PRELIMINARY RESULTS FROM A CORONAL OSCILLATIONS INSTRUMENT DURING THE 2017 TOTAL ECLIPSE

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Two possible heating mechanisms are considered as candidates for the primary heating mechanism in the solar corona:

DC heating mechanism based on numerous tiny local reconnections (it is on nanoflares) *Parker 1988*

AC heating mechanism based on local dissipations of the MHD or Alfven waves spreading along the magnetic structures of various topology in the solar corona *Hollweg 1982; Parker 1994; Klimchuk 2006*

Required energy flux to heat the quiet corona is roughly equal to 3×10^2 [J·m^{-2}·s^{-1}]:

Significant energy flux can be carried by short-period (≤ 1 s) MHD waves *Porter et al. 1994*

Small scale X-ray and UV phenomena appear to be not powerful enough (factor ~3) *Aschwanden 2004*

Direct observations of the Alfven waves in the solar corona:

Alfven waves detected in data collected with *Coronal Multi-Channel Polarimeter* (CoMP) *Tomczyk et al. 2007/9*

Alfven waves detected in data collected with *Hinode*/SOT *De Pontieu et al. 2007*

Search for the local periodic brightness variations in the solar corona:

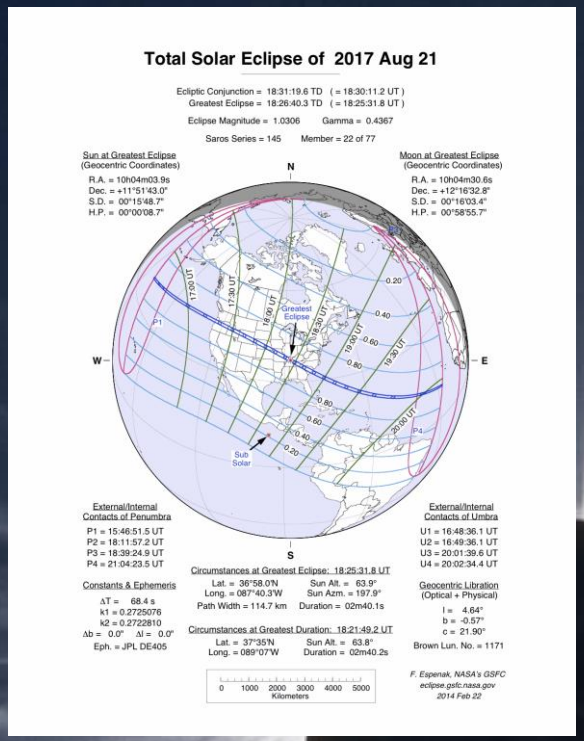
Weak (<1%) periodic oscillations in FeXIV brightness during the 1980 eclipse *Pasachoff and Ladd 1987*

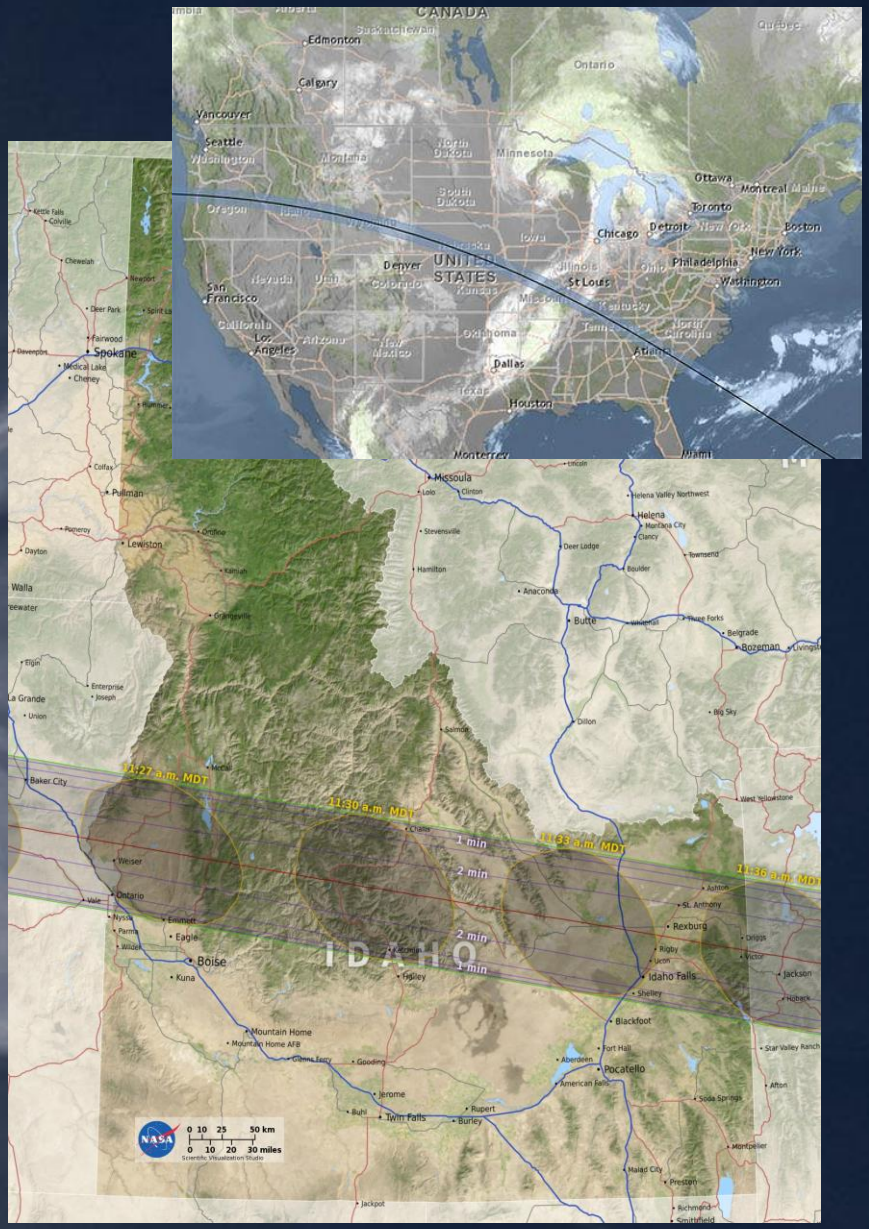
Oscillations with periods between 20 and 27 sec during the 2009 eclipse *Singh et al. 2009*

No significant oscillations detected during the 1999 eclipse *Rudawy et al. 2004*

No significant oscillations detected during the 2001 eclipse *Rudawy et al. 2010*

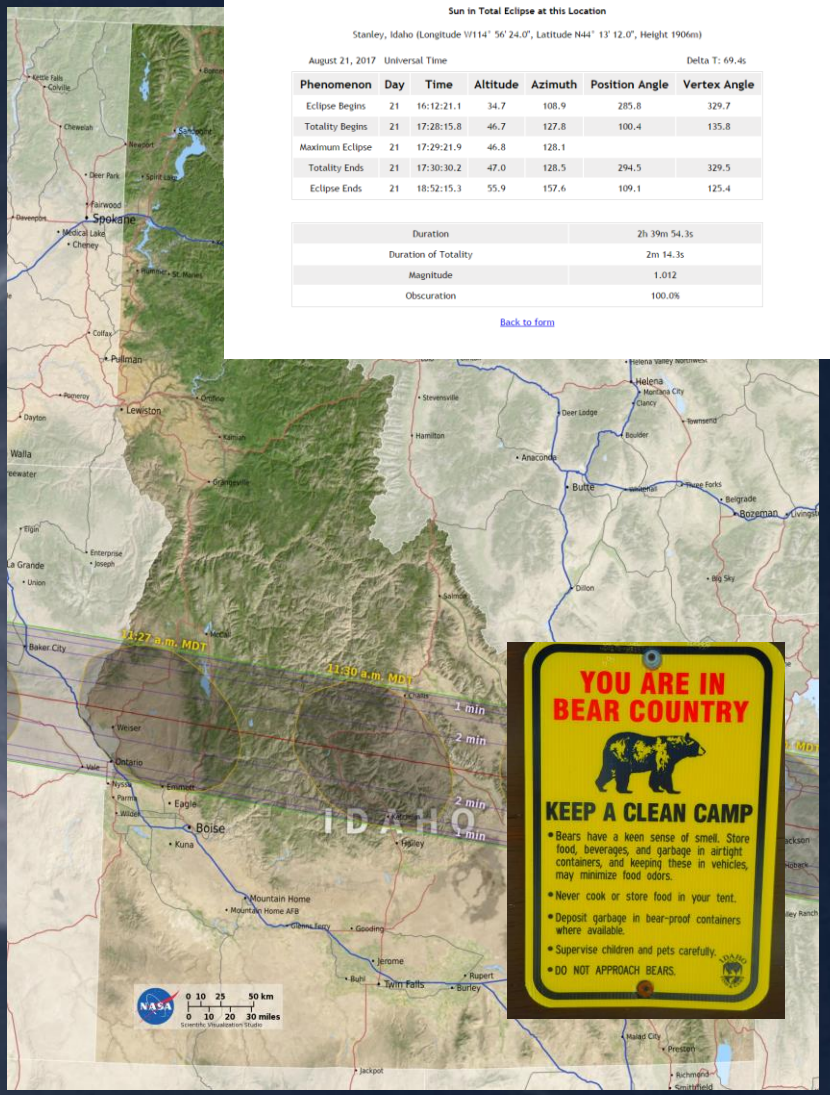
1 000 000 K





OBSERVING SITE

The instruments were installed in the Park Creek Ranch, about 10 km to the north of Stanley city, Idaho.
W114°56'24" N44°13'12", 1906 m above see level.



Solar Eclipse Computer

U.S. Naval Observatory
Astronomical Applications Department

Solar Eclipse of 2017 Aug. 21

Sun in Total Eclipse at this Location

Stanley, Idaho (Longitude W114° 56' 24.0", Latitude N44° 13' 12.0", Height 1906m)

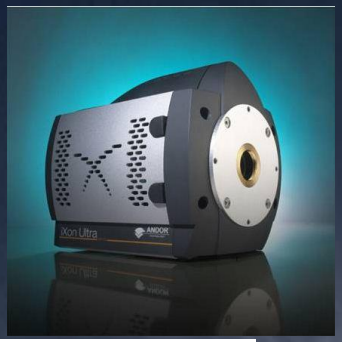
August 21, 2017 Universal Time — Delta T: 69.4s

Phenomenon	Day	Time	Altitude	Azimuth	Position Angle	Vertex Angle
Eclipse Begins	21	16:12:21.1	34.7	108.9	285.8	329.7
Totality Begins	21	17:28:15.8	46.7	127.8	100.4	135.8
Maximum Eclipse	21	17:29:21.9	46.8	128.1		
Totality Ends	21	17:30:30.2	47.0	128.5	294.5	329.5
Eclipse Ends	21	18:52:15.3	55.9	157.6	109.1	125.4

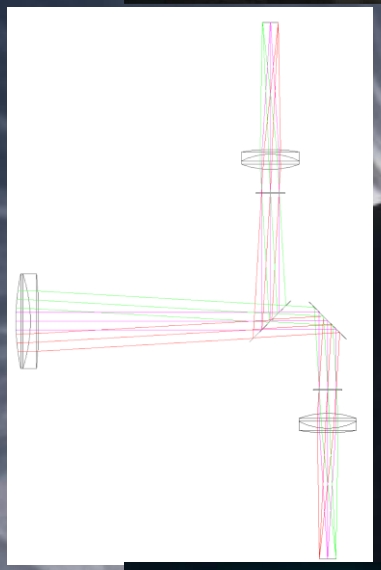
Duration	2h 39m 54.3s
Duration of Totality	2m 14.3s
Magnitude	1.012
Obscuration	100.0%

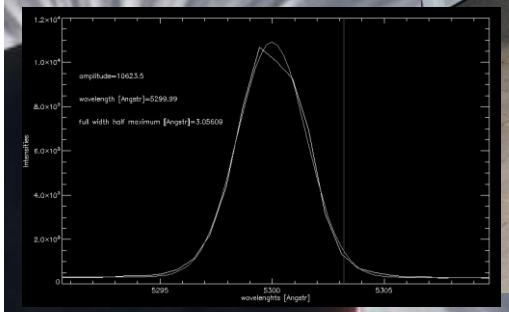
Back to form

No local obstacles in front of the instruments (despite a presence of a few medium and remote trees and bushes). The remote horizon was outlined by Rocky Mountains.



Andor iXon3 885
1004x1002

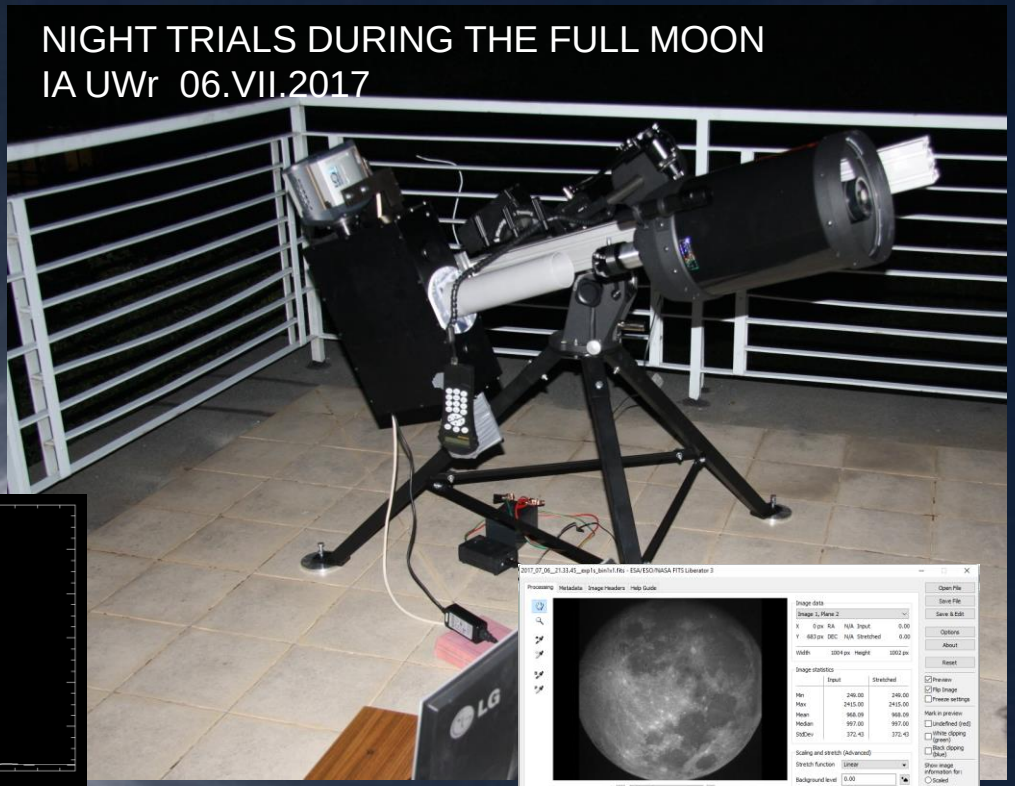




FeXIV 530 nm/0.6 nm

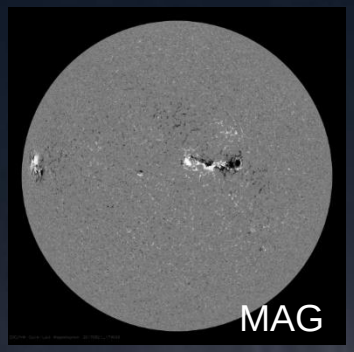
Andor Zyla 5.5
2560x2160

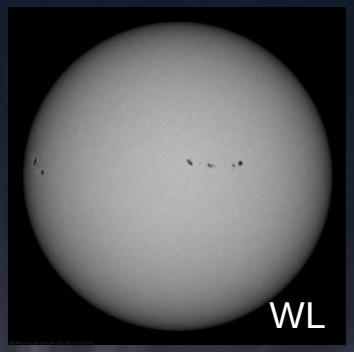
NIGHT TRIALS DURING THE FULL MOON
IA UWr 06.VII.2017

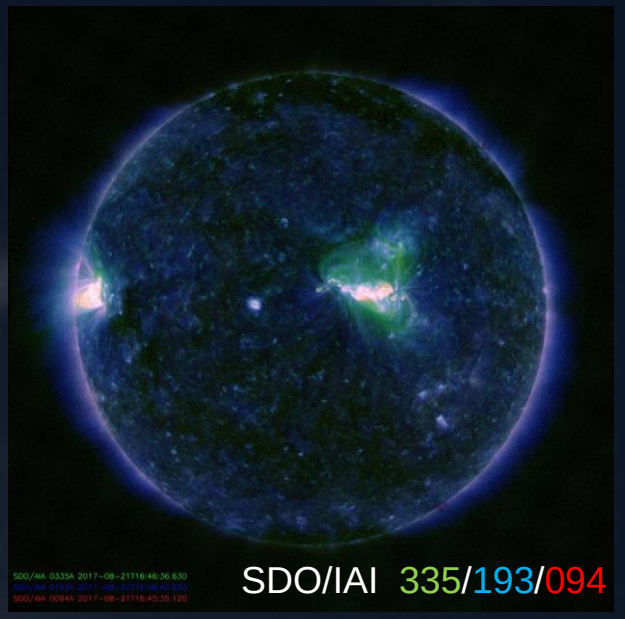


THE INSTRUMENT

- 200 mm f/10 Celestron C8S XLT refracting telescope
- modified SECIS optical box
- Andor iXon3 885 CCD 16-bit 1004x1002
  FeXIV channel; effective spatial resolutions 1.55 arcsec (1140 km)
- Andor Zyla 5.5 sCMOS 16-bit 2560×2160
  WL channel; effective spatial resolutions 1.27 arcsec (927 km)
- SkyWatcher EQ-8 drive on top of a massive tripod





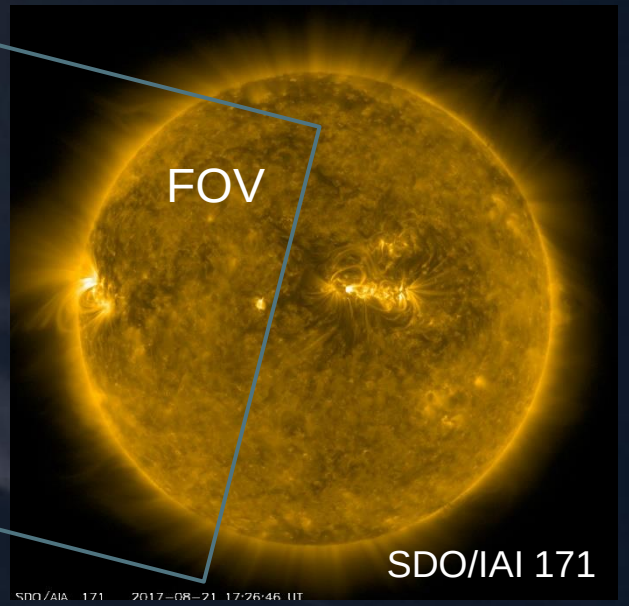


SELECTION OF THE OBSERVED REGION OF THE SOLAR LIMB:

Solar magnetic activity before and during the eclipse was low.
Two active regions were seen during the eclipse day on the solar disk:
NOAA 12671 AR of βγ type near the central part of the solar disk
NOAA 12672 AR of β type near the east limb at N05E61.

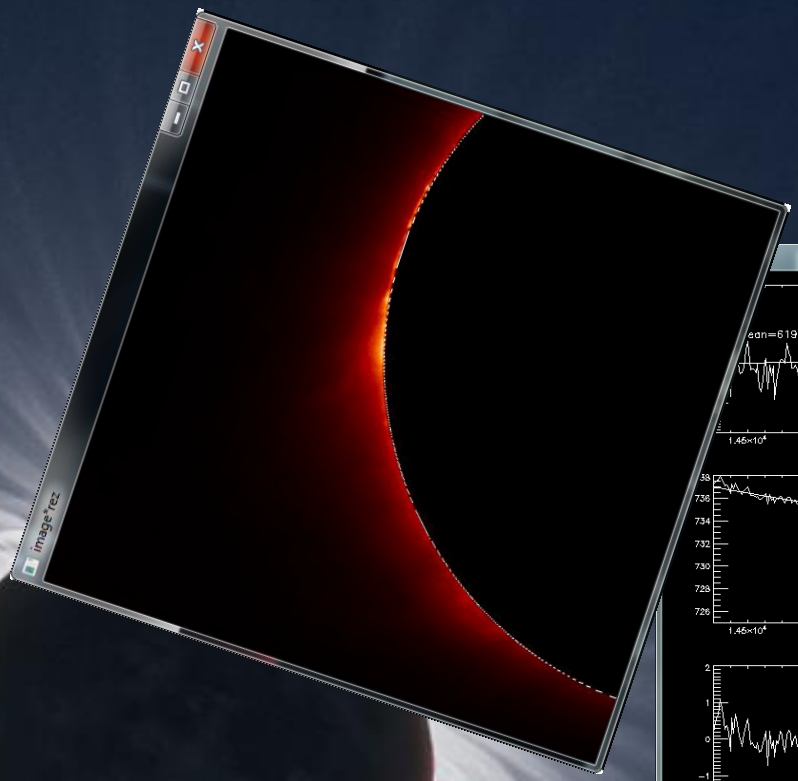
Bright coronal structures of various geometry above the east and southeast parts of the solar limb.

The selected FOV included a bright system of loops emerging from the active region AR12672. Near the active region a coronal emission in the green-line was recognizable out to a radial distance of about 150,000 km above the solar limb.



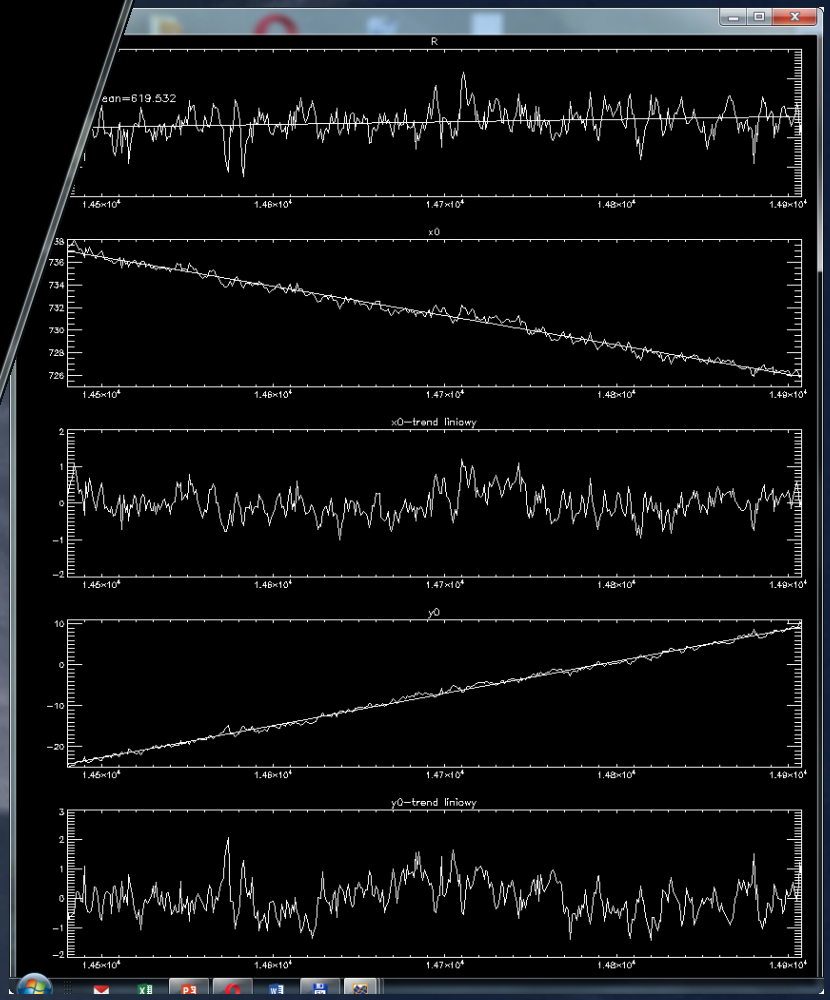
OBSERVING CONDITIONS:

The elevation of the Sun during the totality was 46°48', with azimuth 128°06' (at 17:29 UT or 11:29 LT)
Before the eclipse the weather was perfect.
During the totality the sky to the north-west of the observing site was partially covered with scattered clouds.
Very transparent layer of a rather homogenous fog was marginally perceptible above the observing site toward the Sun.



FeXIV 530.3 nm

Mpfitellipse (C.B. Markwardt, NASA/GSFC



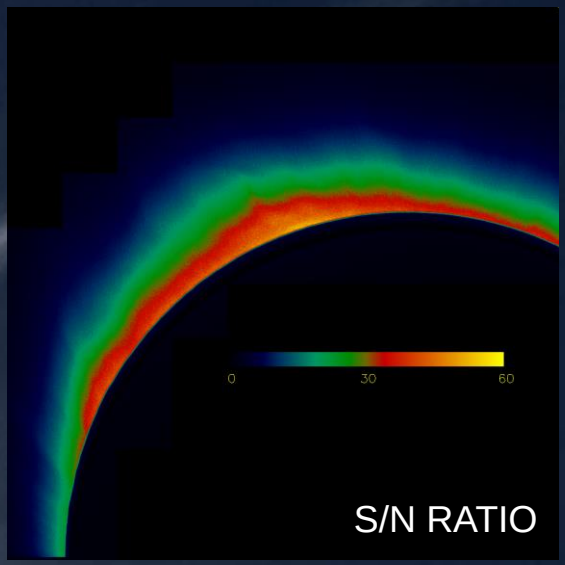
FOV STABILITY AND IMAGE COALIGNMENT

the pointing of the telescope was not perfectly stable against the solar corona
- slow drift caused by errors in an adjustment of the drive axes - sub-pixel quasi-stochastic variances of the pointing in both axes

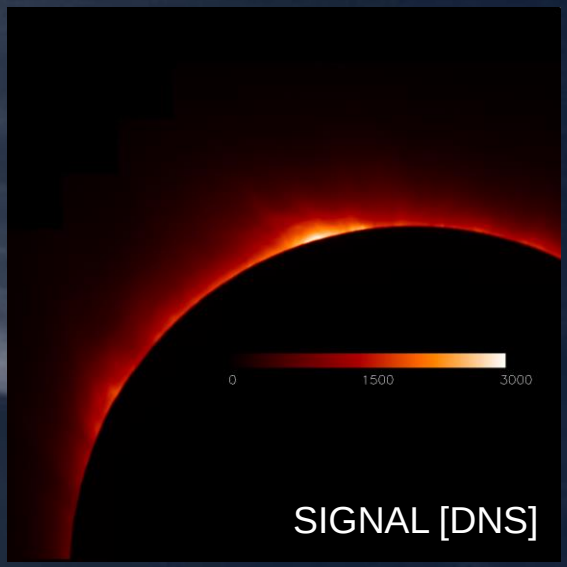
2D correlations of the bright coronal structures

PROCESSED DATA
429 images in 122.2 sec, 3.5 image/sec
21 August 2017

IMAGES #14480-#14908



S/N RATIO



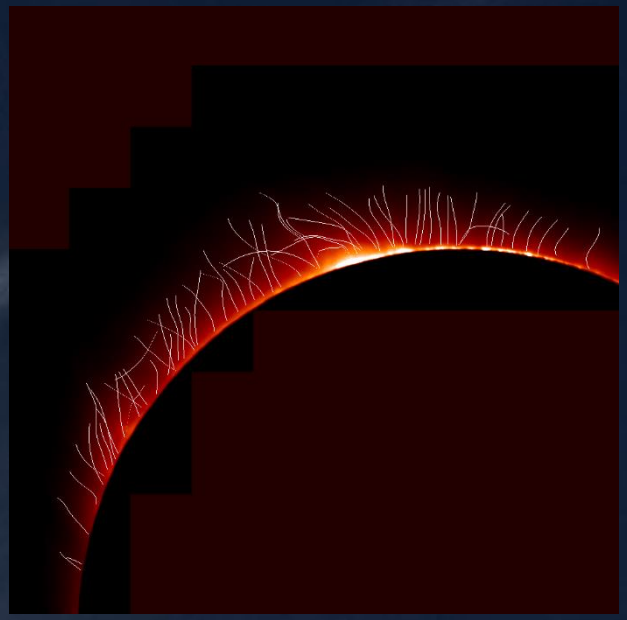
SIGNAL [DNS]

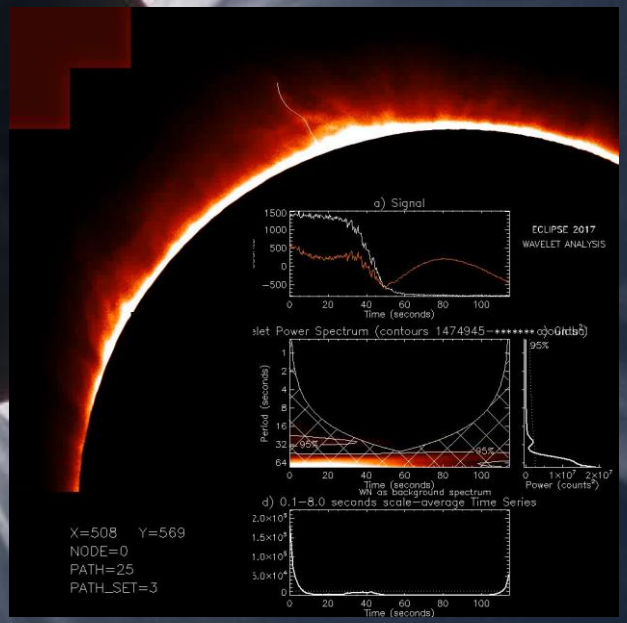
WAVELET ANALYSIS

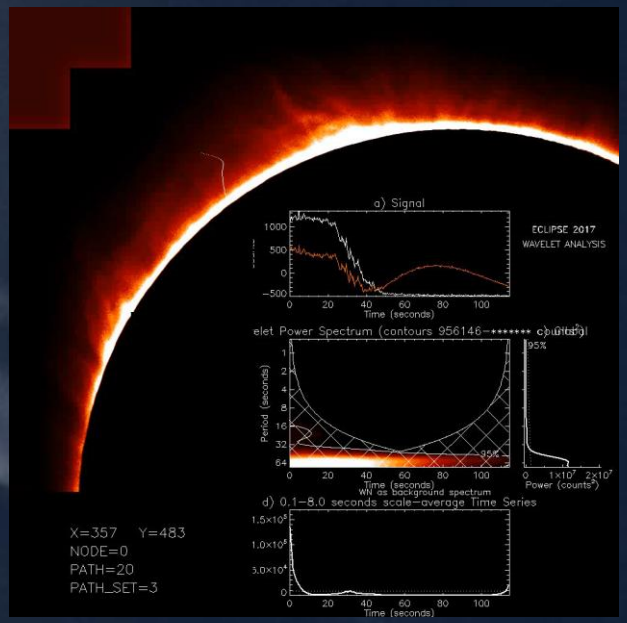
The short-period variations of the coronal emission in the green coronal line were searched in the bright coronal structures and within the whole field-of-view of the instrument.

- frequency range 1.6-0.0025 Hz
- assumed significance level 95%

Numerous short-lasting detections in upper parts of the visible structures or plain corona, where the signals were low and relatively noisy. In our opinion all these detections are spurious.





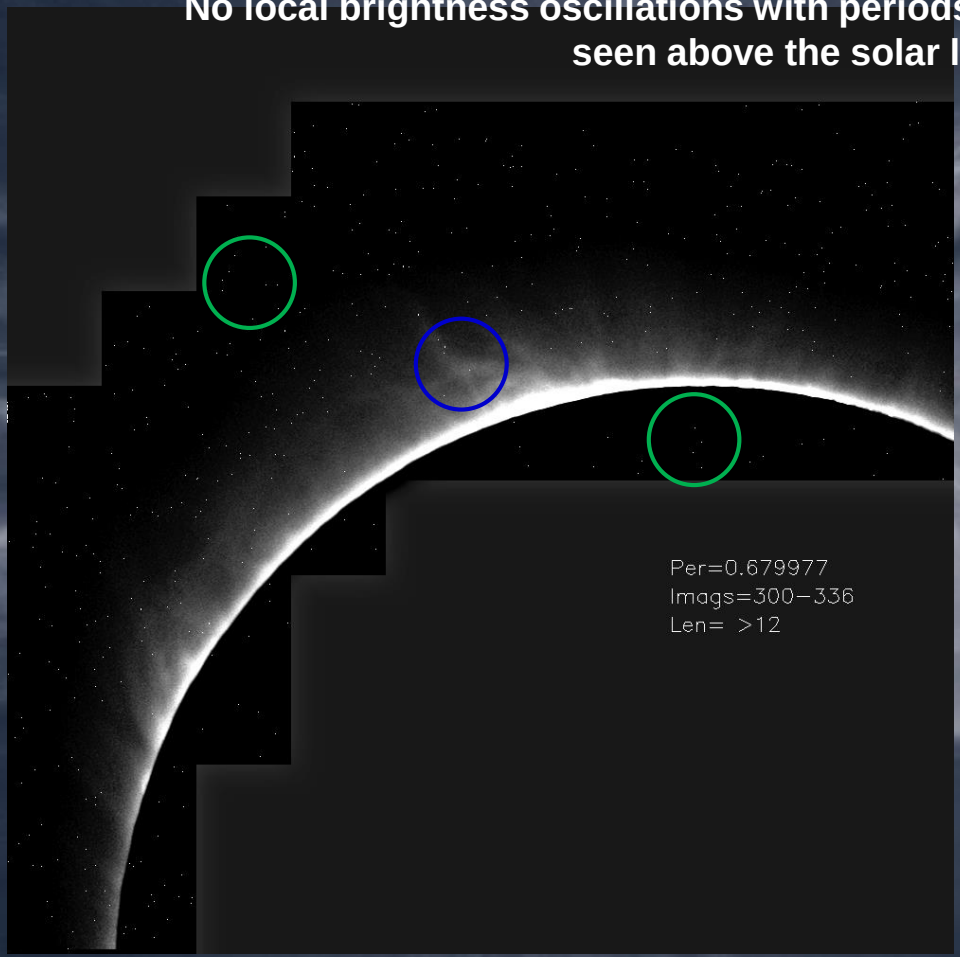


Wavelet analysis for all points inside the whole FOV

Search for spatial or temporal correlations between oscillations detected in groups or clusters of points, the wavelet analysis was performer for 4980 000 pixels (whole usable FOV).

- detections are very rare in the bright coronal structures
- some detections are present on the edges of the structures, likely caused by local jitter

No local brightness oscillations with periods longer than 0.6 s in the coronal structures seen above the solar limb in the whole FOV



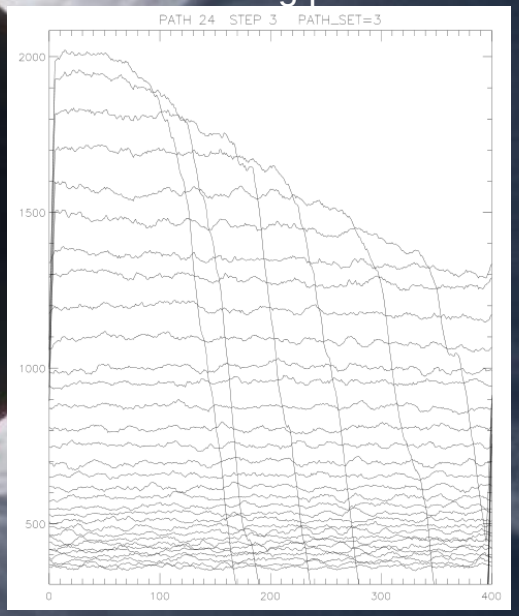
SEARCH FOR FAST-MODE MAGNETO-ACOUSTIC WAVES

- variations of the local brightness measured in numerous points selected along the bright structures
- structures selected "by hand", following dense structures visible in the corona

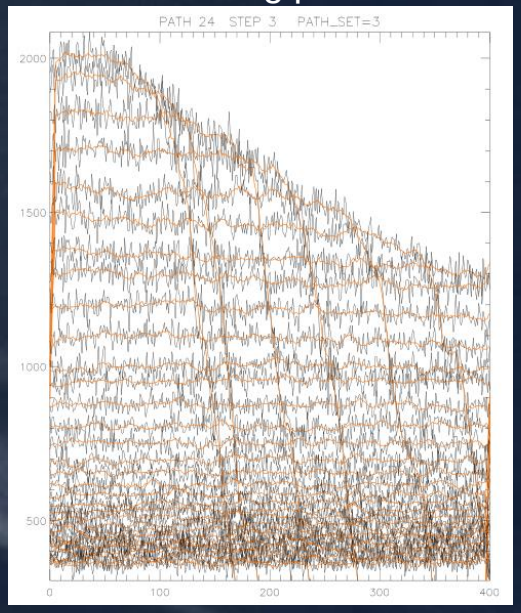
No systematic time-shifts between the light curves along any inspected path

Path #24

Points along path #24



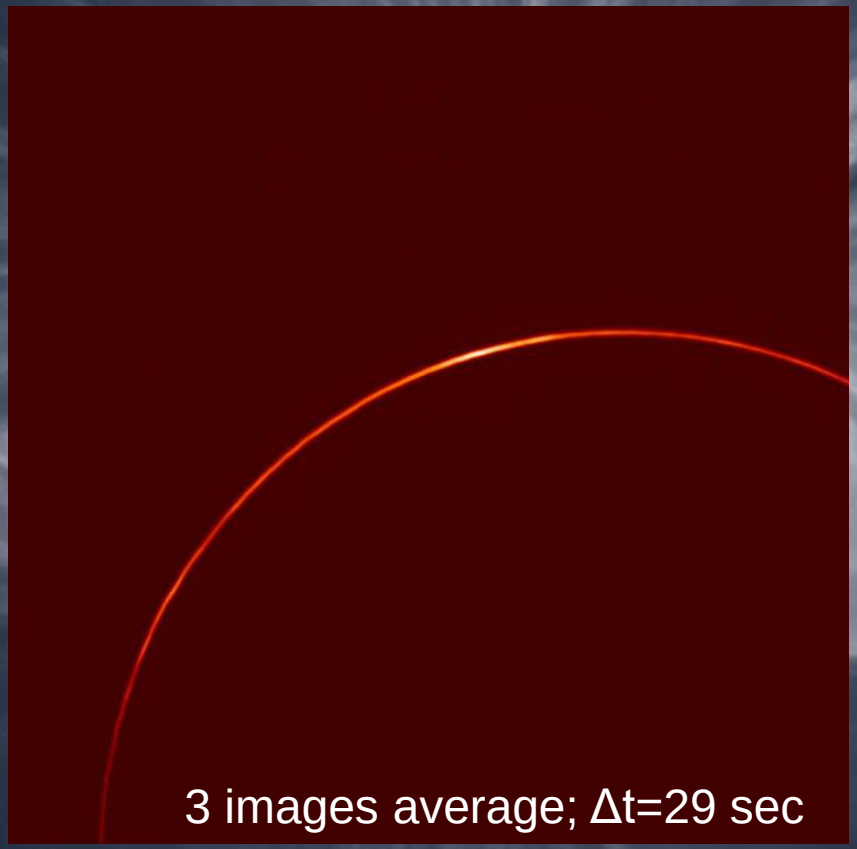
Points along path #24

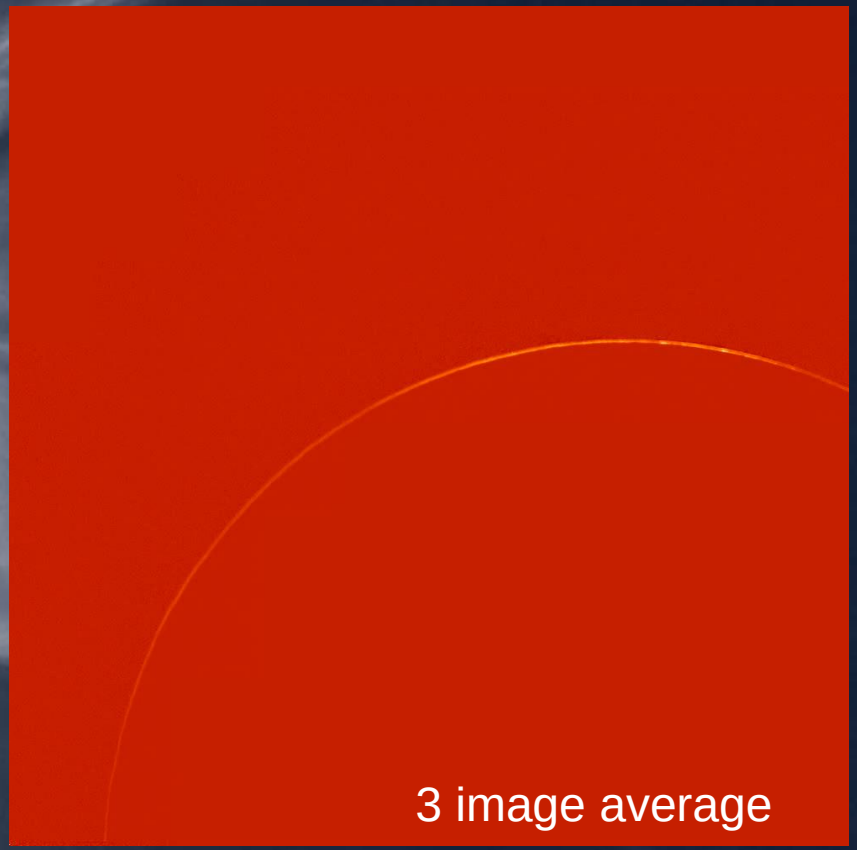


DIFFERENTIAL IMAGES

Differential images calculated as differences between
- consecutive images
- consecutive averaged images
- averaged images separated by long time-steps

No detectable macroscopic displacements of the observed coronal structures during the totality





SUMMARY

The data were collected by joint UK-Polish eclipse expedition near Stanley, Idaho, USA on 21 August 2017.
- 122-seconds-long period (91%) of the 21 August 2017 total solar eclipse have been recorded
- Spatial resolution 1.55 arcseconds square
- Frame rate 3.5 images per second

- Wavelet spectral analysis of the variations in the local brightness in 480 000 points
- The frequency range 1.6-0.025 Hz.

The provisional result: we did not detect jet any statistically significant evidence of local periodic variations of the coronal emission in FeXIV green line, however the detailed analysis of data using various mathematical tools is still under way.

Our preliminary result is in accordance with our previous findings based on observations collected during the 1999 and 2001 total solar eclipses and it confirms that the wave phenomena of Alfven-type, reported already by Tomczyk et al. (Nature 2007, ApJ 2009), even if common and always present in the solar corona, does not rise periodic fluctuations of the intensity of the coronal emission.

Thank you for your attention

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