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Eclipse 2017: New Results on the Dynamical inner-Corona

by

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Abstract :

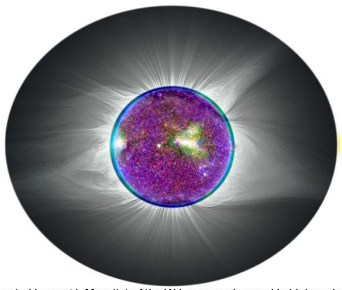
The total solar eclipse of 21 Aug. 2017 was observed by our teams in excellent conditions for almost 1 hour (from Oregon at 17h12, Idaho 17h27, Wyoming 17h36 and Missouri, 18h12 U.T.). Excellent images were recorded in white- light (W-L), including a very high spatiotemporal resolution sequence covering faint dynamical phenomena related to an exceptionally slow CME that evolved over the E- limb. In addition:

i) The overall polarized K- corona, from linearly polarized images taken in 12 positions with a green filter, is analyzed, to be compared to the latest quantitative magnetic dynamical coronal modeling of the Mikic et al. team.

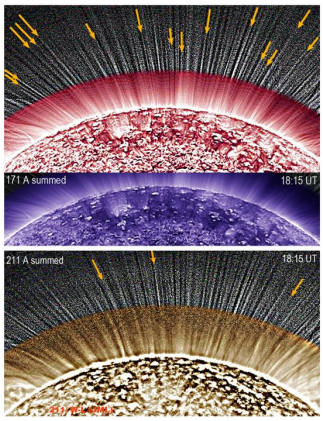
ii) The Polar Regions are specially considered to compare the well observed fine- scale W-L plumes with the EUV plumes simultaneously observed using the AIA of the SDO mission; we integrate 60 successive AIA images taken with the 171, the 193 and the 211 filters to improve the S/N ratio of EUV frames. The new view of dynamical polar plumes is illustrated at different temperature regimes, including a high temperature regime. Some evidence of fast propagating transverse waves is obtained using deep spatially filtered W-L imaging of long linear polar filaments for larger radial distances.

iii) The E- limb slow CME that shows a constant 250 km/s velocity from the LASCO (SoHO) observations is analyzed in W-L with HR eclipse images and with images from SECCHI of the STEREO mission and the AIA of the SDO mission. Very small scale and faint moving and curved W-L features at r> 2 Rs, possibly owning to high disrupted loops, are analyzed for the 1st time with a 20 sec temporal resolution movie; falling back remnants of the high latitude erupted prominence found at the feet of the CME are detected in W-L, well after the eruption.

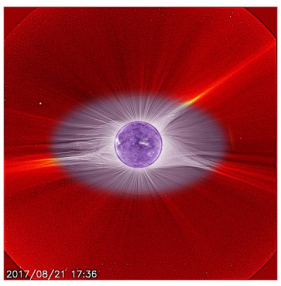
Large-scale image taken from our main site in Idaho demonstrating the quality of the sky during the totality.



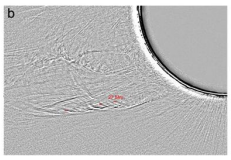
Reconstructed image (J. Mouette) of the W-L corona observed in Idaho using a sequence made for a full movie of the totality with the AIA (SDO) composite coronal image put instead of the Moon



Analysis of the N- pole region with polar plumes and jets:
search for correlations in position and intensities using the highly processed W-L image of J-M. Lecleire (18:12 UT) reflecting i) density small- scale variations (shown in the outer B&W parts of the composites); ii) temperature variations (indeed Emission Measures) as visualized using processed and integrated over 10 min filtergrams from AIA (SDO). Top parts is for 171 A emissions at T°< 1 MK and the bottom part, for 211 emissions with T°> 2.5 MK. Arrows show AIA plumes and jets with obvious correlation with the W-L density structures. The analysis suggests a dominance of plumes of low coronal T° and also, of linear jets/plumes of high T° (best ex. is the central linear jet not existing in 171). For the most inner corona W-L parts see the image at left.

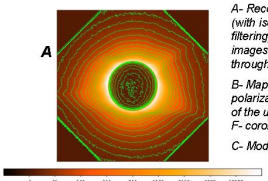


Composite using the W-L eclipse image and coronal images made simultaneously in Space to illustrate the complementarity



Analysis of the E- limb slow CME:

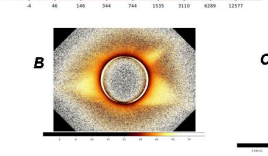
a- the W-L K-corona image at 17:24 UT made using a special processing (N. Lefaudeux) to show fine coronal structures; b- difference image of the corona with a time lapse of 2 min. Black arrows in a) point to eruptive prominence remnants observed as reddish features owing to Hα emission. Red arrows in b) indicate the displacement in 2 min of coronal structures during the totality giving a # 200 km/s proper motion in agreement with the values deduced after from the LASCO movie analysis (see after)

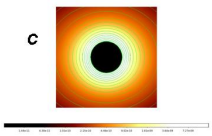


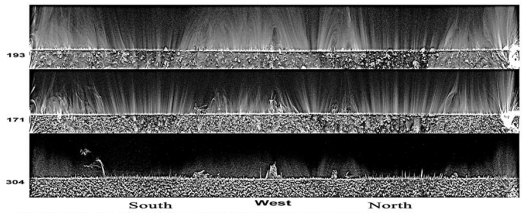
A- Reconstructed W-L coronal image (with isophotes and no radial intensity filtering) from the 12 linearly polarized images taken with a 15° rotational shift through a green color filter.

B- Map of the tangential linear polarization deduced after the subtraction of the unpolarized intensities of the dusty F- corona.

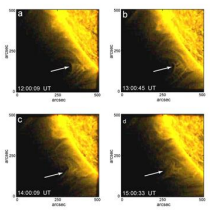
C- Model of the F- corona that is used.



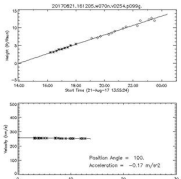




Visualization of the most typical coronal structures in polar coordinates to look at correlations with the eclipse W-L structures (see for ex. the reconstructed image at left and the Tavabi et al 2018 ApJ paper). The AIA corresponding filter values are shown at left. A 10 min integration time is shown (60 pictures are summed for each filter) and the resulting images are greatly enhanced.



SDO/AIA 171 Å images showing the ascending of the dark cavity and coronal loops on 21 August 2017. (Courtesy of the SDO/AIA science team)



Linear fit to SOHO/LASCO observations of the CME on 21 August 2017 presented in the SOHO/LASCO CME Catalog (http://cdaw.gsfc.nasa.gov/CME_list/).

References:

Boulade, S. Delannée, C. Koutchmy, S. et al. *(1997), « Analysis of a High Latitude Slow CME with travelling Ejecta », ESA SP- 404, 217-221 in Proc. 5th SOHO Workshop, Oslo, Norway, June 17- 20, 1997*

Koutchmy, S. Filippov, B. and Lefaudeux, N. *(2018) , "Slow coronal mass ejection observed during the total solar eclipse on 2017 August 21", S.P. in preparation*

Tavabi, E. Koutchmy, S. and Golub, L. *(2018) "Polar Coronal Plumes as Tornado- like Jets", ApJ. Volume 866, Issue 1, article id. 35, 10 pp. in arXiv:1808.07322*

Tavabi, E.; Koutchmy, S.; Bazin, C. *(2018) "Analysis of a Failed Eclipse Plasma Ejection Using EUV Observations", Solar Physics, Volume 293, Issue 3, article id. 42, 16 pp. In arXiv:1801.09222*