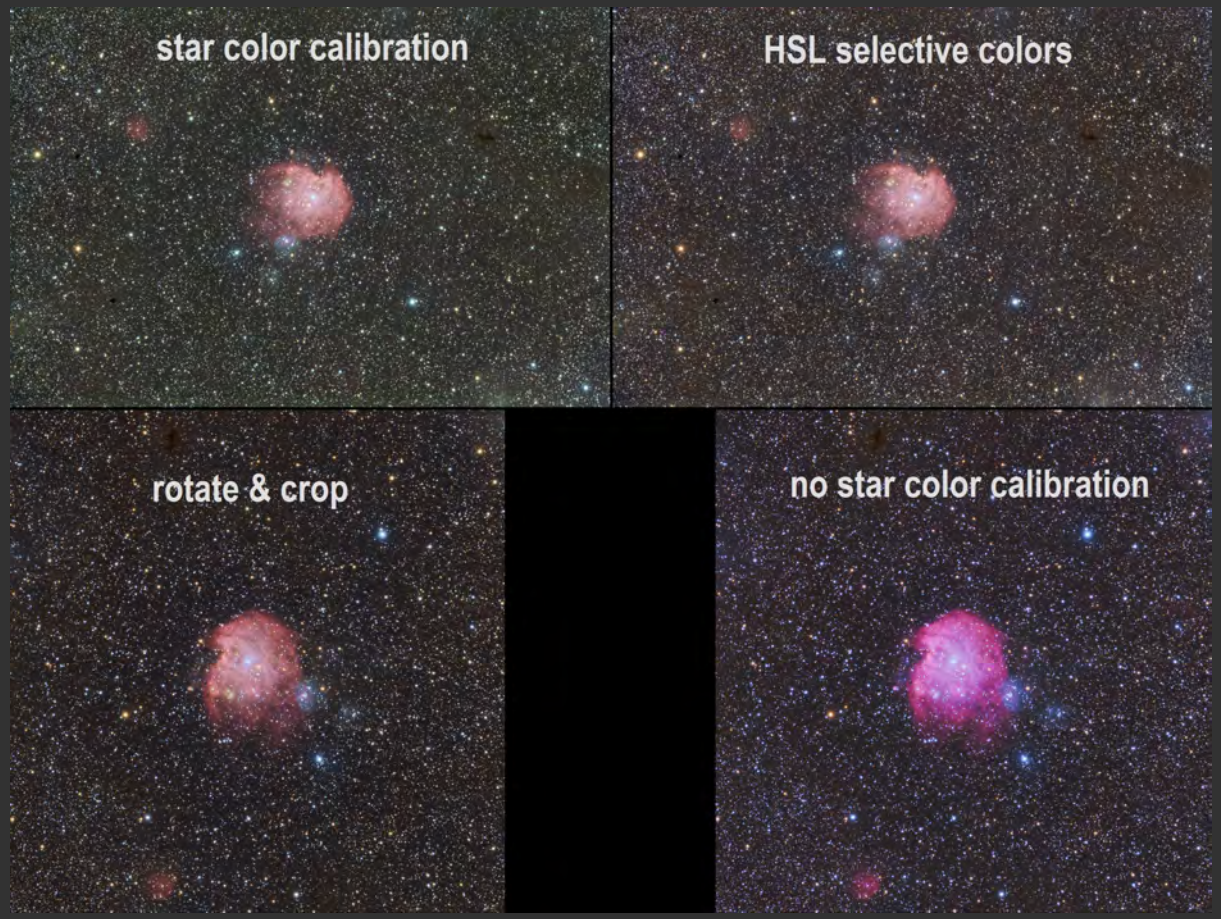
lights 157 x 240 sec = 10,5 uur

bias en flat calibratie

Esprit 100 APO f5.5, Canon 6Da,
10Micron GM2000 HPS II

9) Kees Scherer - NGC2174, Monkeyhead Nebula

9) Kees Scherer - NGC2174, Monkeyhead Nebula



astroforum.nl Forum Power

Rosette Nebula SHO & M51, the Whirlpool Galaxy LHaRGB

Beta team

Grote dank aan:

Yves van den Broek, Rob Musquetier, Dominique Dierick, Marc Theunissen, Vincent Groenewold, Kees Scherer, André van der Hoeven, Wei-Hao Wang, Scott Rosen, Hans van Overzee, Maurice Toet, Olly Penrice, Tom O'Donoghue, Kayron Mercieca, Ralph Snel, Cory & Tanja Schmitz, Christian van den Berge, Marco Verstraaten, Jos Wennmacker, Roberto Colombari

www.starry-night.nl

Beta team, eerste resultaten

Yves van den Broek, Barnard's Loop & NAN to Crescent

Beta team, eerste resultaten

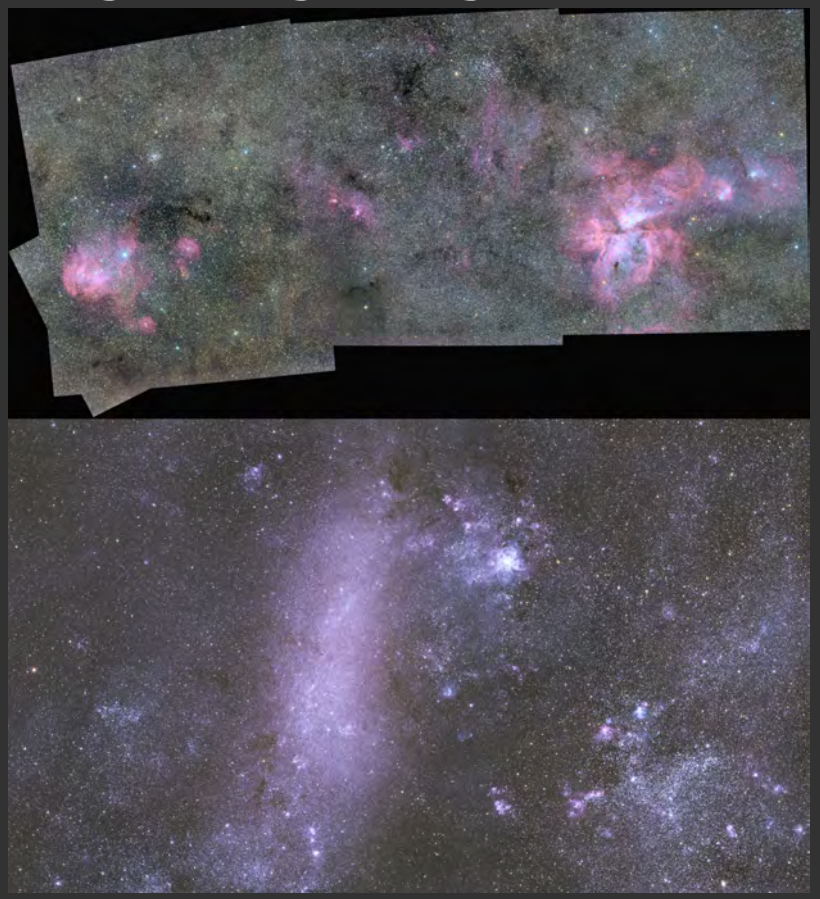
Maurice Toet, M78 & LDN1622, 2 panel mosaïek

Beta team, eerste resultaten

Marco Verstraaten, NGC5907 LRGB

Beta team, eerste resultaten

Christian van den Berge, Large Magellanic Cloud (3) & Carina (7)



Beta team, eerste resultaten

Mabula Haverkamp, de Pleiaden M45, LRGB

slot

- release datum nu 30 april 2017
- 30 dagen volledig werkende proef versie
- forum (nog in ontwikkeling)
- veel gestelde vragen

slot

- handleiding (wordt geschreven)
- optimaliseren
- nieuwe features
- dank aan iedereen voor delen data!

slot

VRAGEN ?

https://www.astropixelprocessor.com/