

# Planifier des Observations

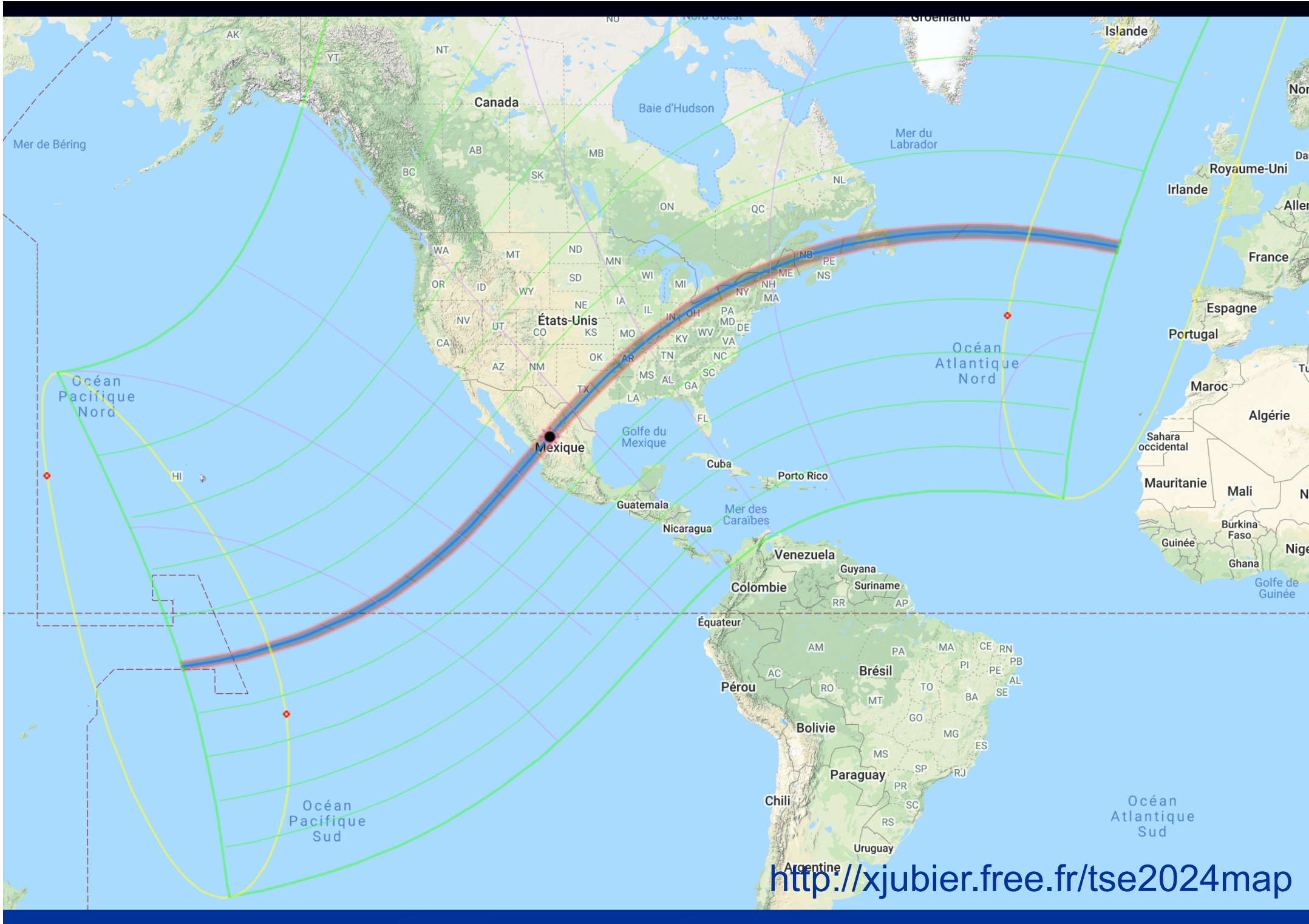
## — Éclipse Totale de Soleil —

### 8 Avril 2024

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SF2A 2021 — Ateliers Collaboration Pro-Am (Session 13)



<http://xjubier.free.fr/tse2024map>

# Mazatlán, Sinaloa, Mexique



# Mazatlán, Sinaloa, Mexique



# Route vers Durango, Durango, Mexique



# 20km point de plus grande éclipse, Durango, Mexique



# Solar Eclipse Maestro

- Specialized application
  - Computations at maximum accuracy (atmospheric refraction, lunar limb profile, Baily's beads, sky chart, apparent horizon, etc.)
  - Control your DSLRs or CCDs
  - E-Flight planning and execution
  - And much more
- Available for lunar eclipses and solar transits also
  - Lunar Eclipse Maestro
  - Mercury Venus Transit Maestro

**Solar Eclipse Photography (Total Eclipse August 1, 2008)**

UTC Date & Time : 01/08/2008 11:03:37.6 JD 2454679.960852 No PPS \*SIMULATED TIME\*

Script: A\_2008T\_final.txt

Latitude : 43° 27.16668' Longitude : 94° 50.81664' Altitude : 1147.0m Weixixia - Eclipse-City 2008 (China)

GPS status : Valid Norm Fix 3D Satx : 05/12 EPE (2σ): 27m TZ : +08:00

Eclipse type : Total Obscuration : 100.00% Penum. dur : 1h 55m 07.6s Umbral dur : 01m 58.1s

Centerline dist : 1.444km 0.8nm Bearing : 46.4°T Depth : 98.84% CL duration : (01m 58.1s)

**C2 -04:09.2**

Event	Countdown	Date	Local Time	Alt	Az	P	Z/V	Mag	A	Extn	LC
Sunrise	T-0d 12h 39m 03.2s	01/08/2008	06:24:34.5	-0.3	63.2						
1st Contact	T-0d 00h 54m 30.2s	01/08/2008	18:09:07.4	30.9	266.8	299	249	0.000	1.038	1.4	
2nd Contact	T-0d 00h 04m 09.2s	01/08/2008	19:07:46.9	20.3	276.8	118	69	1.000	1.035	1.7	-0.8s
Max. Eclipse	T-0d 00h 05m 09.5s	01/08/2008	19:08:47.1	20.1	276.9	28	338	1.017	1.035	1.7	
3rd Contact	T-0d 00h 06m 07.3s	01/08/2008	19:09:44.9	19.9	277.1	297	248	1.000	1.035	1.7	-1.3s
4th Contact	T-0d 01h 00m 37.4s	01/08/2008	20:04:15.0	10.3	286.0	117	70	0.000	1.032	2.7	
Sunset	T-0d 02h 06m 02.6s	01/08/2008	21:09:40.2	-0.3	297.0						

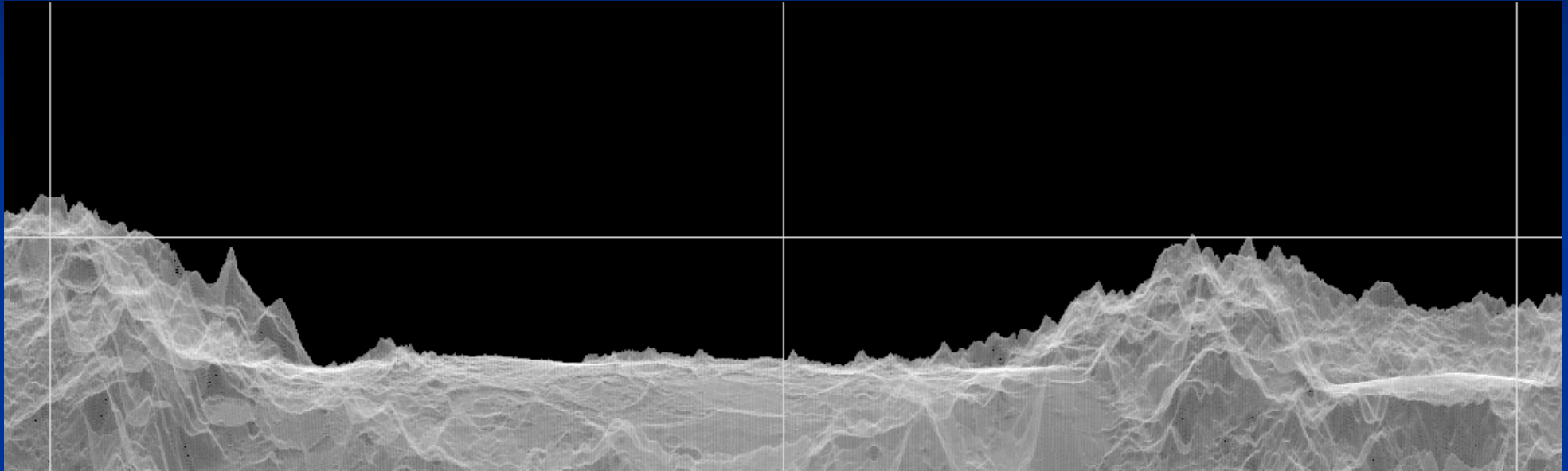
Current Type: Partial Velocity: 1.225km/s 21.0 276.1 0.927 1.035 1.7 R-L-H+

Countdown	Dy Hr:Mn:Sec	Camera	Actn	ExpTime	FRatio	ISO	MLU	Q	Quality	In	Comment
01:10:58.23.8	D300		PICT	1/8000	f/7.1	200	N	13.0	RAW	N	Partial (Mag. 84.0%)
01:10:58.58.9	D300		PICT	1/8000	f/7.1	200	N	13.0	RAW	N	Partial (Mag. 85.0%)
01:10:59.34.1	D300		PICT	1/8000	f/7.1	200	N	13.0	RAW	N	Partial (Mag. 86.0%)
01:11:00.09.3	D300		PICT	1/8000	f/7.1	200	N	13.0	RAW	N	Partial (Mag. 87.0%)
01:11:00.44.5	D300		PICT	1/8000	f/7.1	200	N	13.0	RAW	N	Partial (Mag. 88.0%)
01:11:01.19.7	D300		PICT	1/8000	f/7.1	200	N	13.0	RAW	N	Partial (Mag. 89.0%)
01:11:01.54.9	D300		PICT	1/8000	f/7.1	200	N	13.0	RAW	N	Partial (Mag. 90.0%)
01:11:02.30.1	D300		PICT	1/8000	f/7.1	200	N	13.0	RAW	N	Partial (Mag. 91.0%)
01:11:03.05.3	D300		PICT	1/8000	f/7.1	200	N	13.0	RAW	N	Partial (Mag. 92.0%)
-00:02.9	01 11:03:40.5	D300	PICT	1/8000	f/7.1	200	N	13.0	RAW	N	Partial (Mag. 93.0%)
-00:38.1	01 11:04:15.7	D300	PICT	1/8000	f/7.1	200	N	13.0	RAW	N	Partial (Mag. 94.0%)
-01:13.3	01 11:04:50.9	D300	PICT	1/8000	f/7.1	200	N	13.0	RAW	N	Partial (Mag. 95.0%)
-01:48.5	01 11:05:26.1	D300	PICT	1/8000	f/7.1	200	N	13.0	RAW	N	Partial (Mag. 96.0%)
-02:23.7	01 11:06:01.3	D300	PICT	1/8000	f/7.1	200	N	13.0	RAW	N	Partial (Mag. 97.0%)
-02:58.9	01 11:06:36.5	D300	PICT	1/8000	f/7.1	200	N	13.0	RAW	N	Partial (Mag. 98.0%)
-03:34.0	01 11:07:11.7	D300	PICT	1/8000	f/7.1	200	N	13.0	RAW	N	Partial (Mag. 99.0%)
-03:39.2	01 11:07:16.9	Filters_Off.wav	PLAY								FILTERS OFF!!!!
-03:42.2	01 11:07:19.9	D300	PICT	1/8000	f/7.1	200	N	13.0	RAW	N	99%+ beads no filter
-03:45.2	01 11:07:22.9	D300	PICT	1/6400	f/7.1	200	N	12.7	RAW	N	99%+ beads no filter

272 actions

Solar Eclipse Maestro main window – Xavier Jubier

# Lunar Limb Profile

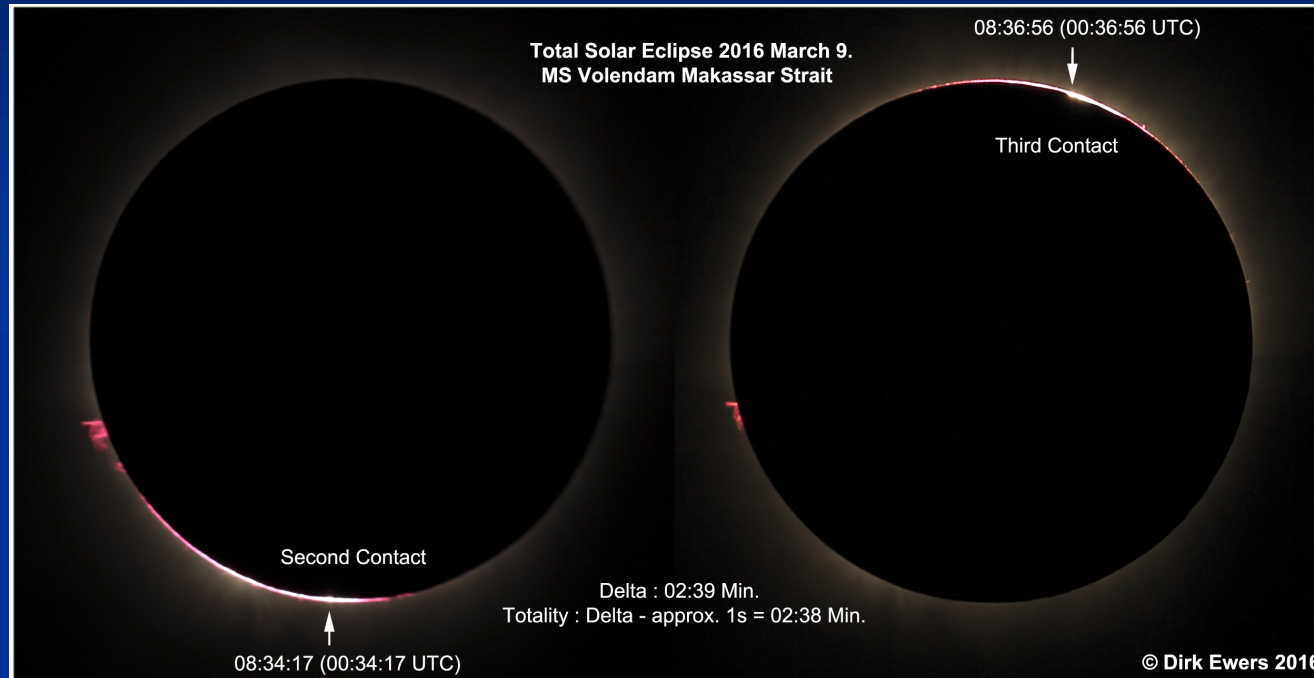


Sample of the lunar limb profile reconstructed with the latest data (September 2014) from the Kaguya and LRO probes

- Details of less than 100 meters can be distinguished.
- Solar eclipse contact times can be computed to about a tenth of a second
  - A 0.1 second difference equals to approximately an error of 50 meters (0.03")



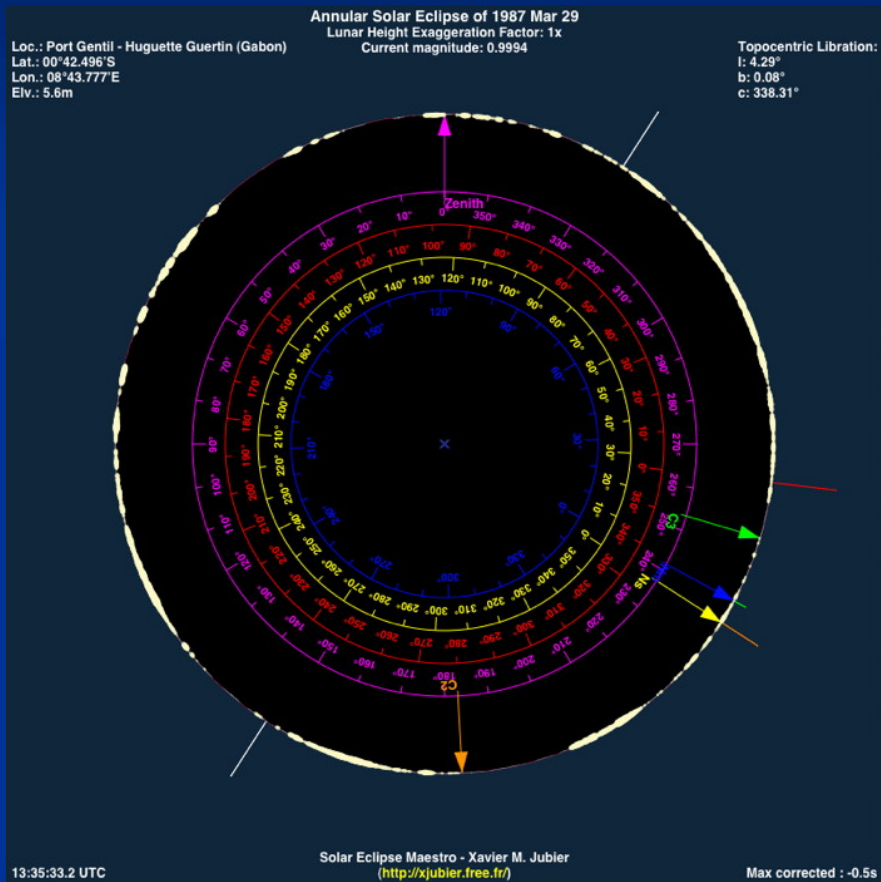
# Total Solar Eclipse 2016



From those two pictures it is clear that the duration of totality is shorter than 2 minutes and 39 seconds as you can still see small Baily's beads around 2<sup>nd</sup> and 3<sup>rd</sup> contacts, which means using a standard photospheric solar radius of 959.63" at 1au is incorrect as eclipse predictions taking into account the true lunar limb profile would result in a duration of about 2 minutes and 40 seconds.

So this shows that the photospheric solar radius is necessarily bigger than the standard value. The observed true duration was about 2 minutes and 38 seconds, and this is compatible with a photospheric solar radius of about 959.98" at 1au.

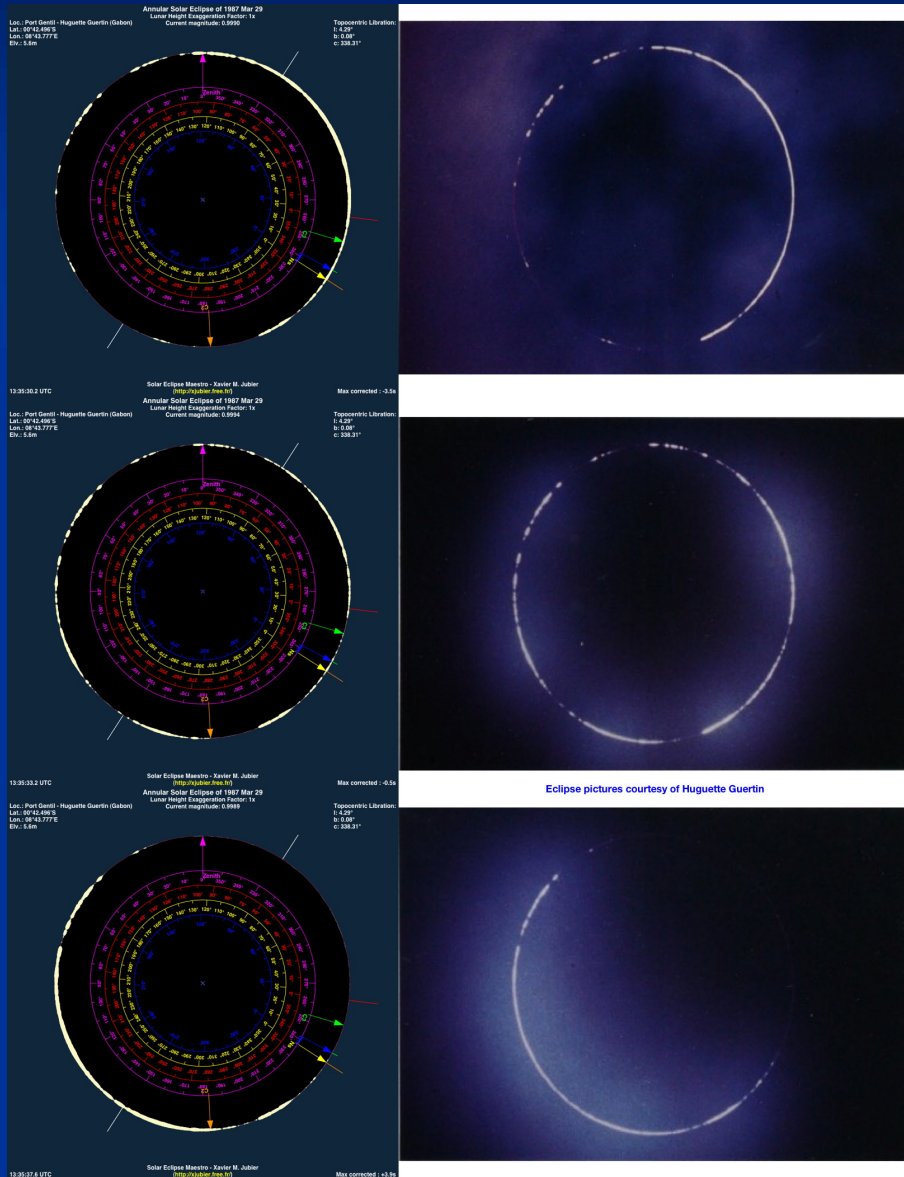
# Hybrid Solar Eclipse 1987



Using hybrid solar eclipses to measure our Sun with greater accuracy is the best way because there are Baily's beads all around our Moon, which means matching Baily's beads simulations with actual pictures is easier.

Broken annular taken without solar filter through thin clouds.

# Hybrid Solar Eclipse 1987



Broken annular taken without solar filter through thin clouds.

Again with the standard photospheric solar radius of 959.63" at 1au it is impossible to get a positive match between the actual pictures and the Baily's beads simulations. However a true radius of about 959.98" at 1au does match in terms of position, shape, brightness and timing.

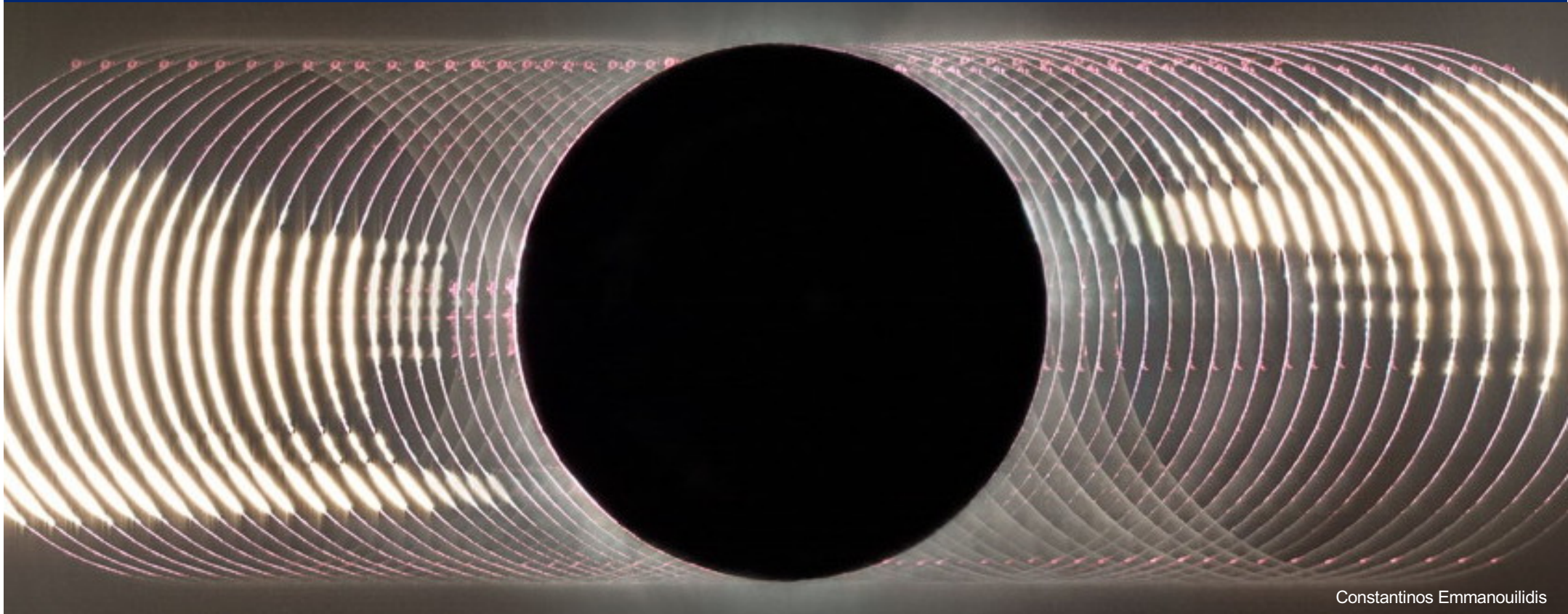
Question: why not using a solar filter?

Well simply because a filter would introduce a bias in the measurements made as the filter removes some important and crucial data.

Also if there are any clouds how can you be certain that they didn't hide something because the filter is hiding the clouds as well.

Those pictures provide even more information to the trained eye, we will come to this later.

# Hybrid Solar Eclipse 2013

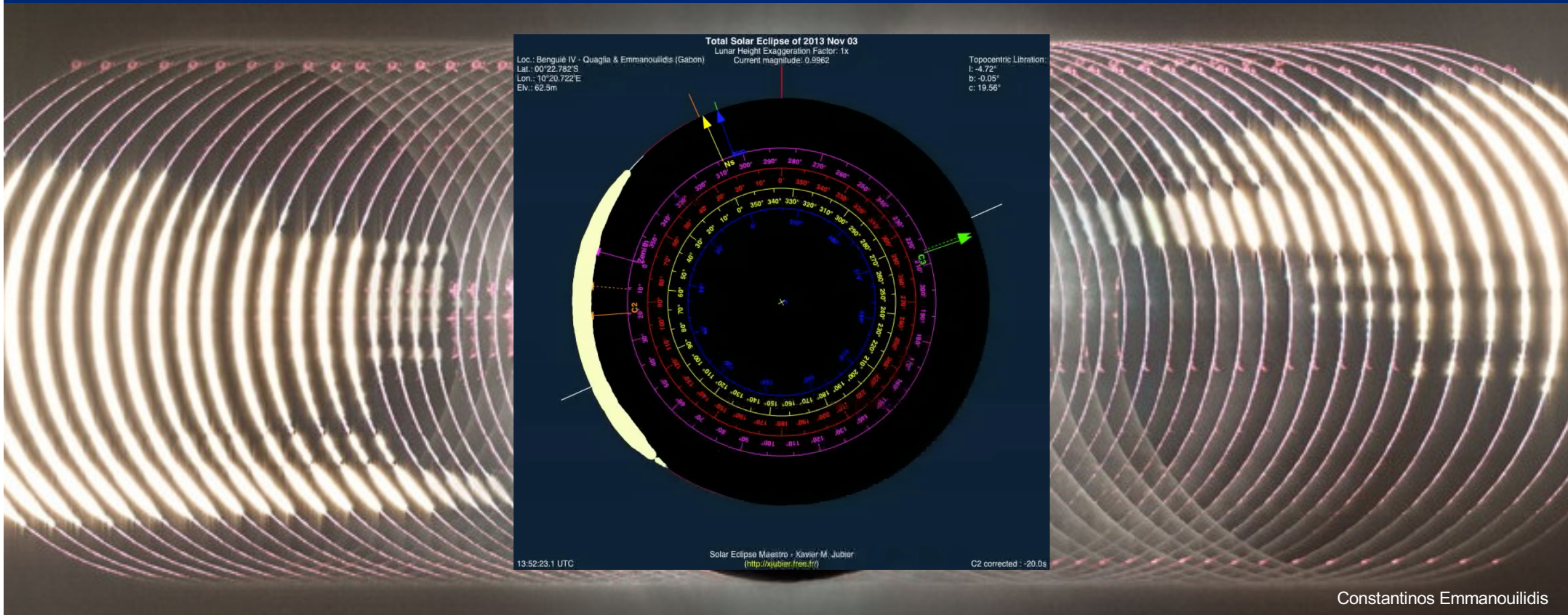


Constantinos Emmanouilidis

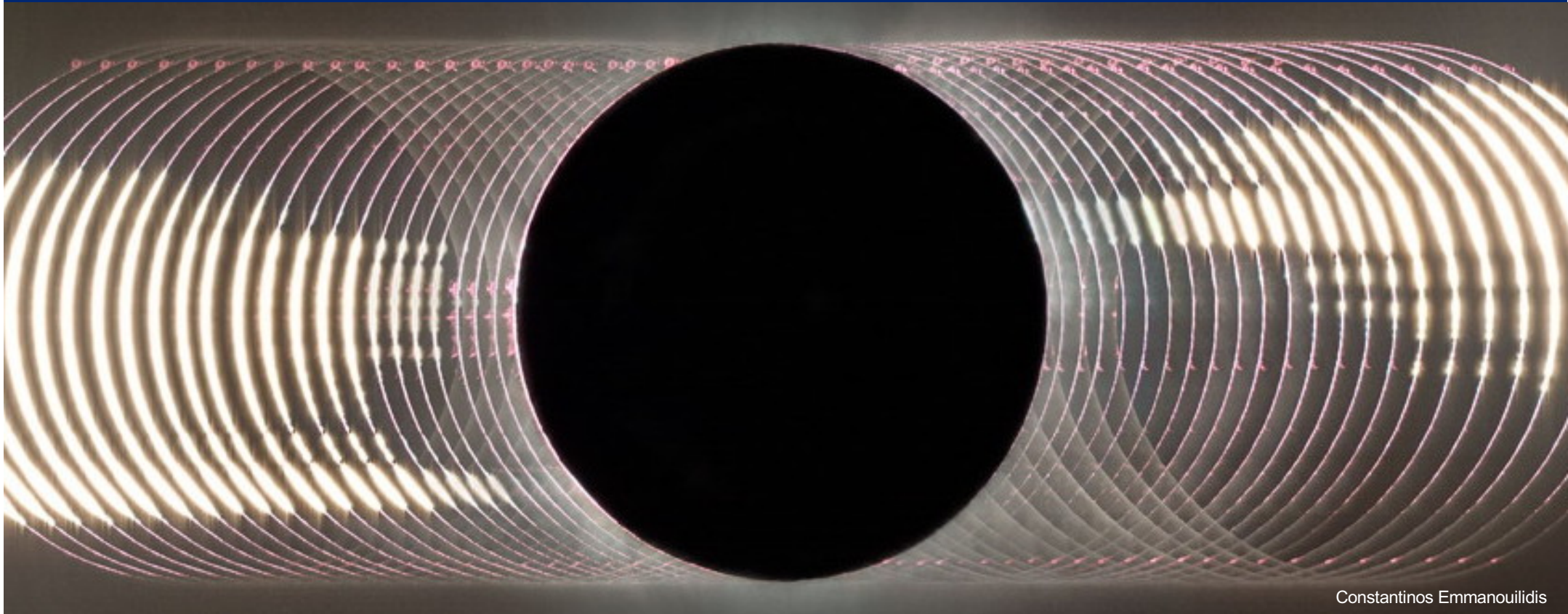
Another key hybrid solar eclipse that provides most of the answers. Again it is impossible to match the actual pictures and the Baily's beads simulations using the standard photospheric solar radius.

And we still need to adjust the solar radius to about  $959.98''$  at 1au to have a positive match in terms of position, shape, brightness and timing.

# Hybrid Solar Eclipse 2013



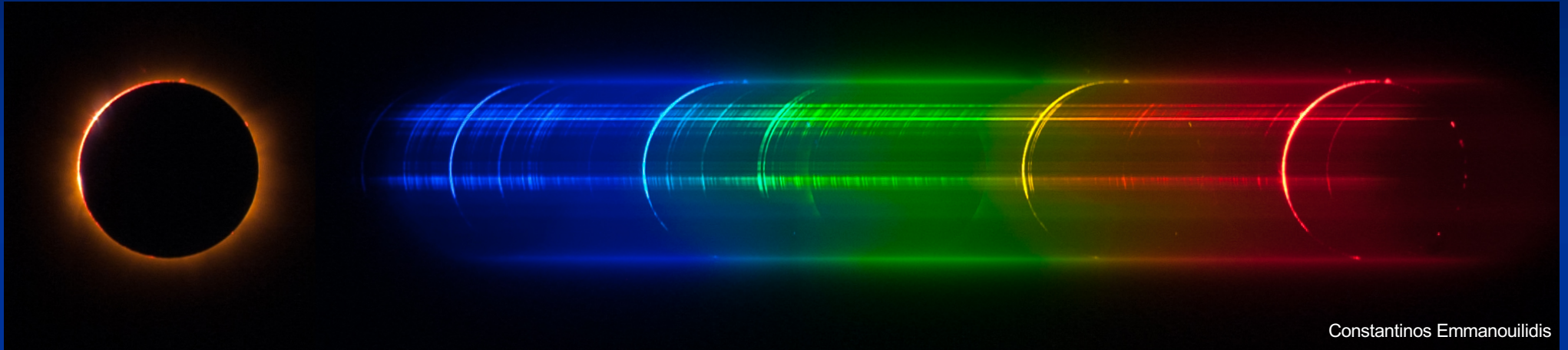
# Hybrid Solar Eclipse 2013



What is also interesting there is that we have hints of the mesosphere, a transition layer between the photosphere, that we're trying to measure, and the pinkish chromosphere above it.

Question: Never heard of the mesosphere? Well now you do! And you'll also learn about the Low First Ionization Potential, aka Low FIP, soon enough...

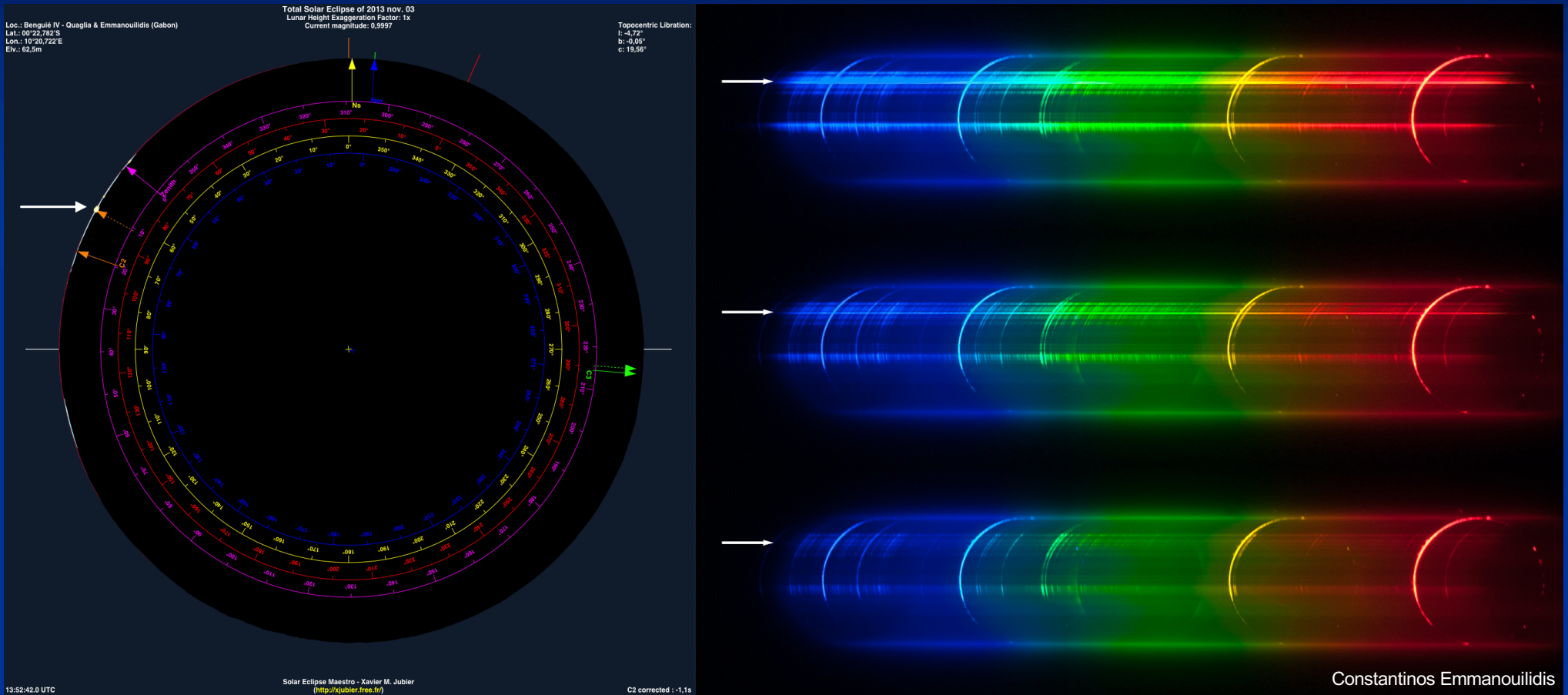
# Hybrid Solar Eclipse 2013



And now we're bringing in spectroscopy to disentangle what we're seeing. On the left a photograph taken shortly before 2<sup>nd</sup> contact and on the right its flash spectrum. The reddish tint of the picture on the left is due to the fact that the DSLR used is unfiltered, i.e. the IR filter has been removed.

What you can see is that where you have Baily's beads you find a continuum on the flash spectrum. Yet there is much more, next to the continuum you have hints of the mesosphere where all those discrete emission lines appear, you know those Low First Ionization Potential we were talking about earlier. And remember I also mentioned this bluish glow, well it is in fact the mesosphere, the transition layer between the photosphere and the chromosphere. So here we now have an accurate way of measuring the photospheric solar radius provided we have a match with the Baily's beads simulations.

# Hybrid Solar Eclipse 2013

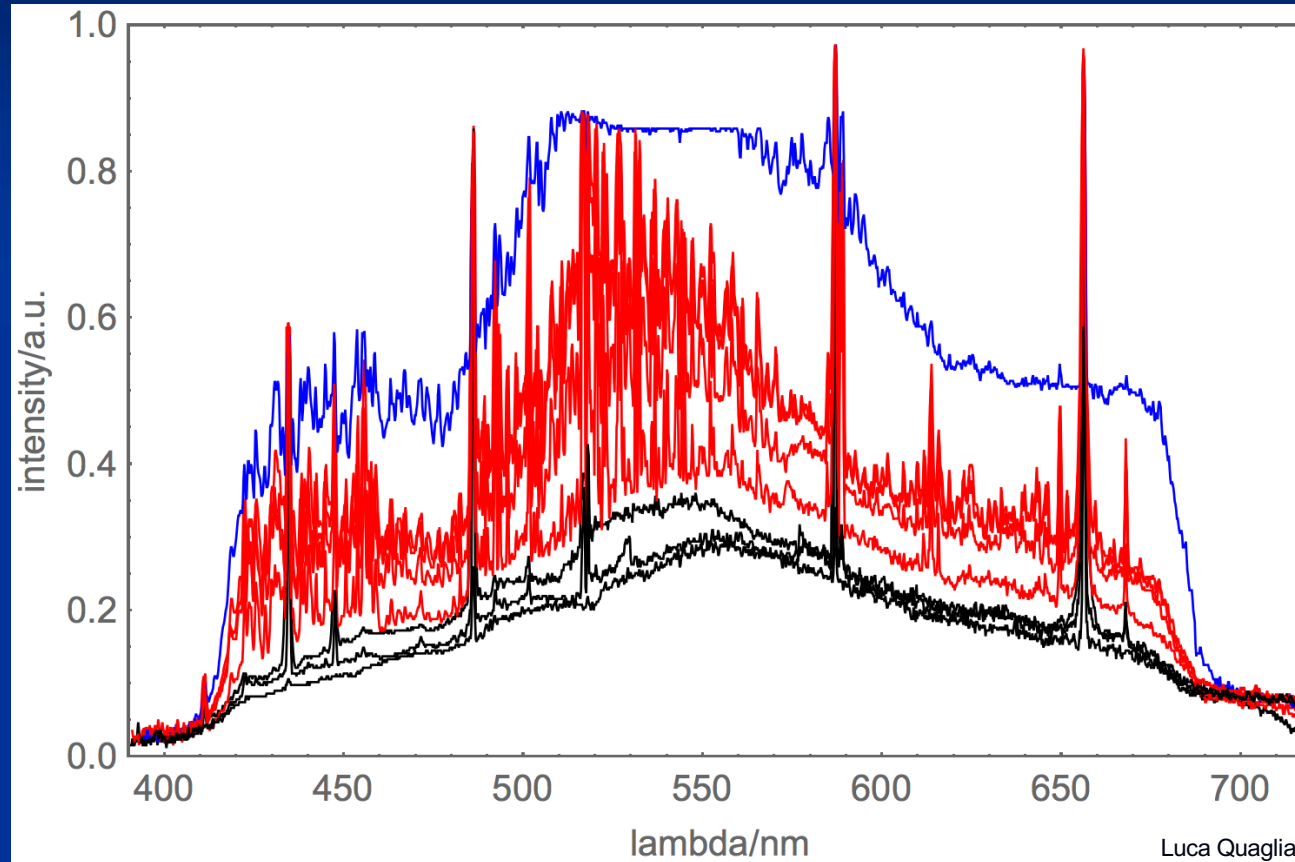


So now with the Baily's beads simulation we can indeed see the bluish mesosphere exactly where it appears on the flash spectrum, but again we can have the proper match only with an increased photospheric solar radius of about 959.98" at 1au.

Bingo, we nailed it!! Lets now see how we can confirm this on an annular solar eclipse.



# Hybrid Solar Eclipse 2013

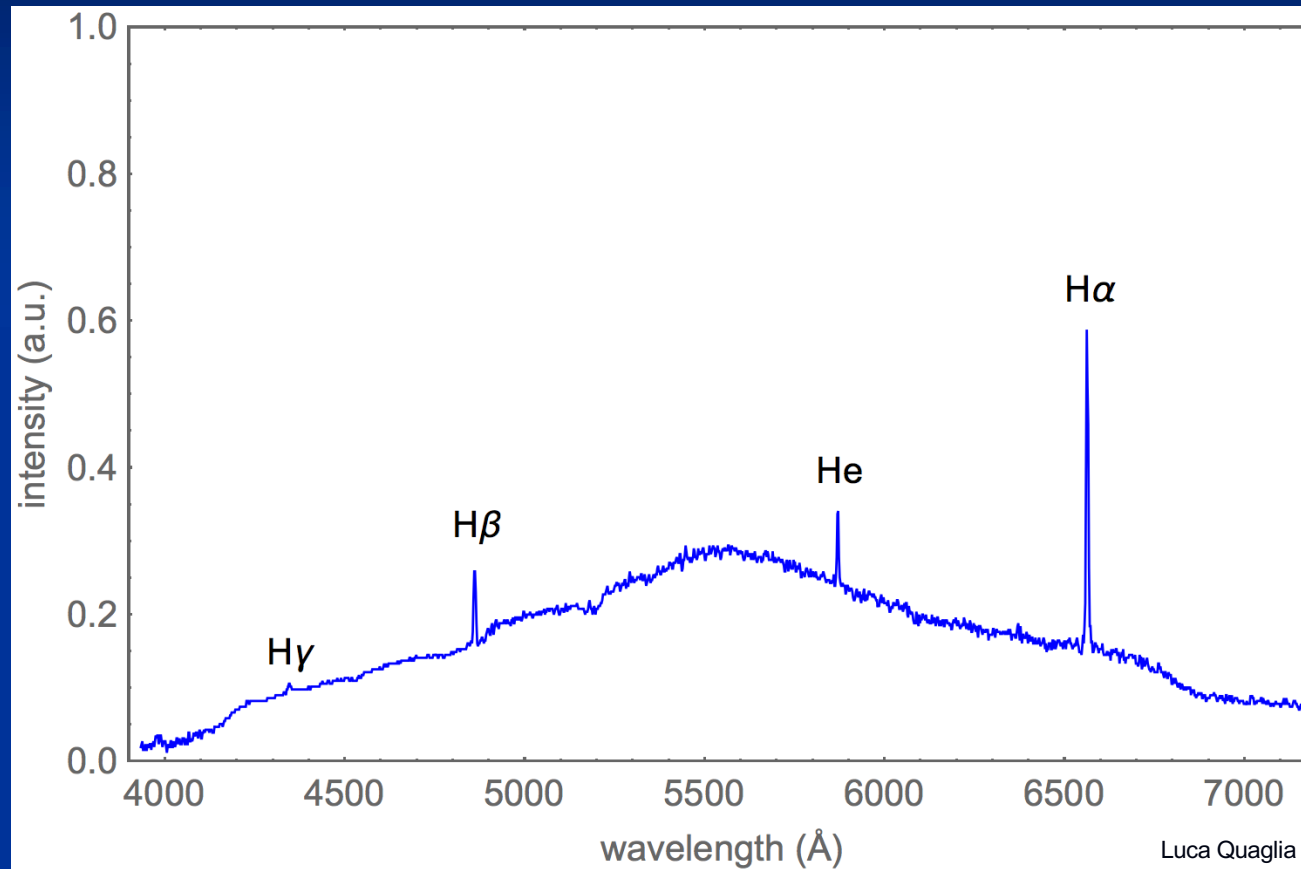


Blue = photosphere

Red = mesosphere (Low First Ionization Potential emission lines from 460nm to 480nm)

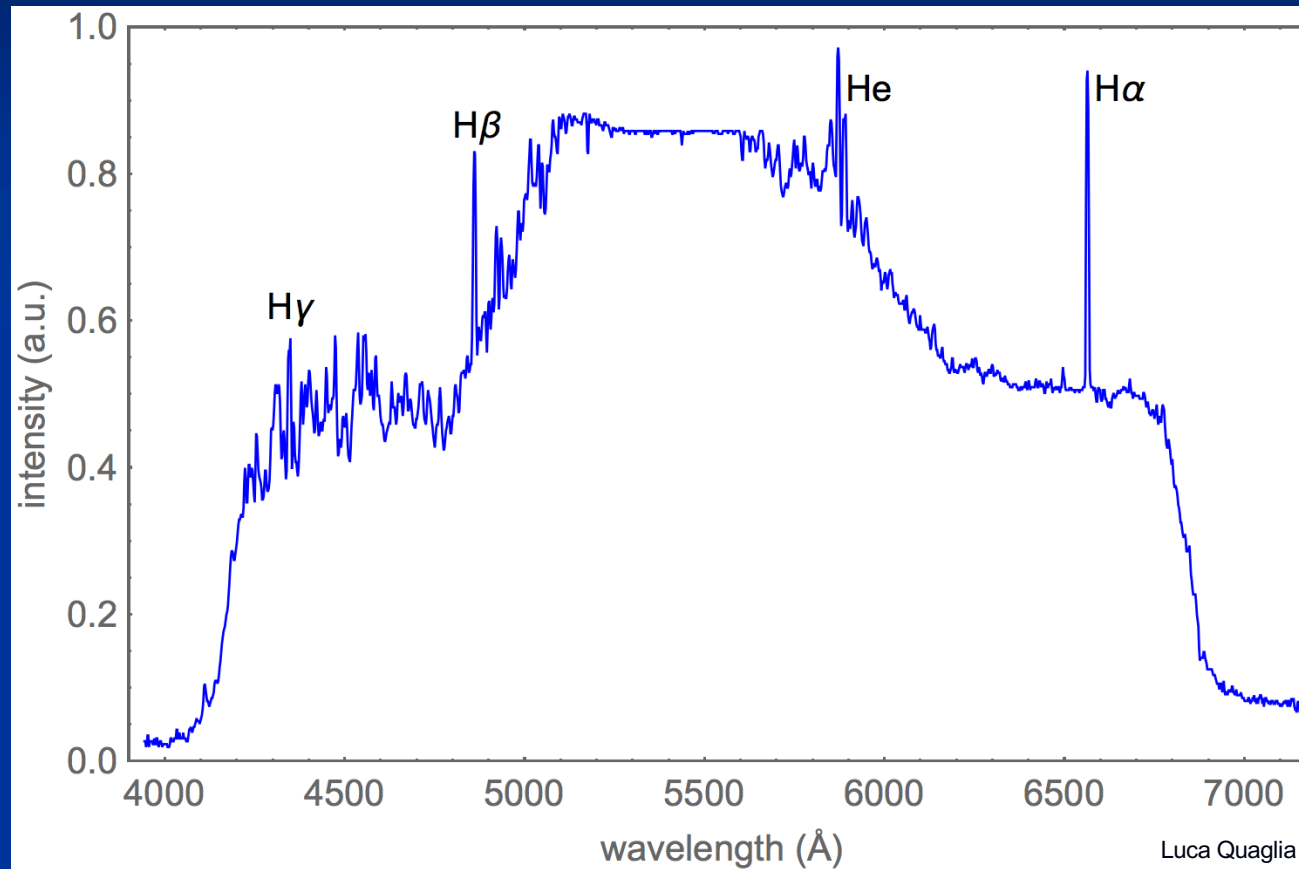
Black = chromosphere

# Hybrid Solar Eclipse 2013



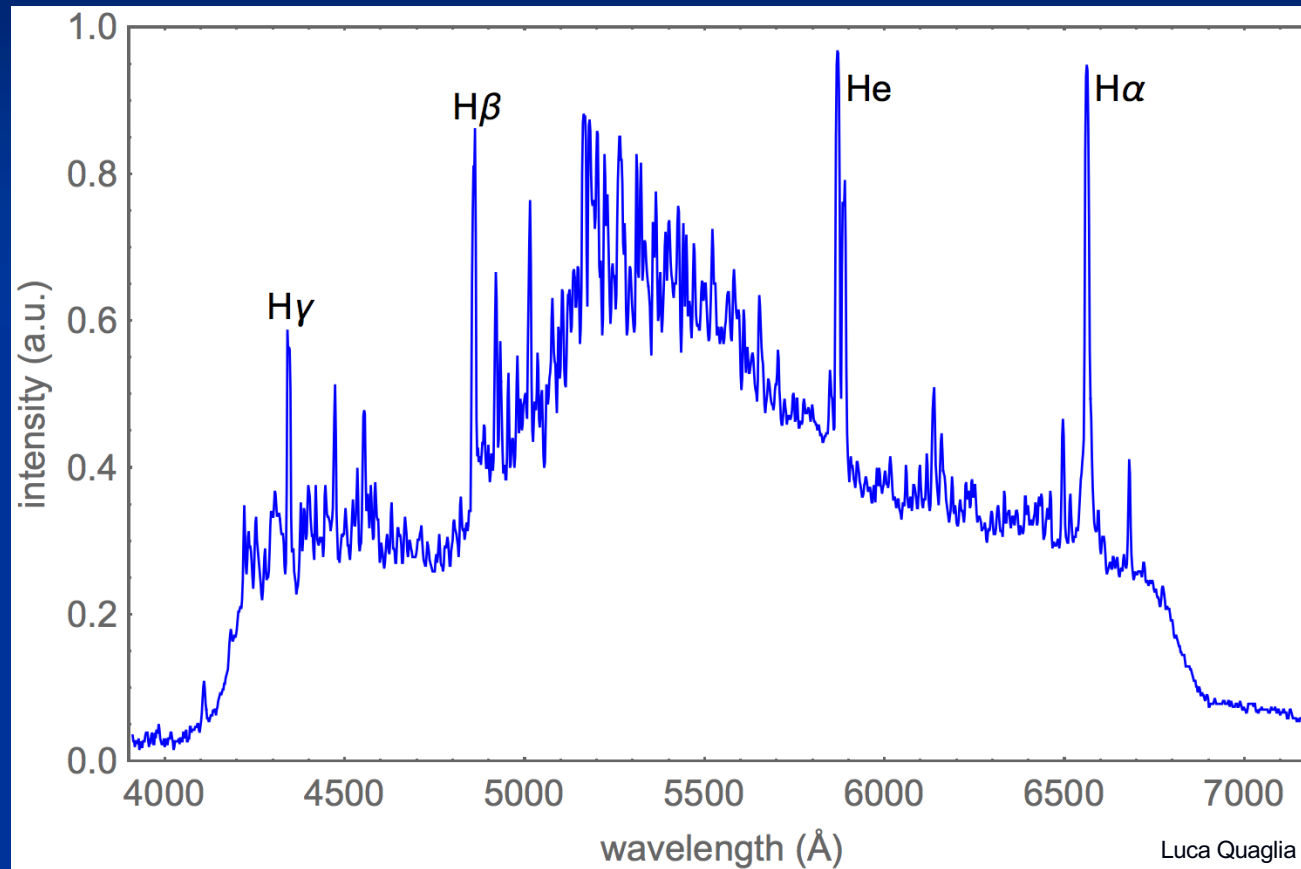
Chromosphere with its H-alpha emission line

# Hybrid Solar Eclipse 2013



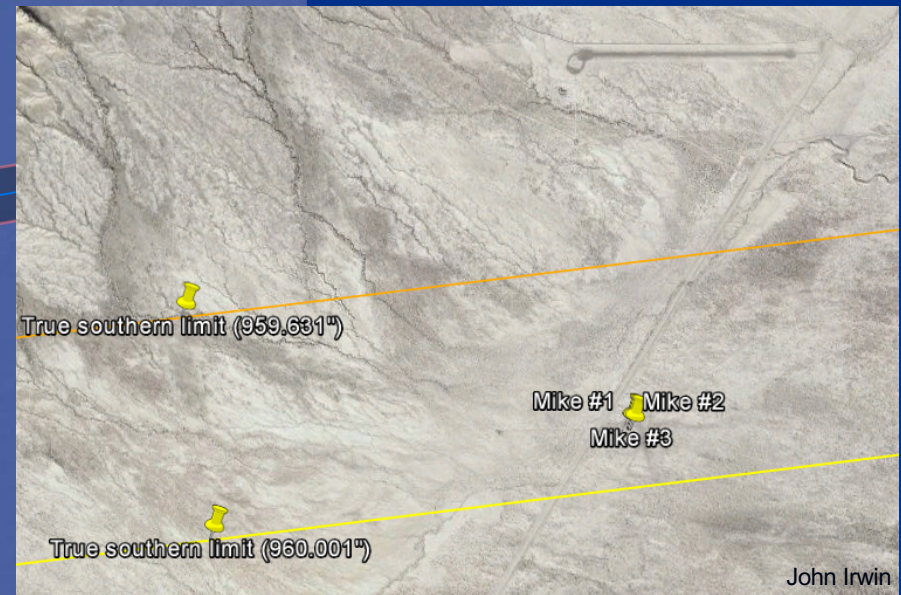
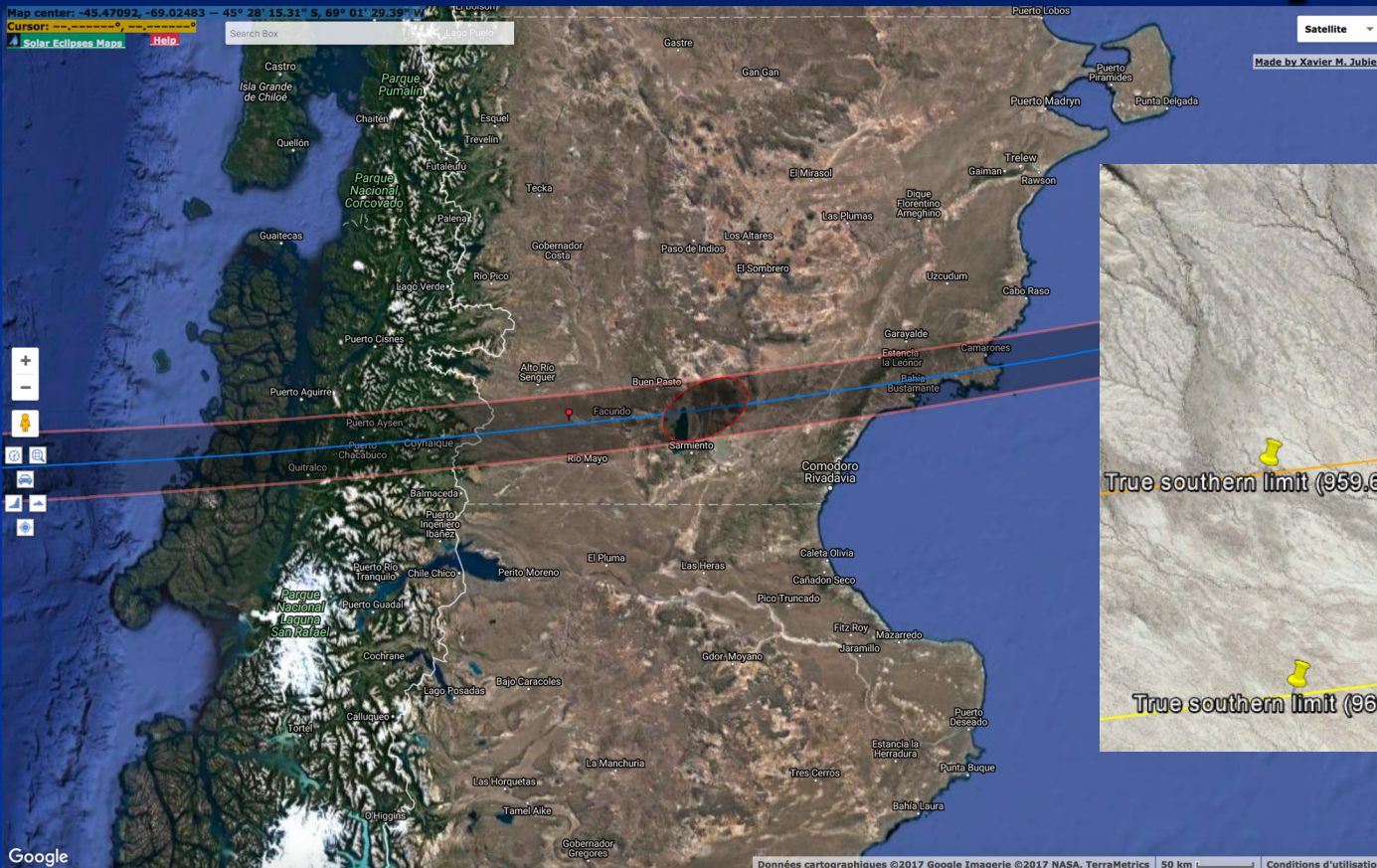
Photosphere at the main Baily's beads

# Hybrid Solar Eclipse 2013



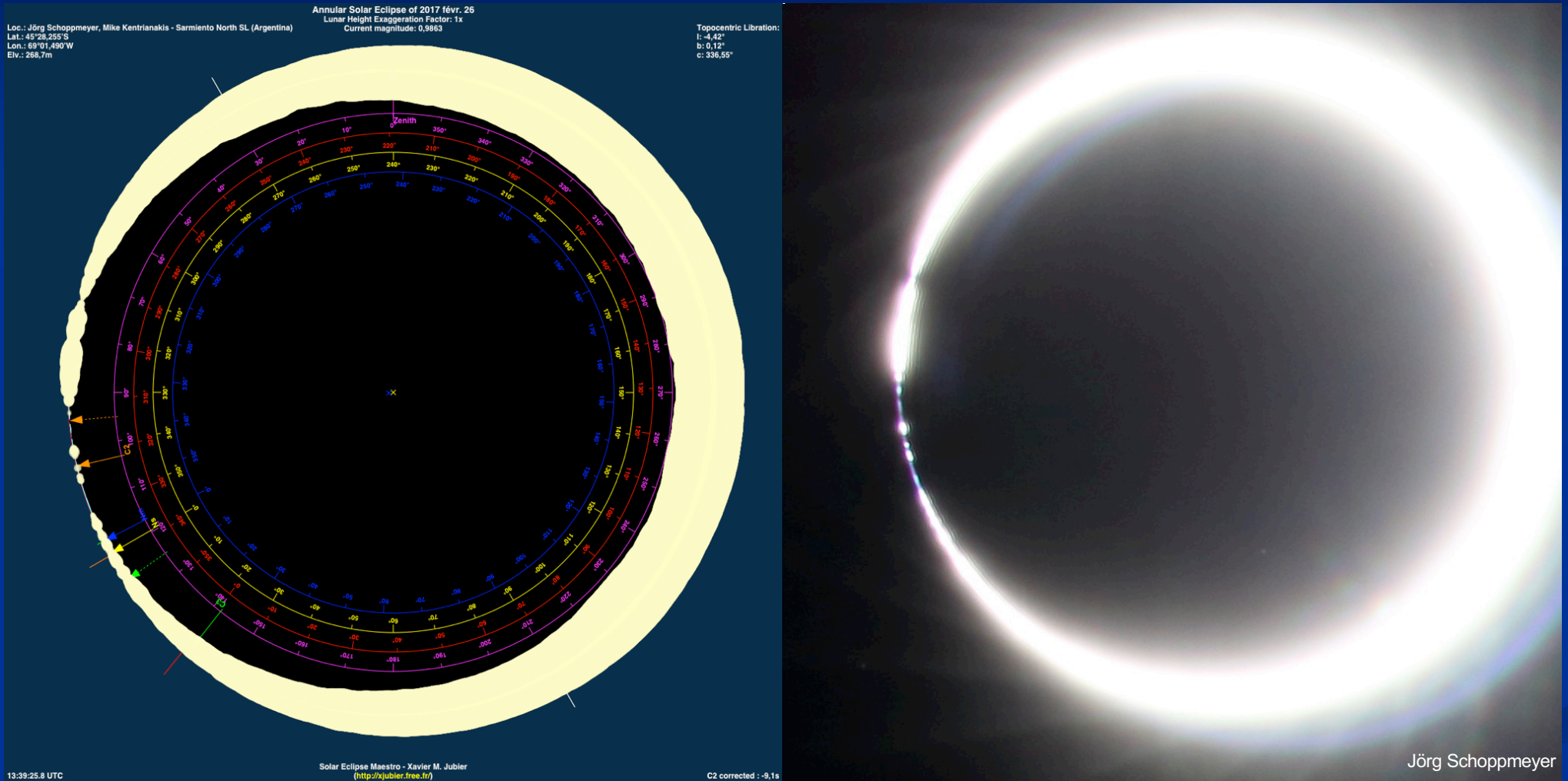
Mesosphere and its Low First Ionization Potential emission lines (4600Å to 4800Å) intermixed with some photosphere or pseudo-continuum

# Annular Solar Eclipse 2017



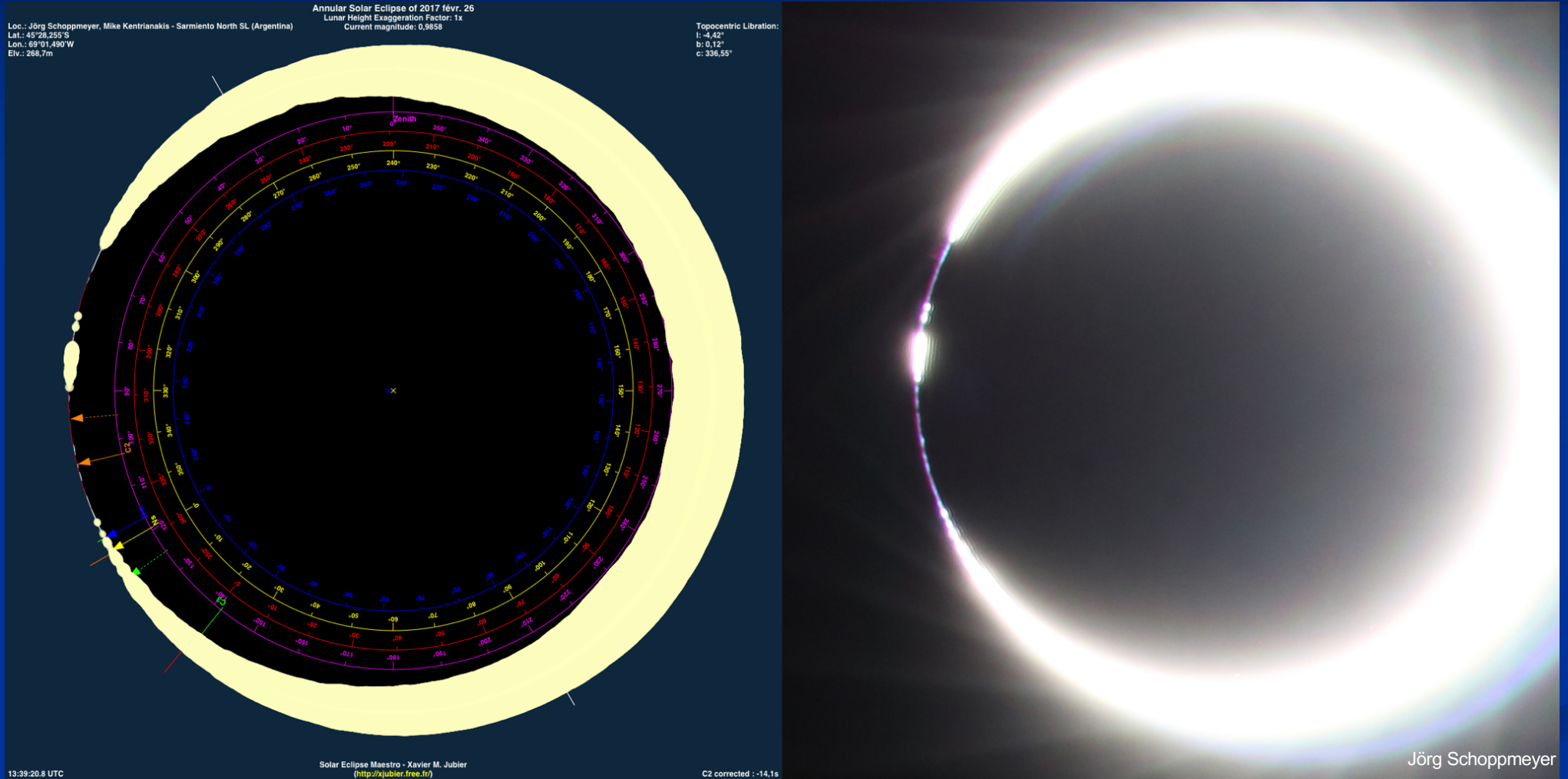
Lets now see how we can confirm this on an annular solar eclipse.  
To achieve this tour de force we're going to place ourselves willingly just barely outside the central eclipse path, yet inside the true eclipse path with our adjusted photospheric solar radius, and we'll take pictures at 2<sup>nd</sup> and 3<sup>rd</sup> contacts without any solar filter (never do this if you don't know exactly what you're doing).

# Annular Solar Eclipse 2017



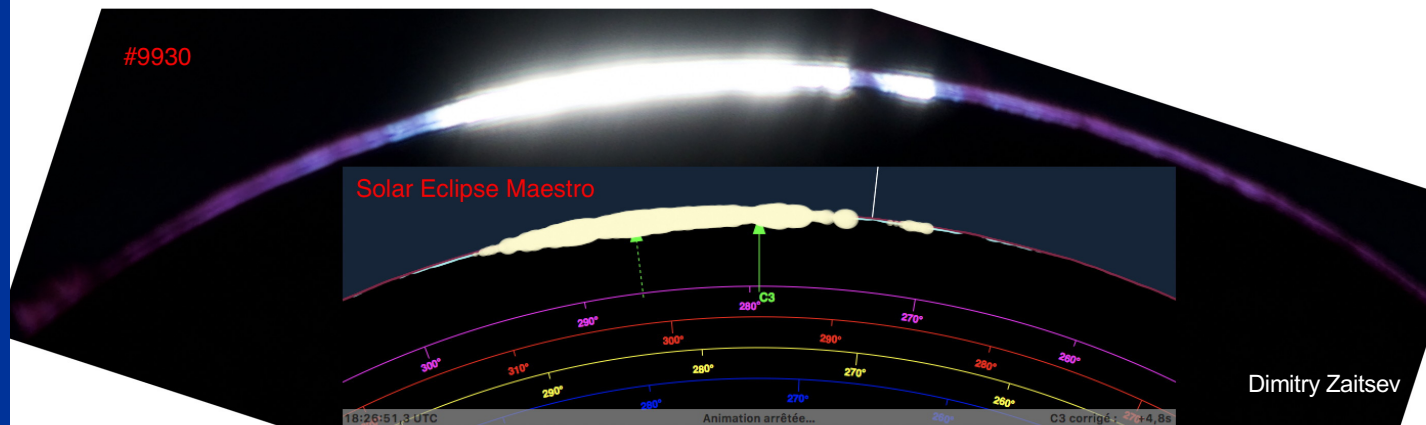
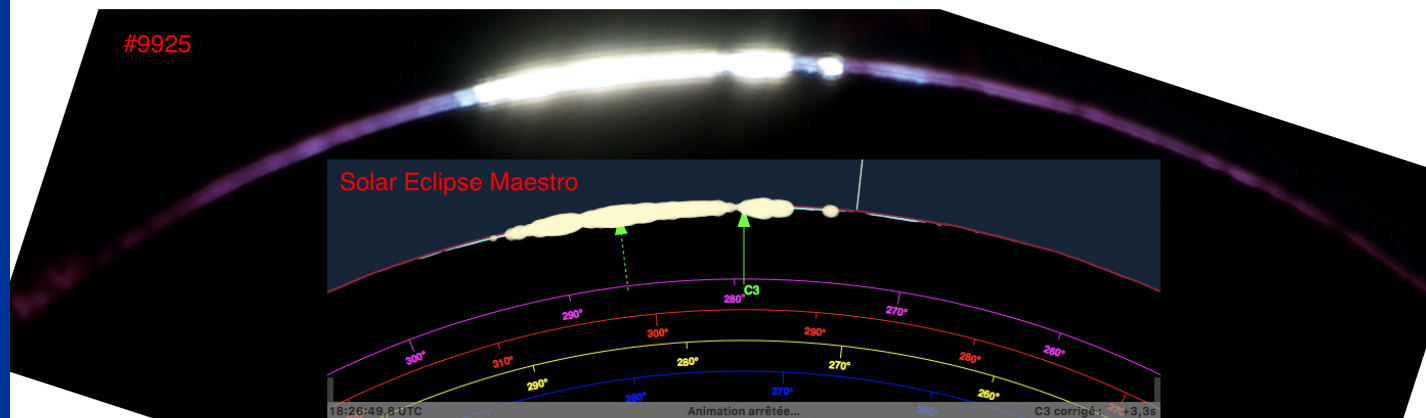
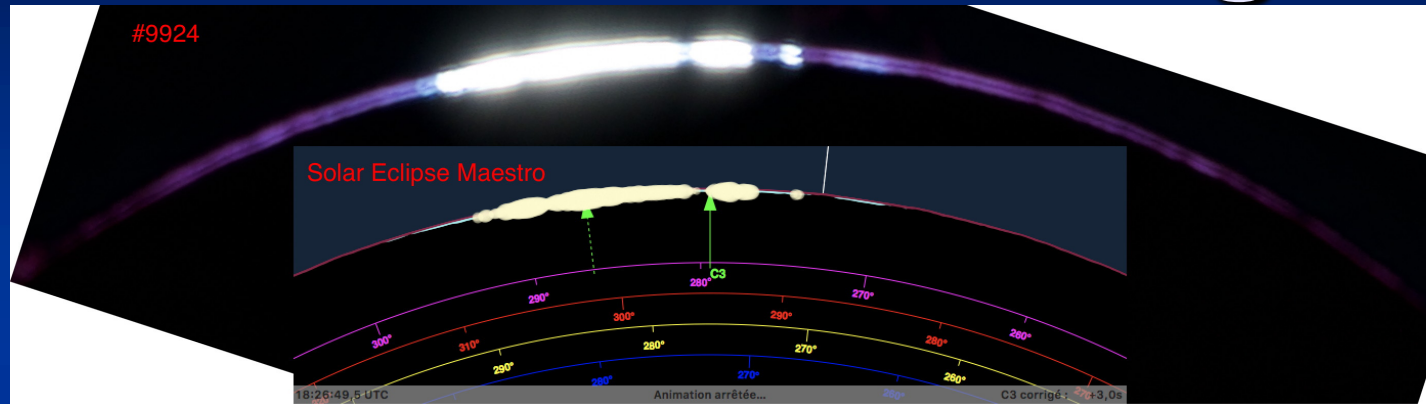
Hehe we again have a match using an increased photospheric solar radius, an impossible feat using the standard radius. You can even see the chromosphere and hints of the mesosphere.

# Annular Solar Eclipse 2017



Still not convinced? Well then you'd better look again.

# TSE 2017 White Light



Dimity Zaitsev



# Q & A