



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

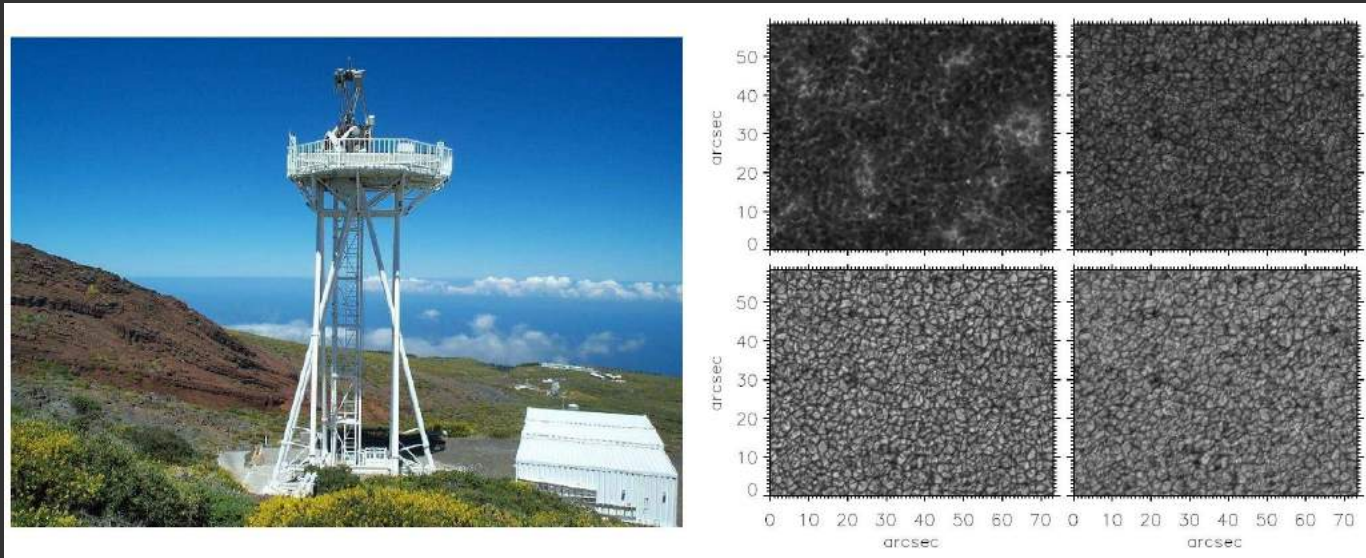


10 april 1977, Ndala (Tanzania)

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

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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

introdunctie - en toen...

Sterke gezondheids problemen...

Na 2 jaar ziekte, diagnose: Chronische Sarcoidose

Geen arbeids mogelijkheden vanwege de beperkingen

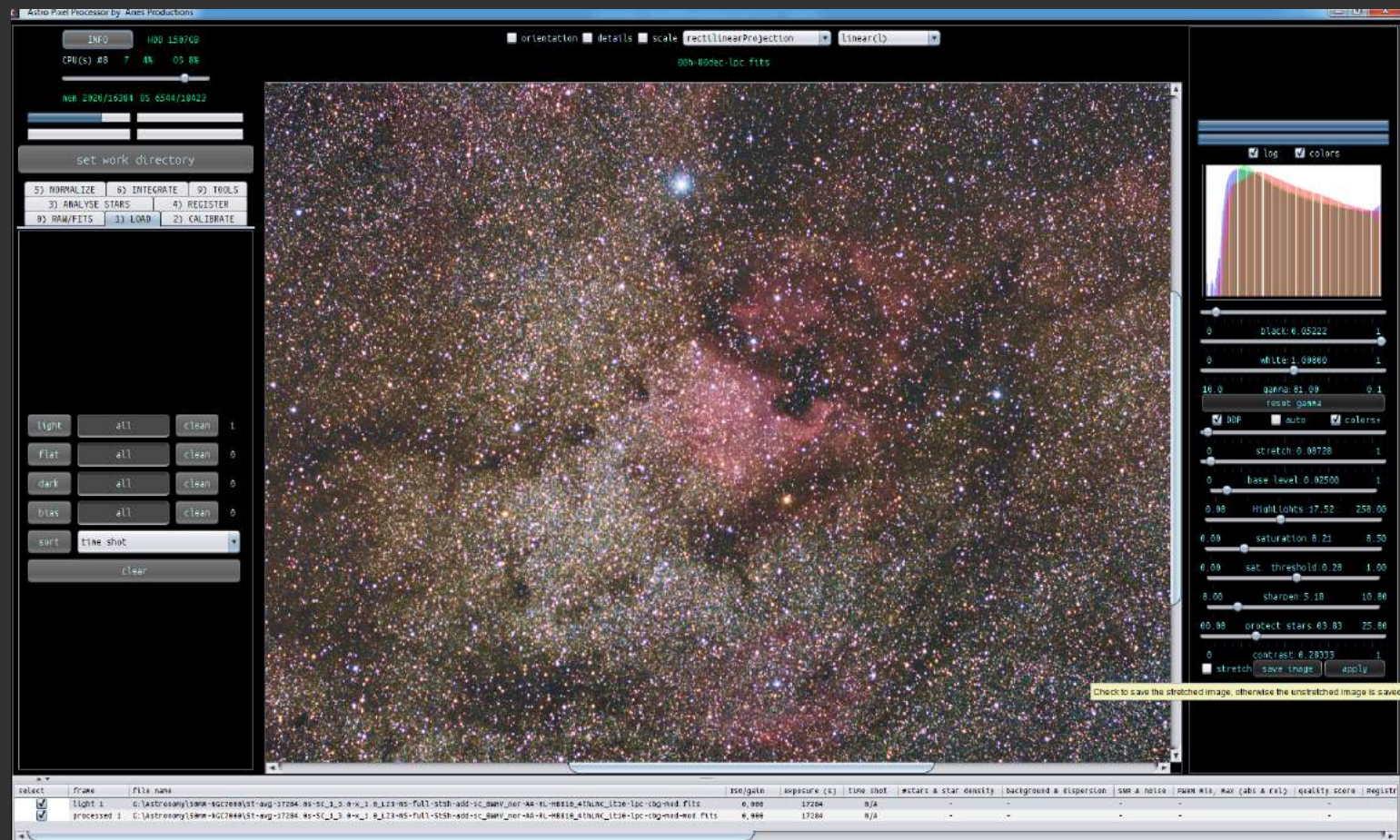
Astro Pixel Processor?

jASS - java Align Stack Stretch?

Deep Space Integrator?

geniale ingeving van Rob Musquetier!

waarom Astro Pixel Processor?



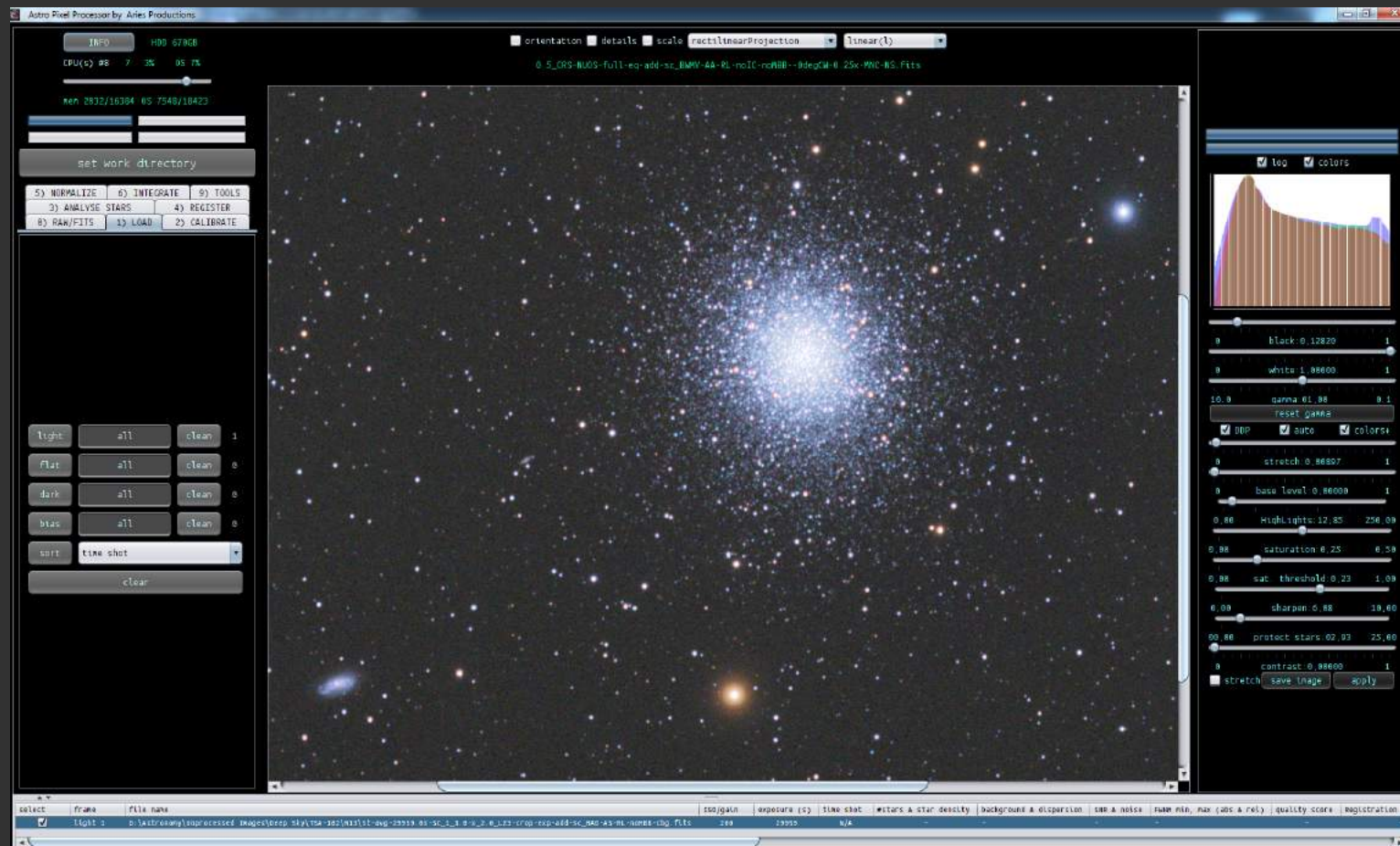
waarom Astro Pixel Processor?

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

waarom Astro Pixel Processor?

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

wat is APP?



wat is APP?

compleet programma voor ver-/bewerking van Deep Sky opnames

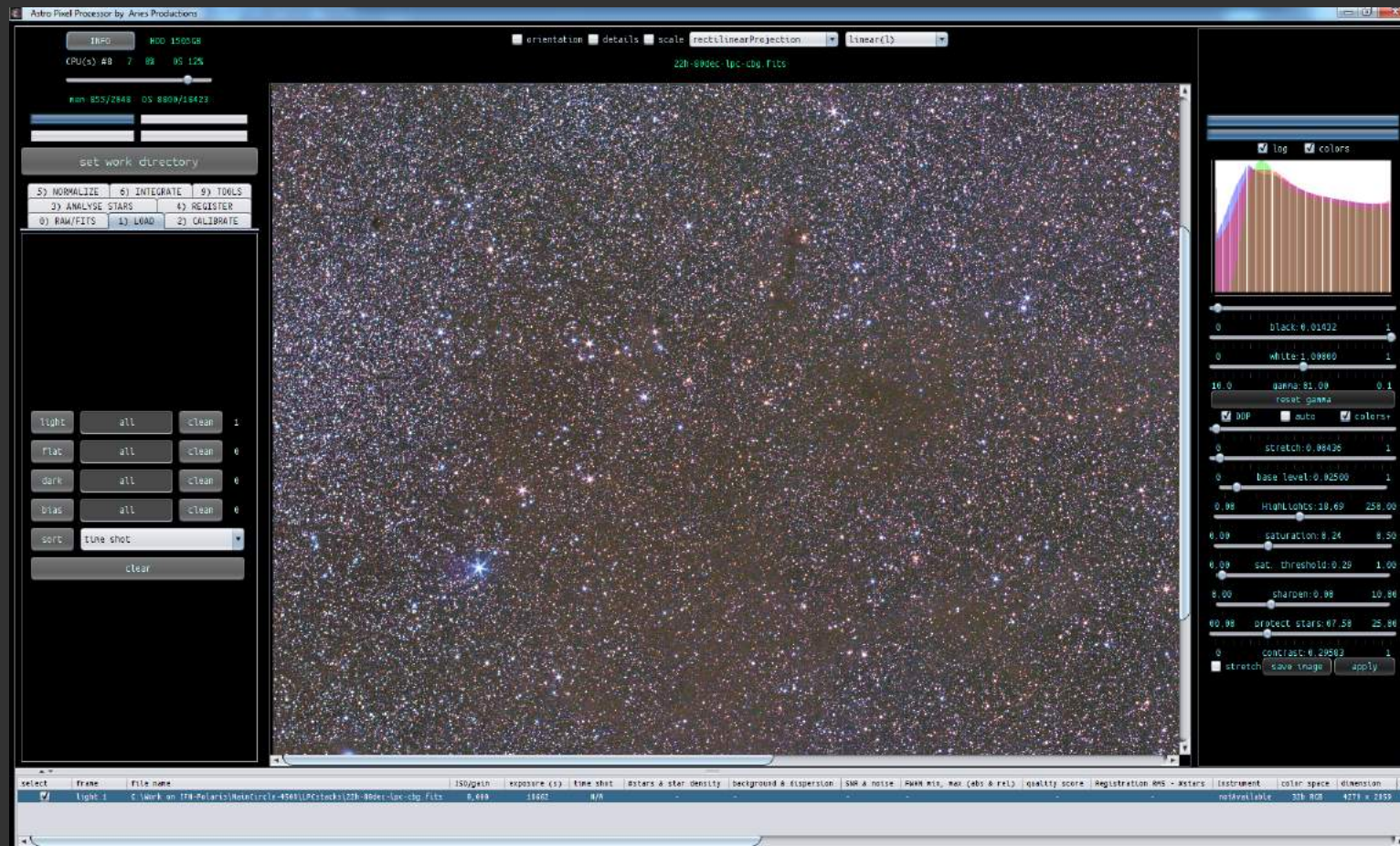
- data calibratie middels bias, darks, flats & Bad Pixel Mapping
- analyseren van sterren, vorm en grootte
- registreren/uitlijnen van opnames, regulier en mozaïeken

wat is APP?

compleet programma voor ver-/bewerking van Deep Sky opnames

- data normalisatie
- data integratie/stacken
- nabewerkings tools

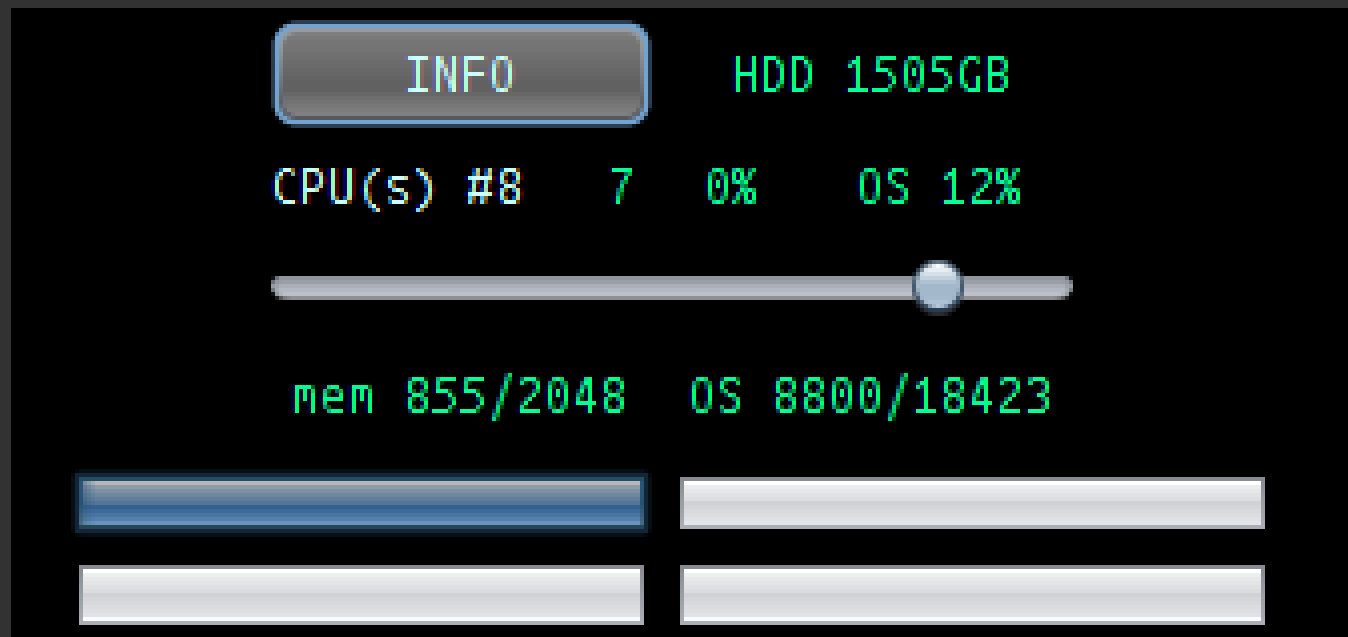
gebruikers interface



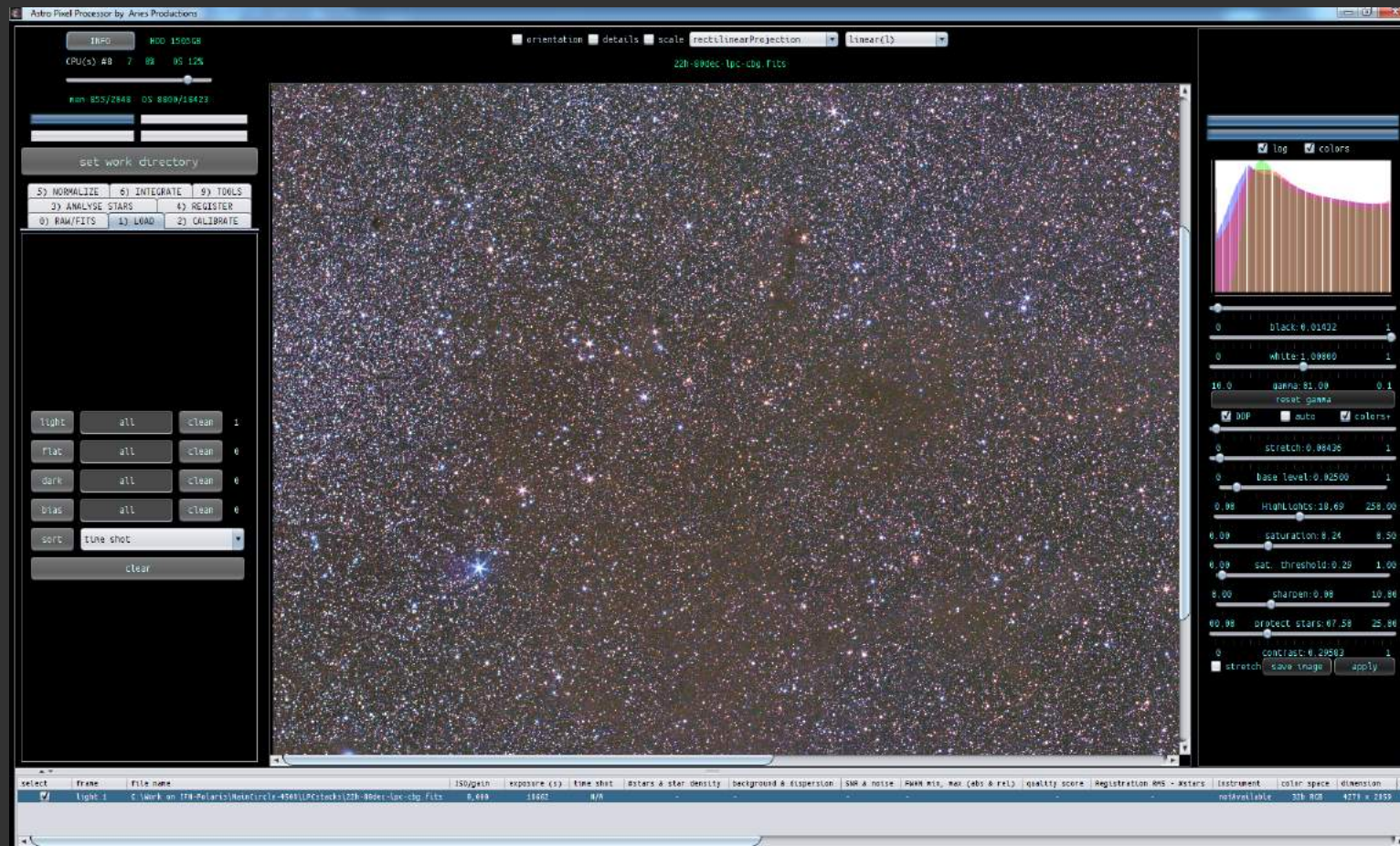
gebruikers interface

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

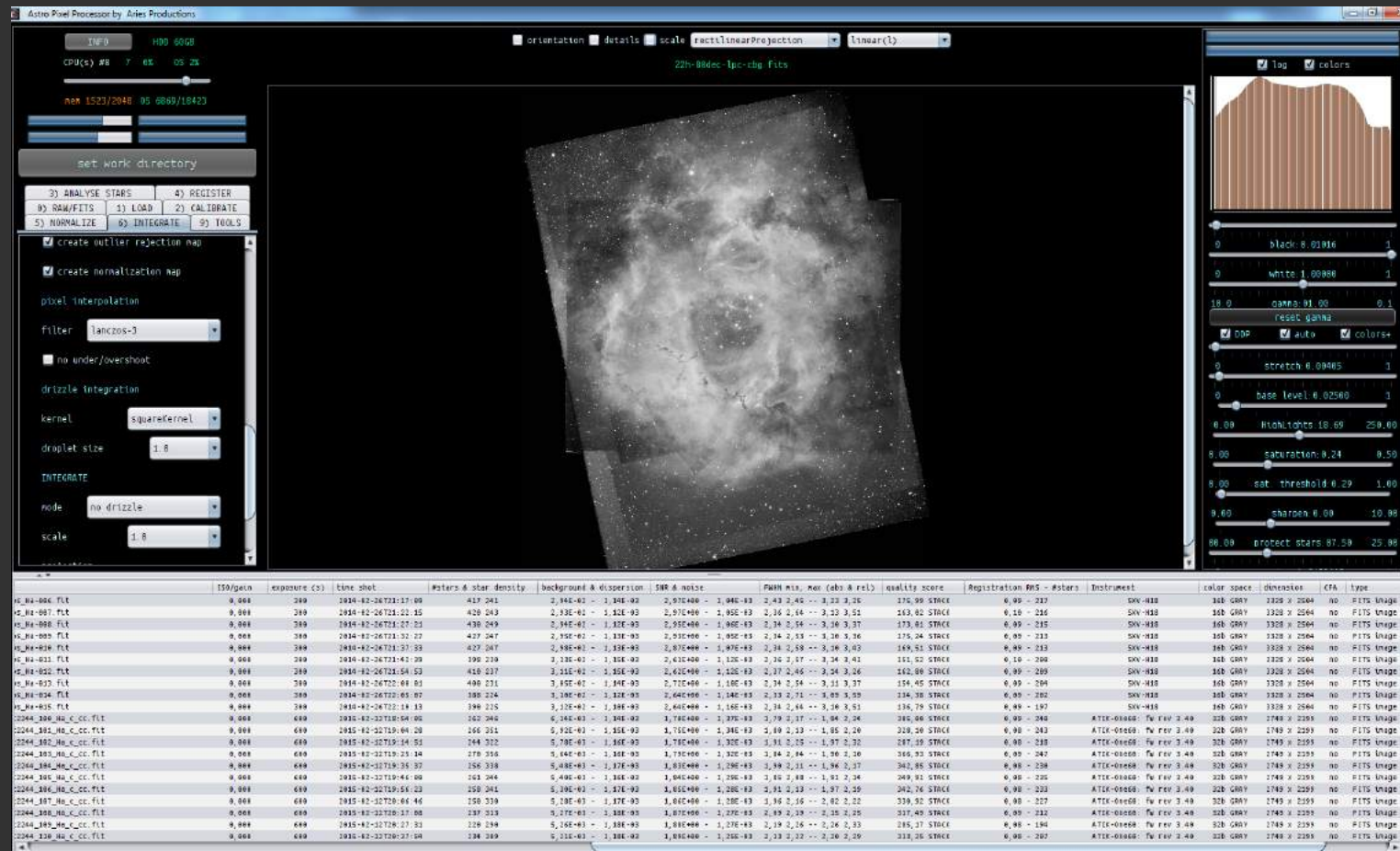
informatie hardware bronnen



controle paneel



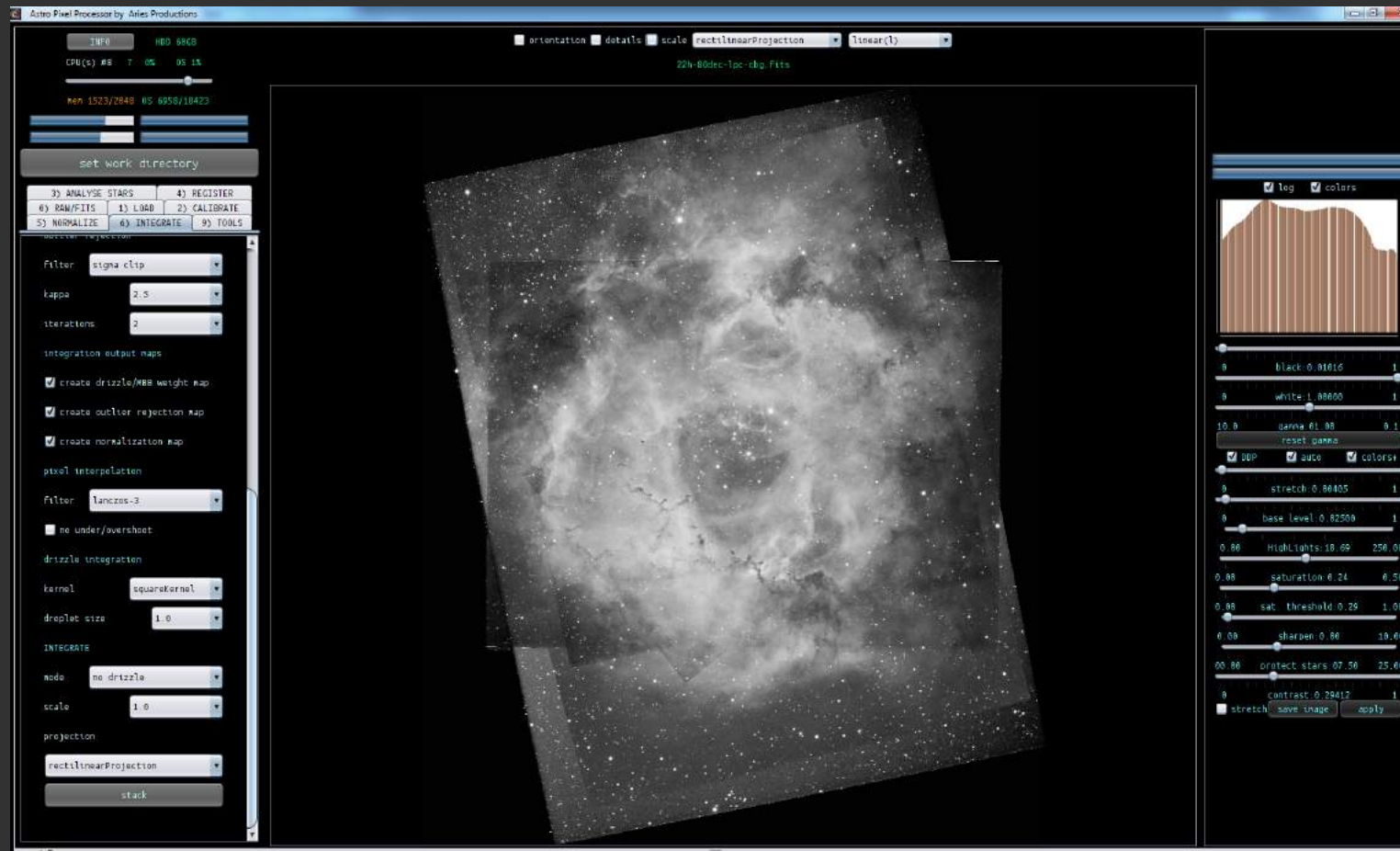
opname informatie



opnameformat

Astro Pixel Processor by Aries Productions																			
	ISO/gain	exposure (s)	time shot	#stars & star density	background & dispersion	SNR & noise	FWHM min, max (abs & rel)	quality score	Registration RMS - #stars	Instrument	color space	dimension	CFA	Type					
H_00-006 FLT	0,000	300	2014-02-26T21:17:09	427 241	2,940-02 - 1,140-03	2,970+00 - 1,840-03	2,43 2,45 -- 3,13 2,25	175,99 STACK	0,09 - 217	SVX-H18	160 GRAY	3328 x 2544	no	FITS Image					
H_00-007 FLT	0,000	300	2014-02-26T21:22:15	420 243	2,930-02 - 1,120-03	2,970+00 - 1,850-03	2,36 2,64 -- 3,13 2,51	163,02 STACK	0,10 - 216	SVX-H18	160 GRAY	3328 x 2544	no	FITS Image					
H_00-008 FLT	0,000	300	2014-02-26T21:27:21	430 249	2,940-02 - 1,120-03	2,950+00 - 1,860-03	2,34 2,54 -- 3,14 2,37	173,03 STACK	0,09 - 215	SVX-H18	160 GRAY	3328 x 2544	no	FITS Image					
H_00-009 FLT	0,000	300	2014-02-26T21:32:27	427 247	2,950-02 - 1,130-03	2,930+00 - 1,850-03	2,34 2,53 -- 3,10 2,36	175,24 STACK	0,09 - 213	SVX-H18	160 GRAY	3328 x 2544	no	FITS Image					
H_00-010 FLT	0,000	300	2014-02-26T21:37:33	427 247	2,940-02 - 1,130-03	2,970+00 - 1,870-03	2,34 2,50 -- 3,10 2,43	169,53 STACK	0,09 - 213	SVX-H18	160 GRAY	3328 x 2544	no	FITS Image					
H_00-011 FLT	0,000	300	2014-02-26T21:42:39	399 239	3,130-02 - 1,150-03	2,610+00 - 1,130-03	2,36 2,57 -- 3,14 2,41	151,52 STACK	0,10 - 200	SVX-H18	160 GRAY	3328 x 2544	no	FITS Image					
H_00-012 FLT	0,000	300	2014-02-26T21:54:53	410 237	3,130-02 - 1,150-03	2,620+00 - 1,120-03	2,37 2,46 -- 3,14 2,24	162,08 STACK	0,09 - 209	SVX-H18	160 GRAY	3328 x 2544	no	FITS Image					
H_00-013 FLT	0,000	300	2014-02-26T22:00:01	400 231	3,050-02 - 1,140-03	2,720+00 - 1,100-03	2,34 2,54 -- 3,11 2,37	154,45 STACK	0,09 - 204	SVX-H18	160 GRAY	3328 x 2544	no	FITS Image					
H_00-014 FLT	0,000	300	2014-02-26T22:05:07	380 224	3,100-02 - 1,120-03	2,640+00 - 1,140-03	2,33 2,73 -- 3,09 2,59	134,30 STACK	0,09 - 202	SVX-H18	160 GRAY	3328 x 2544	no	FITS Image					
H_00-015 FLT	0,000	300	2014-02-26T22:10:13	390 225	3,120-02 - 1,100-03	2,640+00 - 1,160-03	2,34 2,64 -- 3,10 2,51	136,79 STACK	0,09 - 197	SVX-H18	160 GRAY	3328 x 2544	no	FITS Image					
12044_100_Ha_Cc FLT	0,000	600	2015-02-12T19:04:05	262 346	6,140-02 - 1,240-03	5,700+00 - 3,270-03	1,79 2,17 -- 1,84 2,24	385,00 STACK	0,09 - 240	ATIX-one60: fw rev 3.40	320 GRAY	2749 x 2199	no	FITS Image					
12044_101_Ha_Cc FLT	0,000	600	2015-02-12T19:04:20	264 351	5,920-02 - 1,150-03	5,750+00 - 1,340-03	1,80 2,13 -- 1,85 2,20	320,18 STACK	0,08 - 243	ATIX-one60: fw rev 3.40	320 GRAY	2749 x 2199	no	FITS Image					
12044_102_Ha_Cc FLT	0,000	600	2015-02-12T19:14:51	244 322	5,780-02 - 1,160-03	5,700+00 - 1,320-03	1,91 2,25 -- 1,97 2,32	287,19 STACK	0,08 - 218	ATIX-one60: fw rev 3.40	320 GRAY	2749 x 2199	no	FITS Image					
12044_103_Ha_Cc FLT	0,000	600	2015-02-12T19:25:14	270 356	5,640-02 - 1,160-03	5,790+00 - 1,320-03	1,84 2,04 -- 1,90 2,10	366,93 STACK	0,09 - 247	ATIX-one60: fw rev 3.40	320 GRAY	2749 x 2199	no	FITS Image					
12044_104_Ha_Cc FLT	0,000	600	2015-02-12T19:35:37	256 338	5,480-02 - 1,170-03	5,830+00 - 1,290-03	1,90 2,21 -- 1,96 2,37	342,85 STACK	0,08 - 230	ATIX-one60: fw rev 3.40	320 GRAY	2749 x 2199	no	FITS Image					
12044_105_Ha_Cc FLT	0,000	600	2015-02-12T19:46:00	261 344	5,440-02 - 1,160-03	5,840+00 - 1,290-03	1,85 2,00 -- 1,91 2,14	349,93 STACK	0,08 - 235	ATIX-one60: fw rev 3.40	320 GRAY	2749 x 2199	no	FITS Image					
12044_106_Ha_Cc FLT	0,000	600	2015-02-12T19:56:23	258 341	5,380-02 - 1,170-03	5,850+00 - 1,280-03	1,91 2,13 -- 1,97 2,20	342,76 STACK	0,08 - 233	ATIX-one60: fw rev 3.40	320 GRAY	2749 x 2199	no	FITS Image					
12044_107_Ha_Cc FLT	0,000	600	2015-02-12T20:06:46	258 330	5,280-02 - 1,170-03	5,860+00 - 1,200-03	1,96 2,16 -- 2,02 2,22	330,92 STACK	0,08 - 227	ATIX-one60: fw rev 3.40	320 GRAY	2749 x 2199	no	FITS Image					
12044_108_Ha_Cc FLT	0,000	600	2015-02-12T20:17:08	237 313	5,270-02 - 1,180-03	5,870+00 - 1,170-03	2,09 2,19 -- 2,15 2,25	317,49 STACK	0,09 - 212	ATIX-one60: fw rev 3.40	320 GRAY	2749 x 2199	no	FITS Image					
12044_109_Ha_Cc FLT	0,000	600	2015-02-12T20:27:31	224 290	5,240-02 - 1,180-03	5,880+00 - 1,270-03	2,19 2,24 -- 2,16 2,33	285,17 STACK	0,08 - 194	ATIX-one60: fw rev 3.40	320 GRAY	2749 x 2199	no	FITS Image					
12044_110_Ha_Cc FLT	0,000	600	2015-02-12T20:37:54	236 309	5,220-02 - 1,180-03	5,890+00 - 1,250-03	2,13 2,22 -- 2,10 2,29	312,25 STACK	0,08 - 207	ATIX-one60: fw rev 3.40	320 GRAY	2749 x 2199	no	FITS Image					
12044_111_Ha_Cc FLT	0,000	600	2015-02-12T20:48:17	237 313	5,200-02 - 1,170-03	5,870+00 - 1,270-03	2,15 2,21 -- 2,12 2,28	317,10 STACK	0,08 - 211	ATIX-one60: fw rev 3.40	320 GRAY	2749 x 2199	no	FITS Image					
12044_112_Ha_Cc FLT	0,000	600	2015-02-12T20:58:40	214 282	5,270-02 - 1,170-03	5,870+00 - 1,270-03	2,20 2,33 -- 2,17 2,41	267,62 STACK	0,08 - 187	ATIX-one60: fw rev 3.40	320 GRAY	2749 x 2199	no	FITS Image					
12044_120_Ha_Cc FLT	0,000	600	2015-02-12T21:17:19	227 299	5,290-02 - 1,180-03	5,830+00 - 1,260-03	2,13 2,40 -- 2,10 2,56	258,05 STACK	0,08 - 203	ATIX-one60: fw rev 3.40	320 GRAY	2749 x 2199	no	FITS Image					
12044_201_Ha_Cc FLT	0,000	600	2015-02-12T21:27:42	237 312	5,380-02 - 1,180-03	5,830+00 - 1,260-03	2,01 2,45 -- 2,07 2,53	269,67 STACK	0,09 - 212	ATIX-one60: fw rev 3.40	320 GRAY	2749 x 2199	no	FITS Image					
12044_202_Ha_Cc FLT	0,000	600	2015-02-12T21:37:45	240 322	5,480-02 - 1,170-03	5,880+00 - 1,240-03	2,01 2,41 -- 2,08 2,49	275,52 STACK	0,09 - 219	ATIX-one60: fw rev 3.40	320 GRAY	2749 x 2199	no	FITS Image					
12044_203_Ha_Cc FLT	0,000	600	2015-02-12T21:48:20	233 305	5,440-02 - 1,150-03	5,790+00 - 1,300-03	2,06 2,42 -- 2,12 2,49	250,30 STACK	0,09 - 206	ATIX-one60: fw rev 3.40	320 GRAY	2749 x 2199	no	FITS Image					
12044_204_Ha_Cc FLT	0,000	600	2015-02-12T21:58:51	213 281	5,430-02 - 1,130-03	5,760+00 - 1,330-03	2,17 2,40 -- 2,14 2,47	244,07 STACK	0,08 - 190	ATIX-one60: fw rev 3.40	320 GRAY	2749 x 2199	no	FITS Image					
12044_205_Ha_Cc FLT	0,000	600	2015-02-12T22:09:14	206 272	5,520-02 - 1,110-03	5,730+00 - 1,350-03	2,21 2,46 -- 2,18 2,54	225,00 STACK	0,08 - 179	ATIX-one60: fw rev 3.40	320 GRAY	2749 x 2199	no	FITS Image					
12044_206_Ha_Cc FLT	0,000	600	2015-02-12T22:19:37	192 253	5,610-02 - 1,090-03	5,690+00 - 1,350-03	2,25 2,51 -- 2,12 2,59	201,44 STACK	0,08 - 166	ATIX-one60: fw rev 3.40	320 GRAY	2749 x 2199	no	FITS Image					
12044_207_Ha_Cc FLT	0,000	600	2015-02-12T22:30:00	166 219	5,670-02 - 1,090-03	5,680+00 - 1,390-03	2,52 2,67 -- 2,40 2,75	146,53 STACK	0,08 - 143	ATIX-one60: fw rev 3.40	320 GRAY	2749 x 2199	no	FITS Image					
12044_208_Ha_Cc FLT	0,000	600	2015-02-12T22:40:22	203 248	5,730-02 - 1,080-03	5,650+00 - 1,410-03	2,17 2,44 -- 2,14 2,51	211,70 STACK	0,09 - 170	ATIX-one60: fw rev 3.40	320 GRAY	2749 x 2199	no	FITS Image					
12044_209_Ha_Cc FLT	0,000	600	2015-02-12T22:50:45	185 244	5,810-02 - 9,980-04	5,520+00 - 1,500-03	2,22 2,37 -- 2,19 2,44	192,32 STACK	0,09 - 161	ATIX-one60: fw rev 3.40	320 GRAY	2749 x 2199	no	FITS Image					
I_1_Light_ngc2237_ha_PMB-2_0-Q51503W5G_Ha...	0,000	600	2015-12-09T22:22:10	476 342	0,620-02 - 1,940-03	3,810+00 - 6,810-04	2,36 2,40 -- 2,01 2,96	451,39 STACK	0,13 - 296	QSI CCD Camera	320 GRAY	3326 x 2544	no	FITS Image					
I_1_Light_ngc2237_ha_PMB-2_0-Q51503W5G_Ha...	0,000	600	2015-12-09T22:33:17	479 344	0,680-02 - 1,960-03	3,970+00 - 6,500-04	2,31 2,47 -- 2,15 2,94	479,88 STACK	0,13 - 298	QSI CCD Camera	320 GRAY	3326 x 2544	no	FITS Image					
I_1_Light_ngc2237_ha_PMB-2_0-Q51503W5G_Ha...	0,000	600	2015-12-09T22:44:26	467 335	0,750-02 - 1,940-03	3,860+00 - 6,770-04	2,37 2,56 -- 2,03 2,95	436,47 STACK	0,12 - 280	QSI CCD Camera	320 GRAY	3326 x 2544	no	FITS Image					
I_1_Light_ngc2237_ha_PMB-2_0-Q51503W5G_Ha...	0,000	600	2015-12-09T22:56:03	457 328	0,840-02 - 1,910-03	3,760+00 - 6,950-04	2,37 2,55 -- 2,03 2,94	419,30 STACK	0,13 - 286	QSI CCD Camera	320 GRAY	3326 x 2544	no	FITS Image					
I_1_Light_ngc2237_ha_PMB-2_0-Q51503W5G_Ha...	0,000	600	2015-12-09T23:07:20	466 335	0,950-02 - 1,920-03	3,770+00 - 6,900-04	2,30 2,53 -- 2,14 2,81	427,06 STACK	0,13 - 290	QSI CCD Camera	320 GRAY	3326 x 2544	no	FITS Image					
I_1_Light_ngc2237_ha_PMB-2_0-Q51503W5G_Ha...	0,000	600	2015-12-09T23:18:45	468 333	0,920-02 - 1,920-03	3,790+00 - 6,920-04	2,35 2,55 -- 2,00 2,94	419,77 STACK	0,13 - 287	QSI CCD Camera	320 GRAY	3326 x 2544	no	FITS Image					
I_1_Light_ngc2237_ha_PMB-2_0-Q51503W5G_Ha...	0,000	600	2015-12-09T23:29:40	422 303	0,370-02 - 1,080-03	3,540+00 - 7,410-04	2,46 2,64 -- 2,12 3,14	347,19 STACK	0,13 - 267	QSI CCD Camera	320 GRAY	3326 x 2544	no	FITS Image					
I_1_Light_ngc2237_ha_PMB-2_0-Q51503W5G_Ha...	0,000	600	2015-12-09T23:41:07	442 318	0,380-02 - 1,050-03	3,560+00 - 7,200-04	2,40 2,55 -- 2,06 3,04	380,66 STACK	0,13 - 278	QSI CCD Camera	320 GRAY	3326 x 2544	no	FITS Image					
I_1_Light_ngc2237_ha_PMB-2_0-Q51503W5G_Ha...	0,000	600	2015-12-09T23:52:31	425 305	0,560-02 - 1,050-03	3,500+00 - 7,360-04	2,46 2,63 -- 2,13 3,13	355,04 STACK	0,14 - 266	QSI CCD Camera	320 GRAY	3326 x 2544	no	FITS Image					
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I_1_Light_ngc2237_ha_PMB-2_0-Q51503W5G_Ha...	0,000	600	2015-12-10T00:15:26	442 310	0,840-02 - 1,940-03	3,770+00 - 6,760-04	2,44 2,65 -- 2,13 3,15	411,62 STACK	0,08 - 273	QSI CCD Camera	320 GRAY	3326 x 2544	no	FITS Image					
I_1_Light_ngc2237_ha_PMB-2_0-Q51503W5G_Ha...	0,000	600	2015-12-10T00:36:50	459 330	0,850-02 - 1,950-03	3,790+00 - 6,760-04	2,30 2,57 -- 2,03 2,86	437,30 STACK	0,08 - 284	QSI CCD Camera	320 GRAY	3326 x 2544	no	FITS Image					
I_1_Light_ngc2237_ha_PMB-2_0-Q51503W5G_Ha...	0,000	600	2015-12-10T00:47:50	460 337	0,930-02 - 1,970-03	3,840+00 - 6,740-04	2,41 2,61 -- 2,07 2,10	443,74 STACK	0,08 - 280	QSI CCD Camera	320 GRAY	3326 x 2544	no	FITS Image					
I_1_Light_ngc2237_ha_PMB-2_0-Q51503W5G_Ha...	0,000	600	2015-12-10T00:59:37	460 331	0,100-02 - 1,080-03	3,830+00 - 6,600-04	2,41 2,62 -- 2,07 2,12	430,40 STACK	0,08 - 282	QSI CCD Camera	320 GRAY	3326 x 2544	no	FITS Image					
I_1_Light_ngc2237_ha_PMB-2_0-Q51503W5G_Ha...	0,000	600	2015-12-10T01:10:49	420 307	0,200-02 - 1,060-03	3,810+00 - 6,810-04	2,55 2,76 -- 2,03 2,29	374,37 STACK	0,08 - 259	QSI CCD Camera	320 GRAY	3326 x 2544	no	FITS Image					
I_1_Light_ngc2237_ha_PMB-2_0-Q51503W5G_Ha...	0,000	600	2015-12-10T01:21:29	427 307	0,650-02 - 1,990-03	3,740+00 - 6,700-04	2,52 2,73 -- 2,00 2,25	386,78 STACK	0,08 - 263	QSI CCD Camera	320 GRAY	3326 x 2544	no	FITS Image					
I_1_Light_ngc2237_ha_PMB-2_0-Q51503W5G_Ha...	0,000	600	2015-12-10T01:32:40	411 296	0,100-02 - 1,950-03	3,640+00 - 7,000-04	2,56 2,83 -- 2,05 3,37	343,99 STACK	0,08 - 254	QSI CCD Camera	320 GRAY	3326 x 2544	no	FITS Image					
I_1_Light_ngc2237_ha_PMB-2_0-Q51503W5G_Ha...	0,000	600	2015-12-10T01:43:31	394 283	0,820-02 - 1,930-03	3,620+00 - 7,110-04	2,67 2,80 -- 2,17 3,33	332,43 STACK	0,08 - 242	QSI CCD Camera	320 GRAY	3326 x 2544	no	FITS Image					
I_1_Light_ngc2237_ha_PMB-2_0-Q51503W5G_Ha...	0,000	600	2015-12-10T01:54:43	426 306	1,010-02 - 1,940-03	3,680+00 - 7,070-04	2,54 2,71 -- 2,02 3,13	371,61 STACK	0,08 - 263	QSI CCD Camera	320 GRAY	3326 x 2544	no	FITS Image					
I_1_Light_ngc22																			

opname informatie

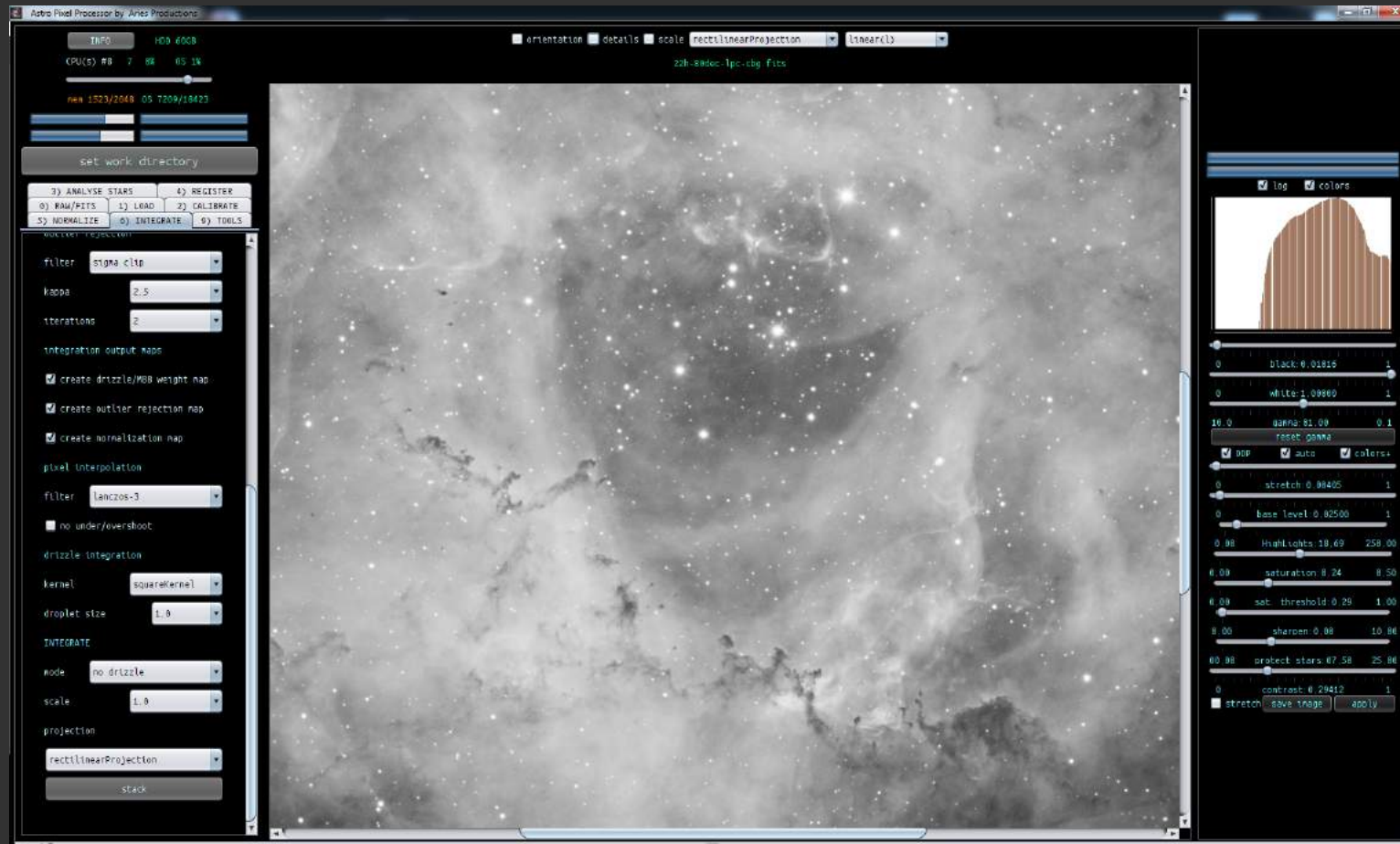


Astroforum.nl Forumpower

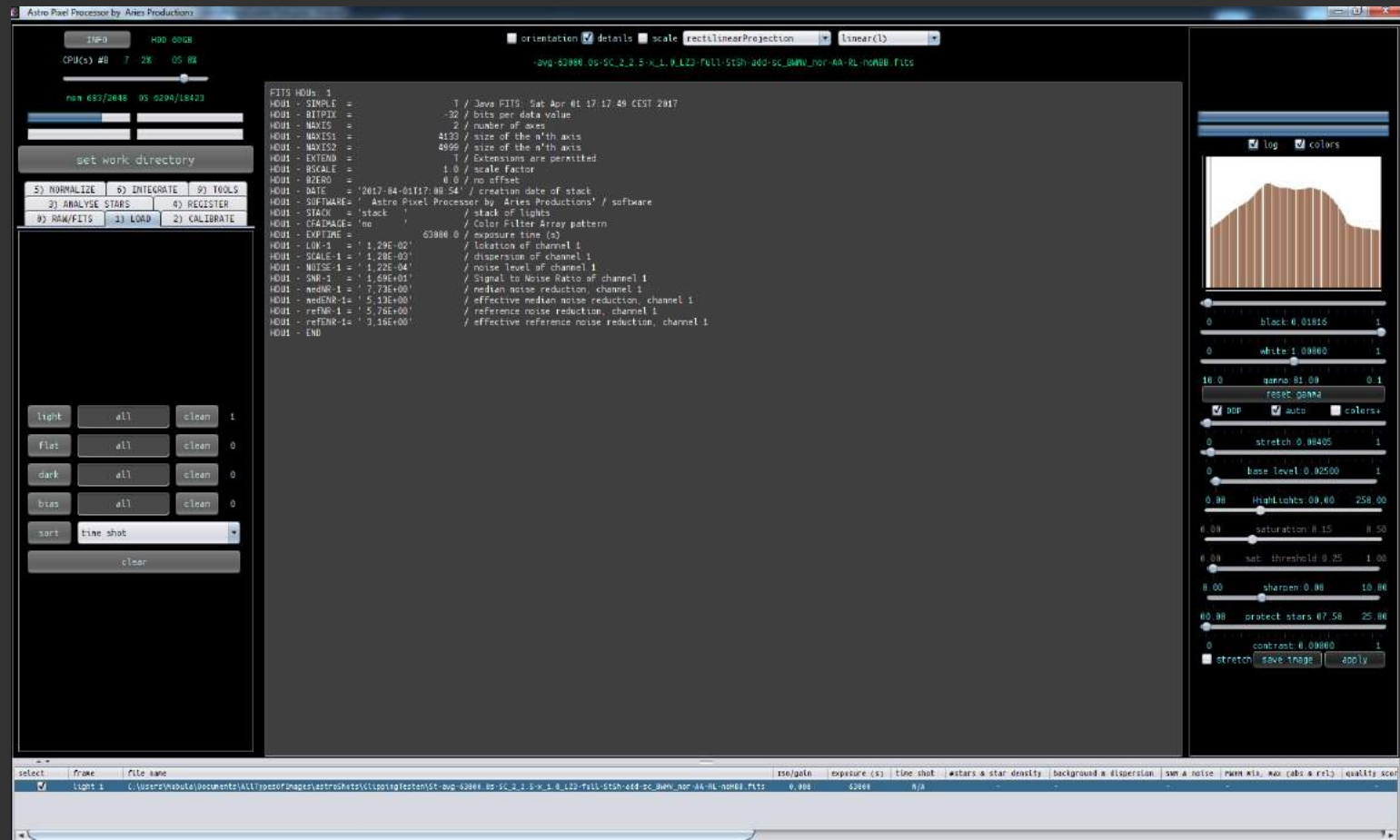
Rosette H-alpha data credits:

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

opname venster - opname

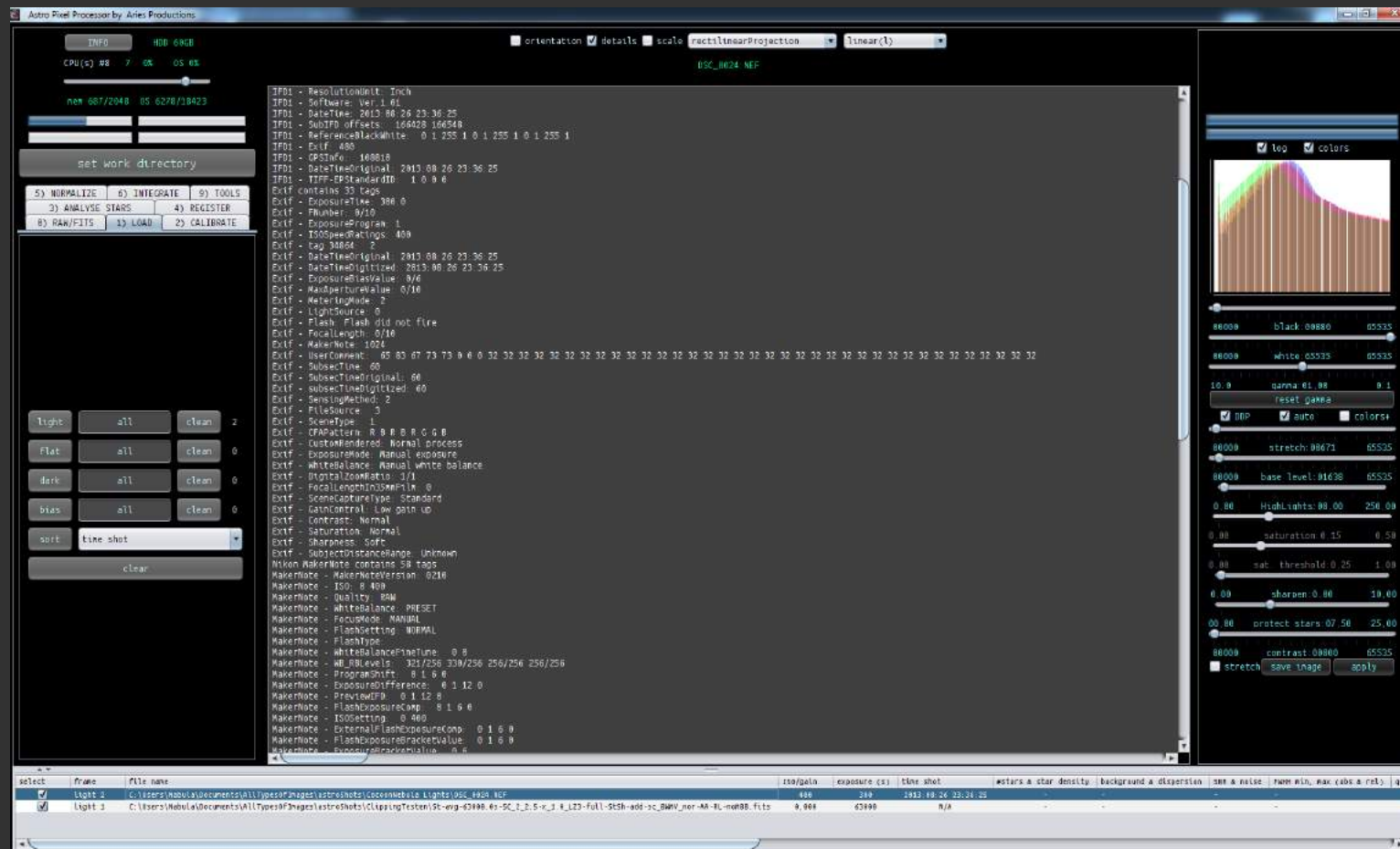


opname venster - meta data

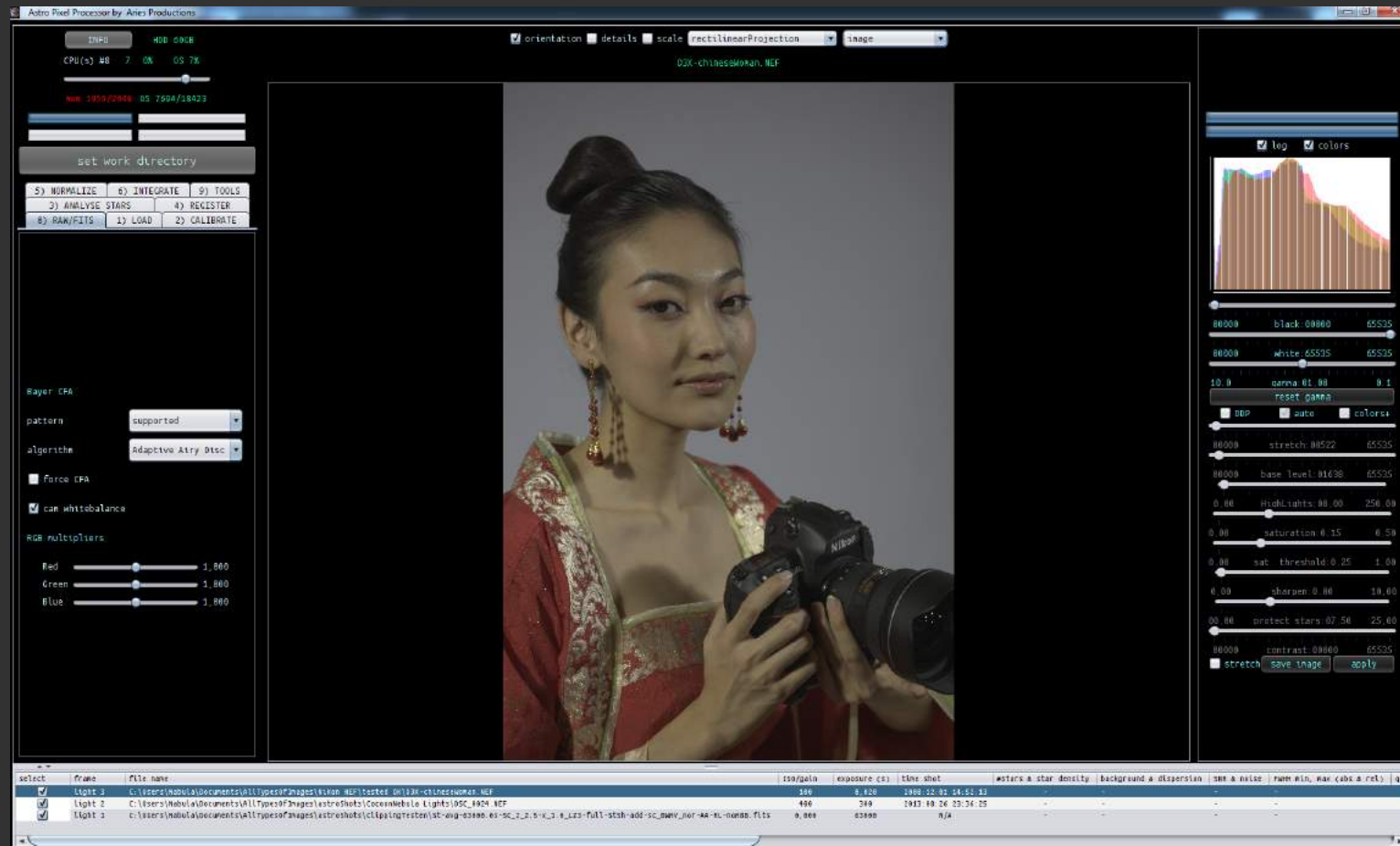


Werkgroep Astrofotografie

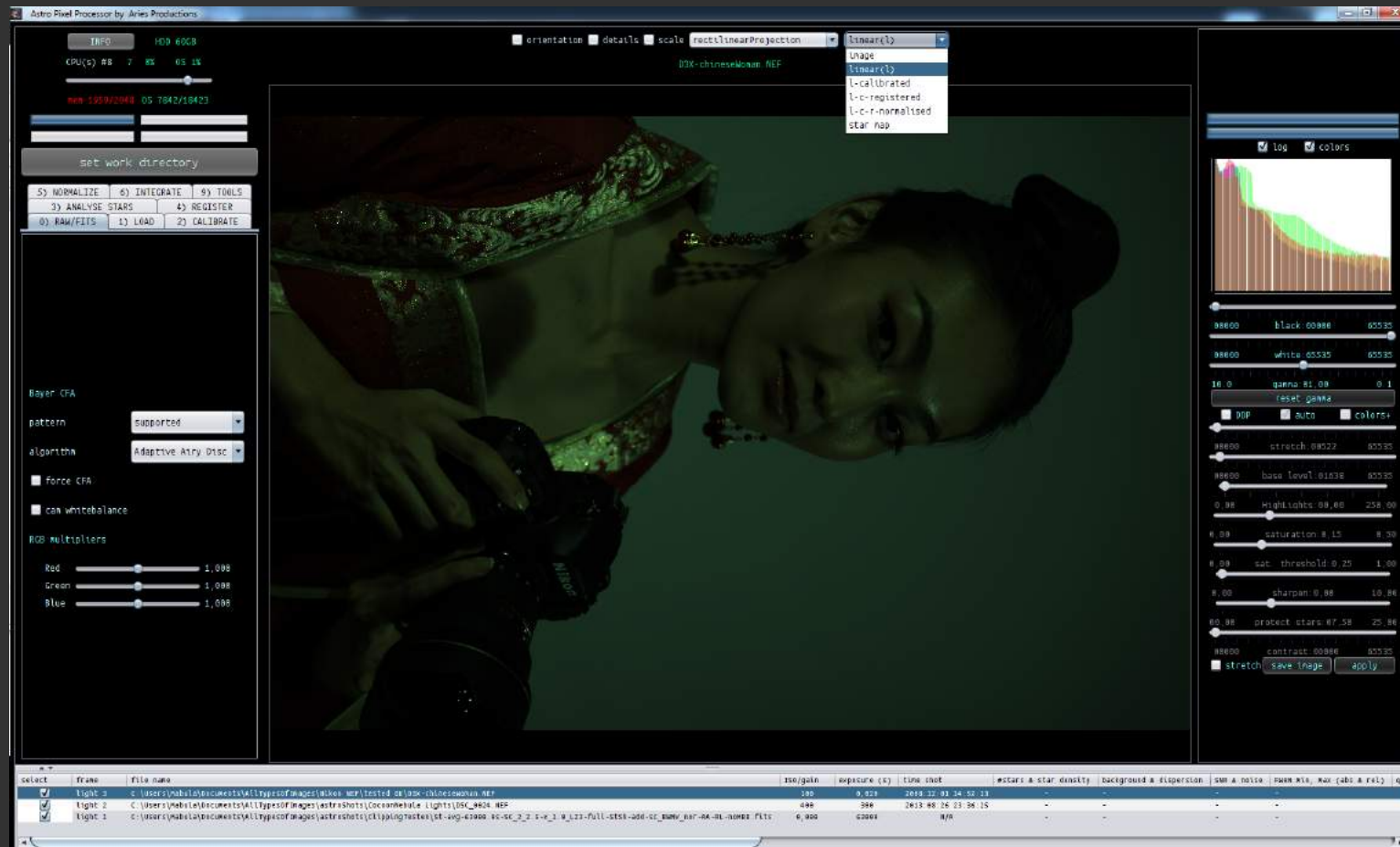
8 april 2017, Oss



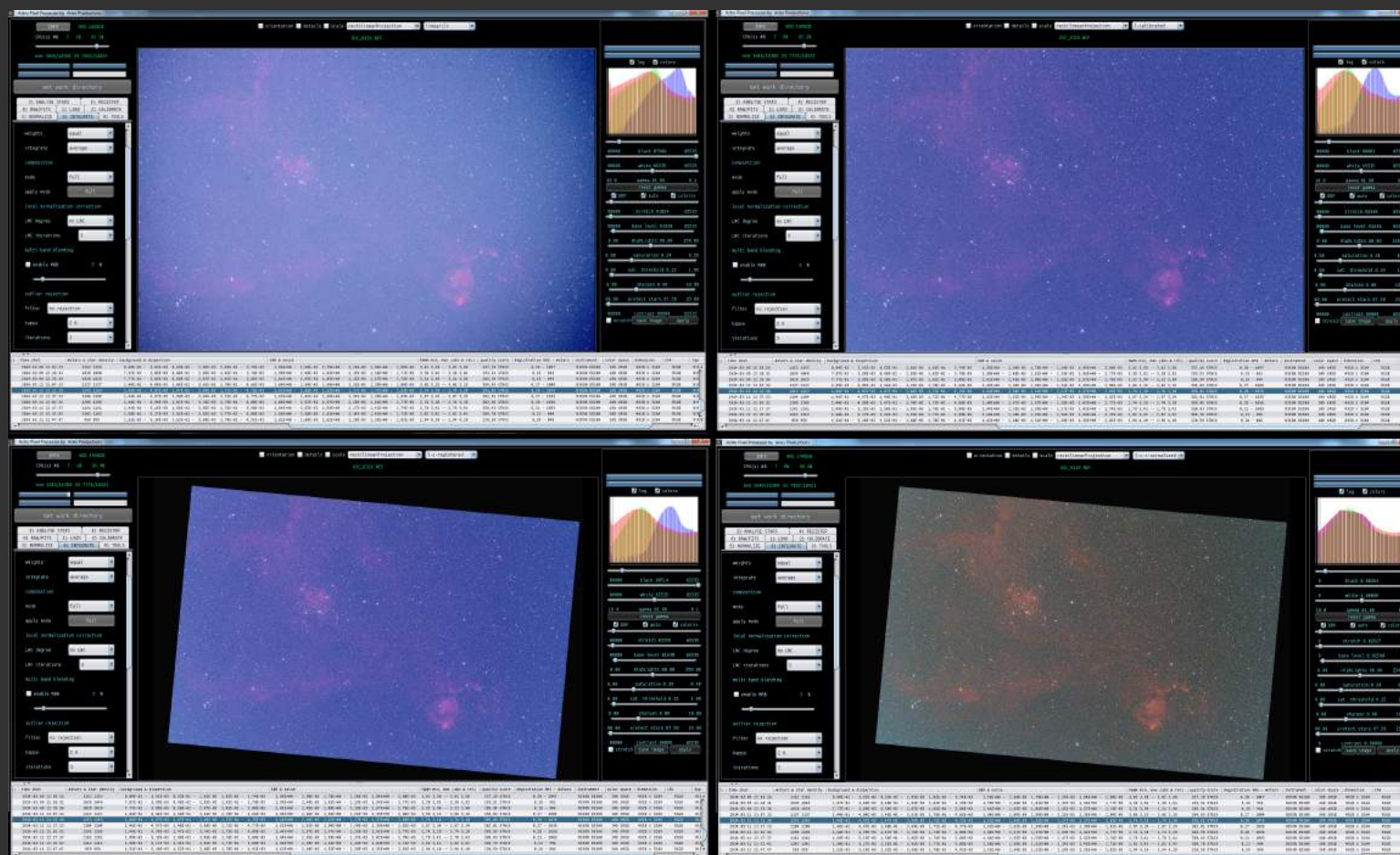
opname venster - image mode



opname venster - linear mode



opname venster - linear to normalized mode



histogram en opname filter - Orion data

Yves van den Broek

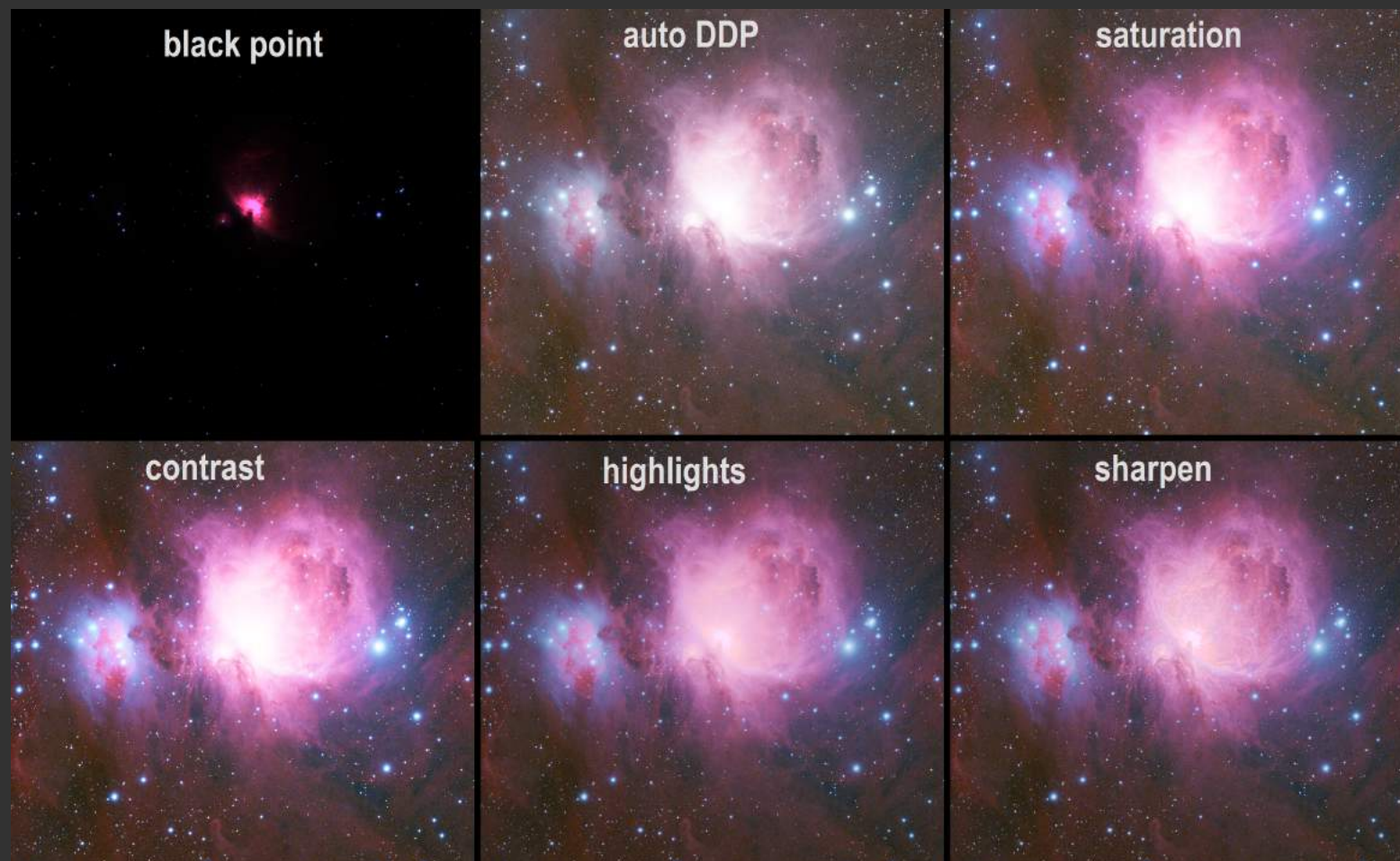
M42 uit Barnard's Loop HaRGB

44 uur belichting

RGB - Nikon D810a

H-alpha - Nikon D600 mono cooled

histogram en opname filter - 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

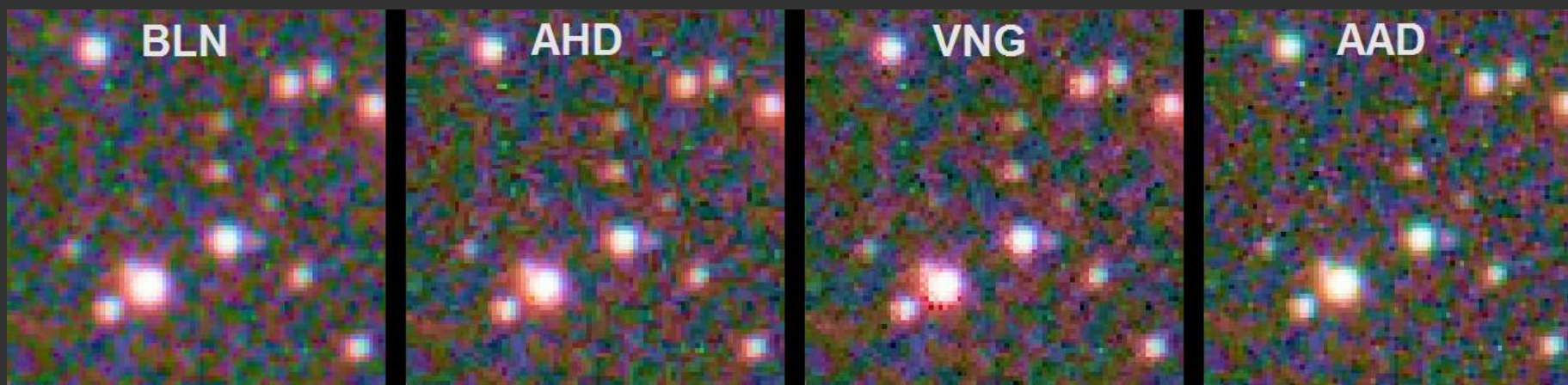
- Bayer CFA patroon (RGGB)
- Bayer CFA algoritme (AAD)
- camera witbalans
- RGB factoren
- forceer CFA interpretatie

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

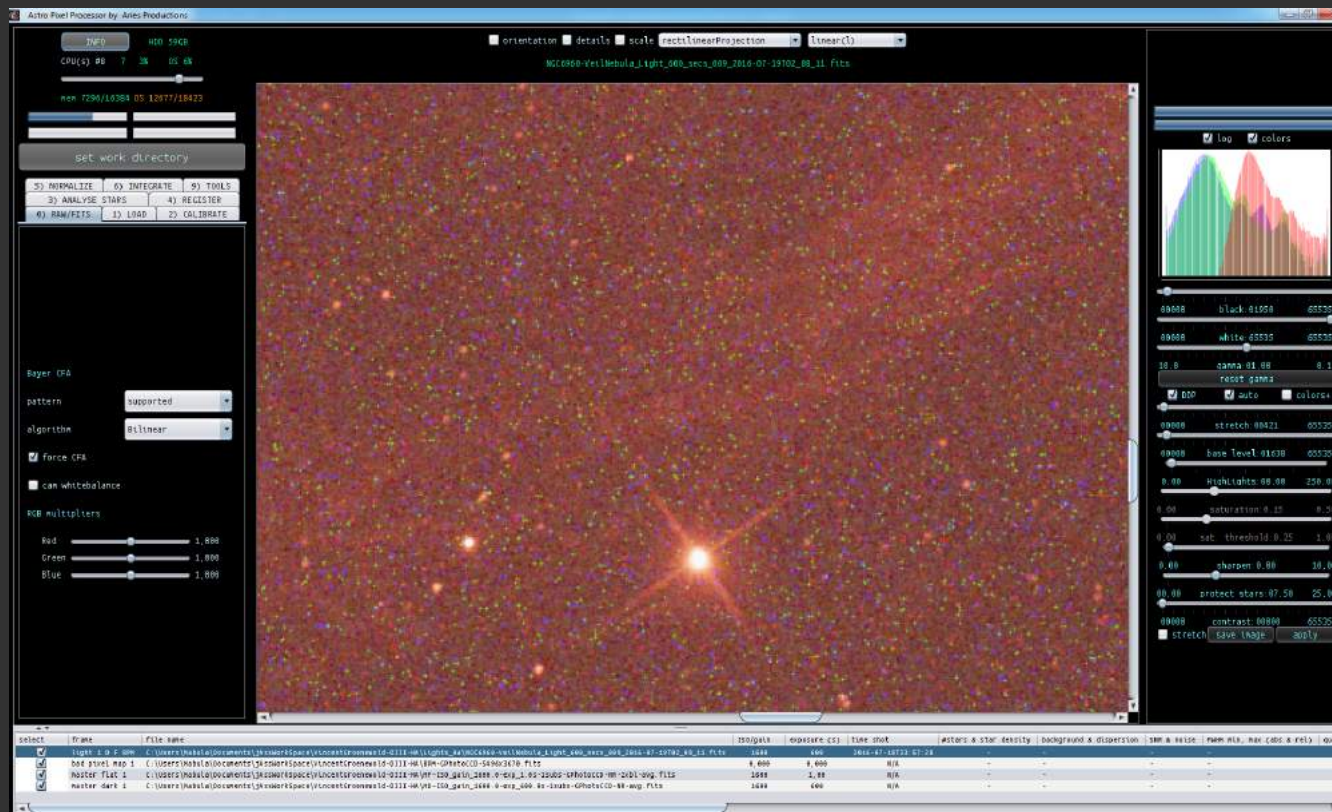
Hydrogen alpha debayer?

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

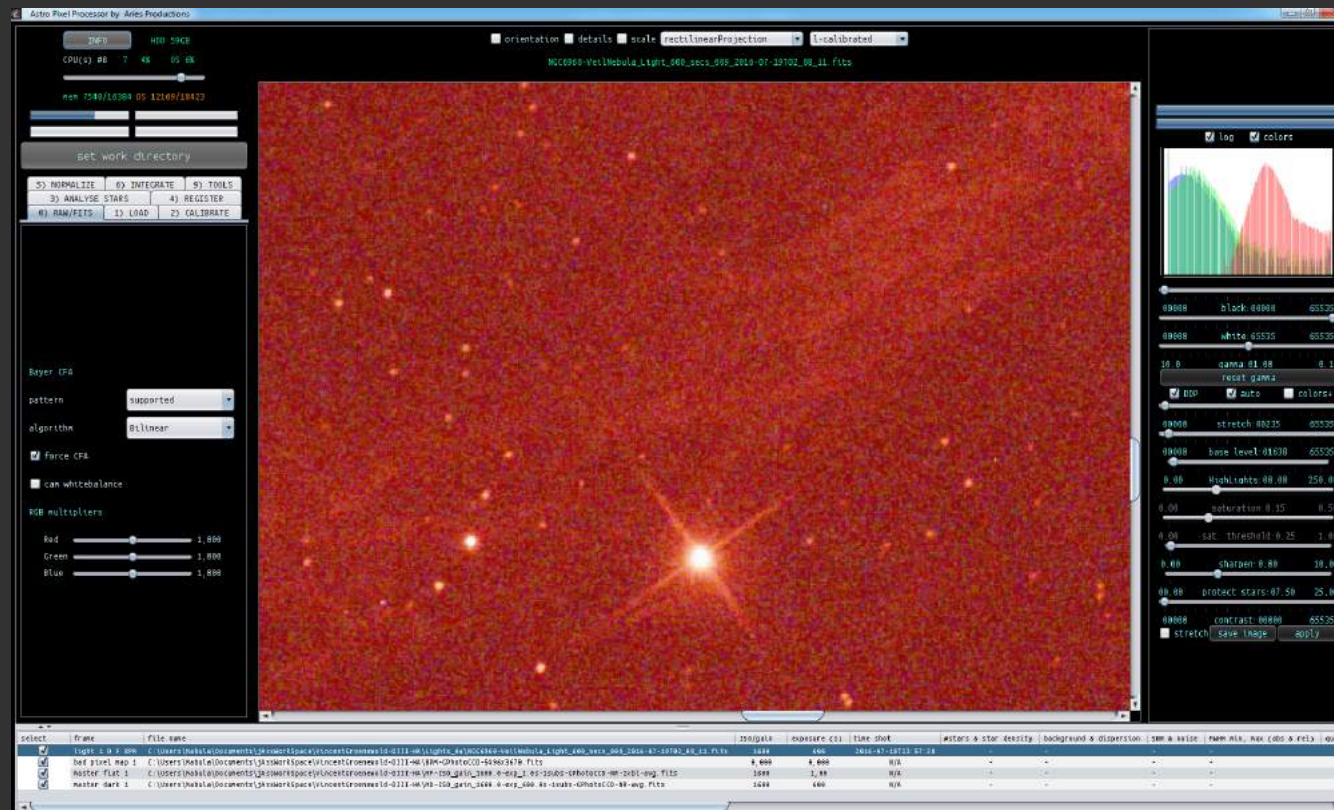
Hydrogen alpha debayer?

Voorbeeld - Veil Nebula, Vincent Groenewold, Canon 6D

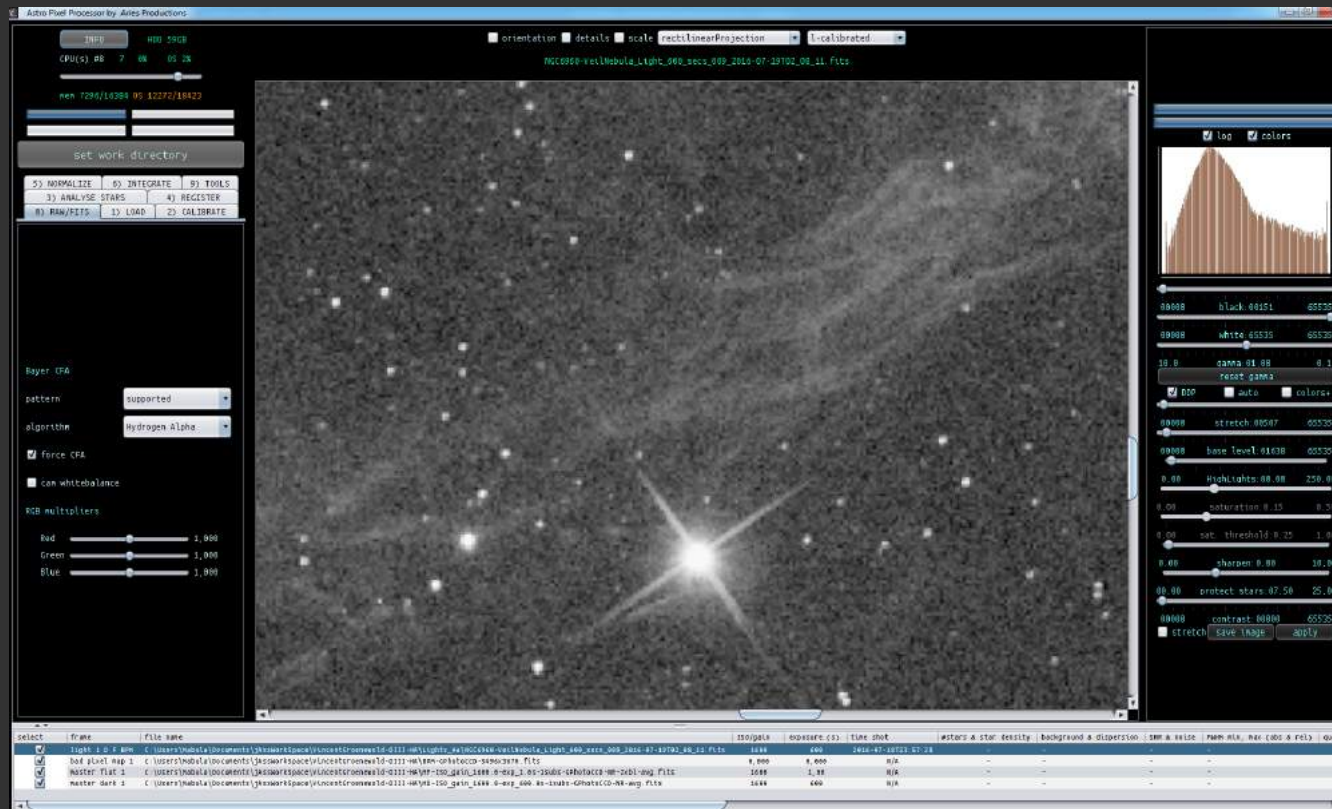


Hydrogen alpha debayer?

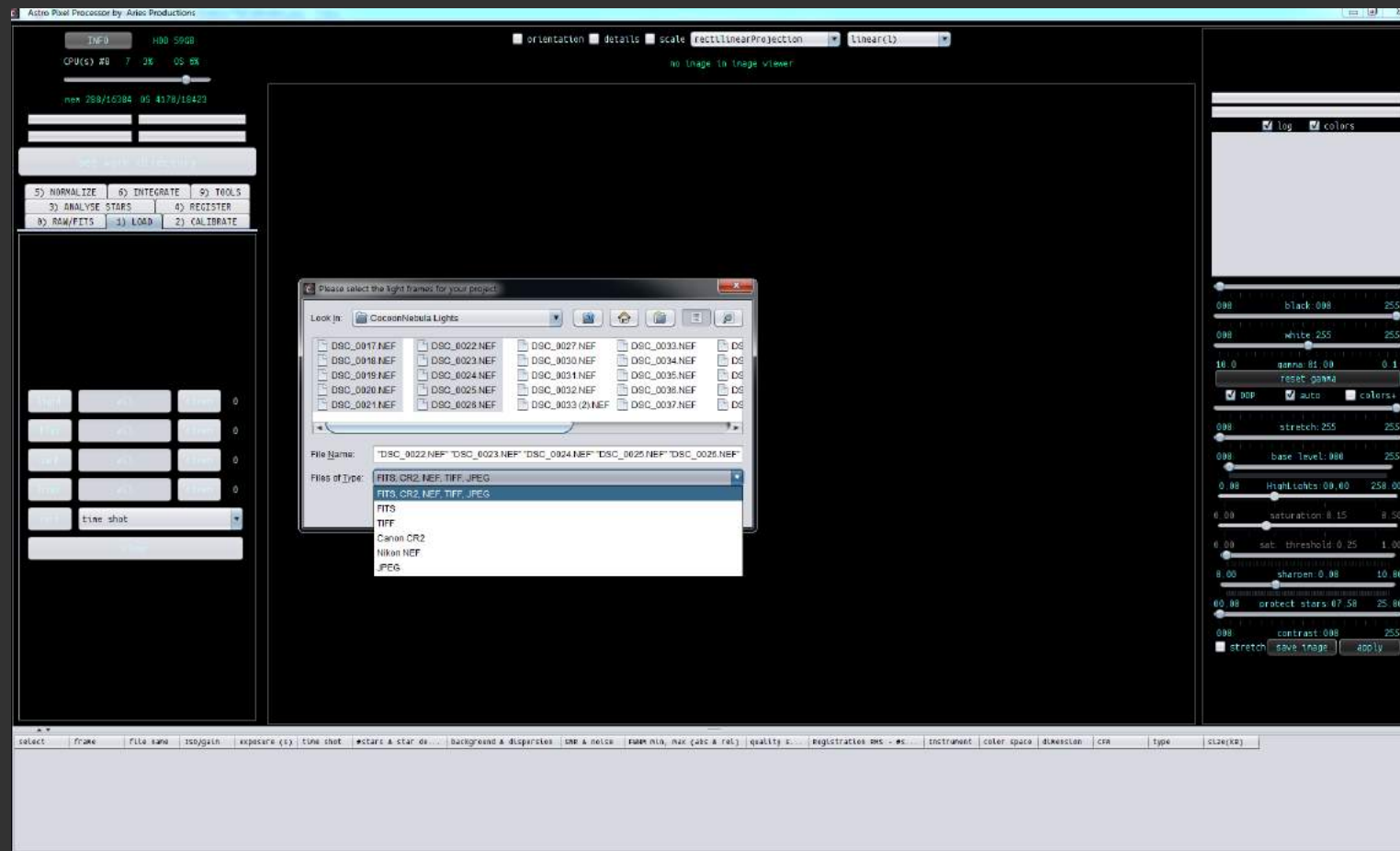
Voorbeeld - Veil Nebula, Vincent Groenewold



Voorbeeld - Veil Nebula, Vincent Groenewold



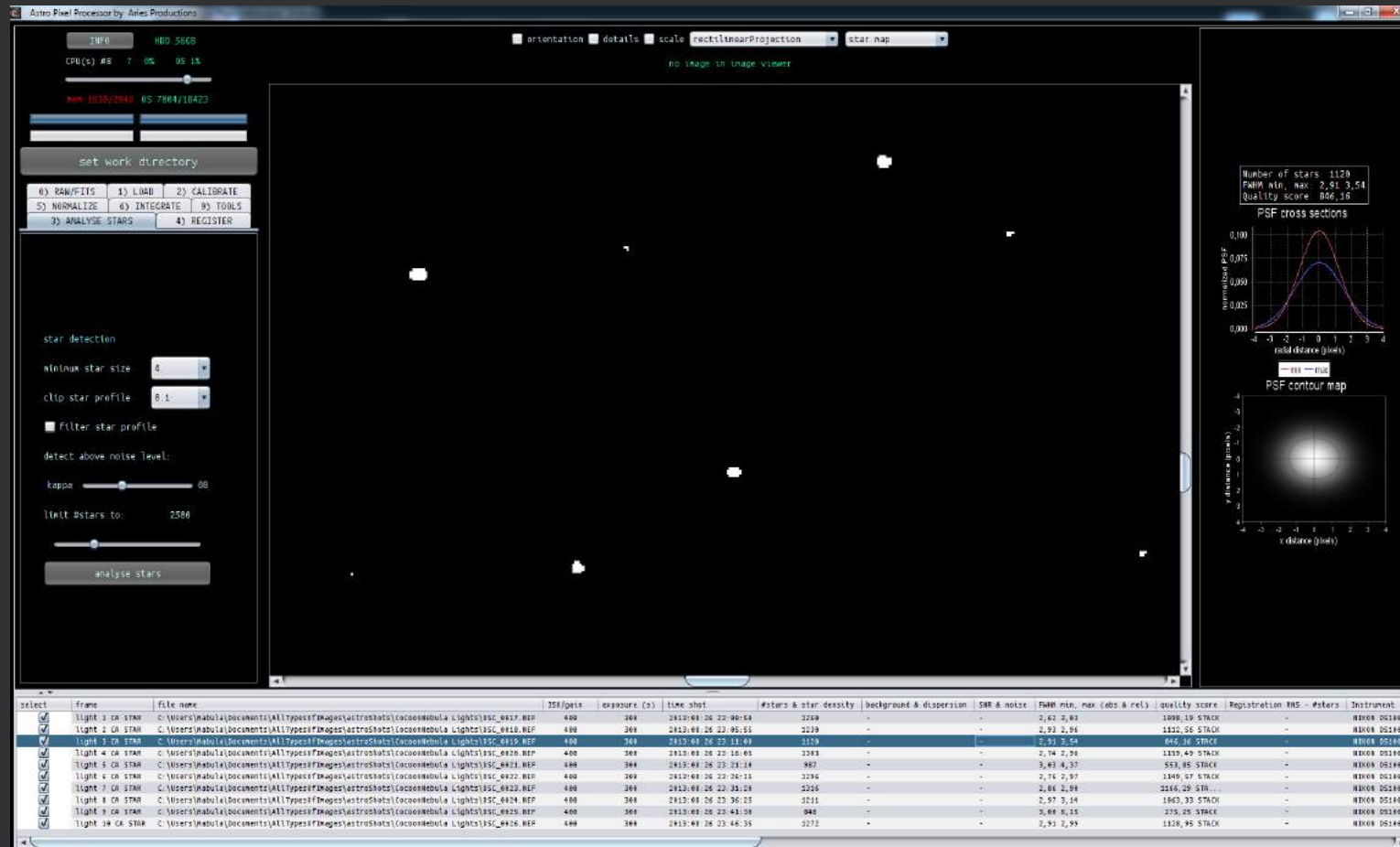
1) LOAD



2) CALIBRATE

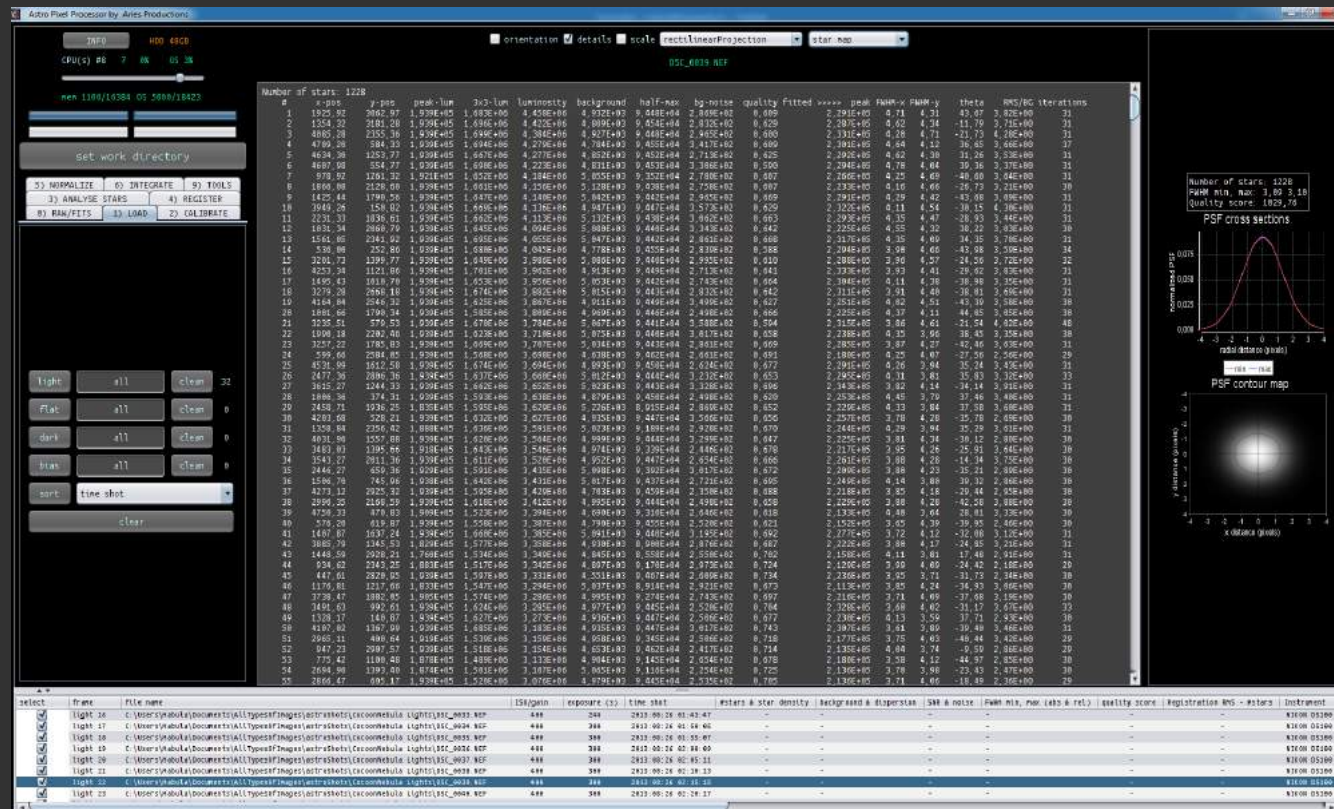
Master Bias	Master Flat	
integrate average	integrate average	☐ align channels
outlier rejection no rejection	outlier rejection no rejection	☐ split channels
kappa 2.0	kappa 2.0	☐ remove light pollution
iterations 3	iterations 3	
☐ create rejection map	☐ create rejection map	
Master Dark	normalize multiply-scale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

3) ANALYSE STARS



3) ANALYSE STARS

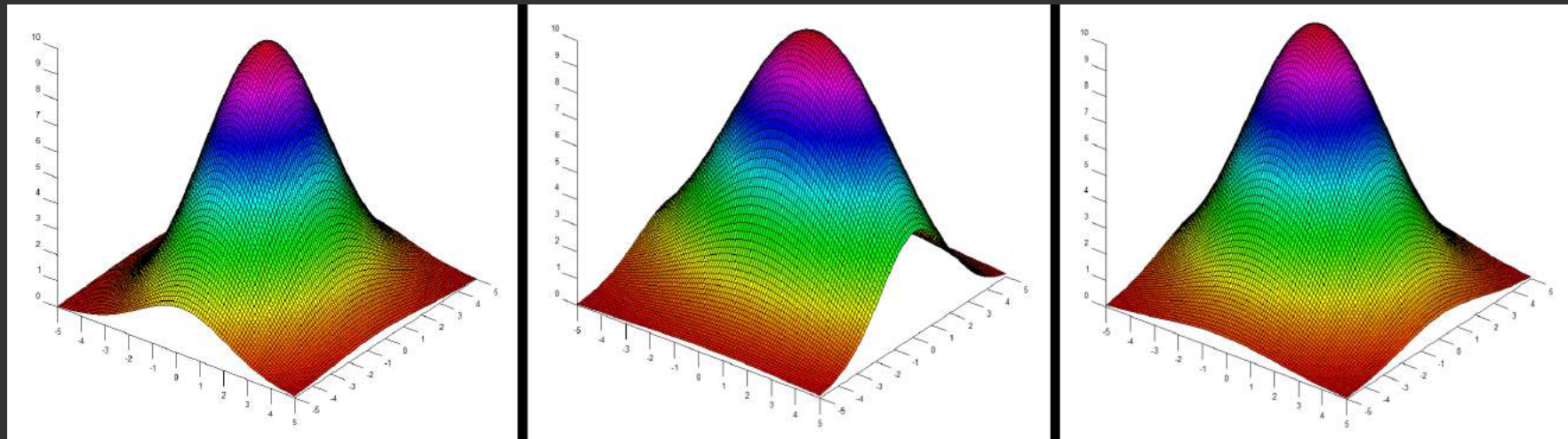
ster lokaties: Intensity Weighted Centroiding (IWC)



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
- transparante 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

Astro Pixel Processor by Arco Productions

INFO: 100% 56GB
CPU(s): 48 7 MW 05.05
mem: 2048/1024 05.7832/18423

set work directory

0) RAW/FITS 1) LOAD 2) CALIBRATE
3) NORMALIZE 5) INTEGRATE 6) TOOLS
3) ANALYSE STARS 4) REGISTER

pattern recognition descriptor shape:
quadrilaterals

☒ Flip descriptors in X/Y

dynamic distortion correction
☒ use dynamic distortion correction

choose saved camera profile:
no distortion model

distortion margin: 0.1

☐ save distortion model

registration mode:
normal

registration model

orientation: details scale: RectilinearProjection linear(1)
St-avg-9980.05-MR-X-1.0-L22-NS-Full-64-400-6C-BWV-NF-AA-RL-NM08.Fits

log colors

Black: 0.01016
White: 1.00098
gamma: 01.60
reset gamma
DOP ☒ auto colors+
stretch: 0.00406
base level: 0.02586
highlights: 60.98 250.98
saturation: 0.15 0.56
sat. threshold: 0.25 1.86
sharpen: 0.00 10.00
protect stars: 07.50 25.00
contrast: 0.00098
stretch save image apply

file	iso/gain	exposure (s)	time offset	stars & star density	background & dispersion	snr & noise	mem min, max (abs & rel)	quality score	registration rms - stars	instrument
cen000000_ngc2237_10x16_35x12021_9980-3_002.Fits	1.00	998	2002-01-15T21:59.54	378 368	5.20E-02 - 3.87E-03	2.08E+00 - 3.88E-02	1.51 1.55 -- 2.54 2.61	329.80 STACK	0.22 - 243	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-5_002.Fits	1.00	998	2002-01-15T22:44.83	377 366	4.32E-02 - 2.84E-03	2.02E+00 - 3.24E-04	1.55 1.56 -- 2.62 2.63	406.90 STACK	0.16 - 151	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-7_002.Fits	0.00	998	2002-01-15T23:51.57	393 383	2.91E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.43 3.85 -- 3.22 4.05	333.10 STACK	0.03 - 161	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-9_002.Fits	0.00	998	2002-01-15T23:51.57	426 243	2.93E-02 - 3.12E-03	3.00E+00 - 1.64E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-11_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-13_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-15_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-17_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-19_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-21_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-23_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-25_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-27_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-29_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-31_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-33_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-35_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-37_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-39_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-41_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-43_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-45_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-47_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-49_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-51_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-53_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-55_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-57_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
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cen000000_ngc2237_10x16_35x12021_9980-61_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
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cen000000_ngc2237_10x16_35x12021_9980-65_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
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cen000000_ngc2237_10x16_35x12021_9980-69_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
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cen000000_ngc2237_10x16_35x12021_9980-75_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-77_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-79_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-81_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
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cen000000_ngc2237_10x16_35x12021_9980-85_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-87_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-89_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-91_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-93_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-95_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-97_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-99_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-101_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-103_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13 3.58	363.14 STACK	0.03 - 119	SVX-H9
cen000000_ngc2237_10x16_35x12021_9980-105_002.Fits	0.00	998	2002-01-15T23:51.57	398 331	3.23E-02 - 3.15E-03	3.00E+00 - 1.63E-03	3.36 3.84 -- 3.13			

4) REGISTER - optische vervorming correctie (DDC)

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

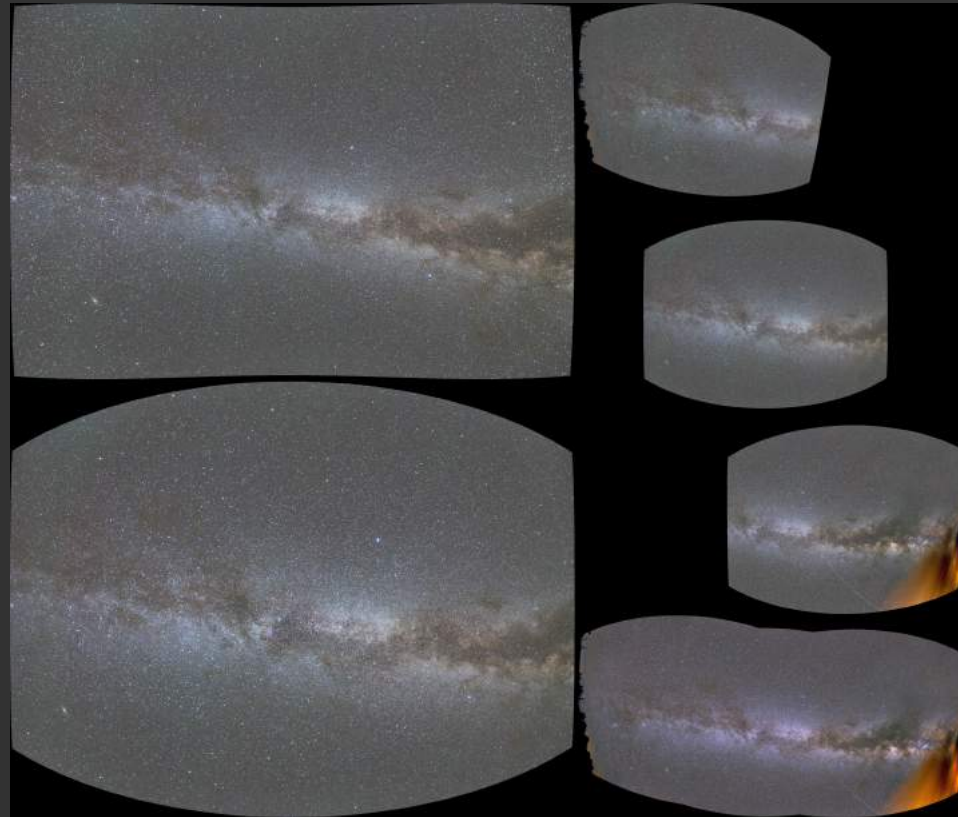


4) REGISTER - optische vervorming correctie (DDC)

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

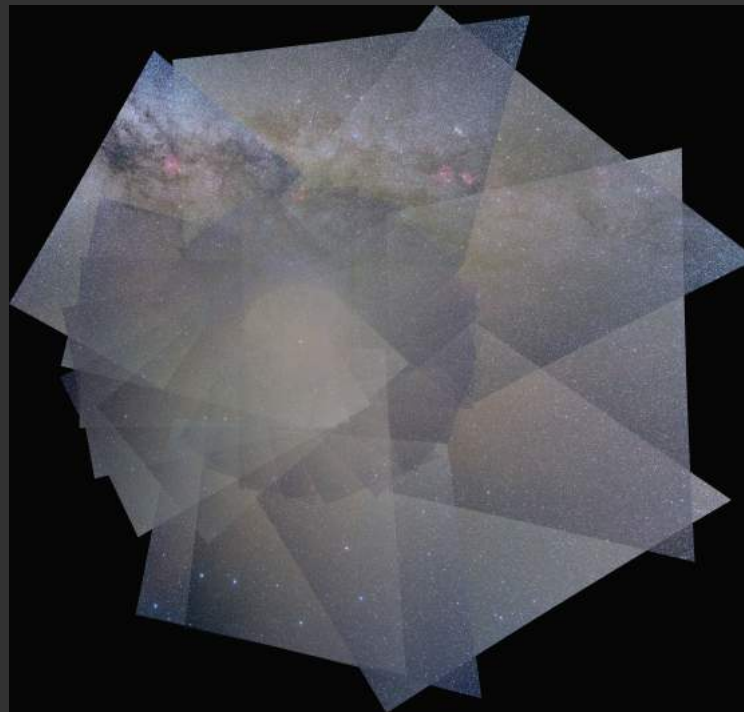
4) REGISTER - camera calibratie

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

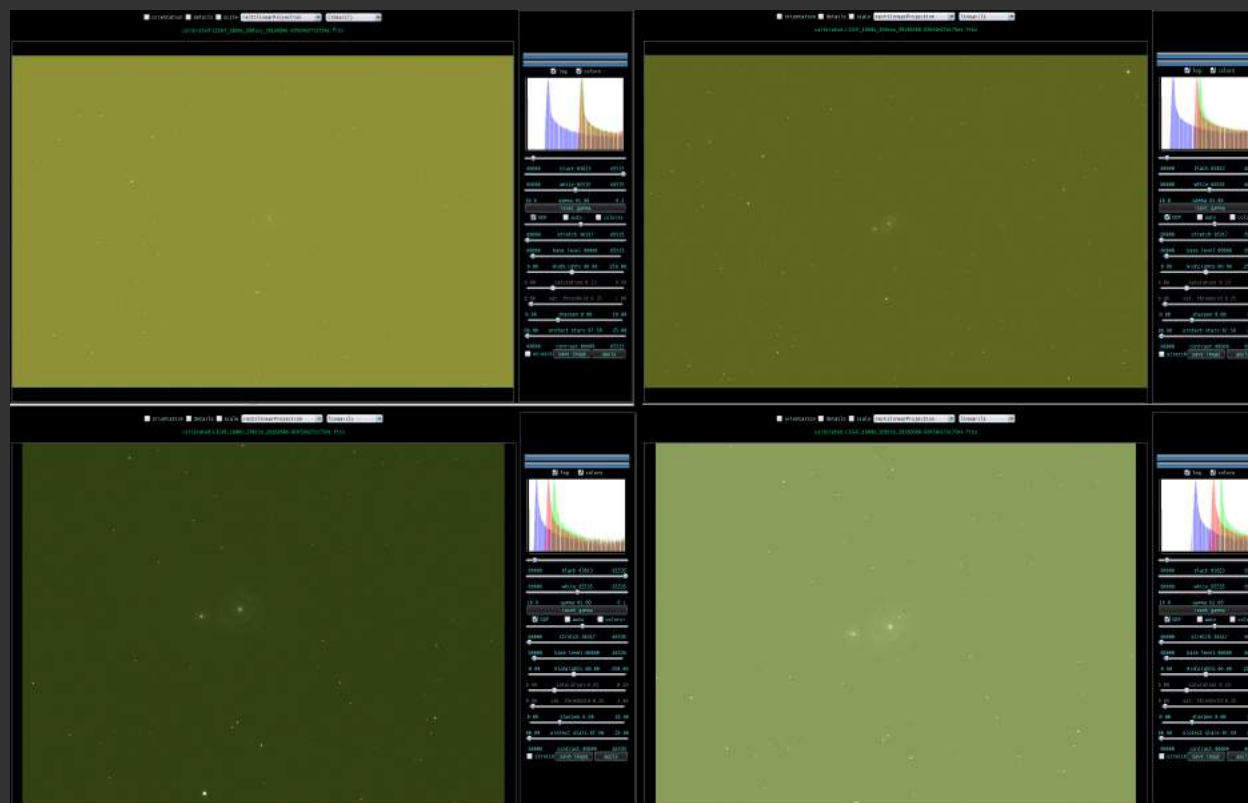
Nikon D5100 BCF, Takahashi TSA102

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	1,36E-01	-	2,48E-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

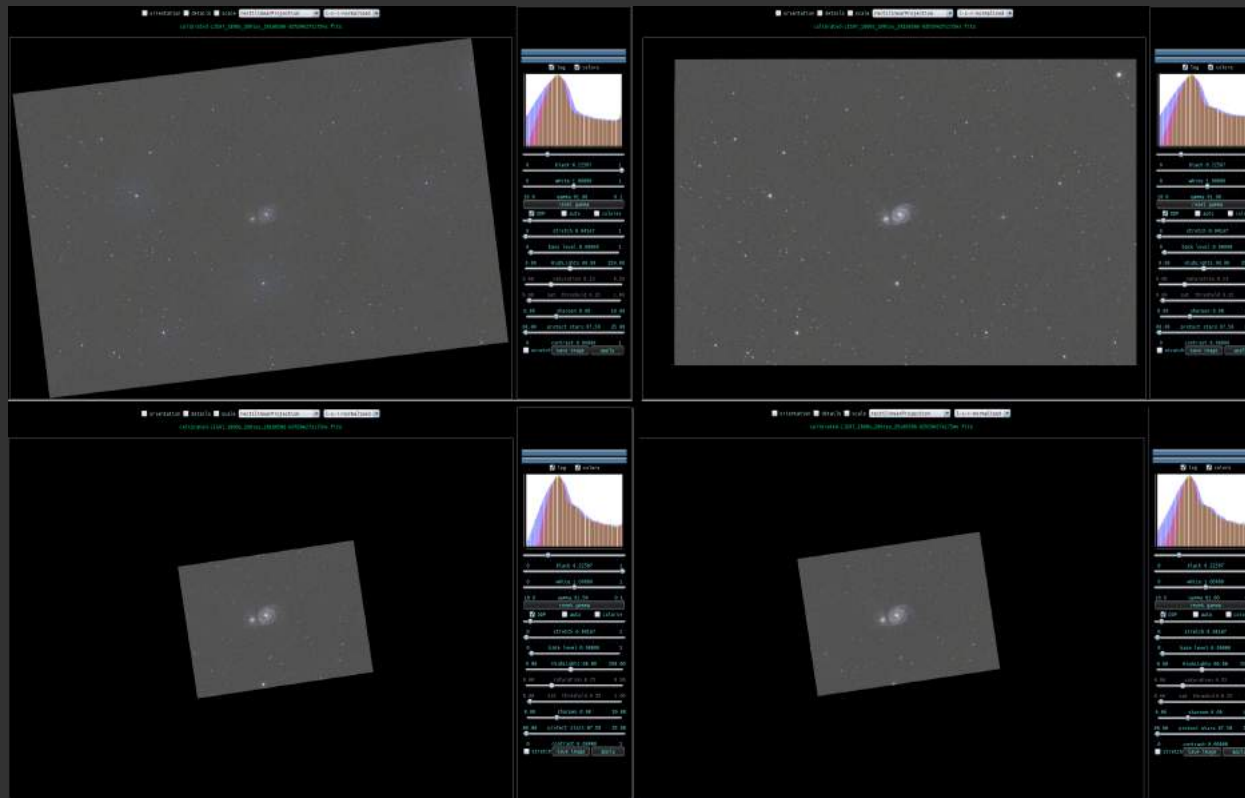
5) NORMALIZE - M51, the Whirl Pool Galaxy

VOOR



5) NORMALIZE - M51, the Whirl Pool Galaxy

NA



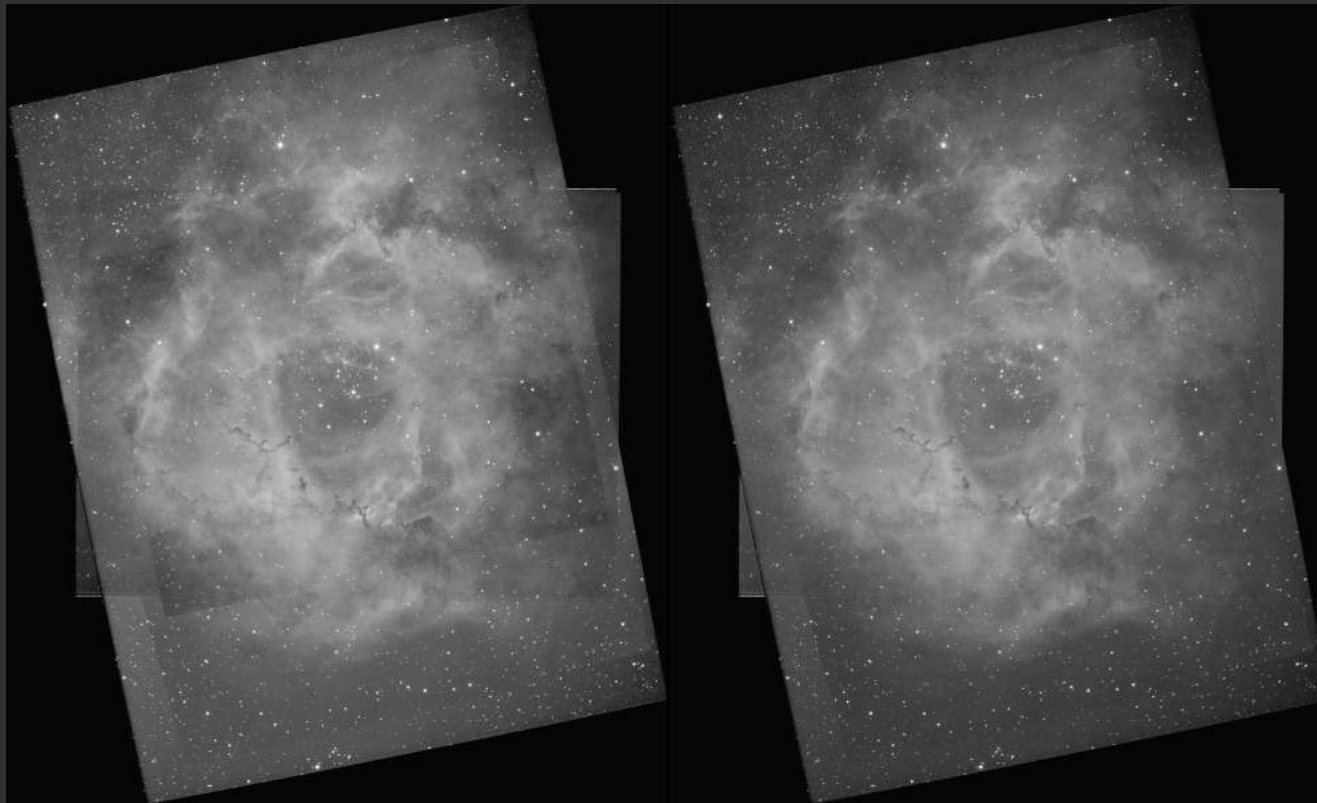
5) NORMALIZE

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

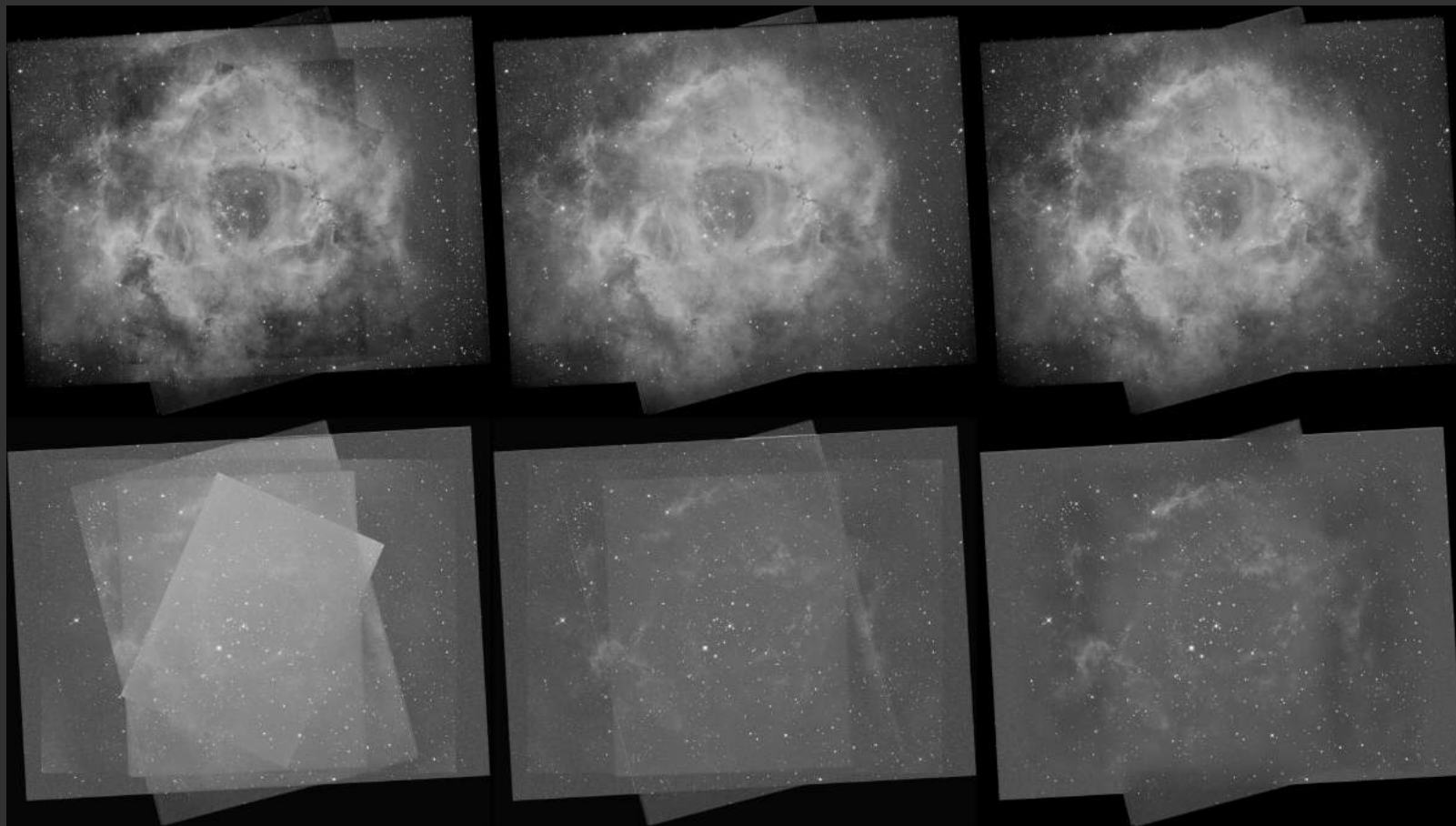
uniek & vernieuwend concept

- 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

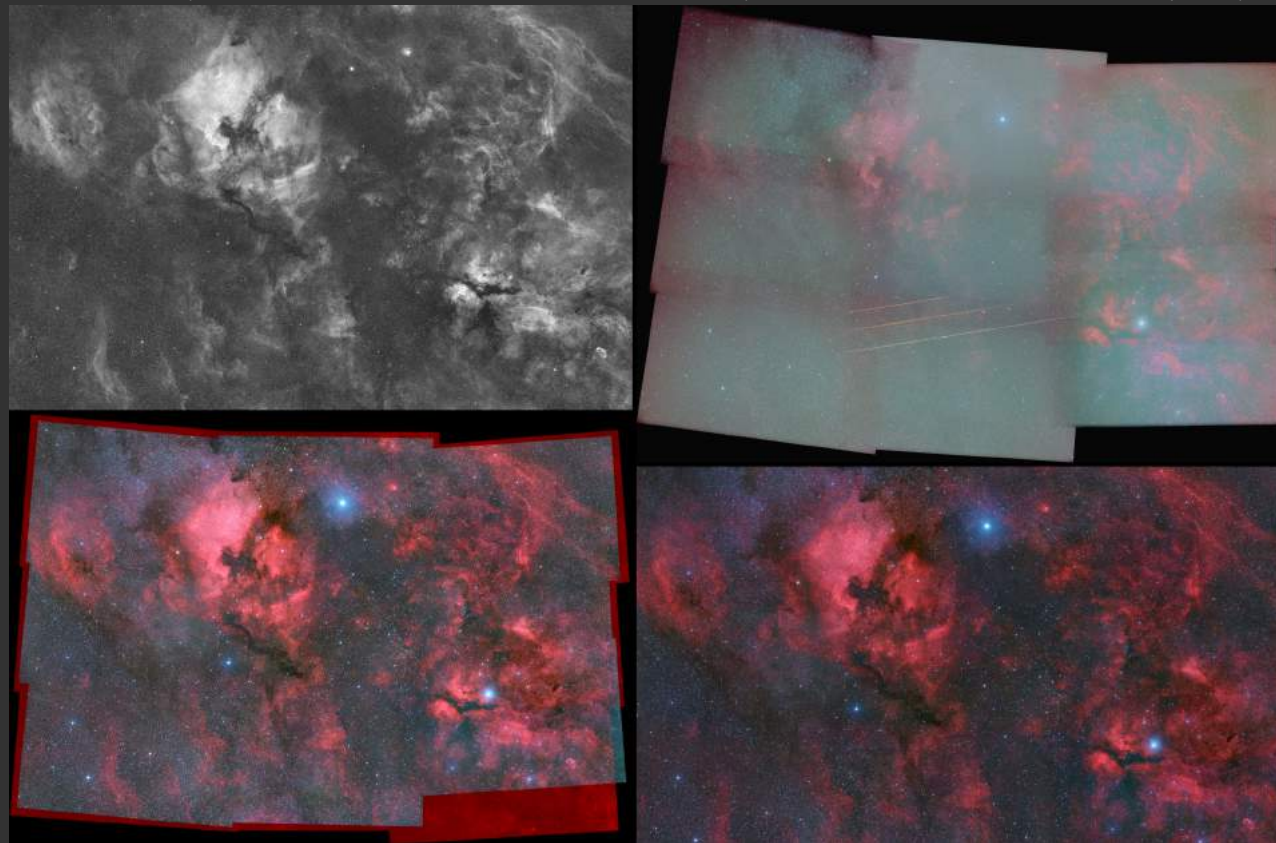
Yves van den Broek - Barnard's Loop

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

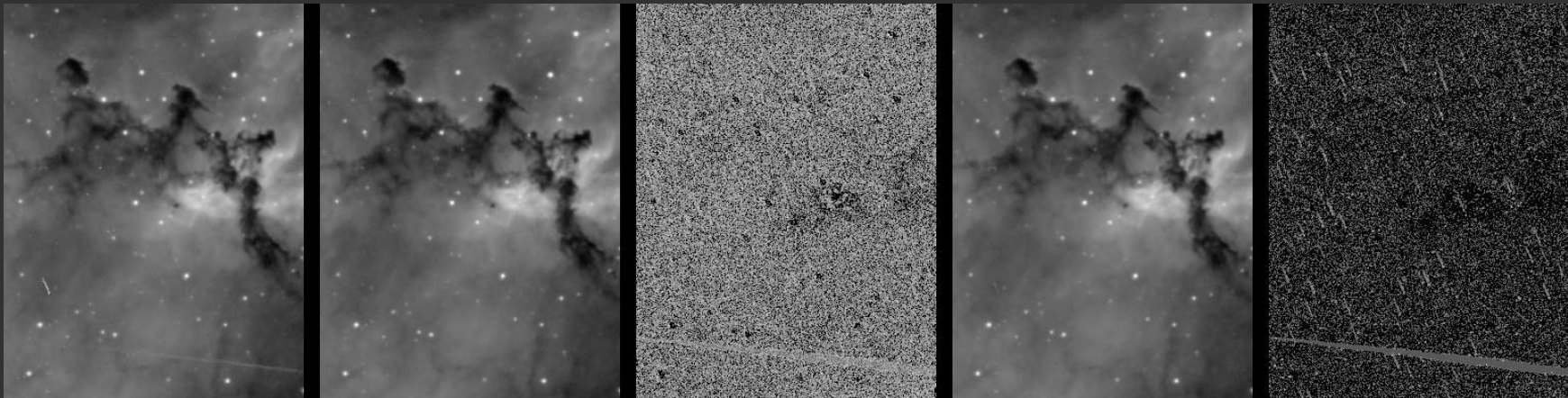


6) INTEGRATE - outlier rejection filters

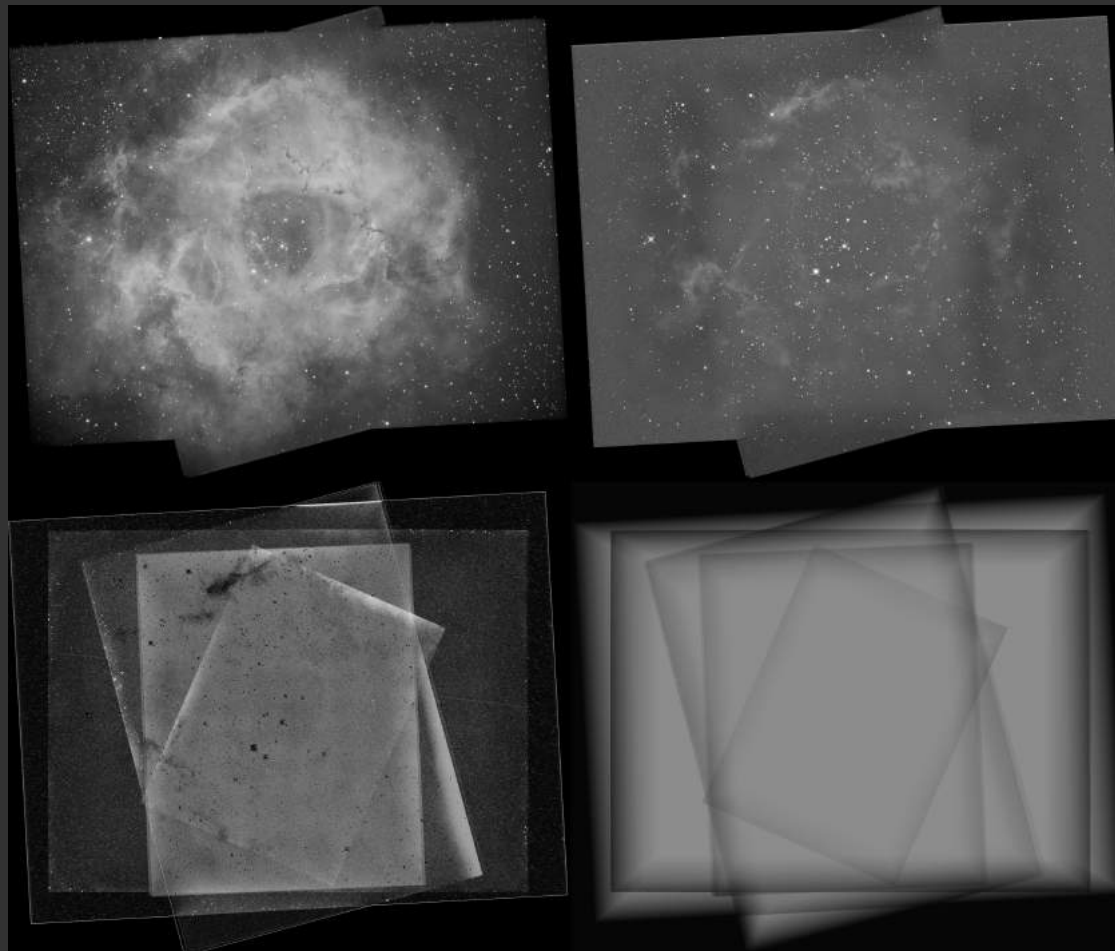
- sigma clipping
- winsorized sigma clipping (fouten)
- linear fit clipping (overbodig door LNC?)

6) INTEGRATE - outlier rejection filters

- laatste hulpmiddel (BPM, dither)
- conservatief toepassen



6) INTEGRATE - output maps

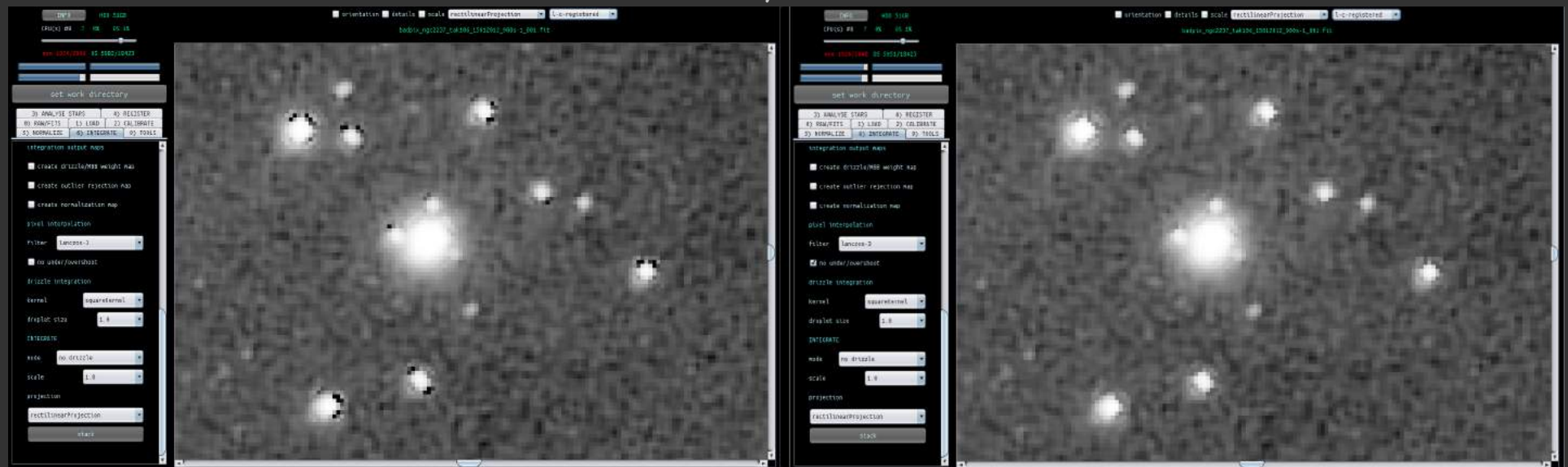


6) INTEGRATE - pixel interpolatie

- 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



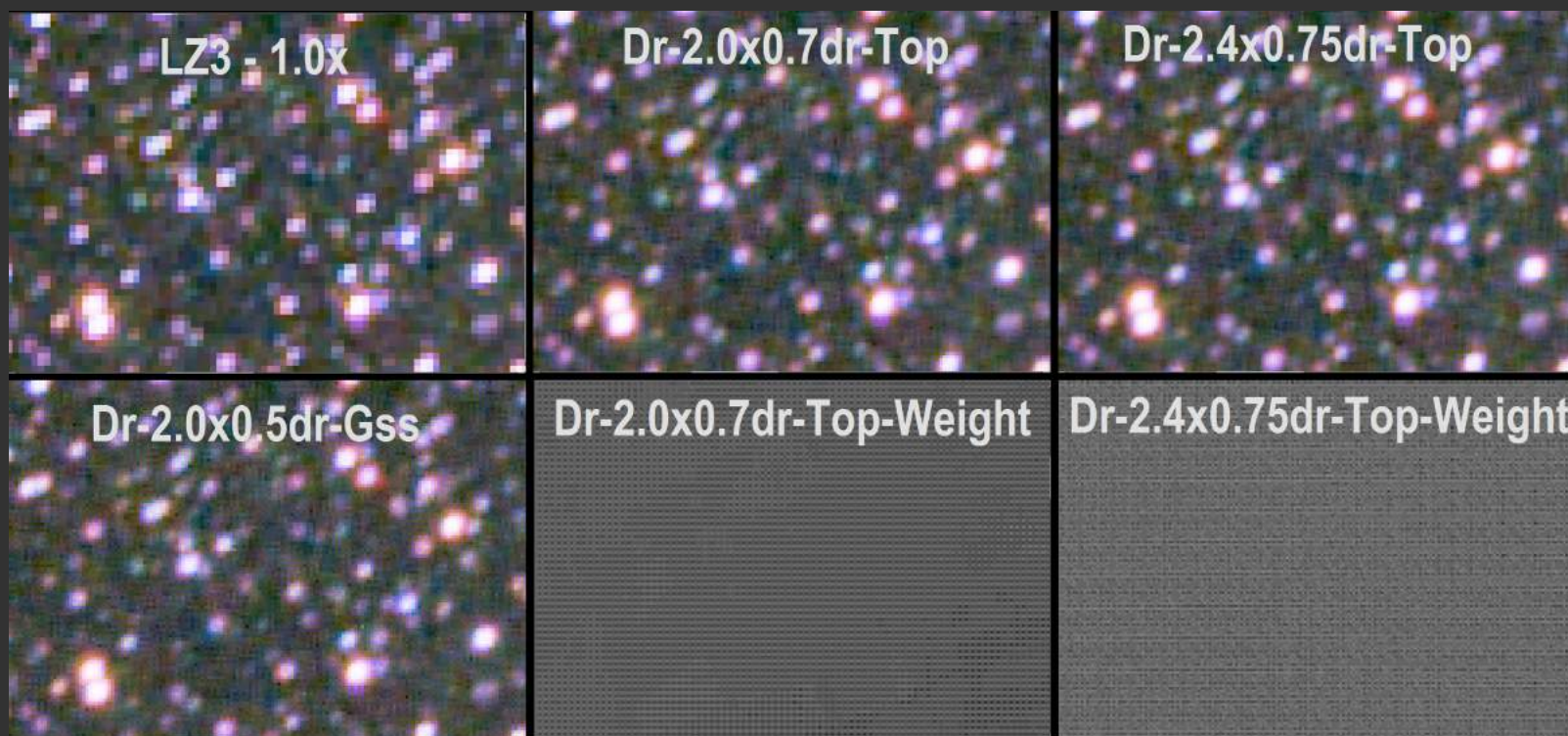
6) INTEGRATE - drizzle

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

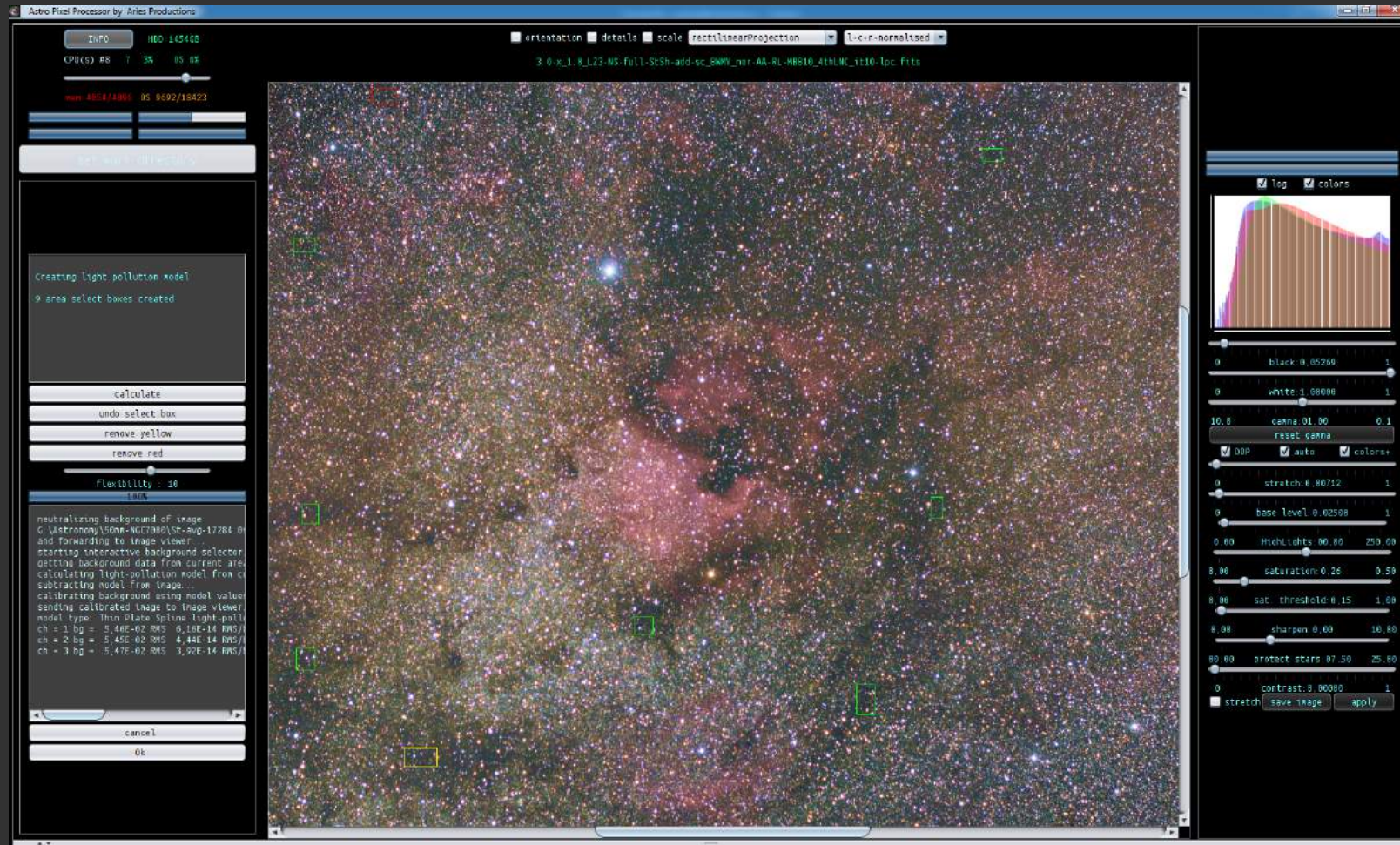
9) TOOLS

- 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 $157 \times 240 \text{ sec} = 10,5 \text{ uur}$

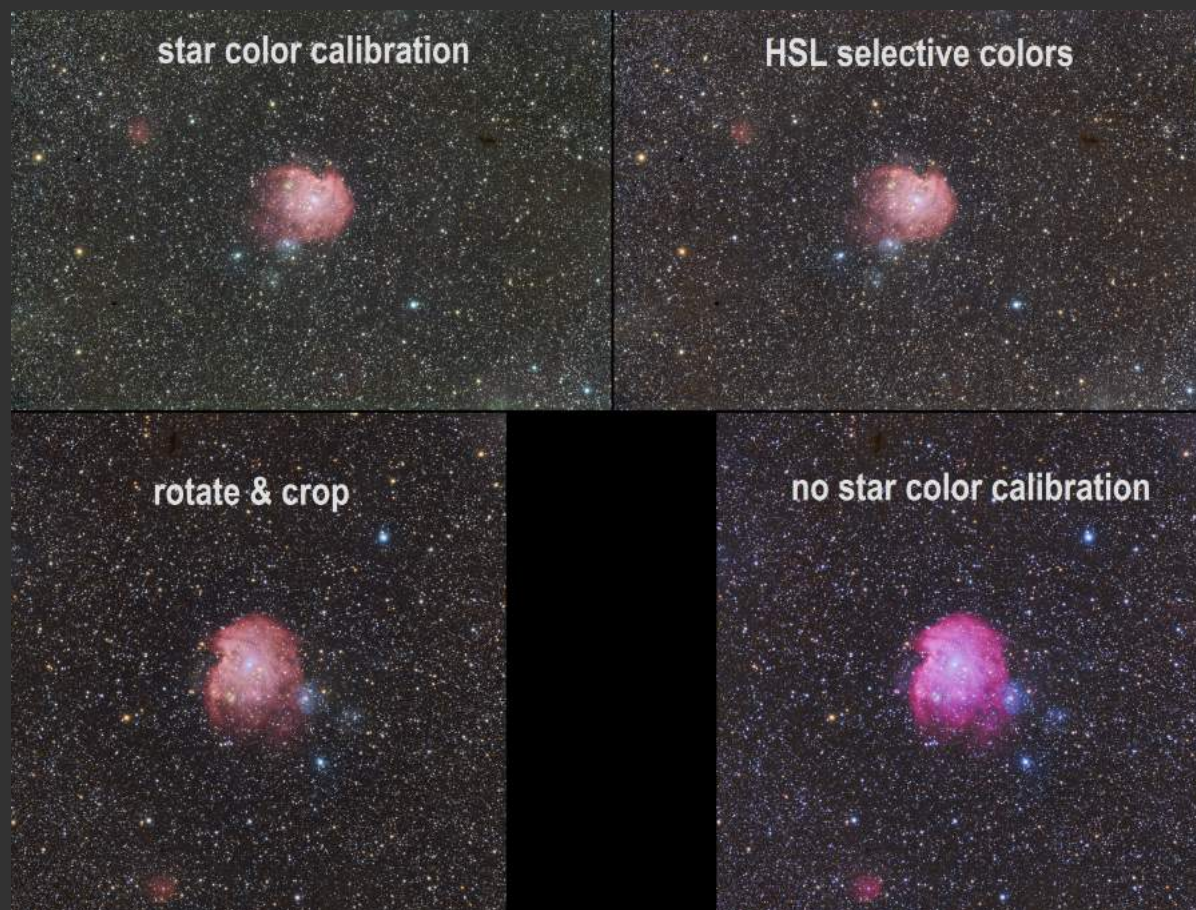
bias en flat calibratie

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



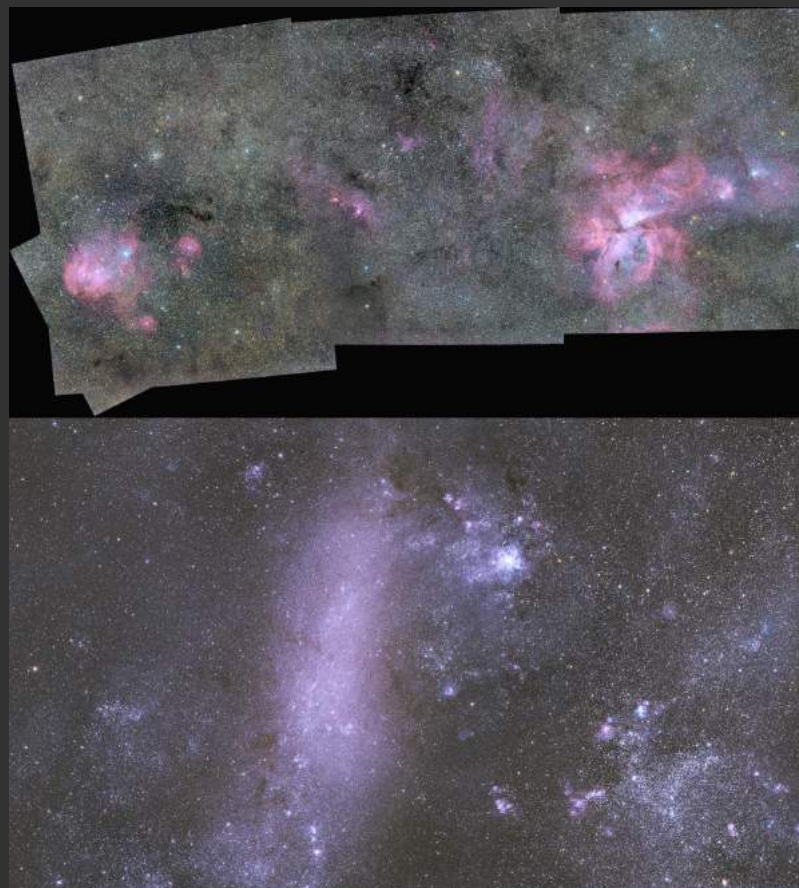
Beta team, eerste resultaten

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 ?

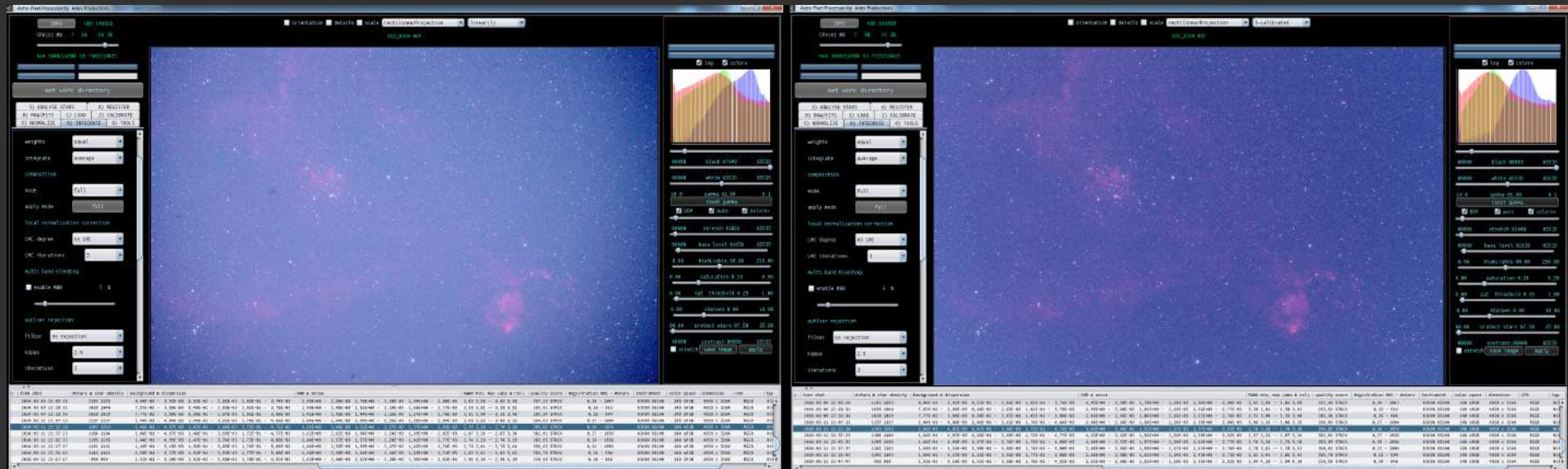
<https://www.astropixelprocessor.com/>



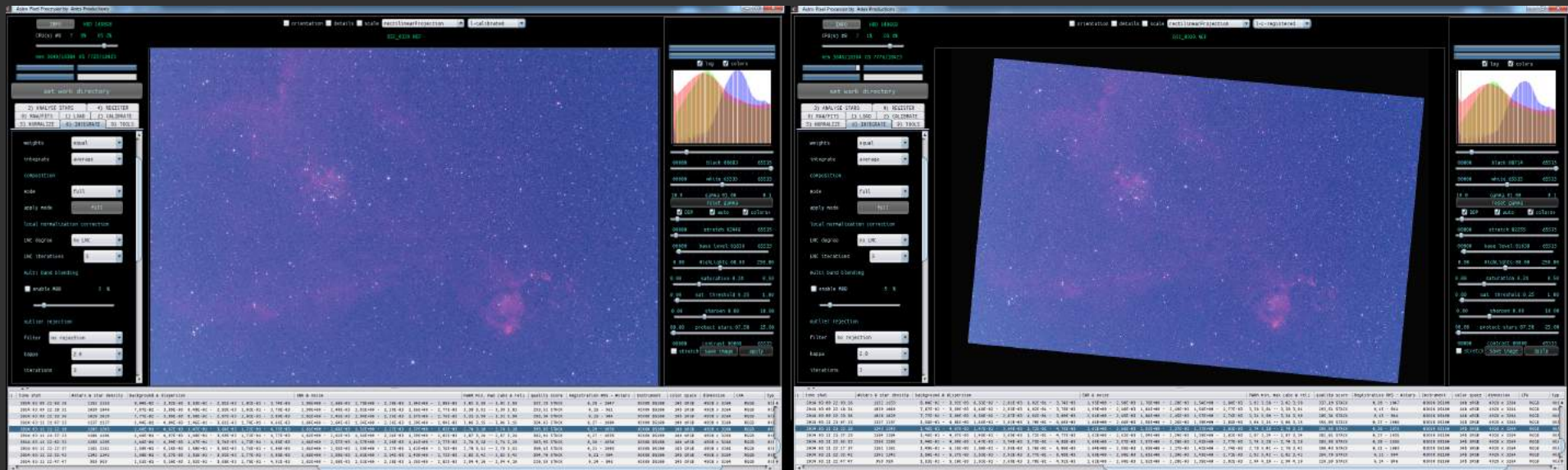
informatie hardware bronnen

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

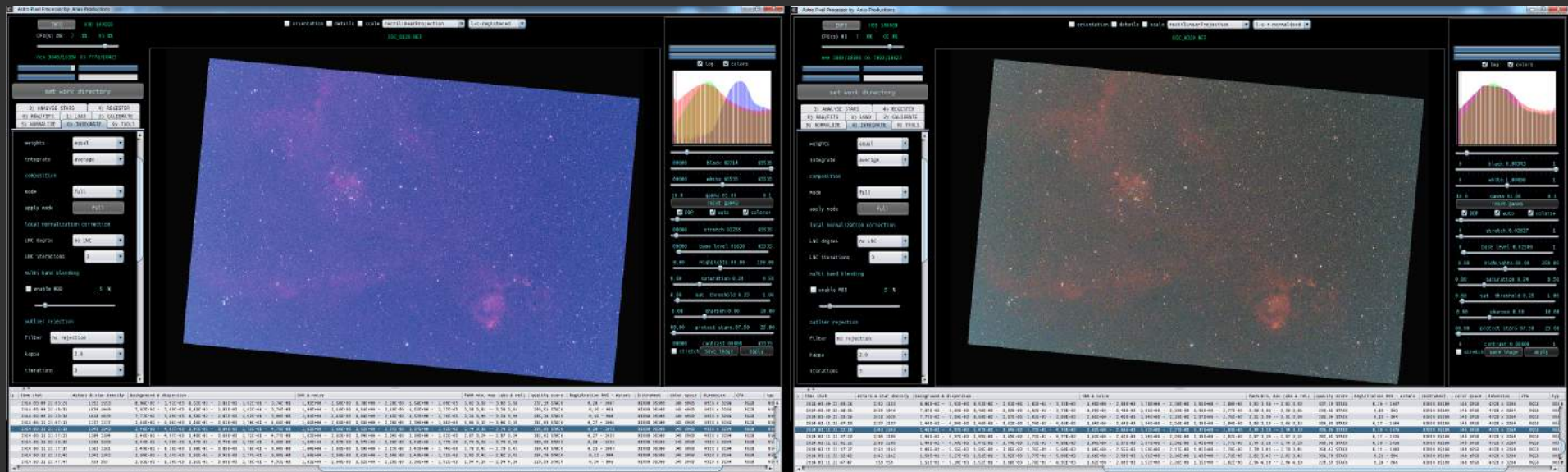
opname venster - linear & calibrated mode



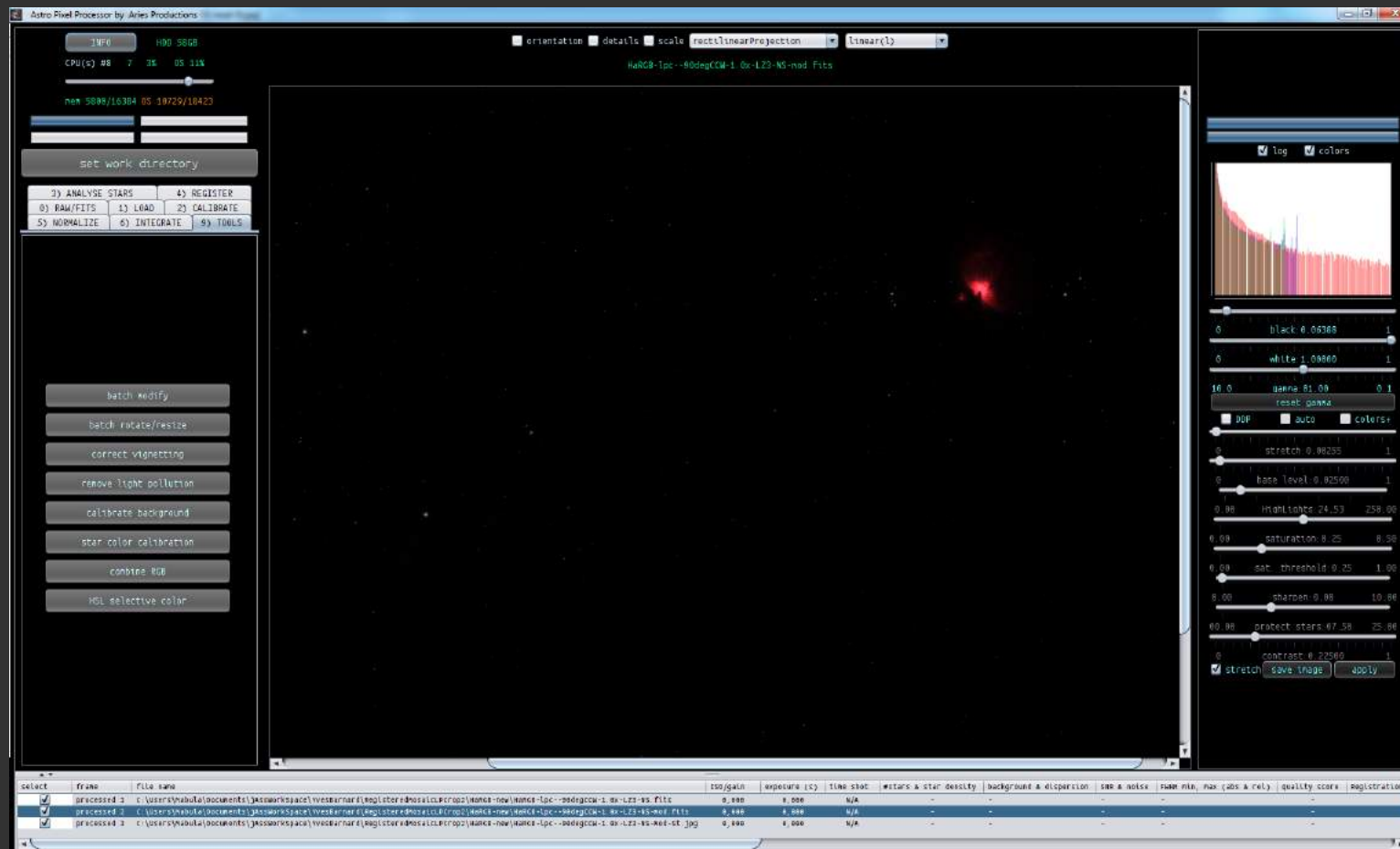
opname venster - calibrated & registered mode



opname venster - registered & normalized mode

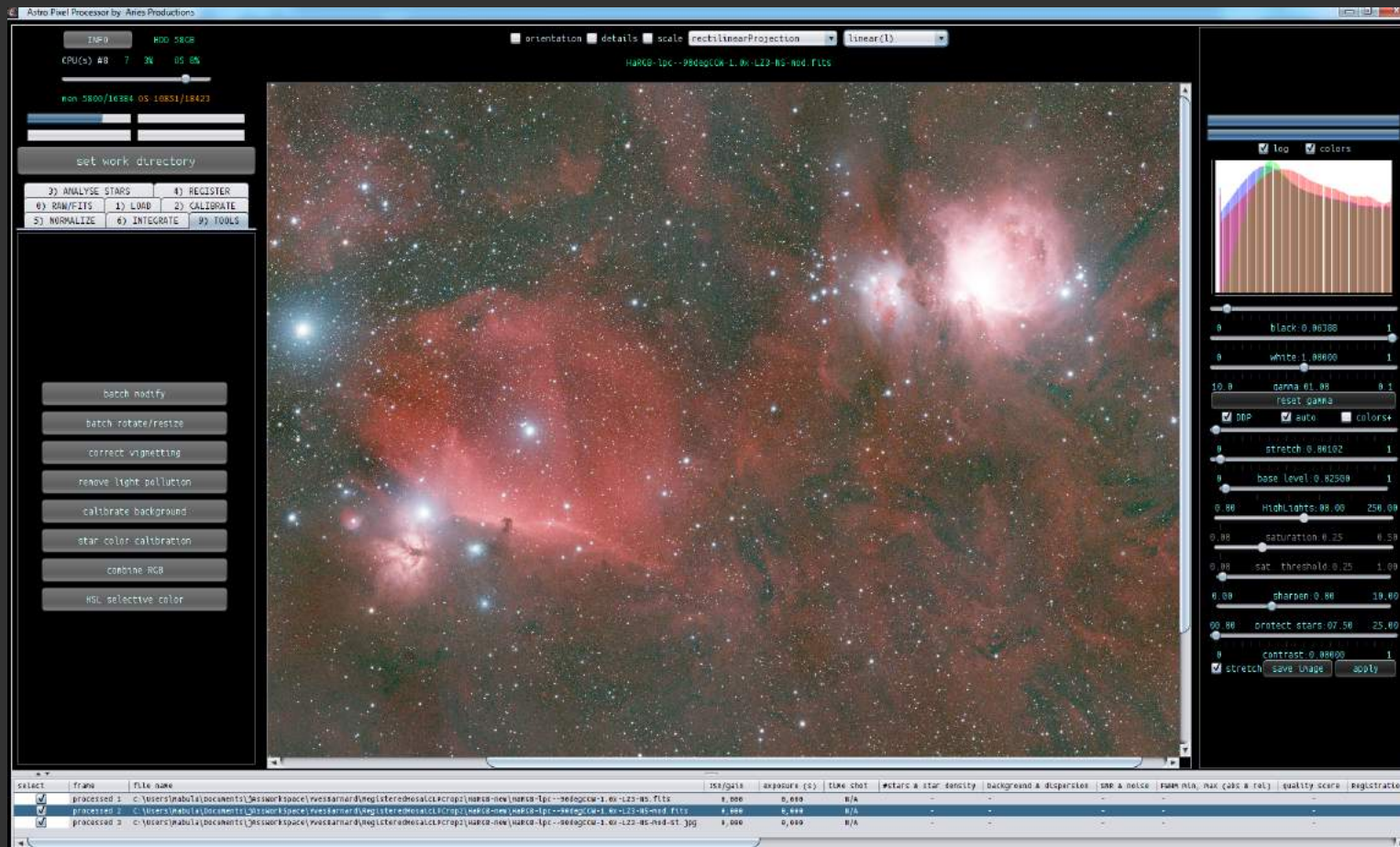


histogram en opname filter - black point

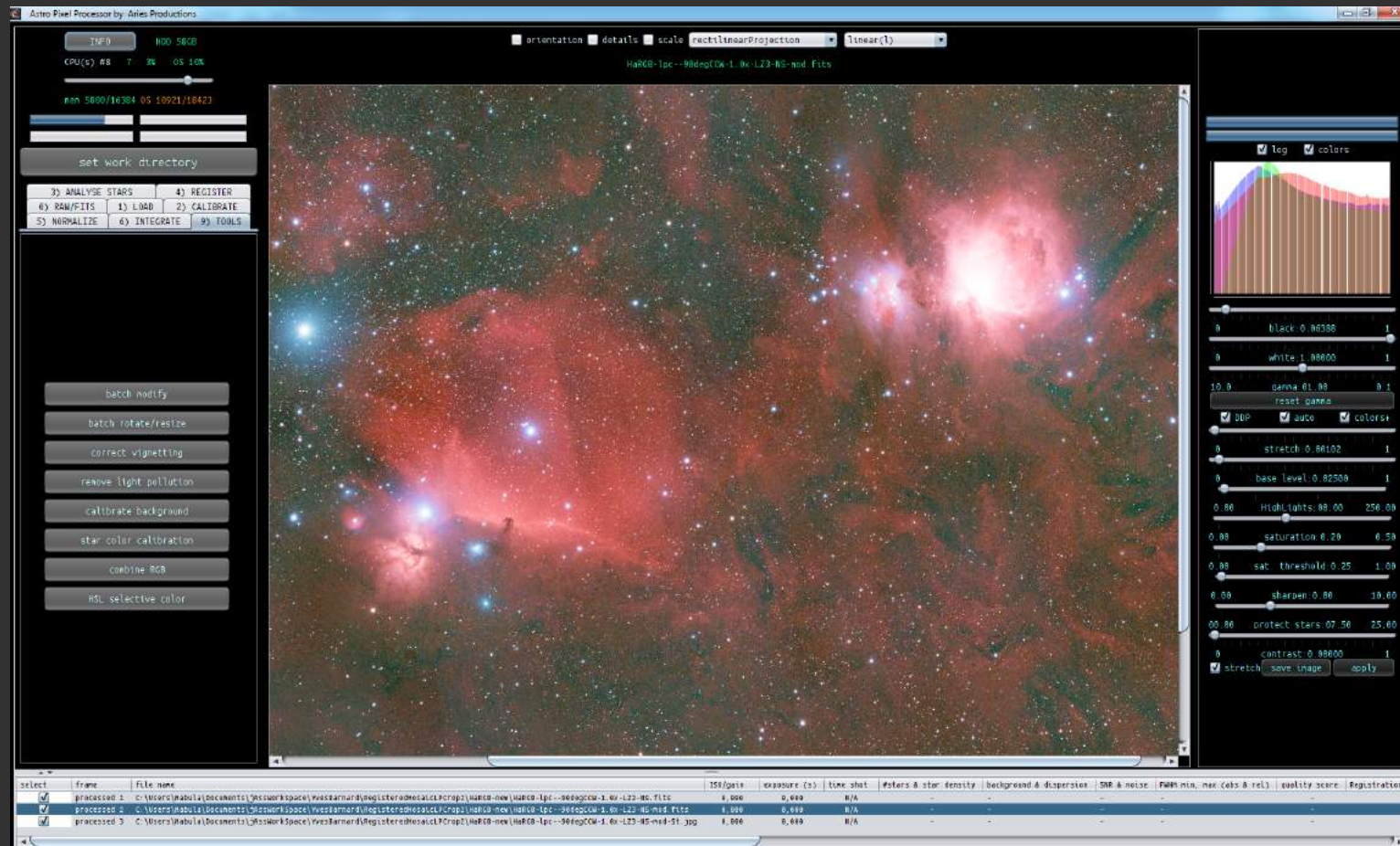


Werkgroep Astrofotografie

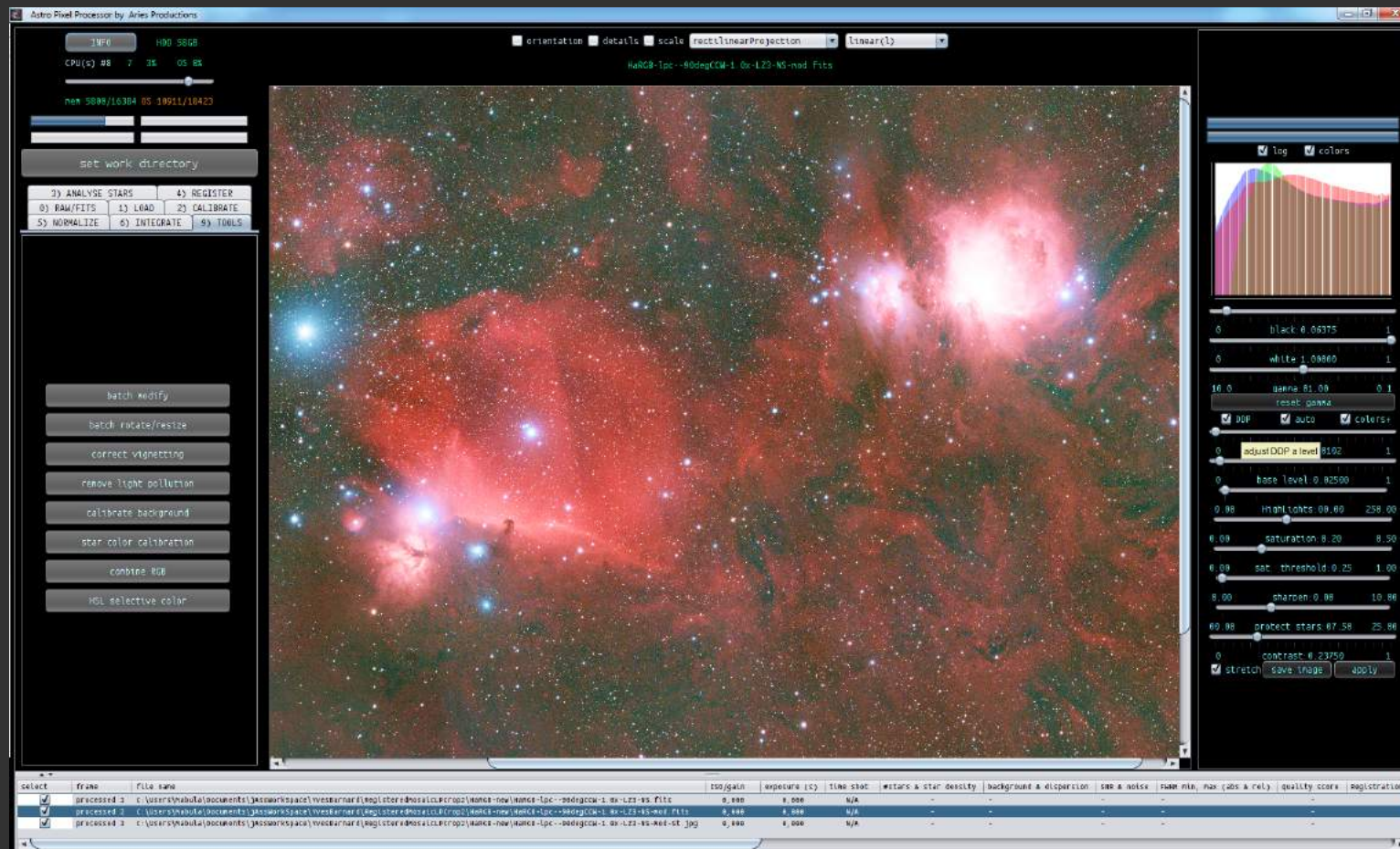
8 april 2017, Oss



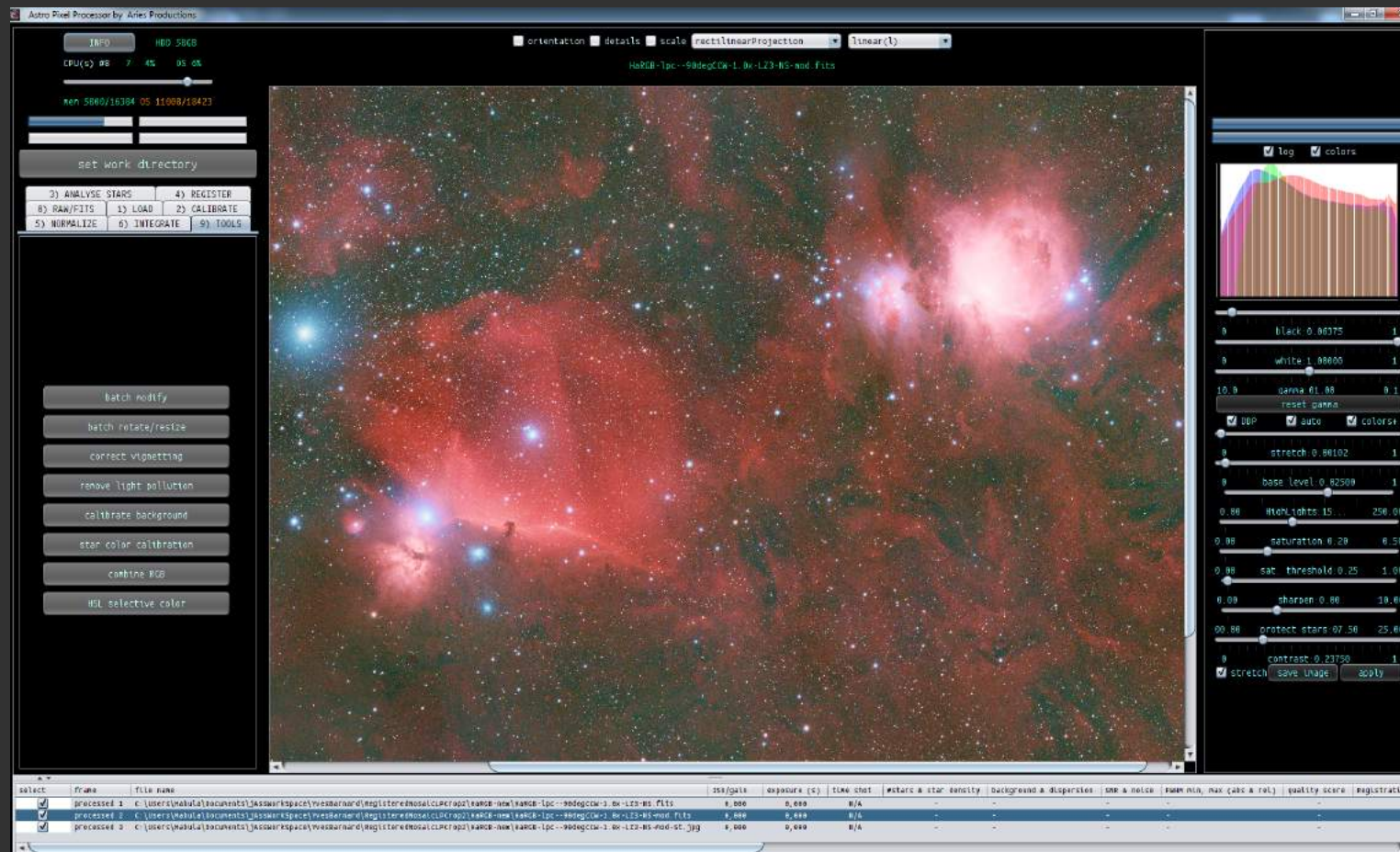
histogram en opname filter - saturatie



histogram en opname filter - contrast



histogram en opname filter - highlights



Werkgroep Astrofotografie

8 april 2017, Oss

