Processing the great American eclipse

by Lorenzo Comolli

images by Emmanuele Sordini and Lorenzo Comolli

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Overview

How to gather and process eclipse images:

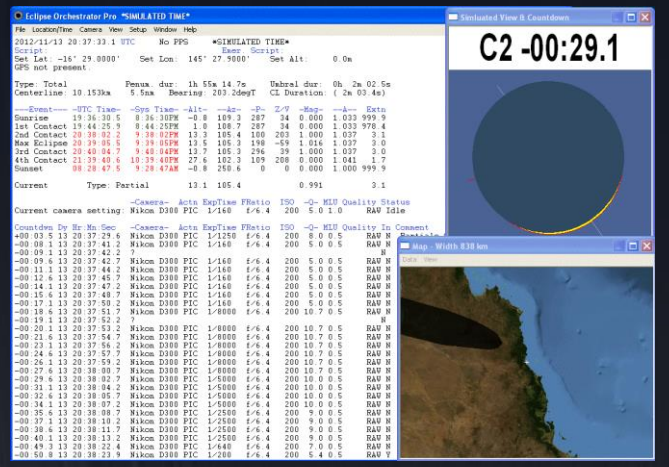
- image gathering:
  - my recipe, fundamental ingredients
- image processing
  - HDR production
  - extracting details
  - fine tuning
- results from this eclipse

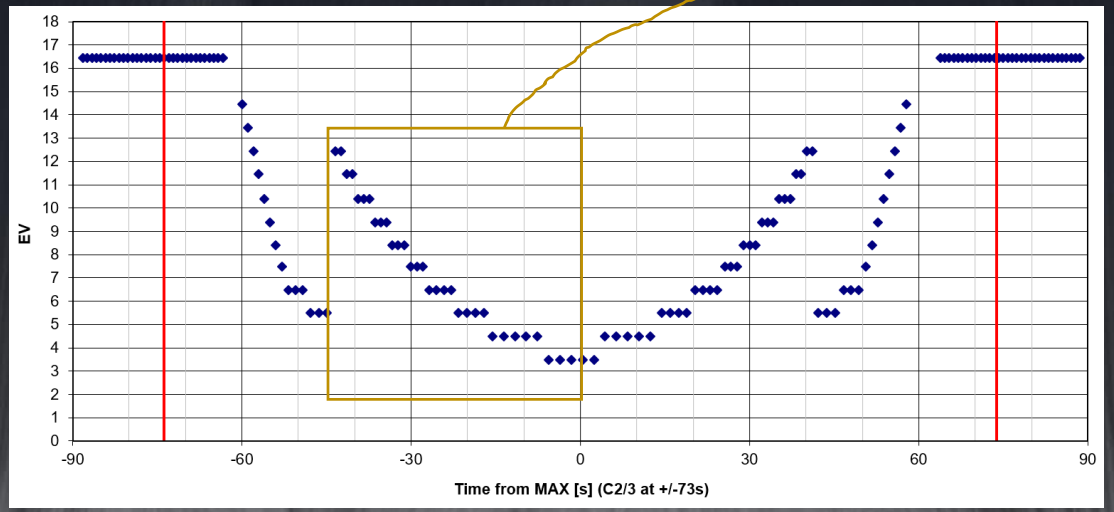
My recipe: fundamental ingredients (1)

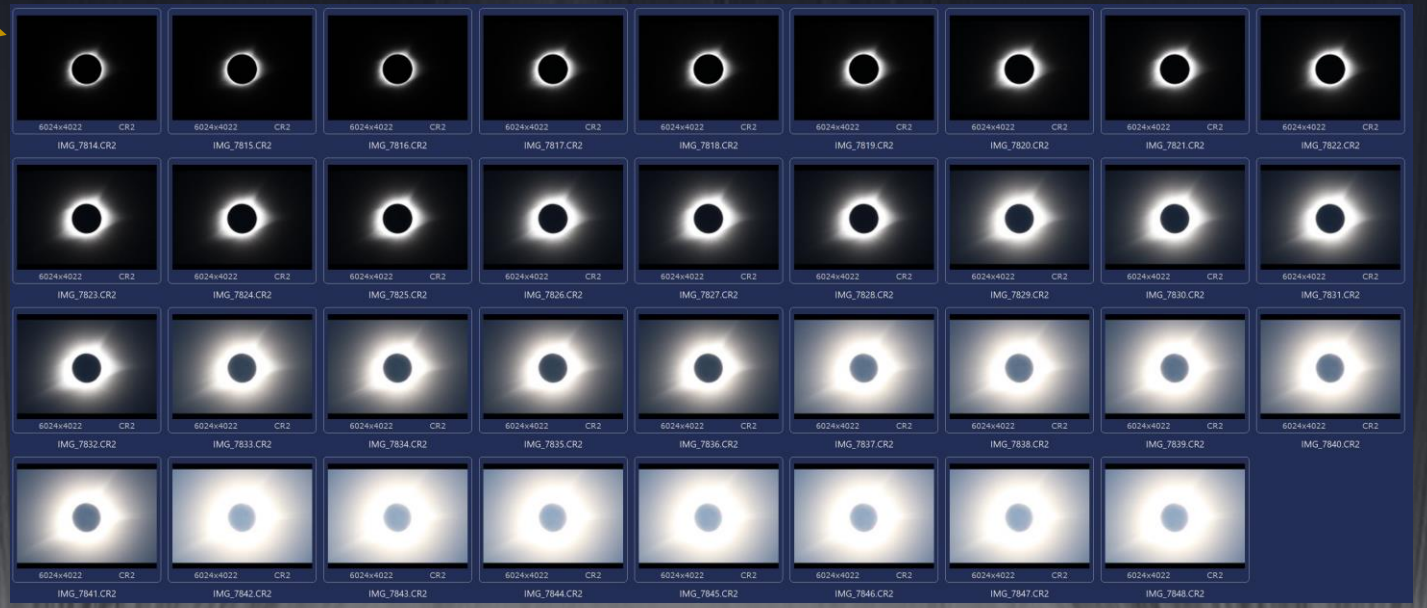
A large number of images to get the best SNR (>100 shots)

- from two nearly identical setups
- automatic acquisition using EclipseOrchestrator

Total: ~100 images were used to produce the final result:
exposures from 1/125 s to 1 s at 200 ISO and 1 s at 400 ISO
EV from 11,5 to 3,5.



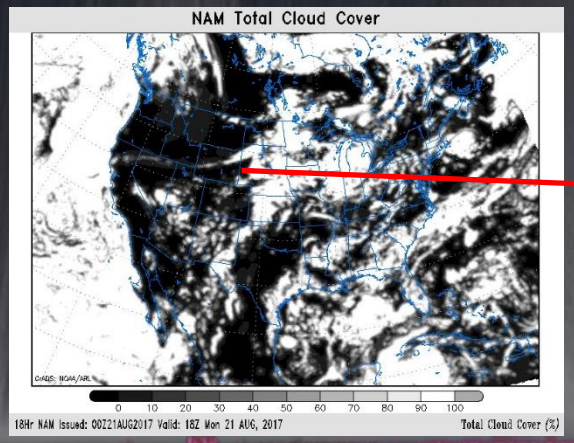


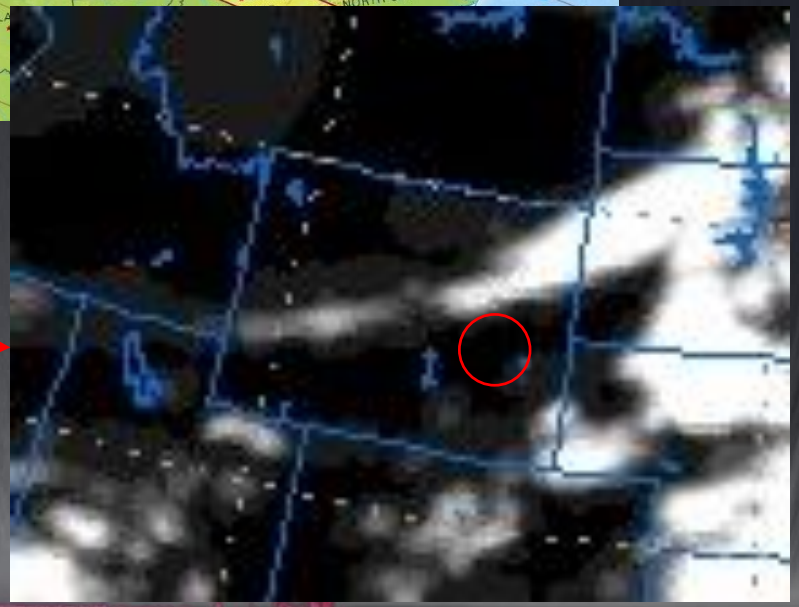


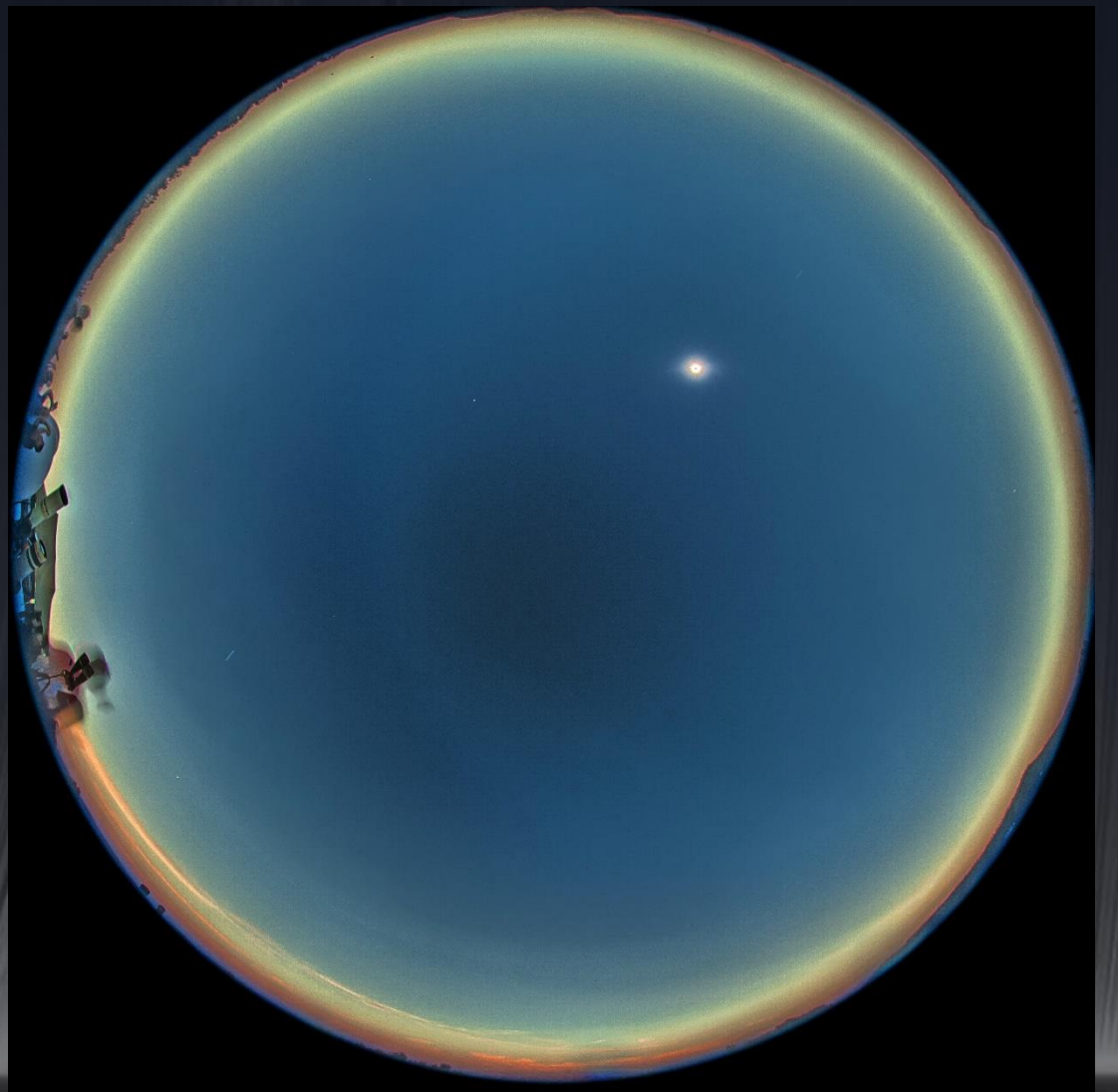
One of the image groups

My recipe: fundamental ingredients (2)

Perfect sky, obtained thanks also to very accurate planning (we observed from Glendo, WY, USA)







My recipe: fundamental ingredients (3+4)

- Great optics: two Pentax 75 corrected astrographs
- Cameras: two Canon DSLR (60D and 760D)

PENTAX

PENTAX

My recipe: fundamental ingredients (5)

Tracking: two relatively robust equatorial mounts, aligned on Polaris the night before

Tracking test on Pleiades, 30 s exposure unguided

zoom

Covered telescopes at sunrise

My recipe: fundamental ingredients (6)

Focus: very accurate using live-view, done 15 min before totality

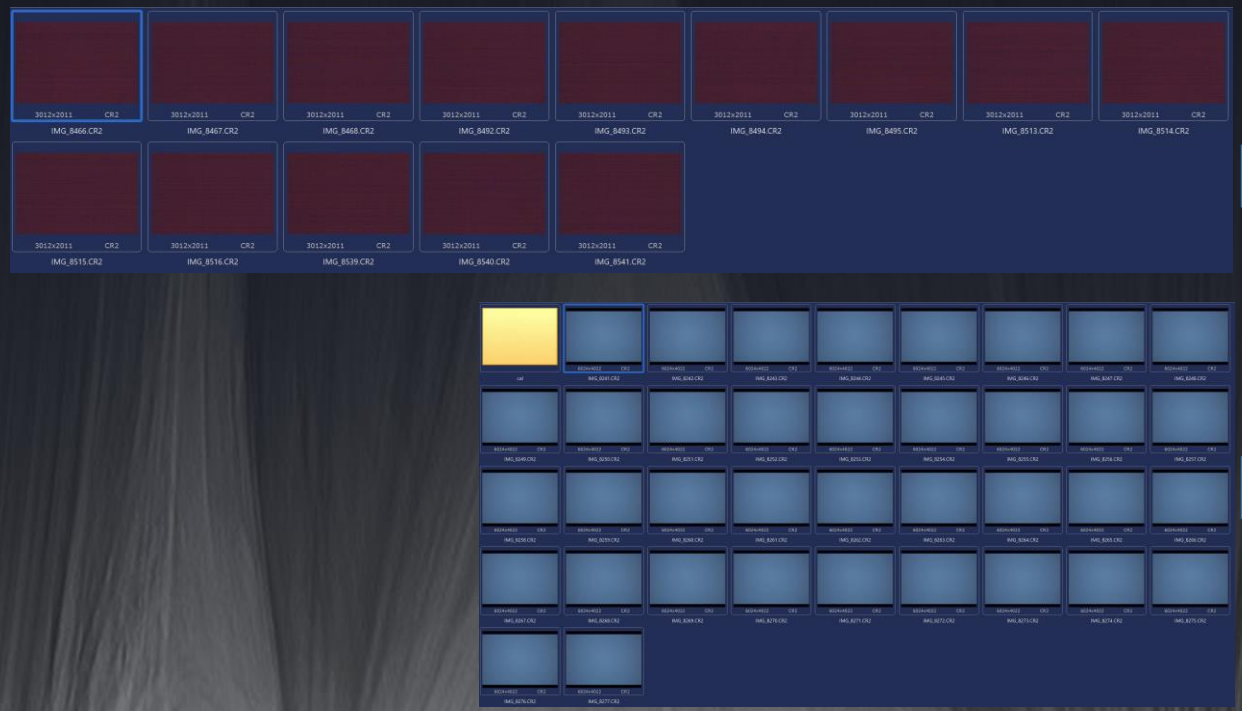
Focus on the stars the night before, but temperature increased and defocused

My recipe: fundamental ingredients (7)

Full calibration with darks, flats and dark of flats.

380 raw files per camera.

Removal of hot pixels, banding, dust, ...



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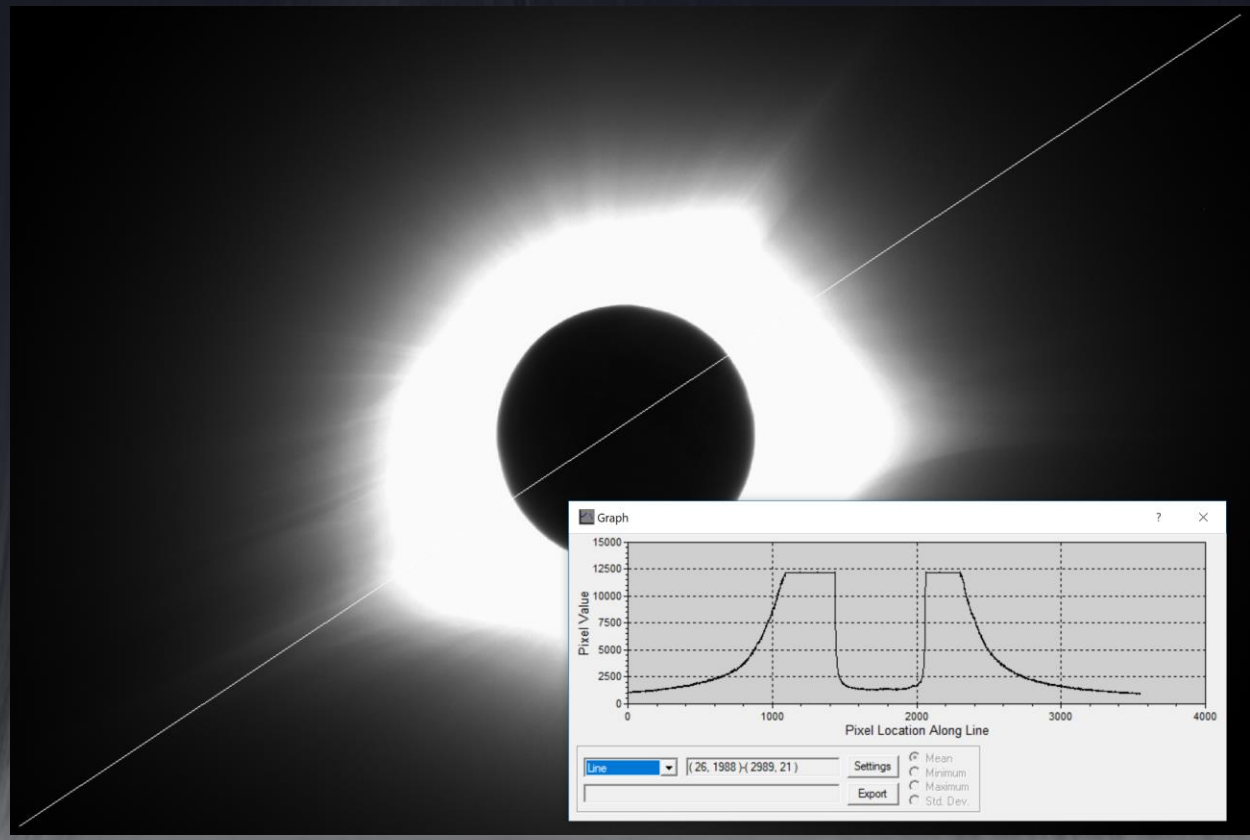
HDR production: calibration (1)

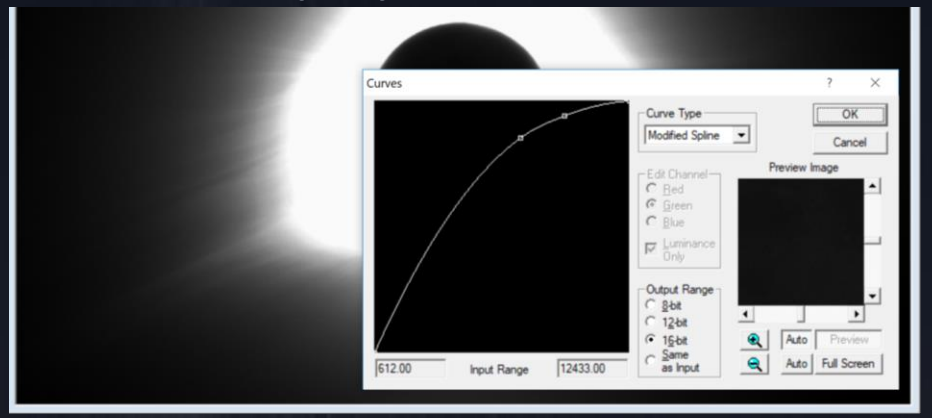
- Calibration of each raw image (dark, flat, darkflat)
- Debayer
- Conversion to black and white (corona is nearly colorless)

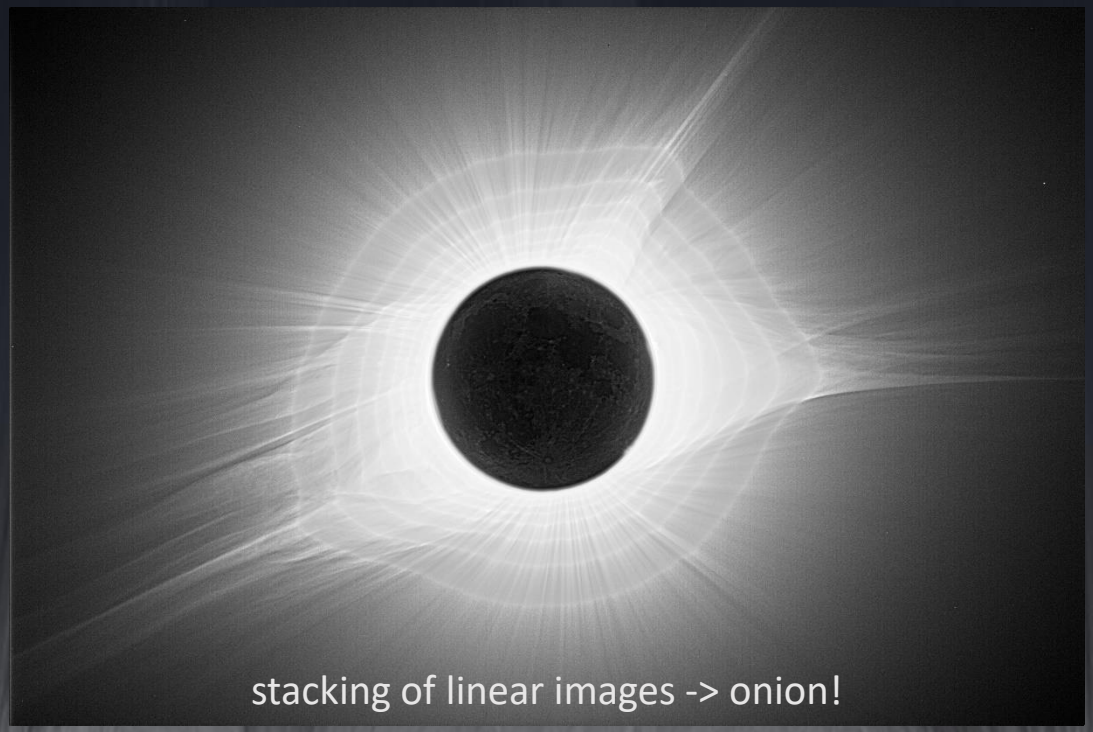


HDR production: curves (2)

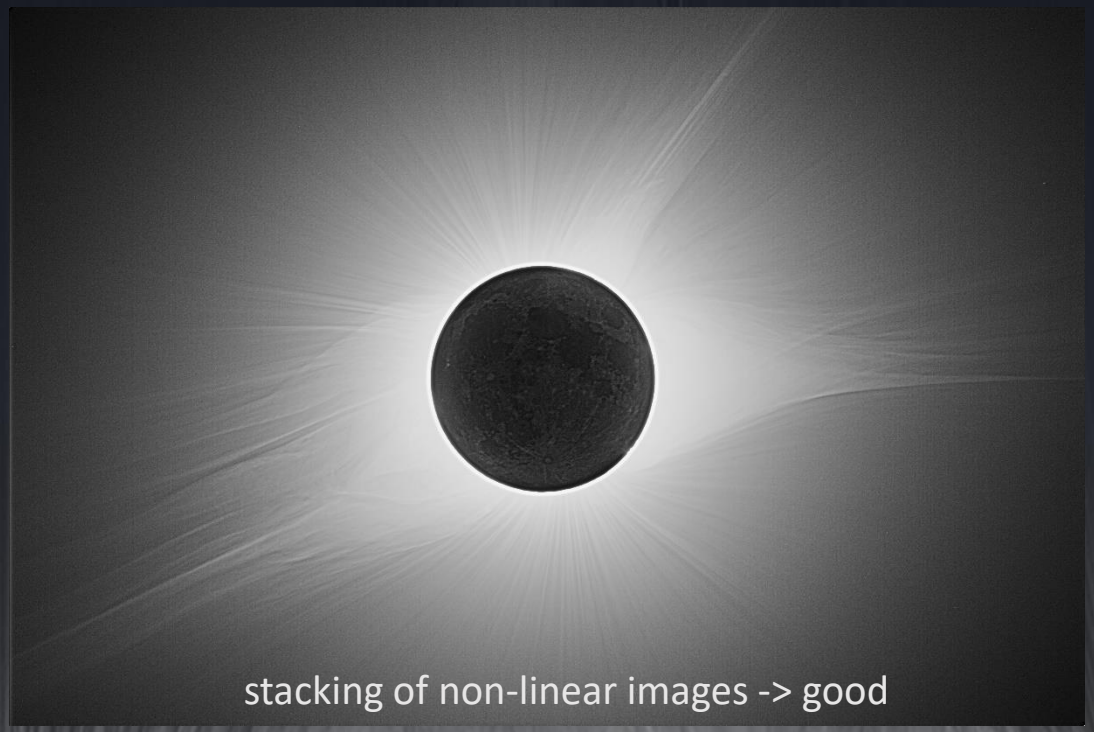
This is the trick to avoid an "onion corona":

apply a **curve** to each image.





stacking of linear images -> onion!



stacking of non-linear images -> good

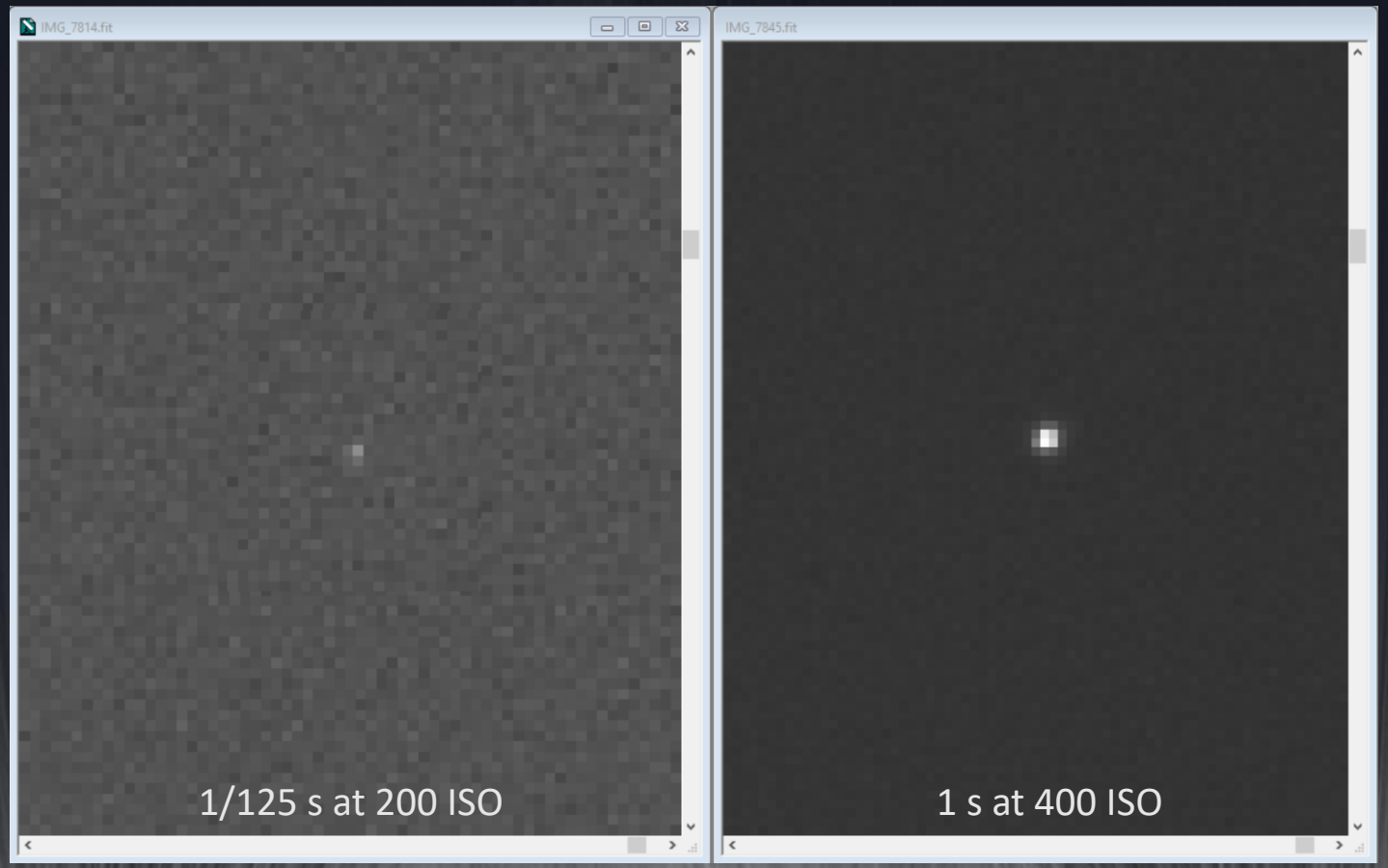
HDR production: alignment on Nu Leo (3)

Luckily during this eclipse, and with my field of view, a bright star was in the field: Nu Leo (mag. 5,3).

Barely visible also with 1/125 s!

And not saturated with 1 s.

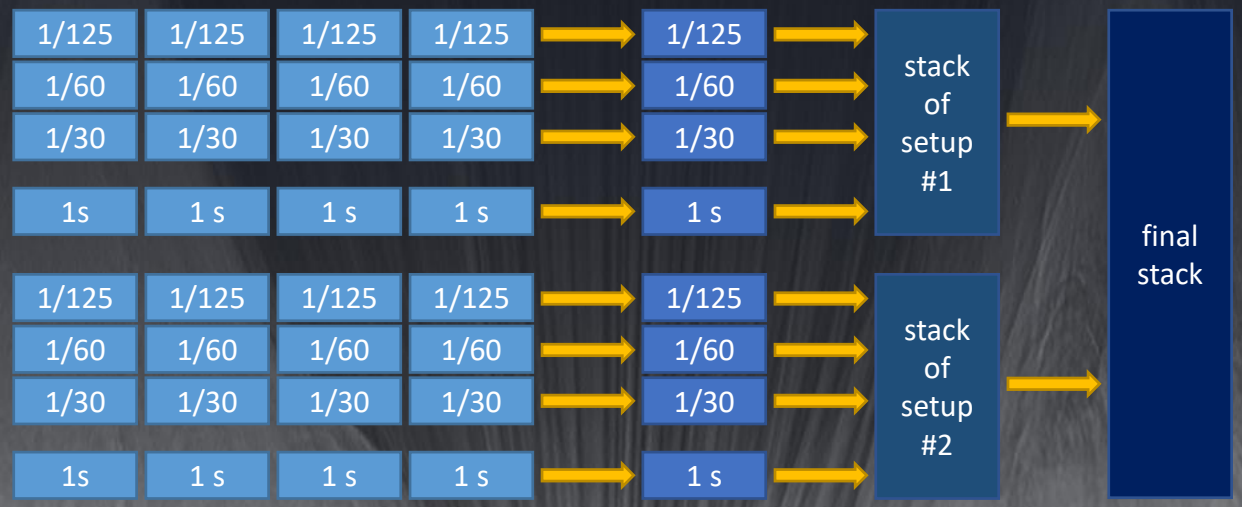
Alignment on the star was sufficient because during the 90 s of used exposures, the Sun traveled only 3,7", that is ~2 pixel (scale 1,8"/pix)



HDR production: stacking (4)

Three step stacking:

1. average of each group of exposure time (i.e. 1/125, 1/60, 1/30, 1/15, 1/8, 1/4, 1/2, 1, 1@400)
2. average of all the intermediate stacking
3. average of the stacking of each setup (after proper resizing and alignment on two stars)



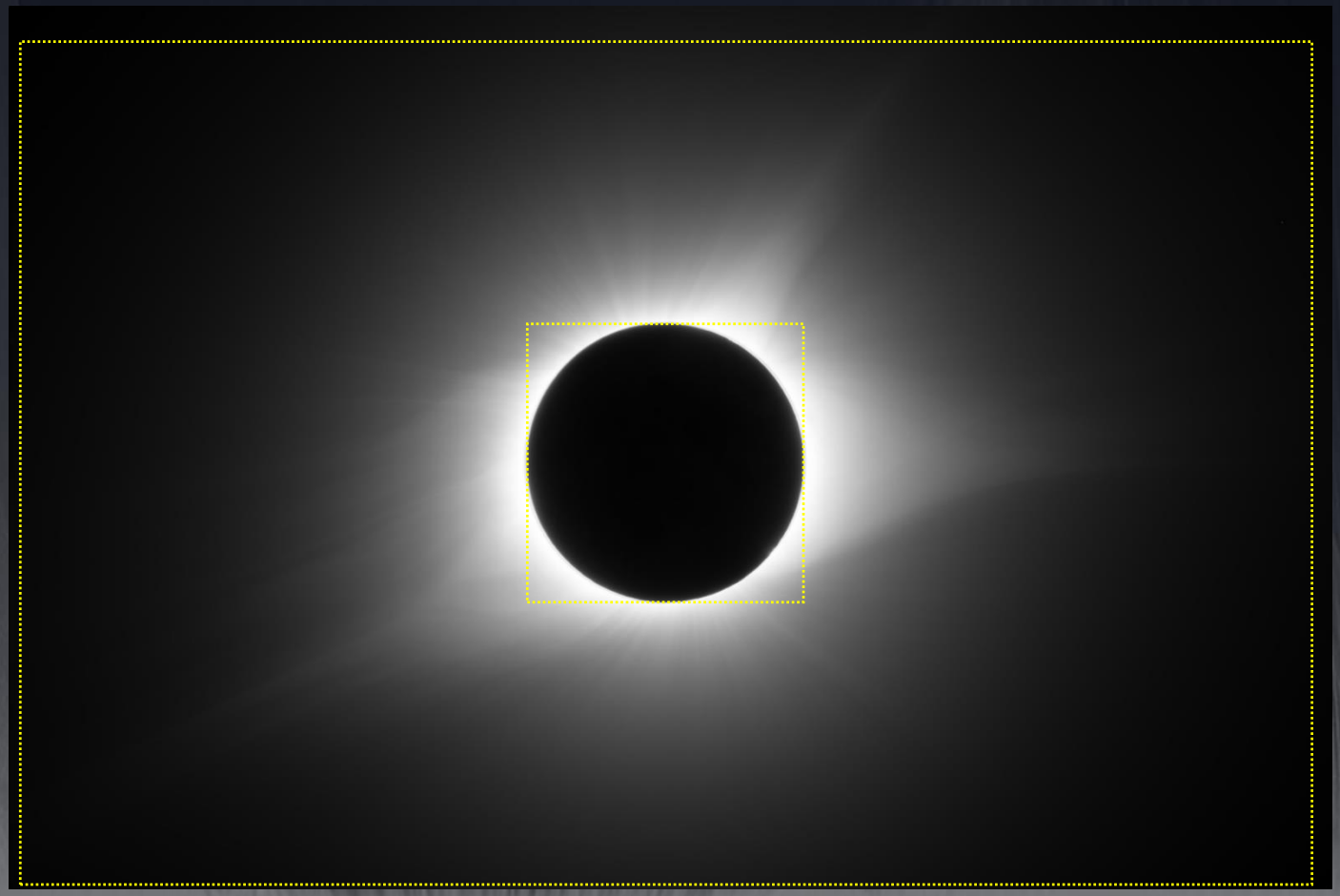
HDR production: result (5)

The result is a very smooth image. Very low contrast. High SNR. Great potential to be extracted via heavy processing.

Processing: cropping centered on the Sun (1)

Fundamental step for the next processing.

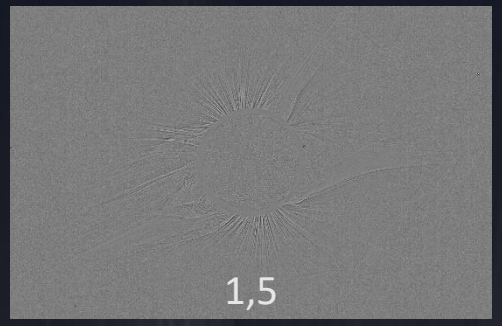
Crop is minimum only if centering of raw images is good.

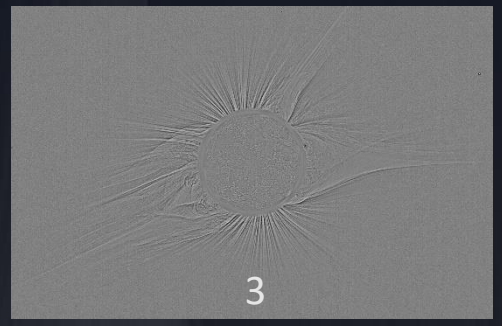


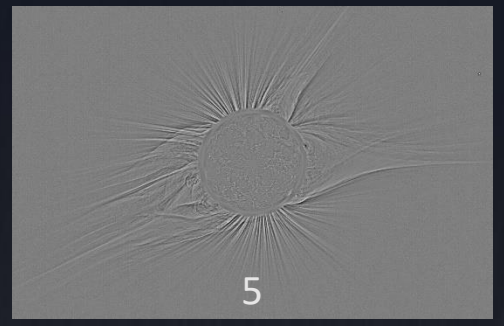
Processing: high pass (2)

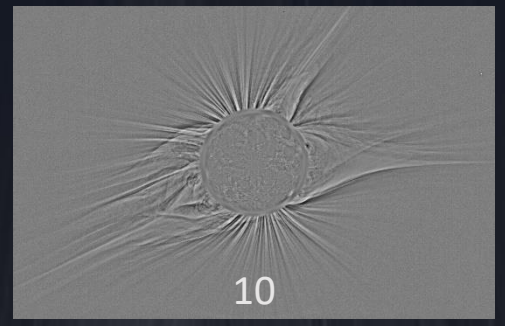
Production of some layers with only details, scales from small to large.

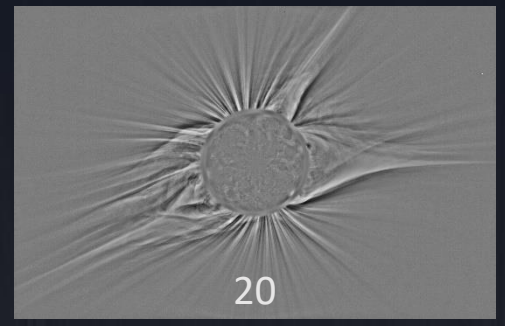
Photoshop: Filters>Other>High Pass: radius parameter.

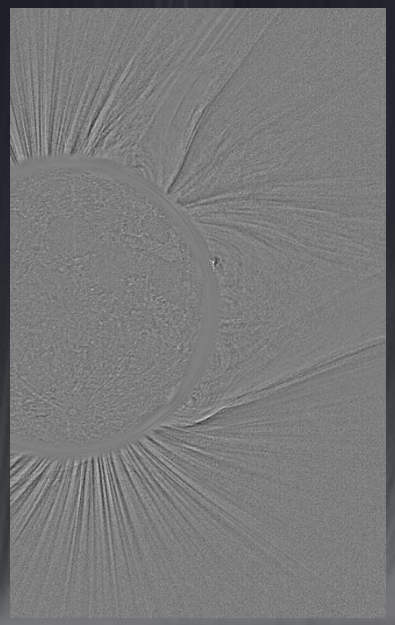


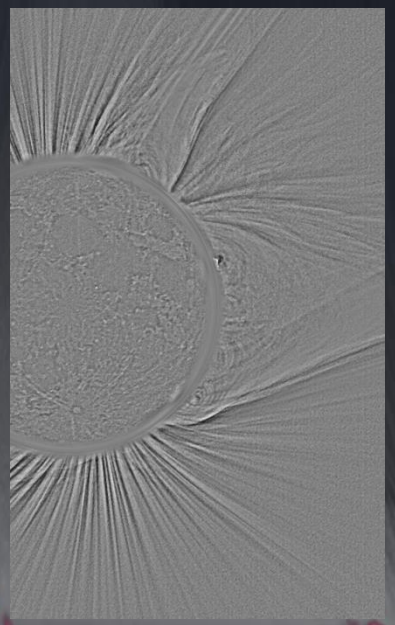


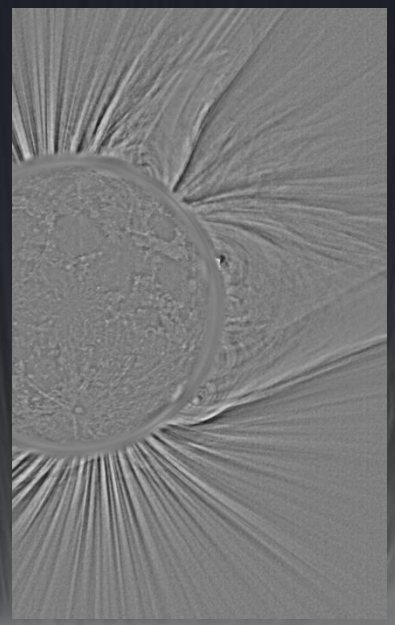


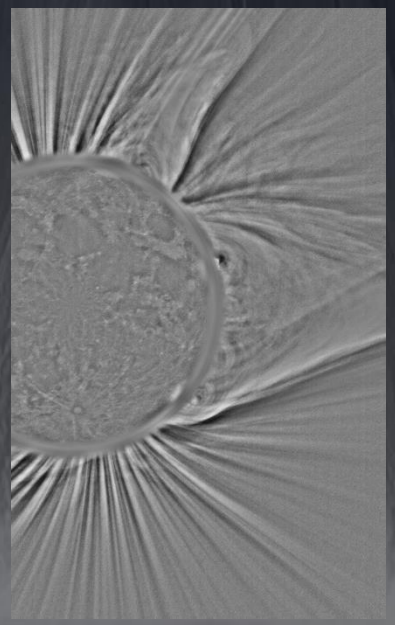


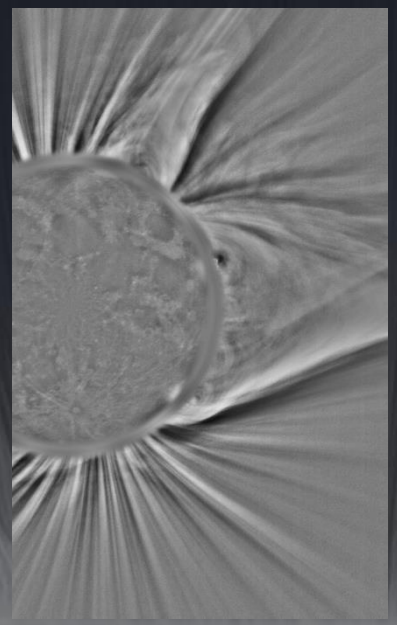








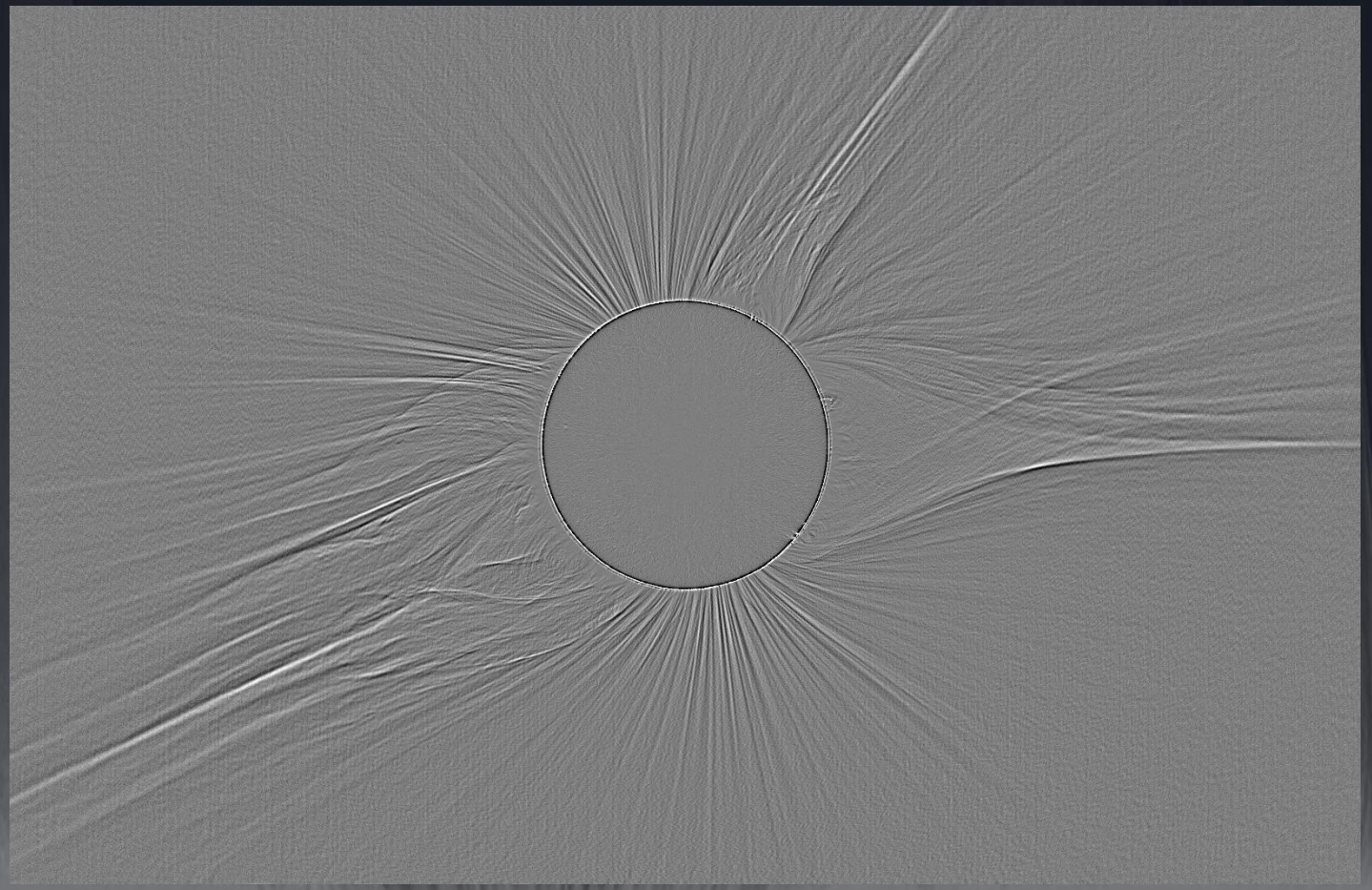




Processing: Larson-Sekanina (3)

The LS algorithm was developed for enhancing comet structures like jets.

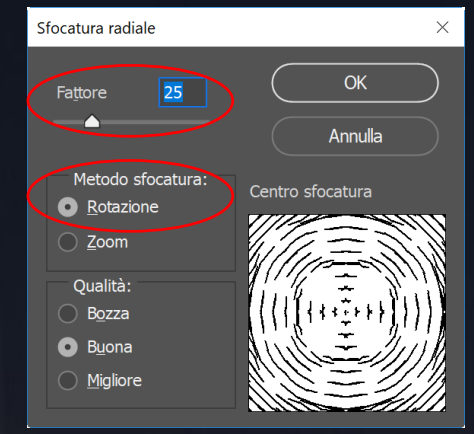
I advise to use a small angle like 0.4°.

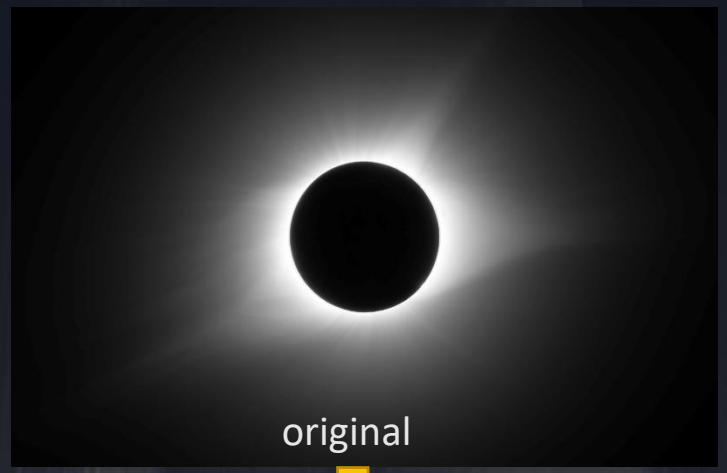


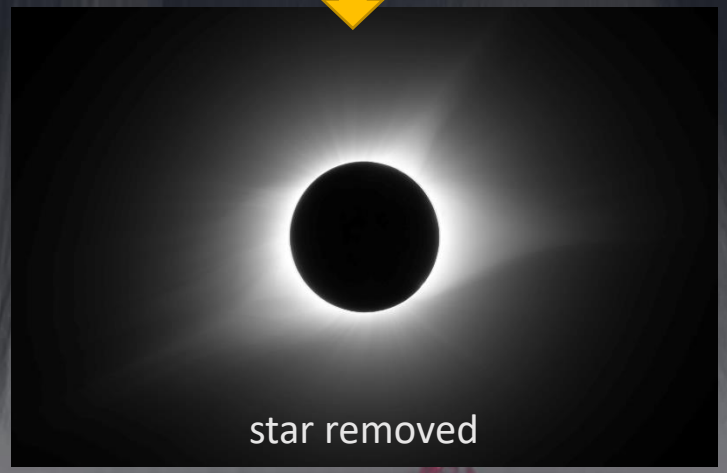
Processing: radial blur (4)

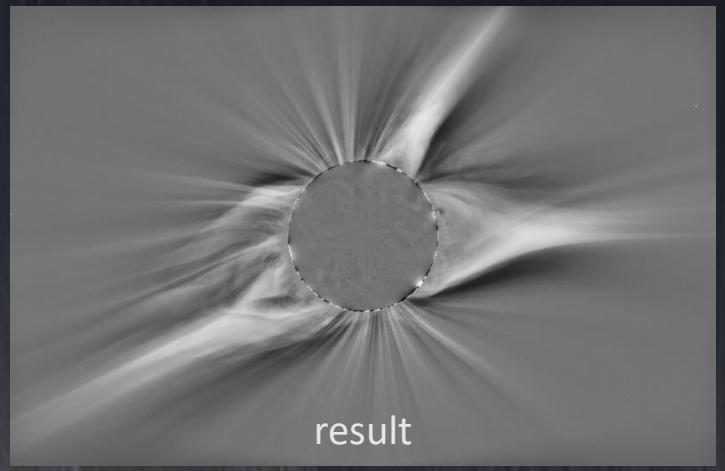
Make a radial blur: PS>Filters>Blur>Radial Blur, option "rotation", factor 25.

Subtract to the original image, obtaining only radial details.







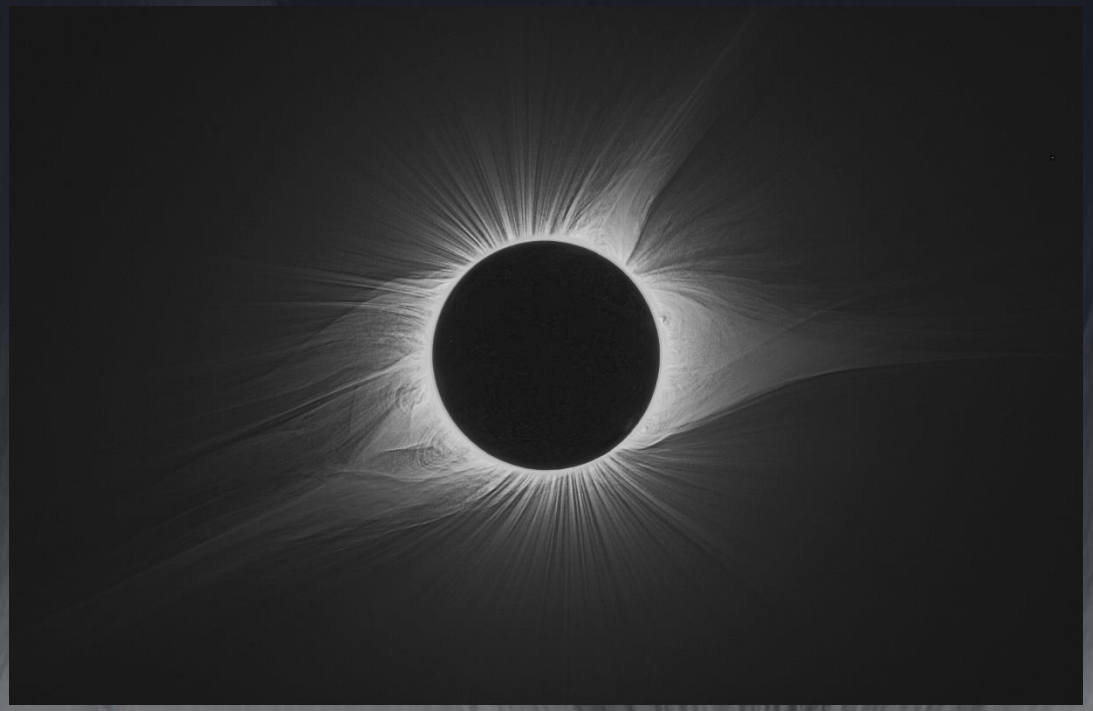


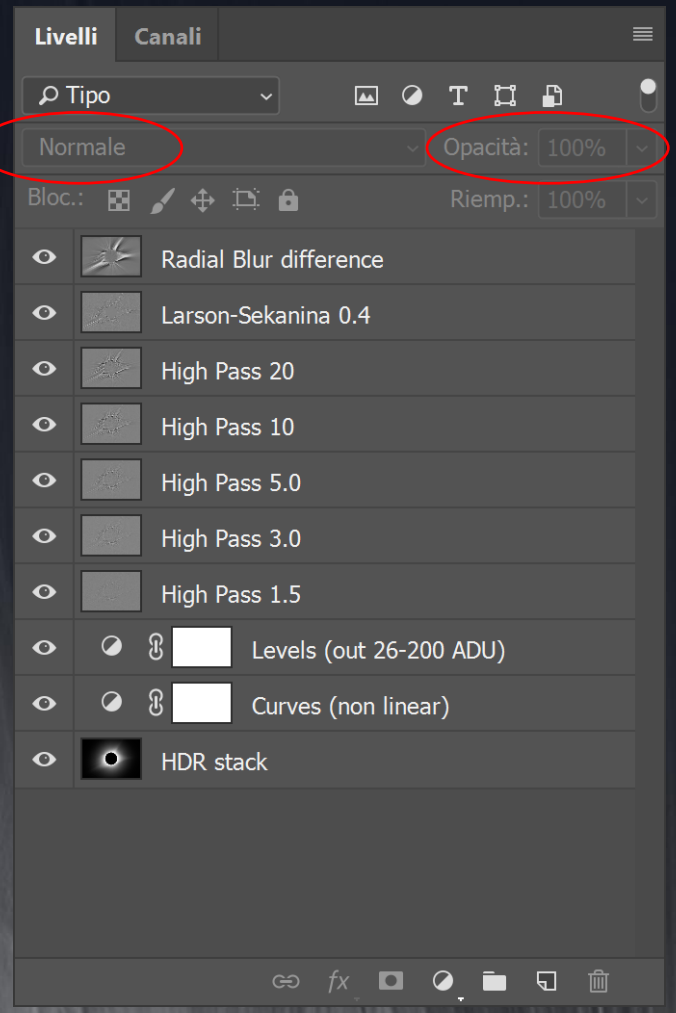
Processing: stacking (5)

Now you have many layers containing only details.

You can process heavily to get the best results, keeping the average gray at mid scale (127 ADU).

Now stack the original HDR with the details, option of fusion "Overlay", with Opacity as preferred.



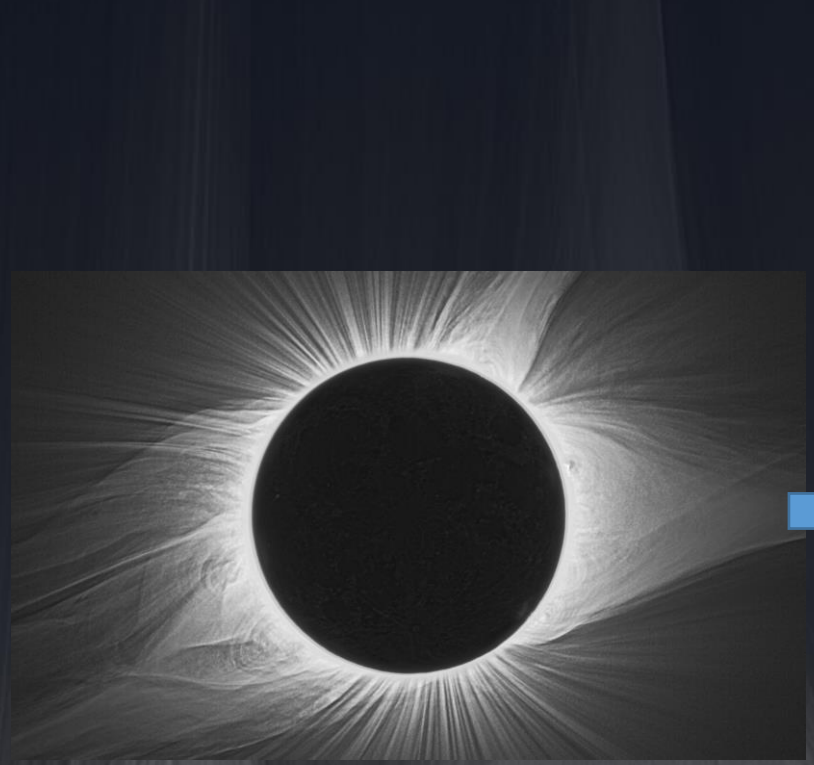


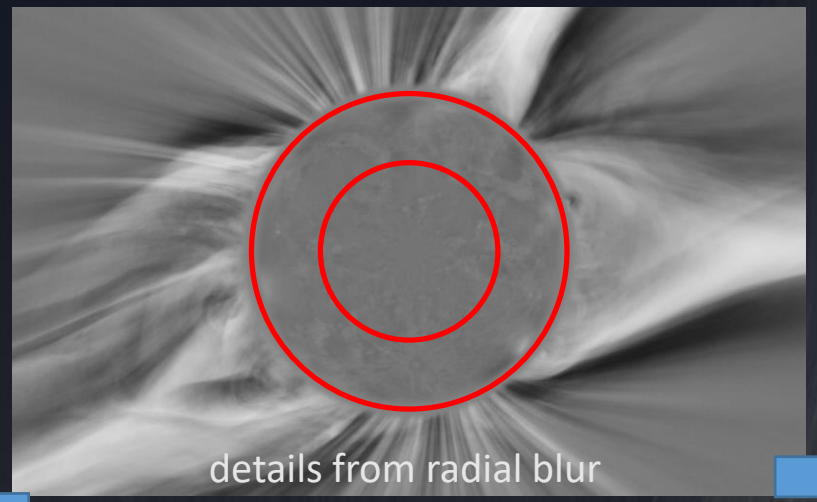
opacity

15%
2%
5%
10%
15%
20%
25%

Fine tuning: Moon (1)

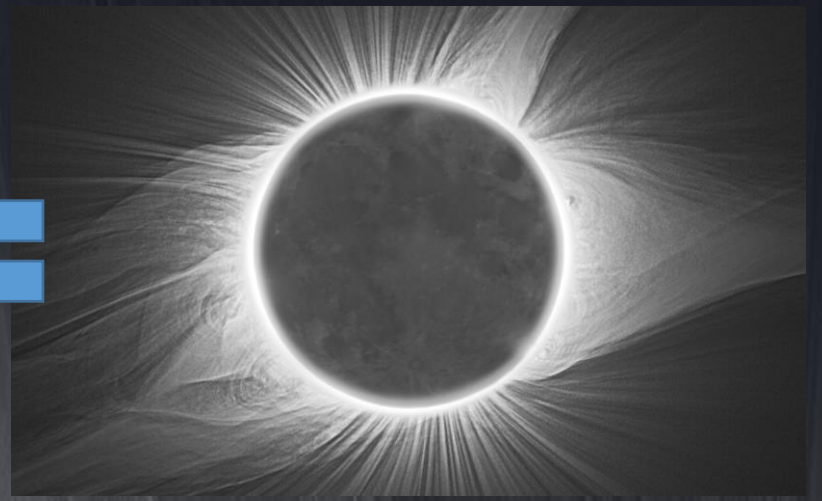
The Moon ashen glow is clearly recorded in the longer exposures, here is the method I used, blending two intermediate processing via "layer masks".





details from radial blur

details from the stack of 2 s exposures



Fine tuning: stars (2)

I produced a layer only with stars, using the High Pass to evidence them.

Then I added enhanced stars above using "Overlay" fusion.

Example with many stars from the wide field HDR (f.l.=150 mm)

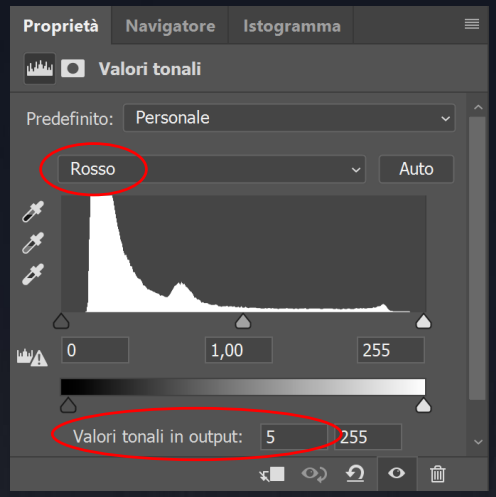
Fine tuning: color (3)

Convert to RGB and make the dark region with these RGB values: 25-34-57.

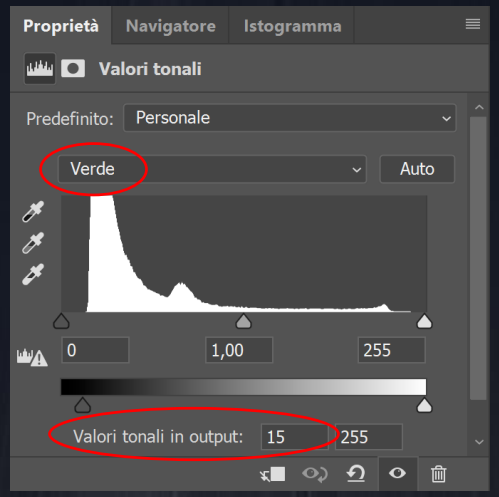
Using a "Level" layer and output values.

More fine tunings as the layer stack in the figure.

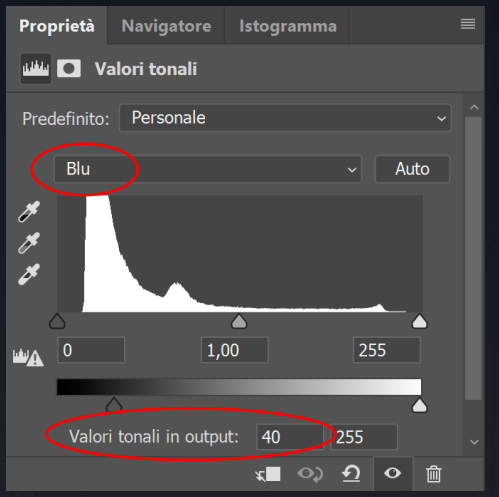
Note in particular the subtle desaturation of the corona center (to get white corona).



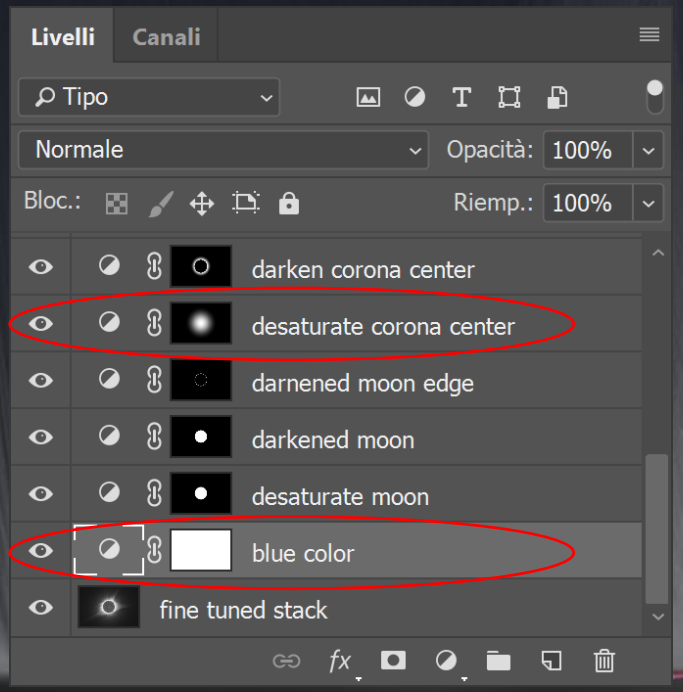
Red



Green



Blue

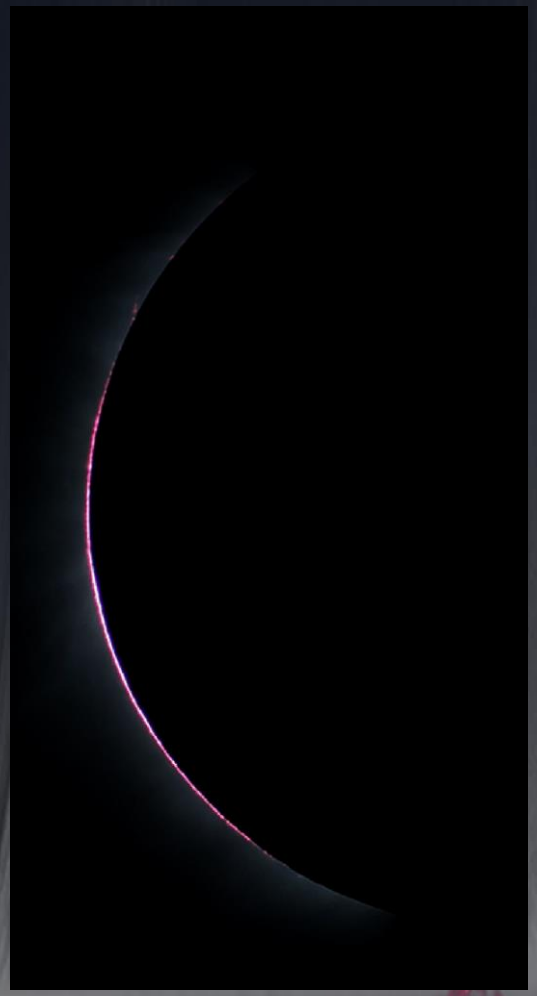


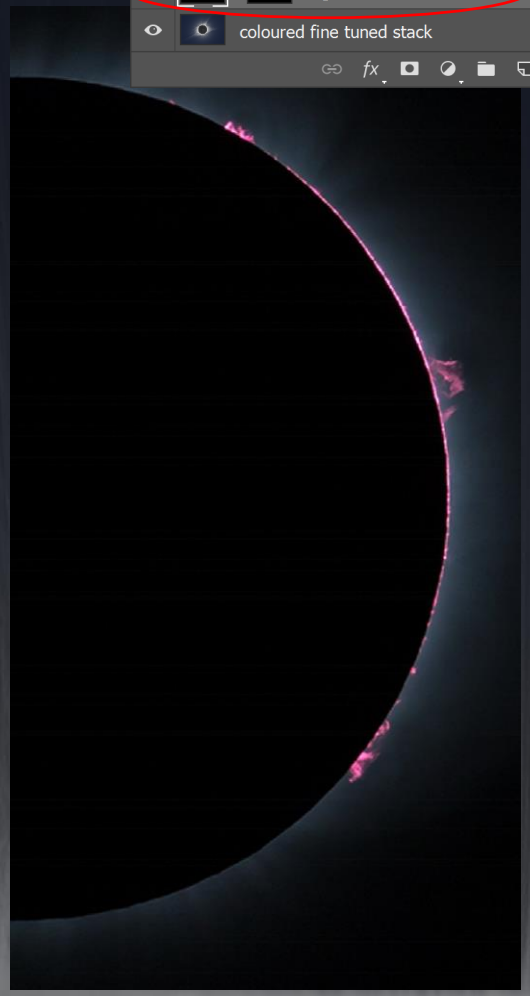
Result

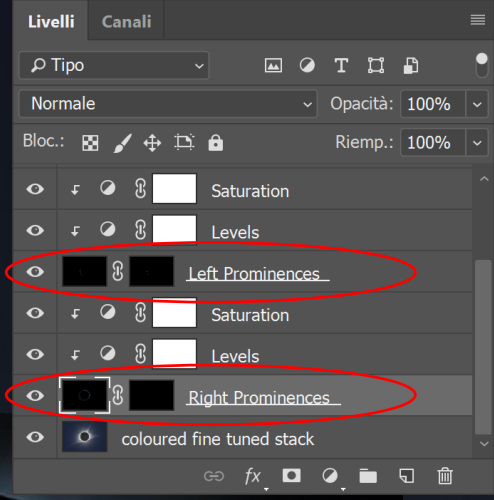
Fine tuning: prominences (4)

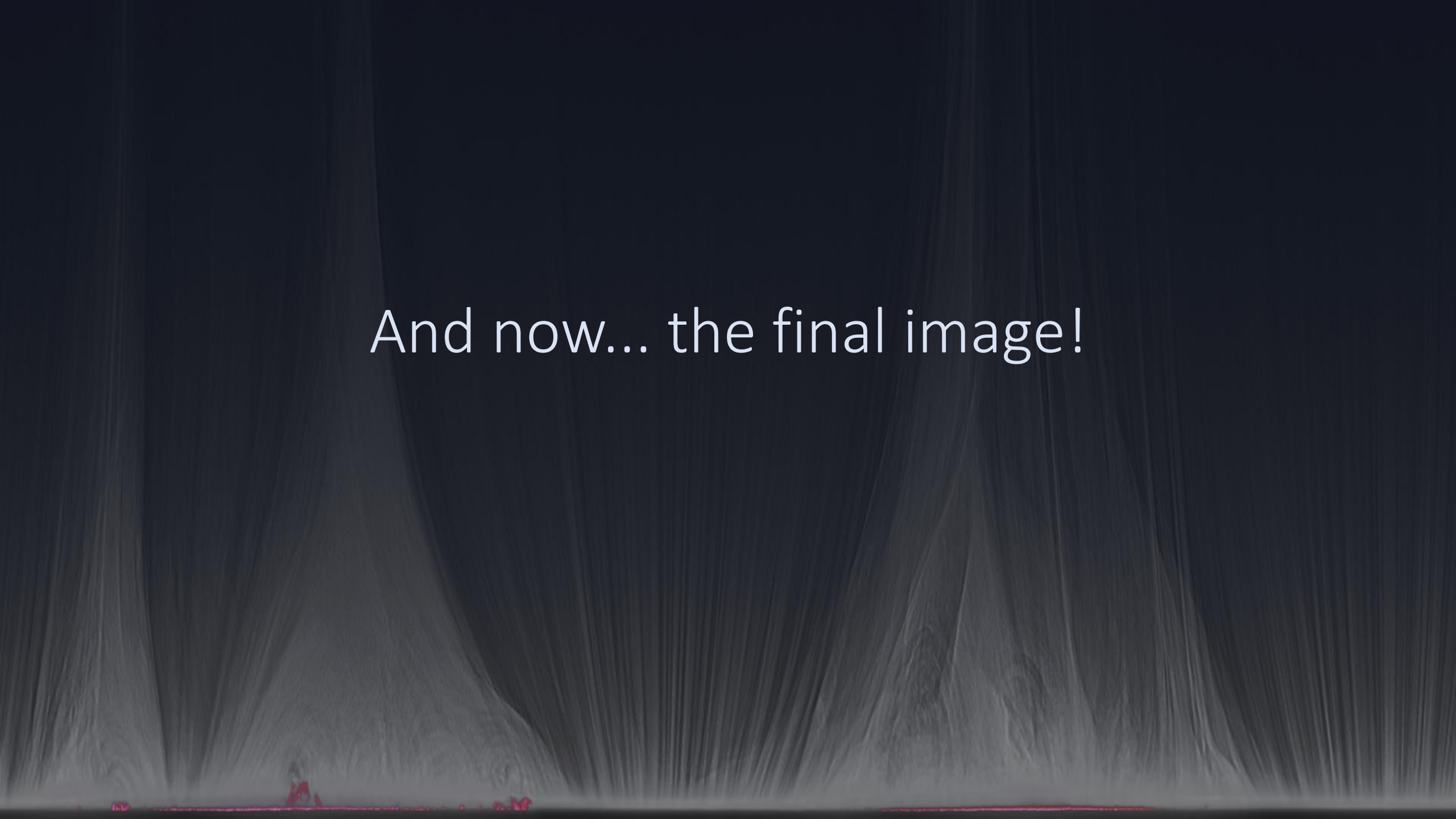
Prominences added from images captured at C2 and C3.

Stacking masked using a contrasted copy.








And now… the final image!

Two Pentax 75 refractor (500mm f.l. f/6.7), Canon 760D and 60D, two tracking mounts (Vixen GP and Kenko NES), exposures between 1/125 s and 1 s at 200 ISO, plus 1 s at 400 ISO. Nearly 100 total exposures were used.
This image is a collaboration between Emmanuele Sordini and Lorenzo Comolli.

Rectangular projection of the HDR corona image.

Much more than a single image

During the 2 minutes and 29 seconds we captured:

- 300 shots for each Pentax 75 setup
- 160 shots for each Canon 100-400 @150 mm
- 160 shots for flash spectrum
- ... and much more for all-sky time-lapses, videos, meteo measurements, SQM readings, ambient luminance, 20x100 binocular observations ...

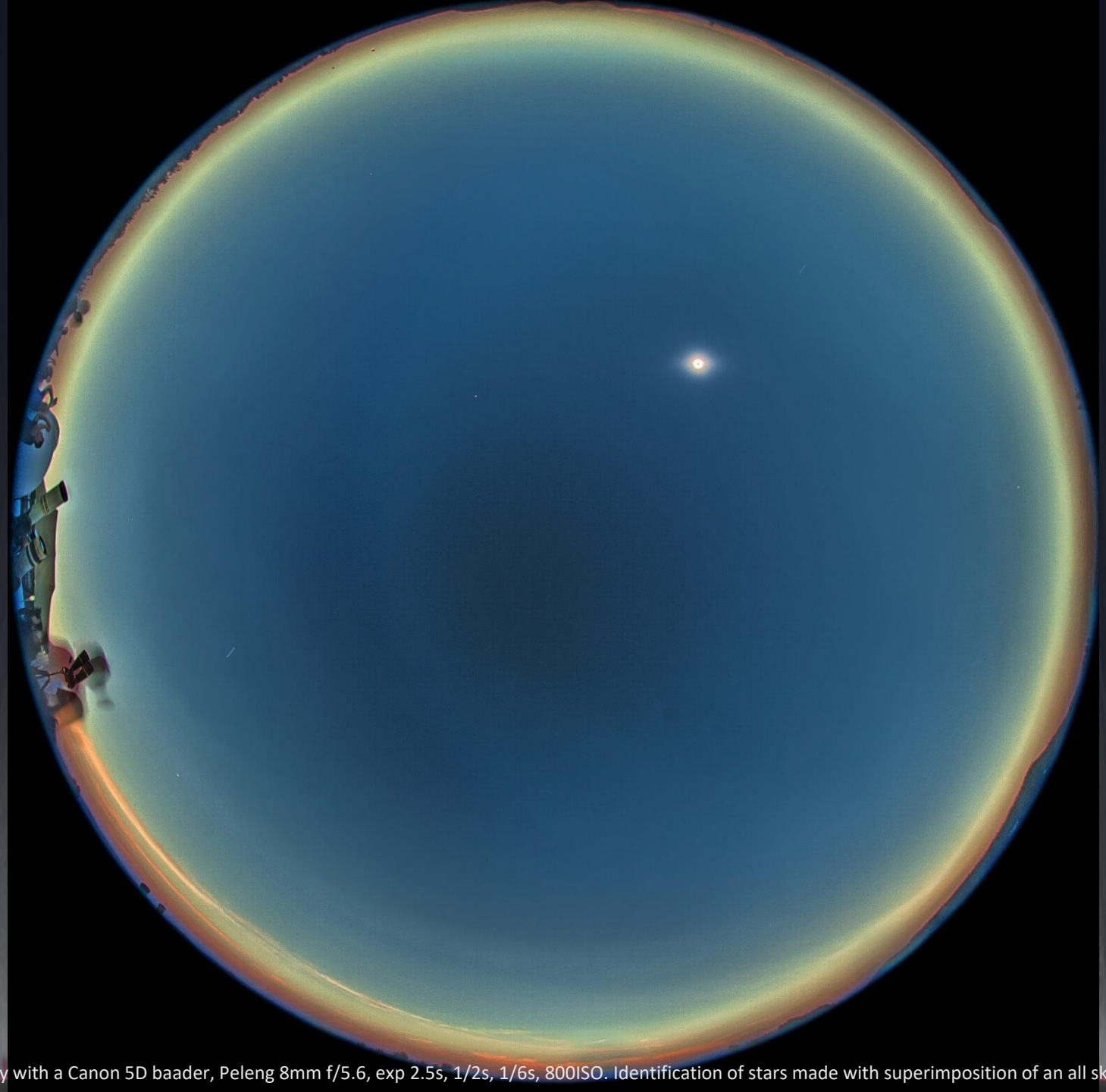
More images online:

Lorenzo Comolli
http://www.astrosurf.com/comolli/ecl17a.htm

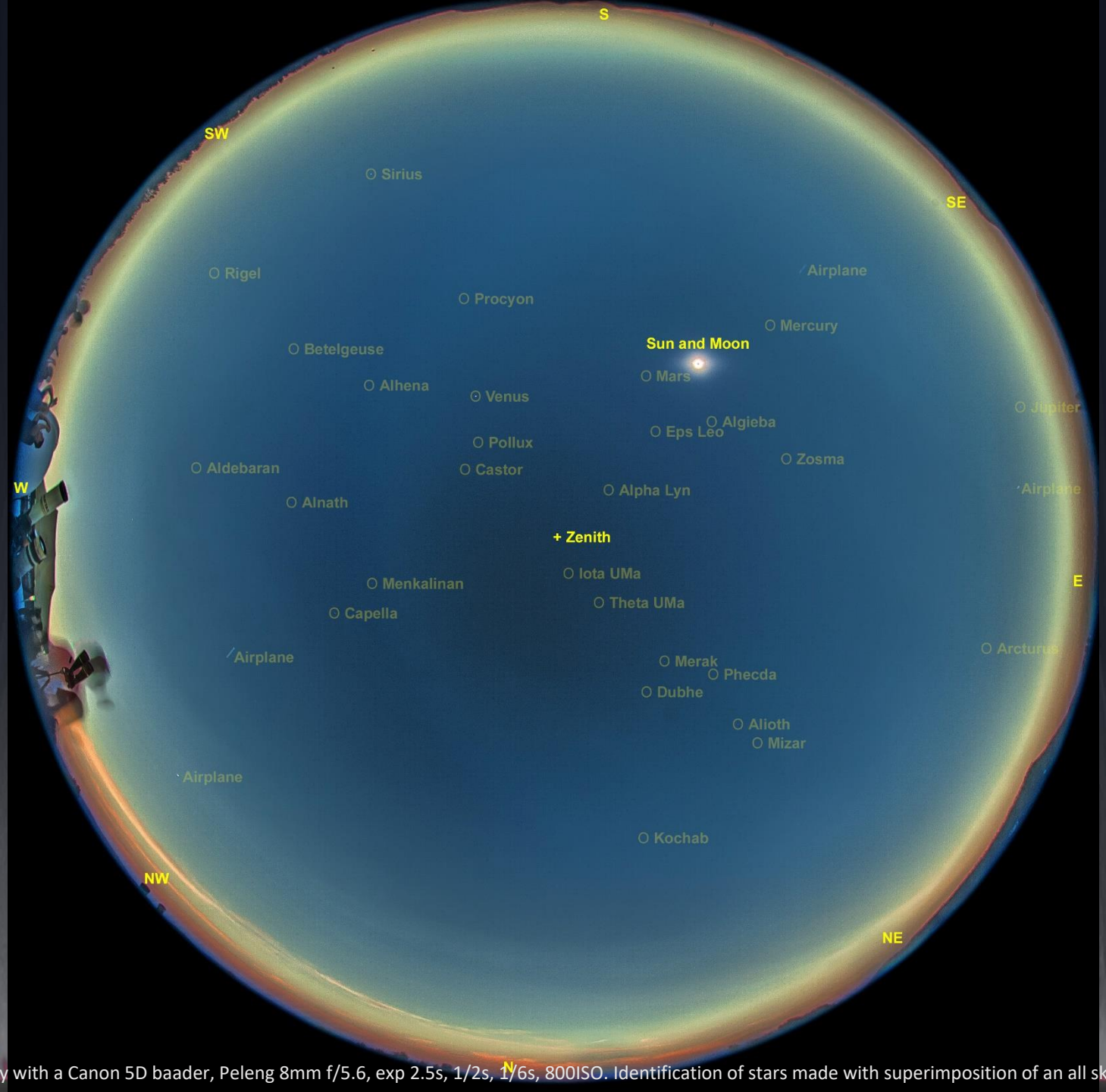
Emmanuele Sordini
http://www.bloomingstars.com/

Two Canon 100-400 lenses (used at 150mm f/8), two Canon 6D, two tracking mounts (Vixen GP and Kenko NES), exposures between 1/125 s and 2 s at 400 ISO, plus 2 s at 800 ISO. Nearly 130 total exposures were used.
This image is a collaboration between Emmanuele Sordini and Lorenzo Comolli.

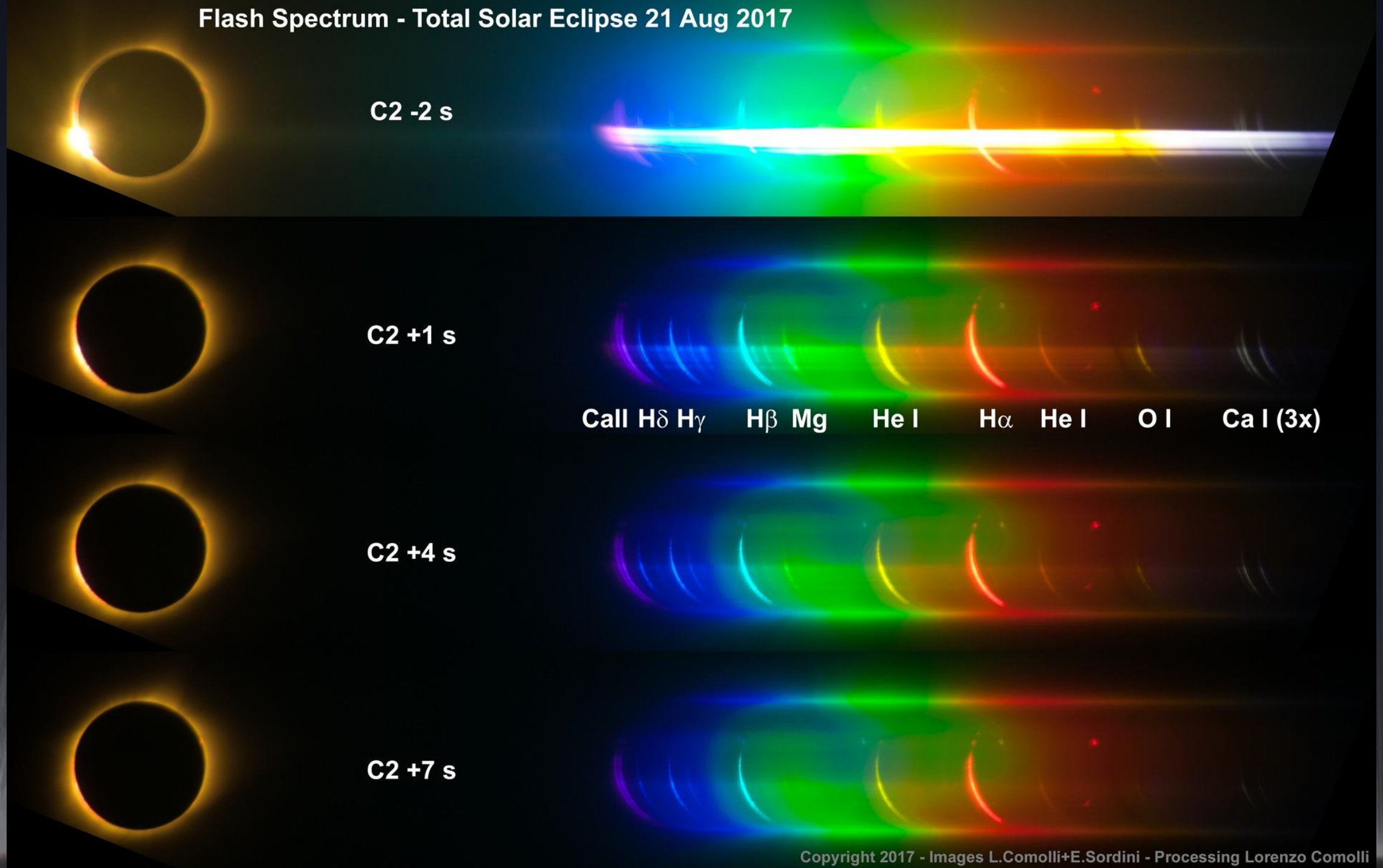
Solar prominences just a second before C3, with also the chromosphere at maximum visibility. Extreme enlargement of the original frame.
Pentax 75 refractor (500mm f.l. f/6.7), Canon 60D, Kenko NES mount, 1/2000s exposure at 100 ISO. North at top-left.



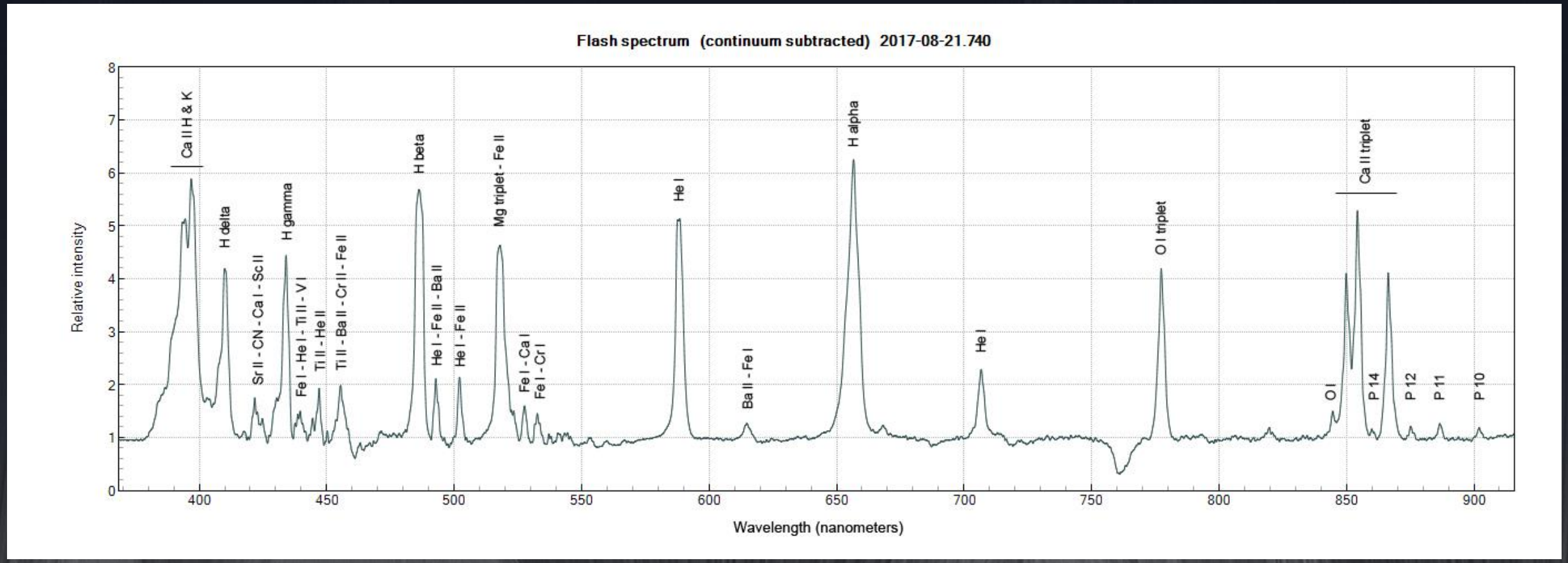
HDR composition obtained at mid totality with a Canon 5D baader, Peleng 8mm f/5.6, exp 2.5s, 1/2s, 1/6s, 800ISO. Identification of stars made with superimposition of an all sky map generated with Perseus software.



HDR composition obtained at mid totality with a Canon 5D baader, Peleng 8mm f/5.6, exp 2.5s, 1/2s, 1/6s, 800ISO. Identification of stars made with superimposition of an all sky map generated with Perseus software.

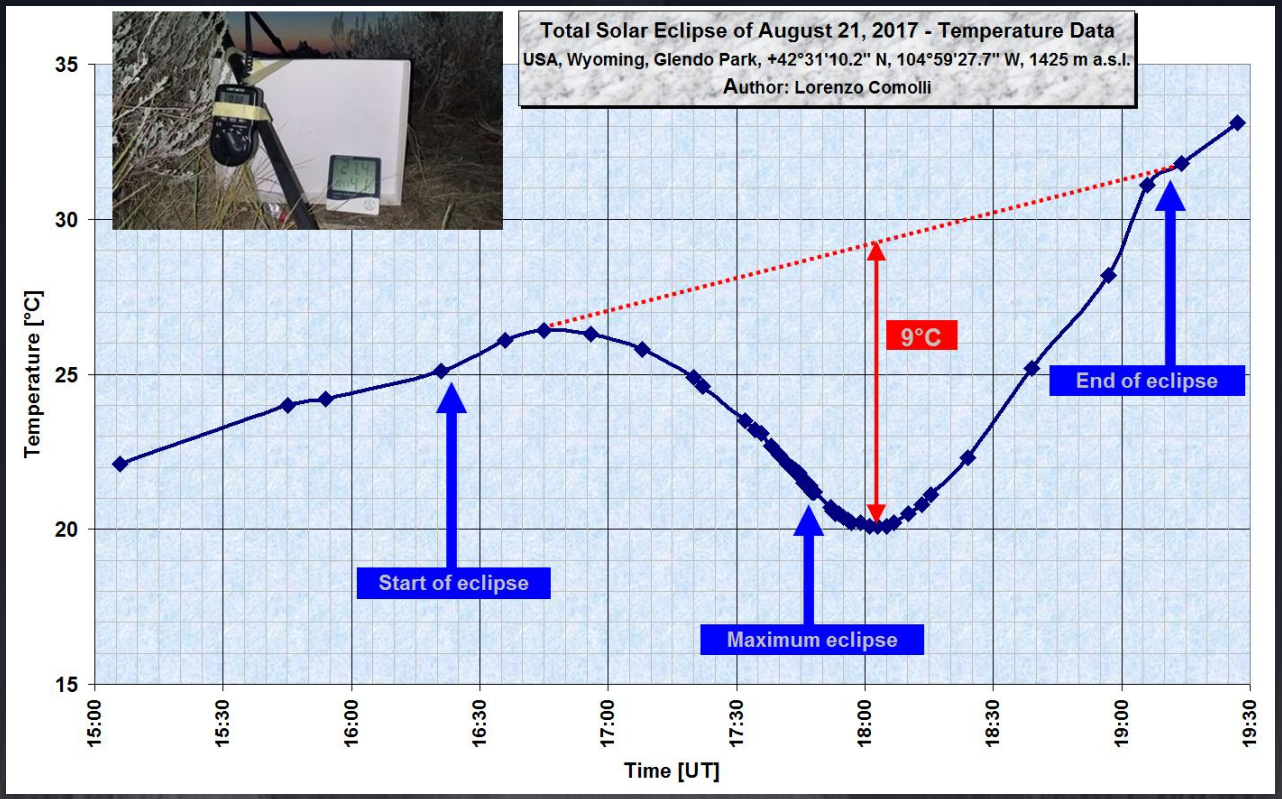

Flash Spectrum - Total Solar Eclipse 21 Aug 2017
C2 -2 s
C2 +1 s
CaII Hδ Hγ Hβ Mg He I Hα He I O I Ca I (3x)
C2 +4 s
C2 +7 s
Copyright 2017 - Images L.Comolli+E.Sordini - Processing Lorenzo Comolli

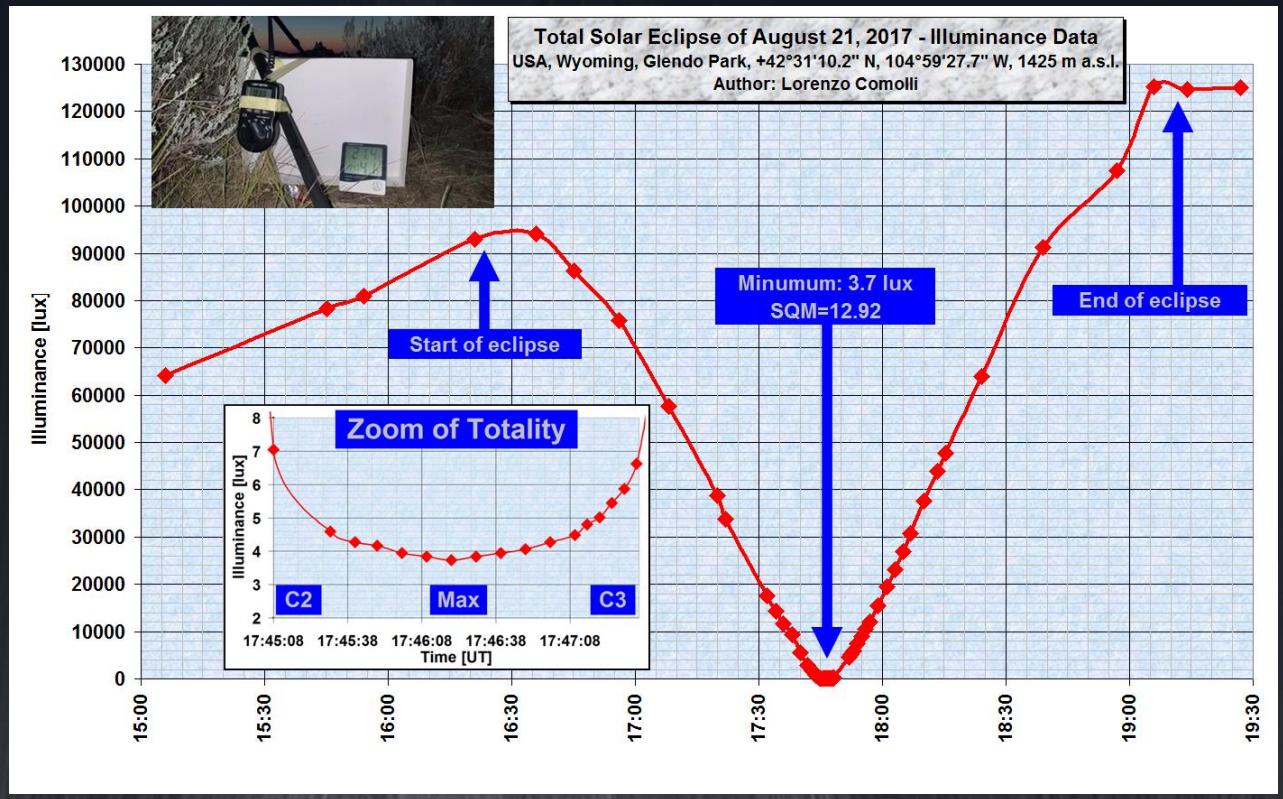
Flash spectrum at C2+1s

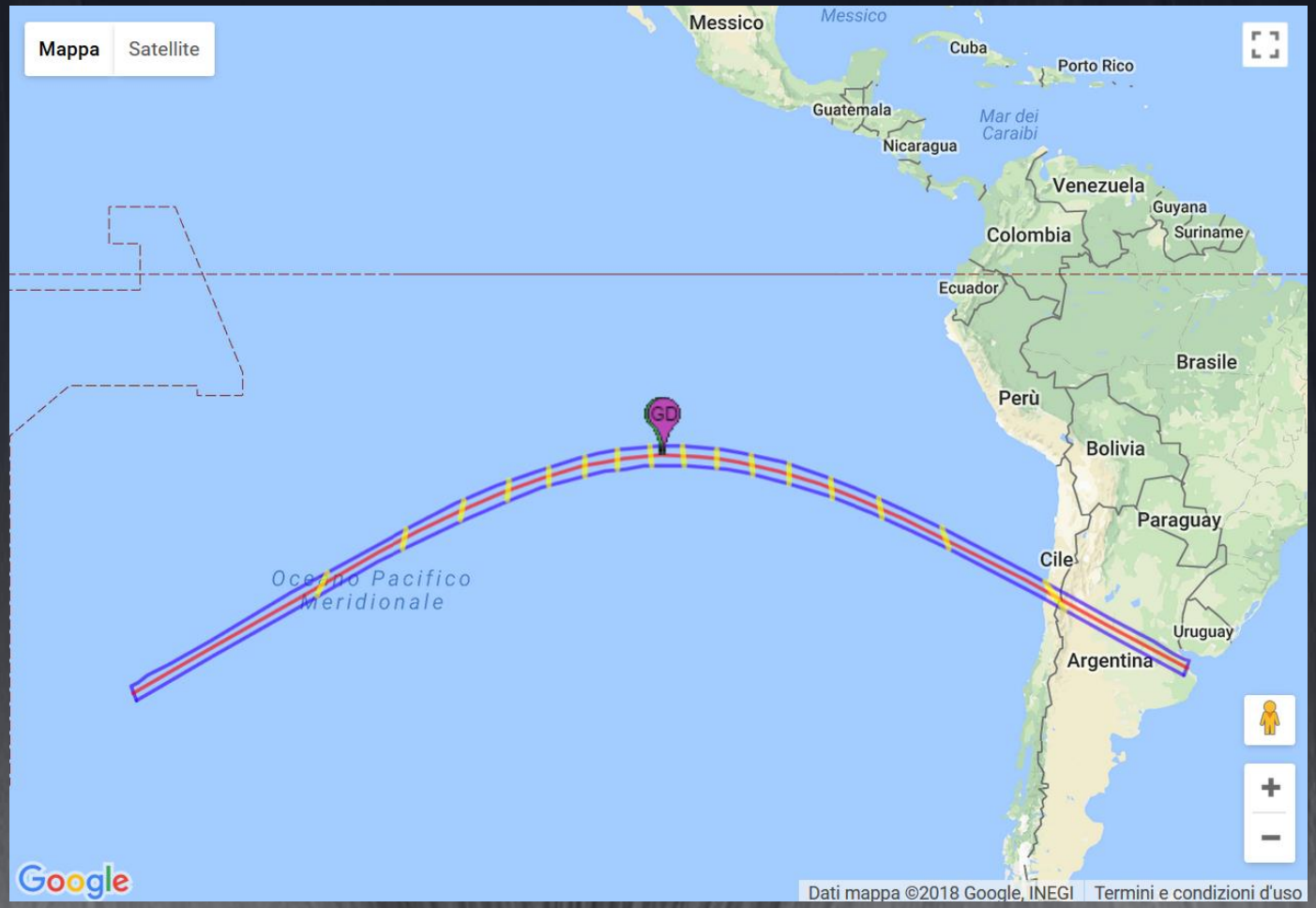


Processing made by Paolo Berardi

Meteo and luminance measurements





The next one... ☺

2 July 2019, Chile and Argentina