



High Resolution and Deep Sky

Optimizing unguided mounts and gaining resolution in image processing by
using newest UDI and APF-R

10 years anniversary
 **CEDIC** '19
central european deepsky imaging conference

by © Christoph Kaltseis 2019



Nano Tracker / Nikon D800e

Why auto guiding or better without auto guiding?

The starting point of nearly every ... 35mm

From my past... until today

- Different Mounts from different Manufacturers.
- Focal lengths from 530mm - 2000mm.
- C14 XLT f6.3 on a ALT AD6 + ST4 - A real adventure or not?
- OAG and MGen...
- Limit of Quality - FWHM
- Always a bit toooooo late...
- Quality of the System?



My decision



- No good guide star at the field / or no guide star with OAG.
- With 2700mm - 3910mm and Bin2 + OAG always a competition.
- MGen was good (up to 2000mm), but the differences was to big, movement of main telescope and guiding scope.
- Also, visually observing possible!
- Without a PC, all inside the mount, but all possibilities if I want to connect the mount!
- Absolute quality and details...



My GM2000HPS II

Overview of the GM HPSII Models





10Micron GM 1000 to 4000HPS

From 25kg up to 150kg optic loads.

10Micron GM HPS Serie - Facts

- ▶ Unguided without PC - but full control of all functions!
- ▶ 60kg Capacity (extrem: C14 EHD - F/10,84 = 3857mm)
- ▶ Computer-Kontrollbox with Linux Management System with full control of the mount and special functionality: Satellitentracking, Mondfeature and much more...
- ▶ Connection: RS232, Ethernet, Wi-Fi
- ▶ 4 Lines Display, heated ...
- ▶ Point Modelle for different optics can be saved!
- ▶ From 11 Stars - without Auto guider.
- ▶ PC control with: Virtual Keypad, Clock Sync Tool, Multi Mount and ASCOM Driver
- ▶ Beautiful finish and Amore :-)





M63 Sunflower 0,35" p/Pixel

Don't **guide** me

10Micron GM HPS II Serie

Pol, Alignment, Pointing ...

Setup, Pol alignment, Values, ...



My Experience

- Setup (Balance, time, GPS)
-> absolut precise!
Control of the alignment error!
- 3 Stars Alignment - choose the stars first, seeing,
Not to close to the horizon, star image
(-> Overexposed)...
- Refine Stars (is what?) - Cables - Stars - distance
between the stars!
A full Pointing for a Pol Alignment - why - yes no???
! RMS value and Pol Error - developments !
- Pol Alignment -> Take care !
Tighten the screws -> Clear Alignment



Pointing for Unguided

- 3 Stars Alignment - Choose the same stars as before. What can be seen - now? Pol alignment error after 3 Stars?
- Refine Stars, 3-4 Stars of the site you choose for the alignment stars then change to the other site of the Meridian. What can I see after every star?
- What should be the best?
- Flip to the other site - next refine stars!
- RMS Values should go down slowly. Position in the center of the Chip is getting better and better. Last refine stars, at...
- RMS Values und control with „Delete Stars“. The RMS Value of the Pointing, single Stars during pointing and final model...



Pointing Examples

Gemma
Ras Alg
Vega
Unukalhai
Pi Hercu
Eltanin
Zeta Hercu
/: mf
Alkaid
Cor Caroli
Dubhe
Arcturus
Nu Ophiuchi
Albireo
Alderamin
Deneb

0,00,55" Pol Alignment
RMS 6,8"

Vega
Altair
Alderamin
5'25" after 3 Stars
Stars:
Eltanin
Deneb
Ras Alhague
Nu Ophiuchi
PI Herculis
/: mf
Alkaid
Arcturus
Cor Caroli
Gemma
Zeta Herculis
Albireo
Enif
RMS: 8,1"
Pol error: 1'05"





M66 - 0,35" p/Pixel




Discovery

0,35" p / Pixel - Seeing 1,77"

Name: MUOS 2 Rakete
Dimension: 4 m x 2 m, zylindrisch
Helligkeit: 3.5 mag (bei 1000 km Distanz, 50% Beleuchtung)
5.5 mag (im Perigäum, voll beleuchtet)
Mittlere Helligkeit aus visuellen Beobachtungen
RCS: 8m² (Radarquerschnitt)
USSPACECOM Nr: 39207 Internat. Bezeichnung: 2013-036B
Orbit: 3578 x 35199 km, 11.43h Inklination: 18.4°
Bahnalter: 🇩🇪 24 Tage (Quelle: Amateurbeobachtungen)

Spurlänge gemäß CALSKY (siehe unten): 0,21arcmin/s x 360s = 12,6'
Spurlänge auf der Aufnahme, Maßstab 0,526 arcsec/px: 13,0'

Daten: CALSKY für 16.3.2017, 20:50 MEZ + 360s, Linz/Österreich

 MUOS 2 Rocket (39207 2013-036-B)	Mag=10.6m Leonis az: 120.6° ESE h: 40.2° dist: 36508.7km ra: 11:16.2 de: +12:53 Winkelgeschwindigkeit: 0.21'/s
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Auswertung: Bernd Koch

Distance 36508,7km

4 x 2m Size!



M42 / RGB

Best value 1,667" FWHM - R (0,68" p / Pixel)

C14 EDGE HD F7.6 = 2703mm
10Micron GM2000 HPS, unguided
SBIG STXL 11002 Baader RGB
ArcSec: 0,68" p/Pixel

APOD 12th March 2017





Why?

Nice images







A wonderful sunflower

Unguided - 0,35"p/Pixel / C14 F7.6 + D810A



M106 (30x360s)

Unguided, 0,35" p/Pixel / C14 F7.6 + D810A



Often asked questions - notes!

- Drifts during ?
- Dithern?
- Bending of the scope?
- Schmidt Cassegrain Teleskop?
- How long does it take for full pointing?
- Tilts!
- 1st frame of a series ...
- All Stars for the alignment -> selected before and learning about the mount, telescope...





Moon
20180521



Next step, a new challenge: 3910mm

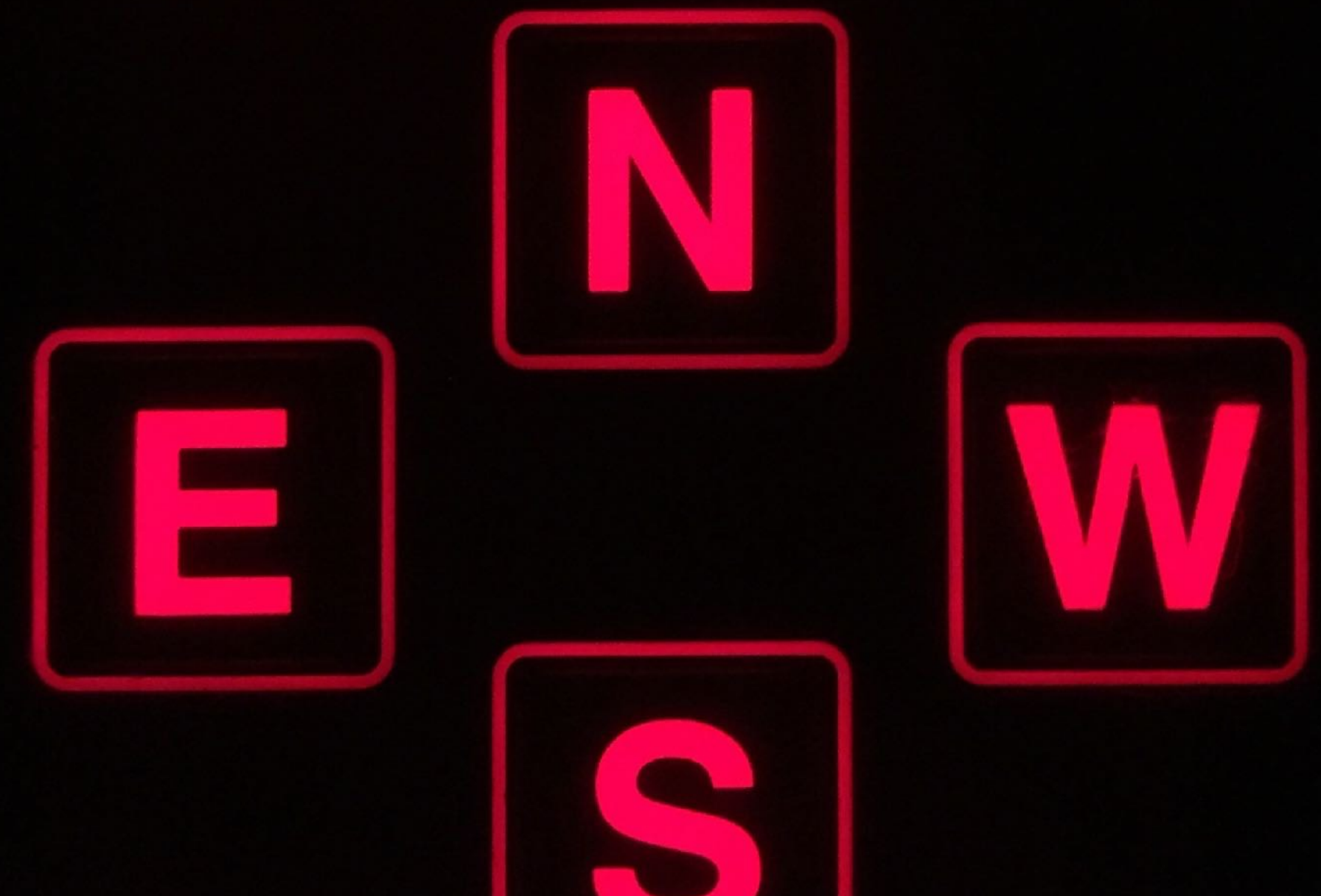
My (A) goal: 3910mm -
unguided -> (0,253 arcsec)

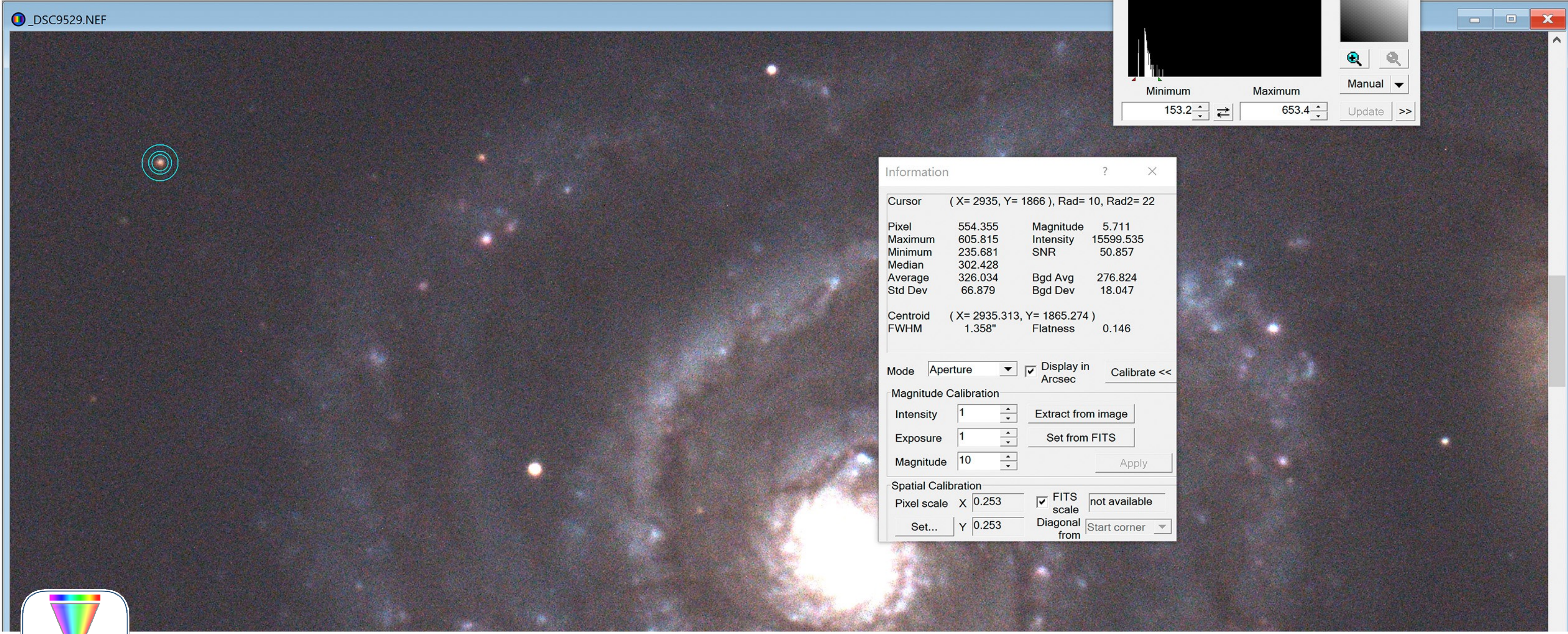
- Two days after full moon, June 2017...
- Testing of Alignment steps with 3910mm
- Pol alignment error was too big, little Elongation stars. (egg shape)
- Correction of the Pol Axis!
- Very small error after 3 Stars and after the full pointing model.
- Ready - GO!? 3910mm running ... ?



14 stars
Az 359°58'38"
Alt +48°32'31"
Polar align err.
000°00'55"

KEYPAD

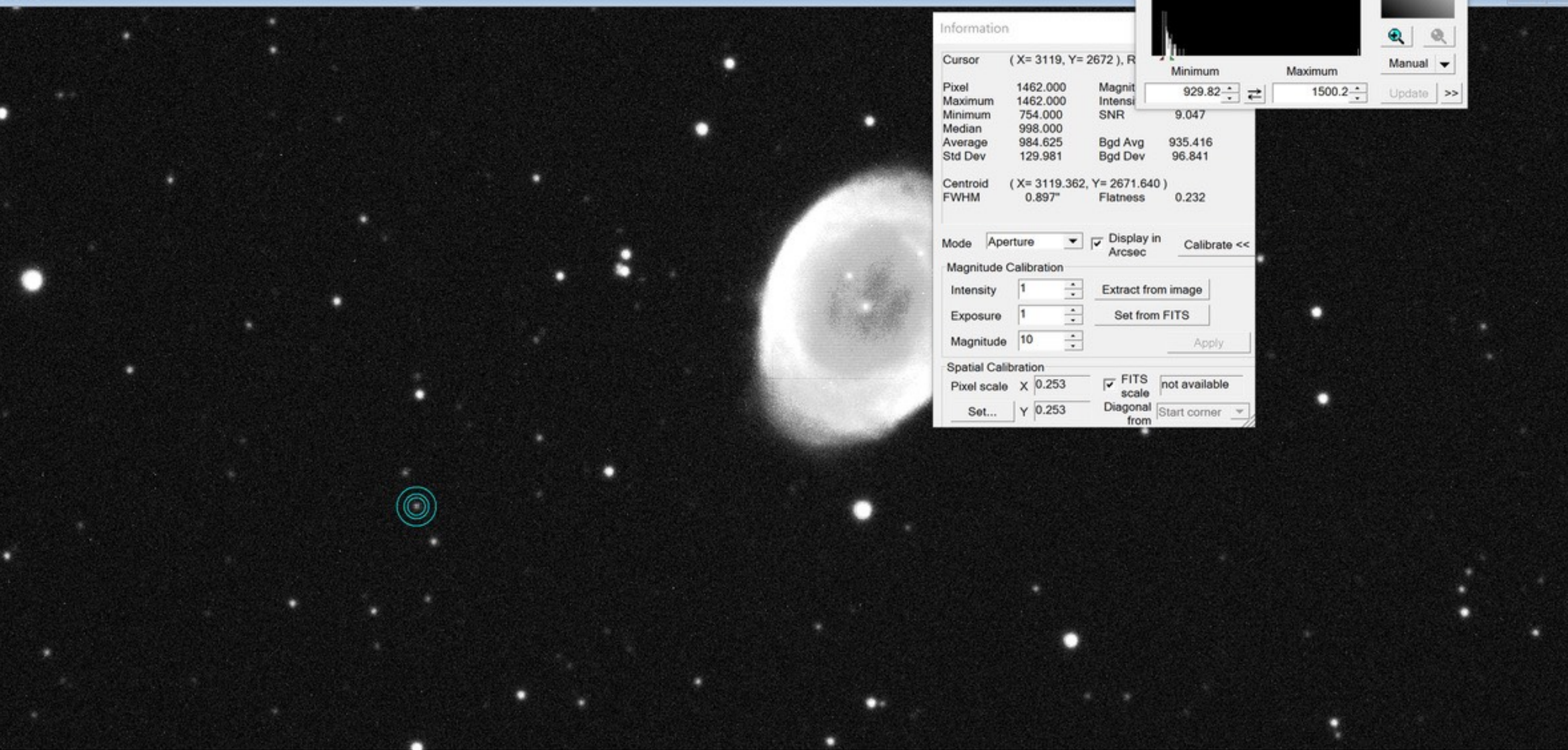




Pushing Limits

0,253" p / Pixel - unguided?

300s with 3859mm



Information

Cursor (X= 3119, Y= 2672), R

Pixel	1462.000	Magnit	
Maximum	1462.000	Intensi	
Minimum	754.000	SNR	9.047
Median	998.000		
Average	984.625	Bgd Avg	935.416
Std Dev	129.981	Bgd Dev	96.841
Centroid	(X= 3119.362, Y= 2671.640)		
FWHM	0.897"	Flatness	0.232

Mode Aperture ☐ Display in Arcsec Calibrate <<

Magnitude Calibration

Intensity 1

Exposure 1

Magnitude 10

Spatial Calibration

Pixel scale X 0.253 ☒ FITS scale not available

Set... Y 0.253 Diagonal from Start corner

Screen Stretch

Minimum 929.82 Maximum 1500.2

Manual



Full frame - Nikon D810A, 3910mm



Information

Cursor	(X= 3133, Y= 2776), R		
Pixel	1433.000	Magnit	
Maximum	1433.000	Intensi	
Minimum	747.000	SNR	7.013
Median	996.000		
Average	975.120	Bgd Avg	936.792
Std Dev	117.560	Bgd Dev	97.312
Centroid	(X= 3132.372, Y= 2775.951)		
FWHM	0.649"	Flatness	0.425

Mode Aperture ☒ Display in Arcsec Calibrate <<

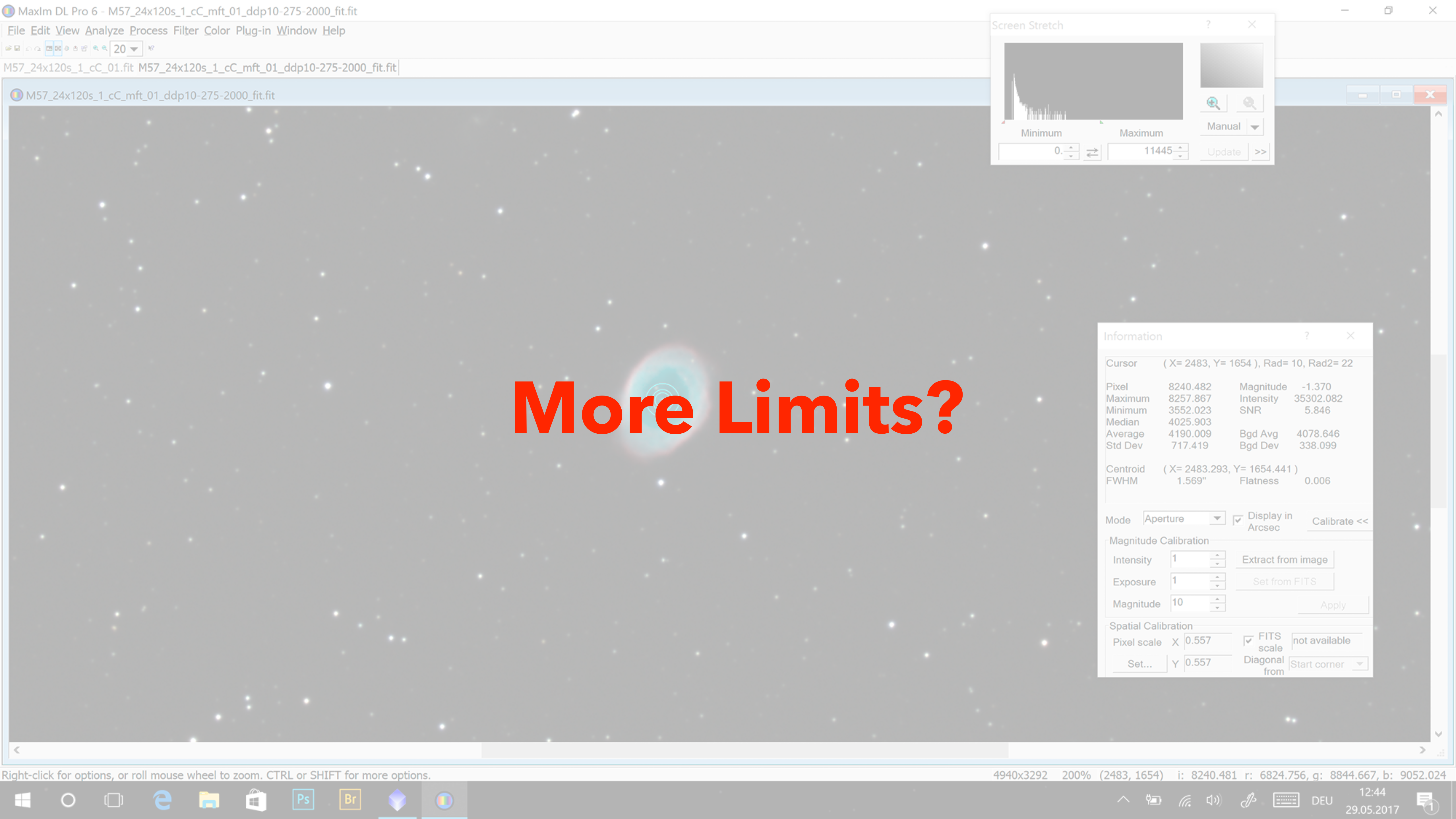
Magnitude Calibration

Intensity	1	Extract from image
Exposure	1	Set from FITS
Magnitude	10	Apply

Spatial Calibration


Pixel scale	X	0.253	<input checked="" type="checkbox"/> FITS scale	not available
	Y	0.253	Diagonal from	Start corner

300sec - 0,256" arcsec



More Limits?

Screen Stretch



Minimum: 0. Maximum: 11445

Manual

Update

Information

Cursor (X= 2483, Y= 1654), Rad= 10, Rad2= 22

Pixel	8240.482	Magnitude	-1.370
Maximum	8257.867	Intensity	35302.082
Minimum	3552.023	SNR	5.846
Median	4025.903		
Average	4190.009	Bgd Avg	4078.646
Std Dev	717.419	Bgd Dev	338.099
Centroid	(X= 2483.293, Y= 1654.441)		
FWHM	1.569"	Flatness	0.006

Mode: Aperture Display in Arcsec Calibrate <<

Magnitude Calibration

Intensity: 1 Extract from image

Exposure: 1 Set from FITS

Magnitude: 10 Apply

Spatial Calibration

Pixel scale X: 0.557 Y: 0.557

FITS scale: not available

Diagonal from: Start corner



Well known ... M27

3910mm / 0,25" p / Pixel - without auto guiding







M57, very good Seeing - final image 0,91" arcsec

3910mm, unguided, 0,25" p/Pixel





PlaneWave CDK 14 f7.2 + Nikon D810A

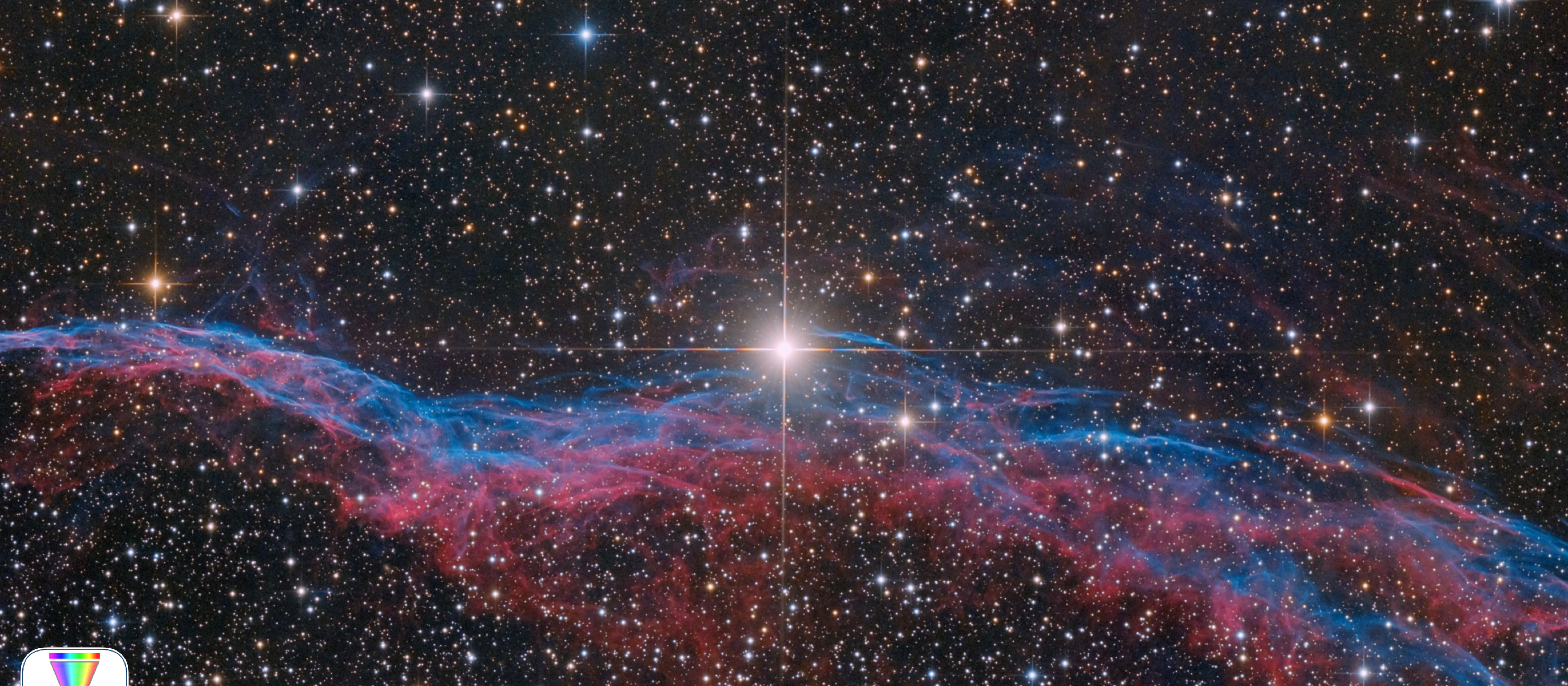
With 2563mm focal length = 0,39" ... 901s



Full frame, 2563mm



Full frame, 2563mm



PlaneWave CDK 14 f7.2

NGC6960 | RGB | 20x480s, Pixel Scale 0,39"





M33 - PlaneWave CDK 14 f7.2

APOD, 27th of September 2018





NGC891 - C14 Edge HD f10.85



Difficult to do ?

Reflexion - and back - GM 2000HPS



„Complicated? -> NO - Doubt and complicated thoughts...”



Thanks, Christoph Kaltseis



M42 | C14 Edge HD f7.6 | Nikon Z6

If, I am always precise, then...

Vision is a question - question is a vision?!



APF-R

absolute point of focus

APF-R Version 2/2019

Update... www.cedic.at/apfr



UDI Astronomy

32Bit to 8Bit...