Aidez-nous à observer la haute atmosphère martienne !

J. Lilensten, JL Dauvergne, E. Beaudoin, C. Pellier, M.Delcroix, M.Vincendon

Mars rising behind the Moon, pictured by Damian Peach

SEPTEMBER 6th, 2020
05:08:12 UTC

Les aurores martiennes ont été découvertes en 2005

nature
Vol 435|9 June 2005|doi:10.1038/nature03603

LETTERS

Discovery of an aurora on Mars

Jean-Loup Bertaux[1], François Leblanc[1], Olivier Witasse[2], Eric Quemerais[1], Jean Lilensten[3], S. A. Stern[4], B. Sandel[5] & Oleg Korablev[6]

In the high-latitude regions of Earth, aurorae are the often-spectacular visual manifestation of the interaction between electrically charged particles (electrons, protons or ions) with the neutral upper atmosphere, as they precipitate along magnetic field lines. More generally, auroral emissions in planetary atmospheres "are those that result from the impact of particles other than photoelectrons" (ref. 1). Auroral activity has been found on all four giant planets possessing a magnetic field (Jupiter[2], Saturn[3], Uranus[4] and Neptune[5]), as well as on Venus, which has no magnetic field[6]. On the nightside of Venus, atomic O emissions at 130.4 nm and 135.6 nm appear in bright patches of varying sizes and intensities[6], which are believed to be produced by electrons with energy <300 eV (ref. 7). Here we report the discovery of an aurora in the martian atmosphere, using the ultraviolet spec-

identified recently[16] as the γ and δ bands of the nitric oxide (NO) molecule, emitted when O and N atoms recombine, after having been produced by solar extreme UV photo-dissociation of CO_2, O_2 and N_2 on the dayside and transported to the nightside.

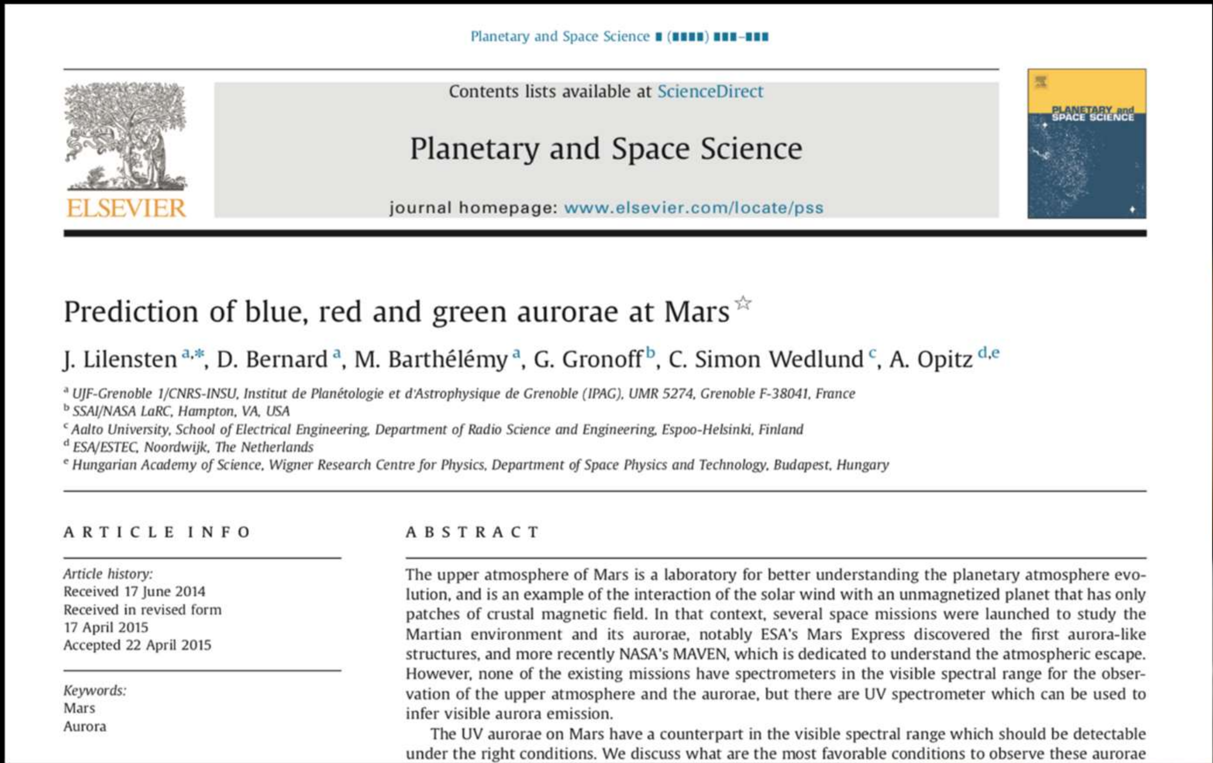
In Fig. 1b the nightglow signal integrated over the wavelength range of the NO bands (181–298 nm) is displayed as a function of time for the five spatial bins. The signal is more intense for spatial bins 3, 4 and 5 than for spatial bins 1 and 2 because the FOV is wider and the source is extended. All curves show the same behaviour, almost identical to the variation of the NO emission observed six days later at orbit 734[16]; this behaviour is explained by the variation of the altitude and the latitude of the Mars nearest point (MNP) when the LOS scans across the NO emitting layer—this layer is confined in the altitude range 60–80 km, and is more intense at large

… mais dans l'UV. Ce qui a fait dire que ce ne sont pas des aurores à proprement parler

E. Enzm

SEPTEMBER 6th, 2020
05:08:12 UTC

Cependant, par des expériences de labo et de la modélisation, j'ai pu faire cette prediction en 2015



Planetary and Space Science ■ (■■■■) ■■■–■■■

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journal homepage: www.elsevier.com/locate/pss

Prediction of blue, red and green aurorae at Mars☆

J. Lilensten [a,*], D. Bernard [a], M. Barthélémy [a], G. Gronoff [b], C. Simon Wedlund [c], A. Opitz [d,e]

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ABSTRACT

The upper atmosphere of Mars is a laboratory for better understanding the planetary atmosphere evolution, and is an example of the interaction of the solar wind with an unmagnetized planet that has only patches of crustal magnetic field. In that context, several space missions were launched to study the Martian environment and its aurorae, notably ESA's Mars Express discovered the first aurora-like structures, and more recently NASA's MAVEN, which is dedicated to understand the atmospheric escape. However, none of the existing missions have spectrometers in the visible spectral range for the observation of the upper atmosphere and the aurorae, but there are UV spectrometer which can be used to infer visible aurora emission.

The UV aurorae on Mars have a counterpart in the visible spectral range which should be detectable under the right conditions. We discuss what are the most favorable conditions to observe these aurorae

Des aurores martiennes visibles et suffisamment brillantes pour être vues à l'œil nu :

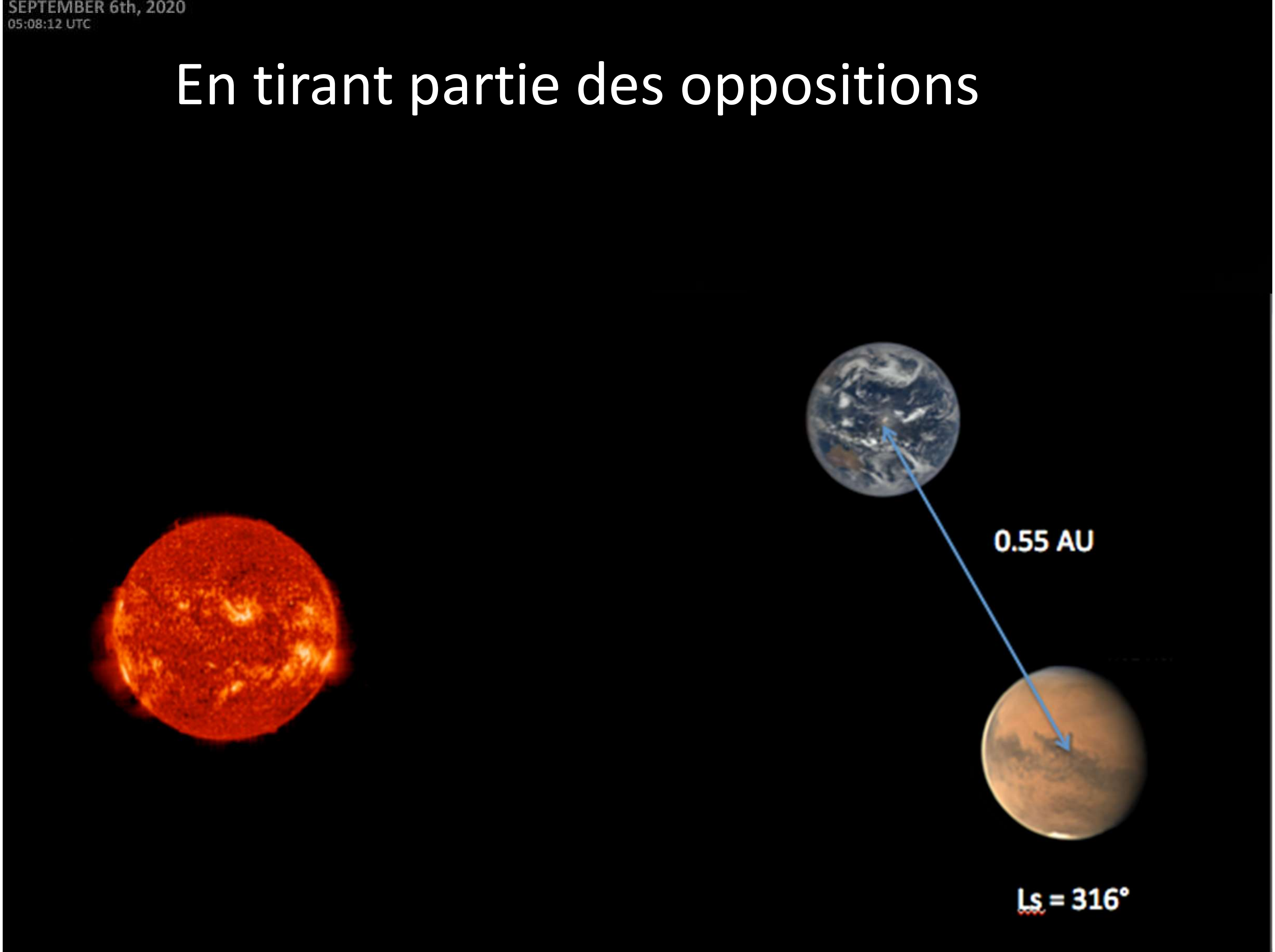
- Bleu (N2+) et vert (O) à 140 km
- Rouge (O) à 160 km

Les émissions bleues à 412 nm et 434 nm sont dues aux bandes Fox-Duffendack-Barker du CO2.Le vert (557,7 nm) et le rouge (630 nm) sont les raies « habituelles » de l'oxygène atomique.

Et Jean-Luc a eu l'idée de les découvrir depuis la Terre avec ... vous

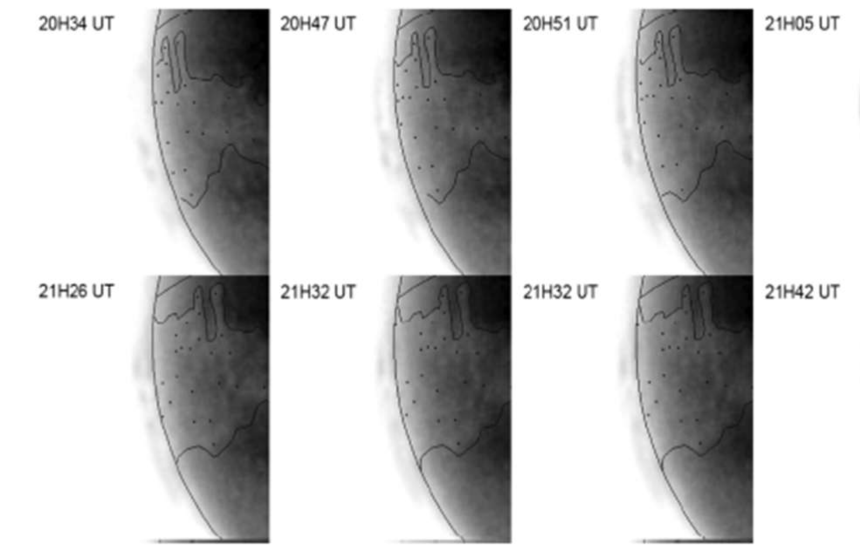
E. Enzm

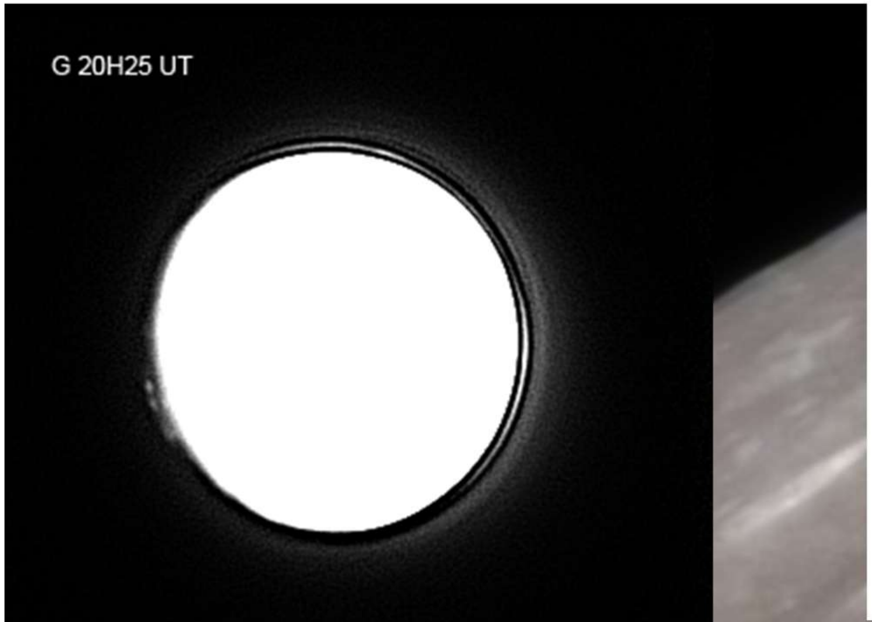
En tirant partie des oppositions

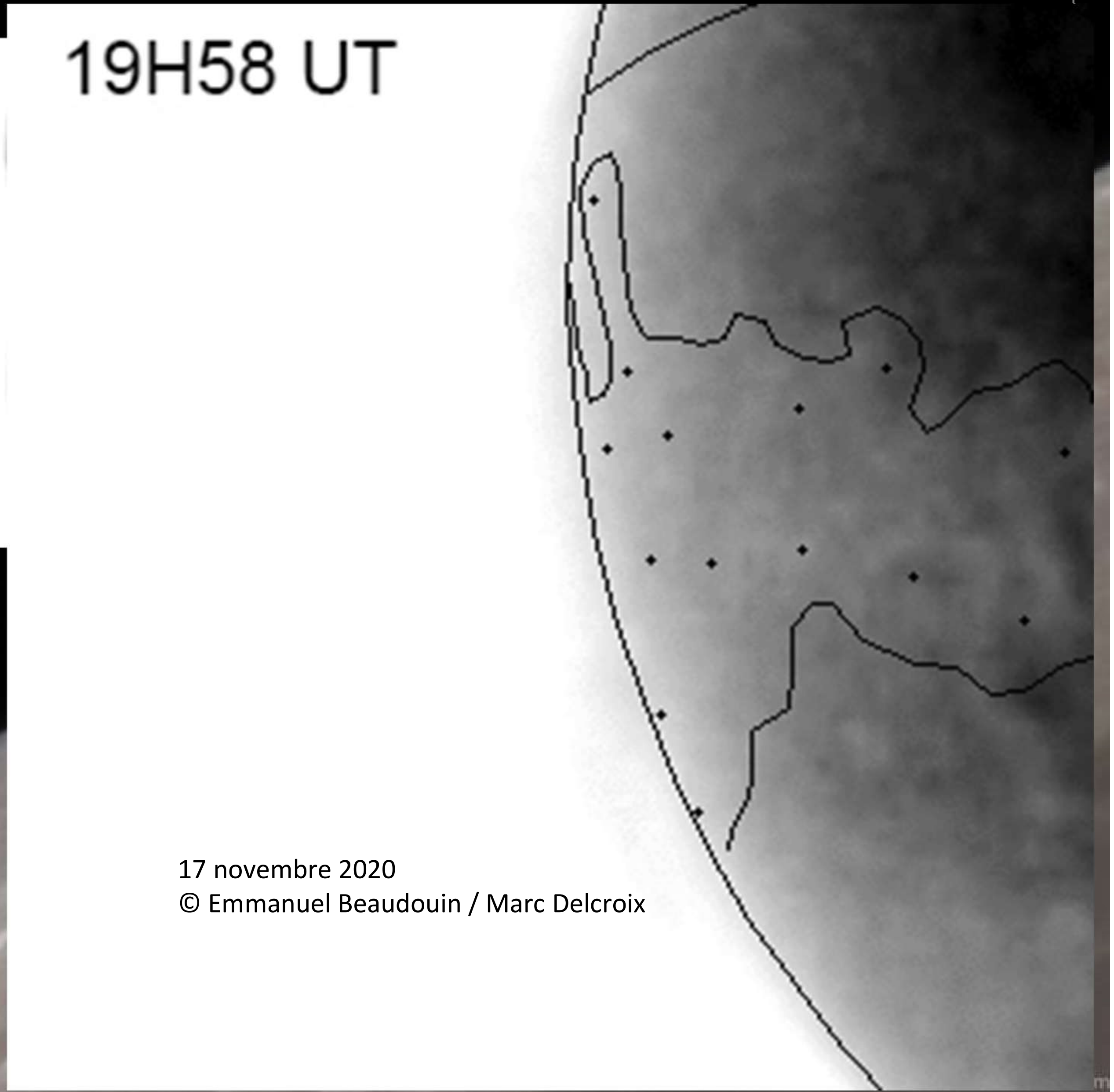


SEPTEMBER 6th, 2020
05:08:12 UTC

Emmanuel Beaudoin et Christophe Pellier détectent indépendamment une structure à très haute altitude émergeant de l'ombre le 17 novembre 2020 (Mars et Terre en quasi-opposition).



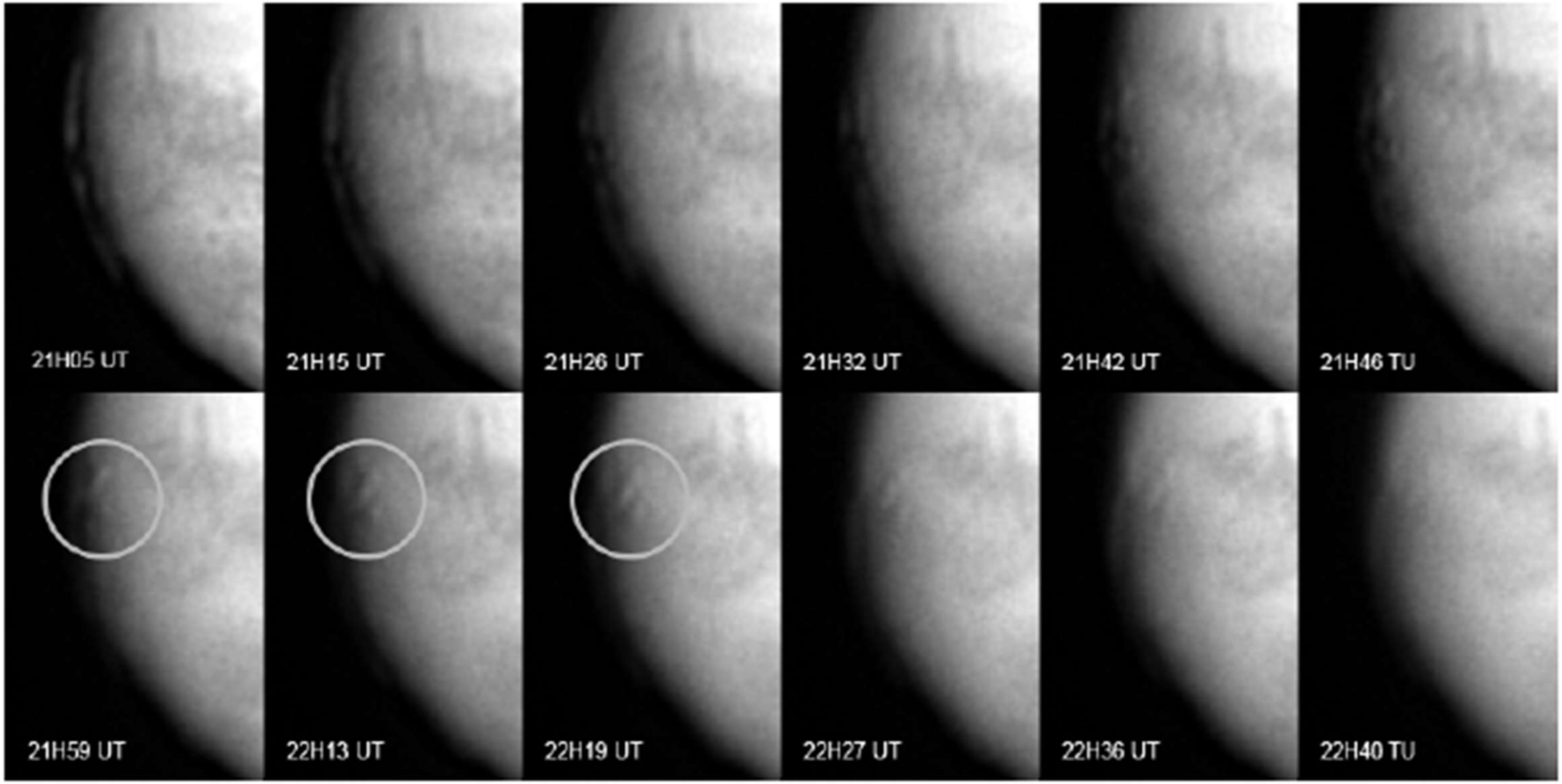




SEPTEMBER 6th, 2020
05:08:12 UTC

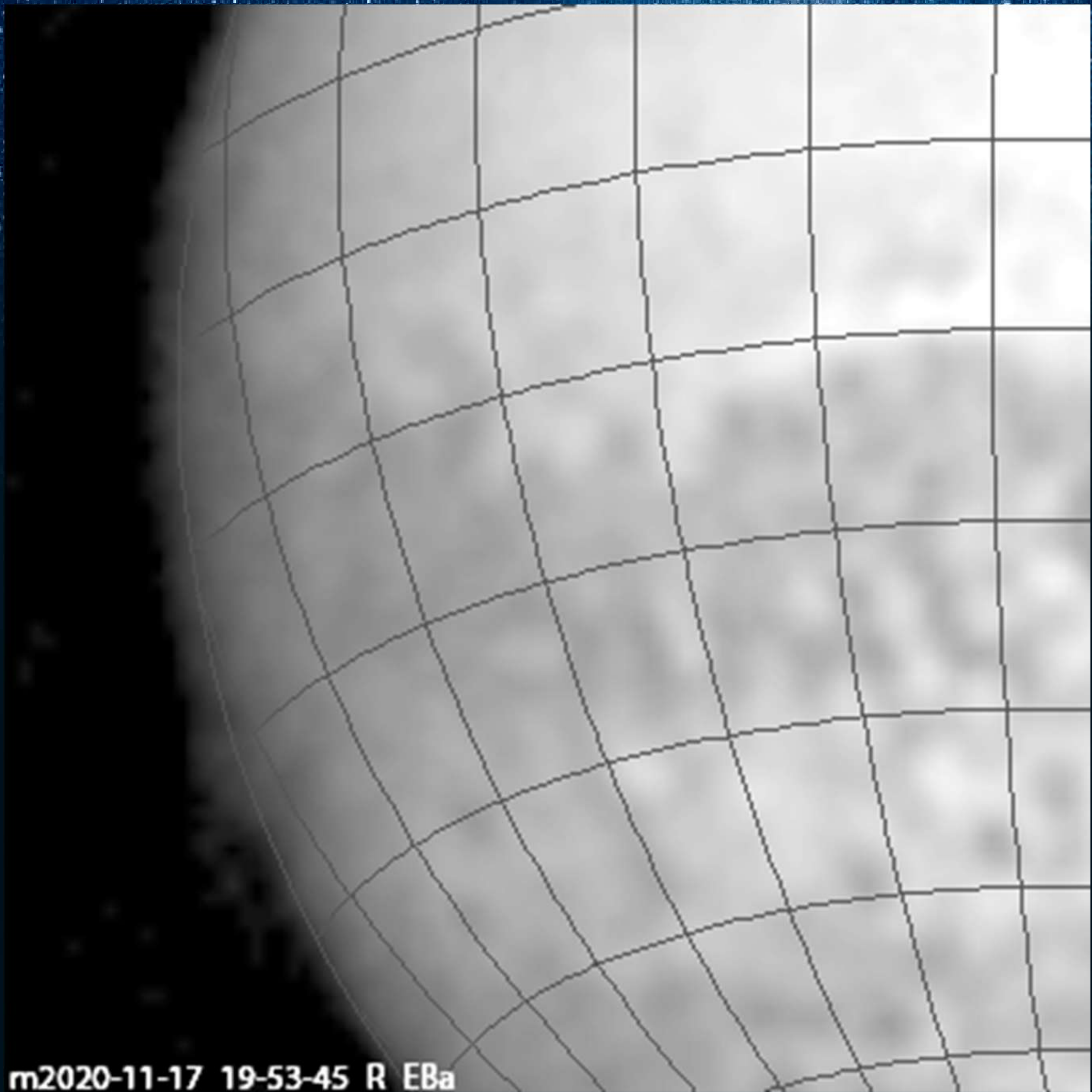
Le traitement d'image de Marc montre que cette structure détachée projette des ombres : Il ne peut s'agir d'une aurore

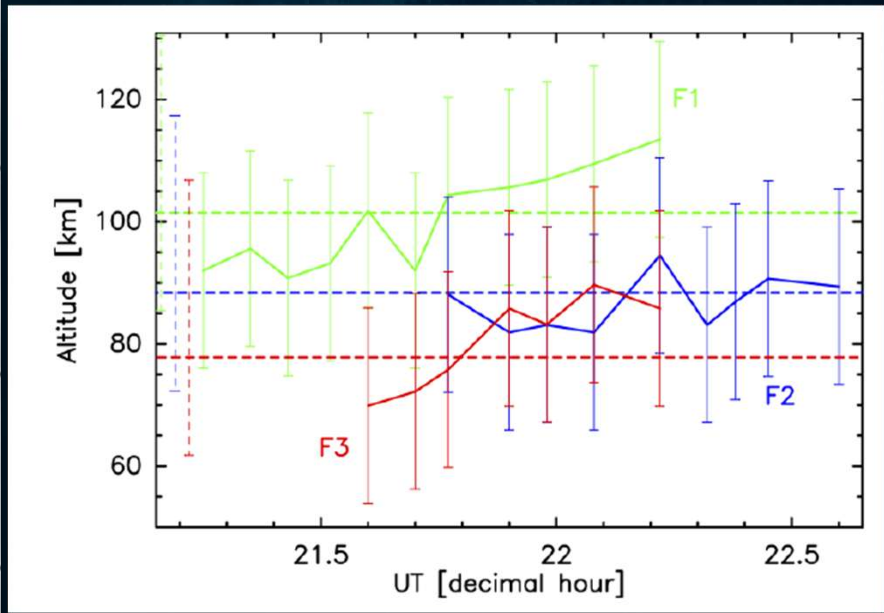
17 novembre 2020



SEPTEMBER 6th, 2020
05:08:12 UTC

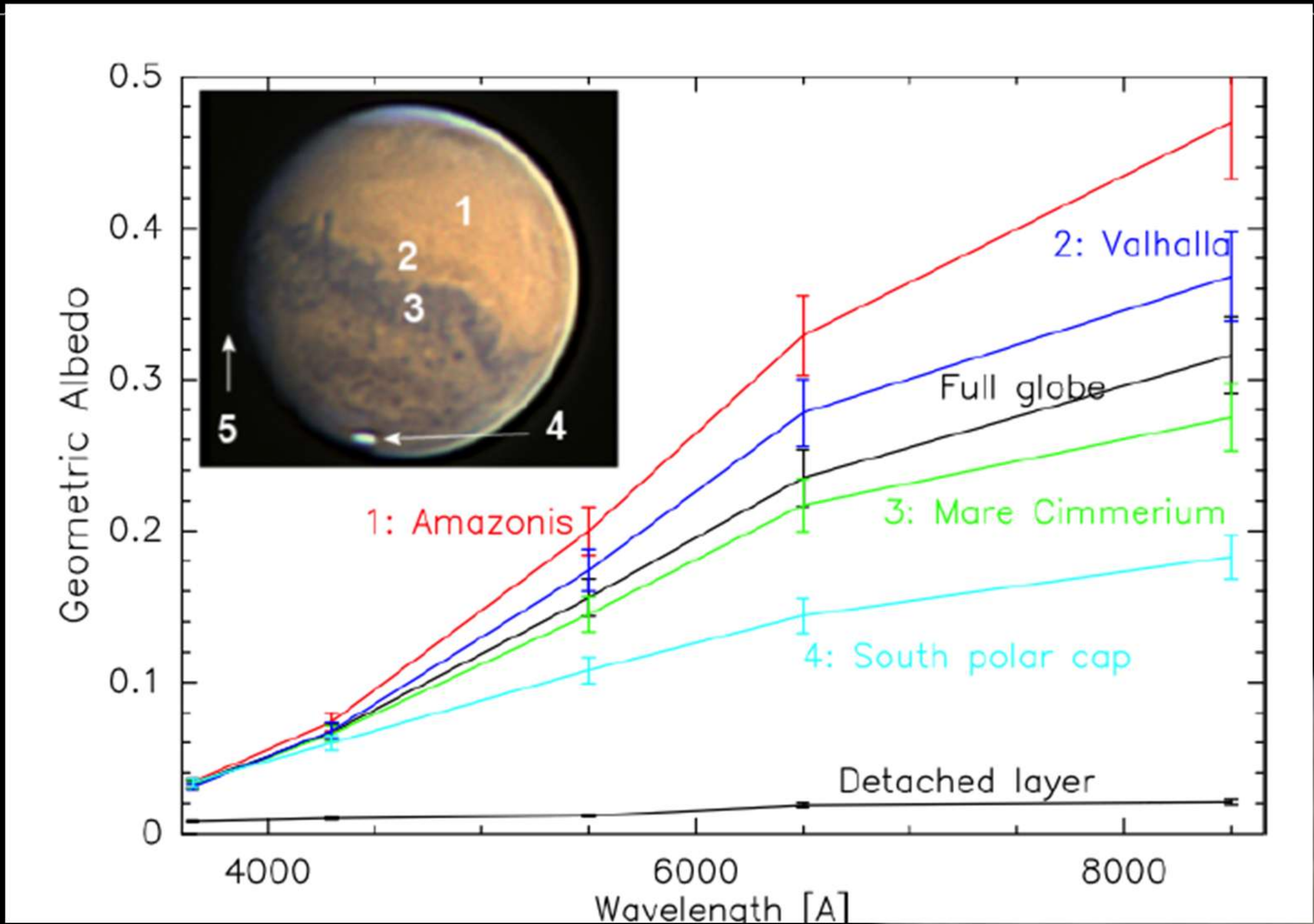
La mesure des positions en suivant la rotation permet de déduire l'altitude.





Altitude : 92 (-16/+30) km
Taille longitudinale : ~3000 km

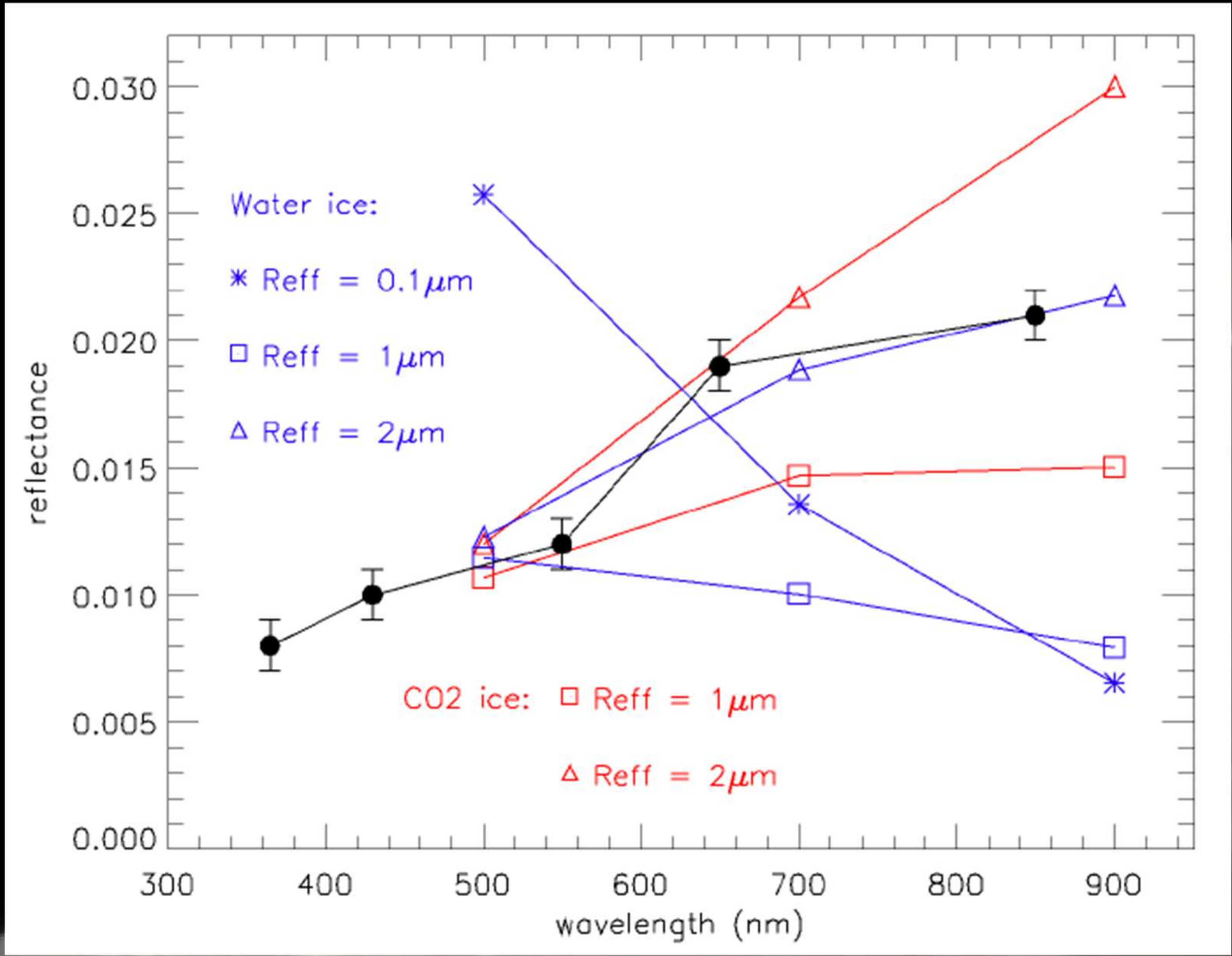
Photometrie



Le spectre de cette couche détachée est radicalement différent de celui du sol martien.

SEPTEMBER 6th, 2020
05:08:12 UTC

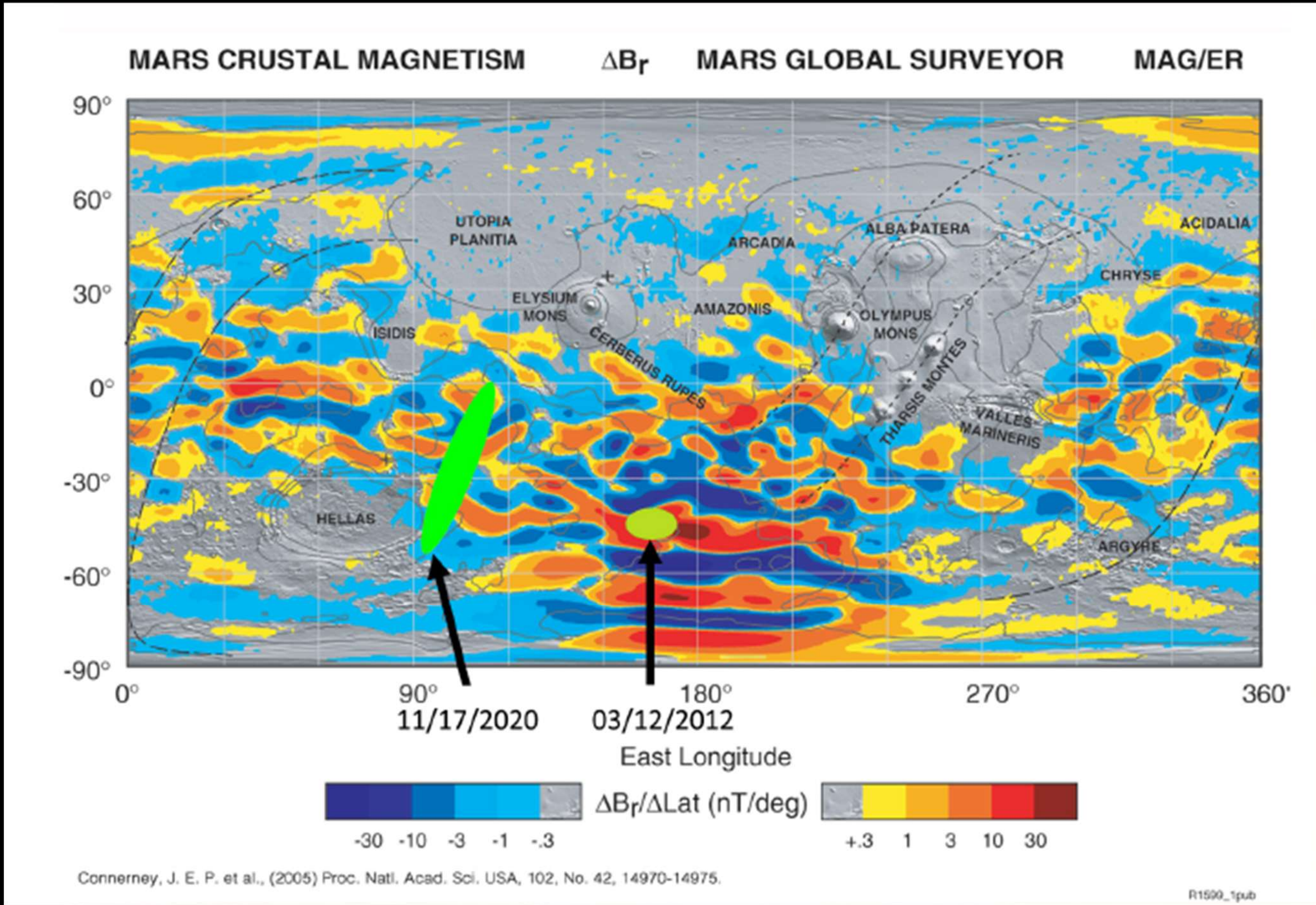
La comparaison avec la modélisation du transfert radiatif montre qu'il s'agit d'un nuage, soit de CO_2, soit (moins probablement) de H_20.



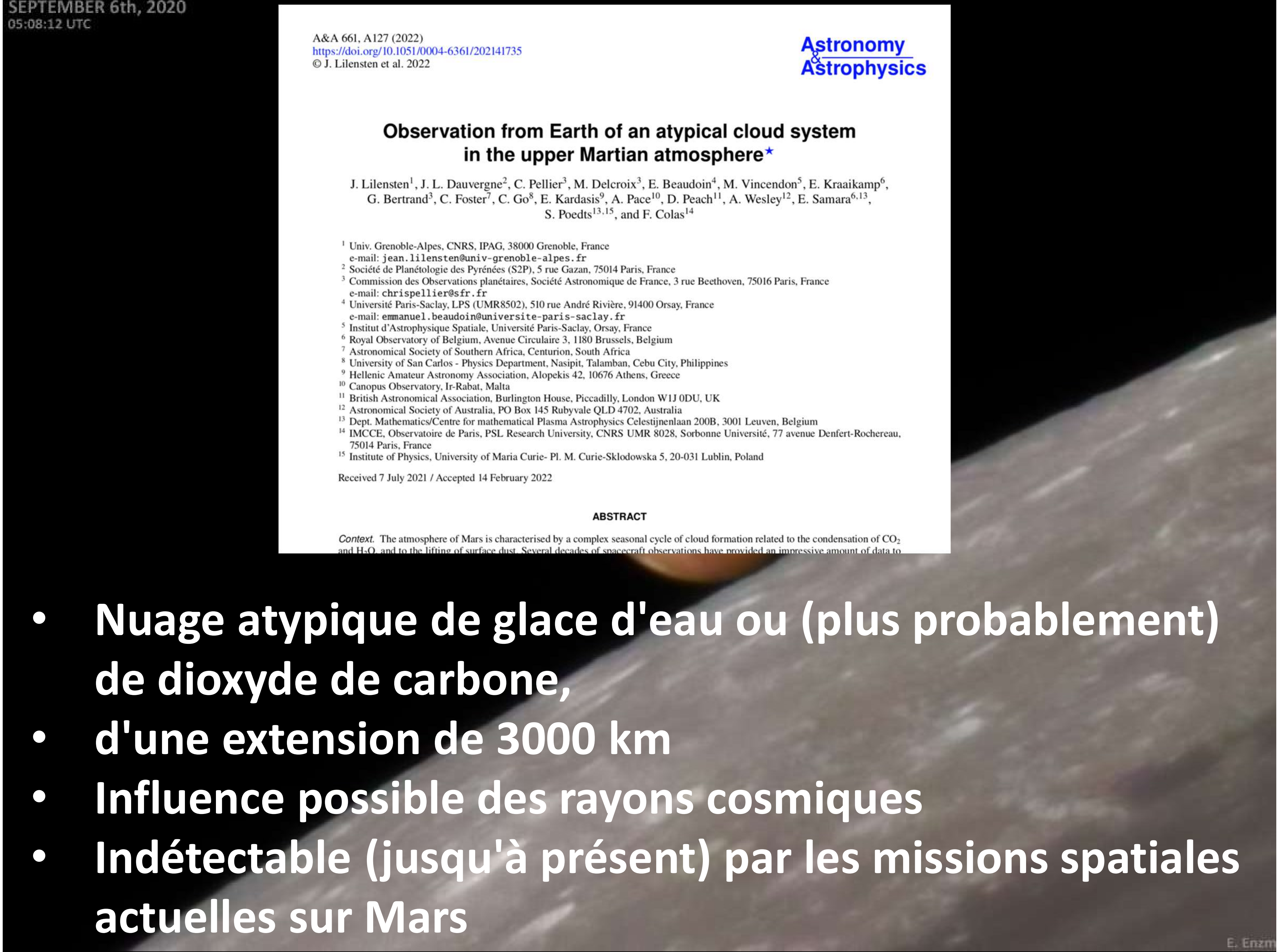
E. Enzm

SEPTEMBER 6th, 2020
05:08:12 UTC

Localisation par rapport au magnétisme résiduel : une origine cosmique ?



E. Enzm



A&A 661, A127 (2022)
https://doi.org/10.1051/0004-6361/202141735

Astronomy & Astrophysics

Observation from Earth of an atypical cloud system in the upper Martian atmosphere★

J. Lilensten[1], J. L. Dauvergne[2], C. Pellier[3], M. Delcroix[3], E. Beaudoin[4], M. Vincendon[5], E. Kraaikamp[6], G. Bertrand[3], C. Foster[7], C. Go[8], E. Kardasis[9], A. Pace[10], D. Peach[11], A. Wesley[12], E. Samara[6,13], S. Poedts[13,15], and F. Colas[14]

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[8] University of San Carlos - Physics Department, Nasipit, Talamban, Cebu City, Philippines
[9] Hellenic Amateur Astronomy Association, Alopekis 42, 10676 Athens, Greece
[10] Canopus Observatory, Ir-Rabat, Malta
[11] British Astronomical Association, Burlington House, Piccadilly, London W1J 0DU, UK
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Received 7 July 2021 / Accepted 14 February 2022

ABSTRACT

Context. The atmosphere of Mars is characterised by a complex seasonal cycle of cloud formation related to the condensation of CO_2

- Nuage atypique de glace d'eau ou (plus probablement) de dioxyde de carbone,
- d'une extension de 3000 km
- Influence possible des rayons cosmiques
- Indétectable (jusqu'à présent) par les missions spatiales actuelles sur Mars

2022 …

C'est pourquoi l'idée est d'augmenter considérablement le nombre d'observateurs. Plus de 100. Dispersés sur toute la Terre. En collaboration.

E. Enzm

Prochaine opposition : 16 janvier 2025.

Les meilleures périodes pour ces observations de maintenant à fin février.

SEPTEMBER 6th, 2020
05:08:12 UTC

Contribuez à découvrir les aurores martiennes dans le bleu (412nm et 434nm), le rouge (630 nm), le vert (557.7 nm) et à mieux caractériser ces nuages ! !! Une observation n'est validée que si au moins 2 observateurs indépendants la font.

E. Enzm

SEPTEMBER 6th, 2020
05:08:12 UTC

Inscrivez-vous auprès de moi et joignez-vous à l'effort :

Jean.lilensten@univ-grenoble-alpes.fr

SEPTEMBER 6th, 2020
05:08:12 UTC

La course est lancée

Title: First detection of the green 557.7 nm oxygen aurora on Mars

Authors: E. W. Knutsen[1], T. H. McConnochie[2], M. Lemmon[2], L. Tamppari[3], S. Viet[9], A. Cousin[5], R. C. Wiens[6], R. Francis[3], C. Donaldson[7], J. Lasue[5], O. Forni[5], P. Patel[8], N. Schneider[9], D. T. Carrasco[10], V. A. Palacio[10]

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[2]Space Science Institute, Boulder, CO, USA
[3]Jet Propulsion Laboratory, California Institute of Technology, Pasader
[4]Norwegian University of Science and Technology, Institute of Physics
[5]IRAP - Institut de recherche en astrophysique et planétologie, France
[6]Purdue University, West Lafayette, IN, USA
[7]Malin Space Science Systems, USA
[8](Priya)
[9]Laboratory for Atmospheric and Space Physics, University of Colorad CO, USA
[10]Instituto Nacional De Técnica Aerospacial (INTA), Spain

Breaking news !!!!

Harada et al. Earth, Planets and Space (2024) 76:64
https://doi.org/10.1186/s40623-024-02010-x

Earth, Planets and Space

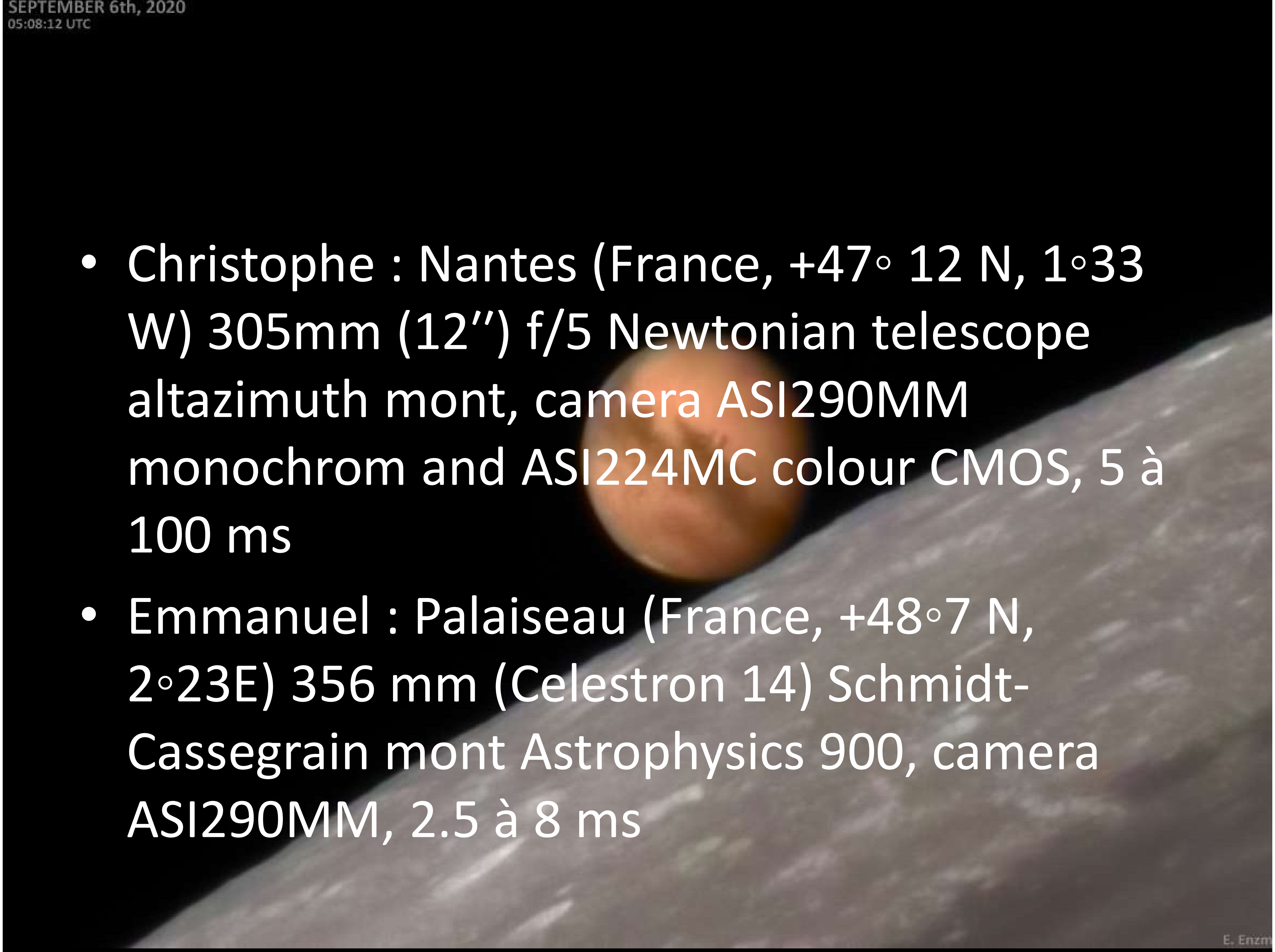
EXPRESS LETTER Open Access

Discrete aurora and the nightside ionosphere of Mars: an EMM–MEX conjunction of FUV imaging, ionospheric radar sounding, and suprathermal electron measurements

Yuki Harada[1*], Yuka Fujiwara[1], Robert J. Lillis[2], Justin Deighan[3], Hiromu Nakagawa[4], Beatriz Sánchez-Cano[5], Mark Lester[5], Yoshifumi Futaana[6], Mats Holmström[6] and Rudy A. Frahm[7]

Abstract

Since 2021, a new surge in discrete aurora detections at Mars has been observed by the Emirates Mars Ultraviolet Spectrometer (EMUS) onboard the Emirates Mars Mission (EMM) Hope Orbiter as EMUS started to regularly obtain synoptic auroral images with a high sensitivity. Here we report on a fortuitous conjunction between EMM and Mars Express (MEX) using far ultraviolet (FUV) imaging of discrete aurora by EMM EMUS, in situ measurements of suprathermal electrons by the MEX Analyzer of Space Plasma and Energetic Atoms Electron Spectrometer (ELS), and topside radar sounding of the nightside ionosphere by the MEX Mars Advanced Radar for Subsurface and Ionosphere Sounding (MARSIS). In this event, EMM EMUS imaged a clear discrete aurora signature around moderately strong crustal magnetic fields on the nightside near the dusk terminator, 11 min before which MEX MARSIS measured a prominent local enhancement of the peak electron density in the nightside ionosphere and MEX ELS observed an in situ enhancement of suprathermal electrons at the corresponding location. A remarkable geographic agreement is found between the enhancements of the aurora, ionosphere, and suprathermal electrons, suggesting that the enhanced ionization and auroral emission are caused concurrently by precipitating suprathermal electrons. Subsequent images indicate that the discrete aurora slightly changed its shape in 15 min and mostly disappeared in a few hours. The MEX MARSIS measurements of the auroral ionosphere display overlapping ionospheric and surface echoes indicative of horizontal gradients of the peak electron density. Analysis of the overlapping echoes implies that the auroral ionosphere and electron precipitation could be highly structured with horizontal spatial scales on the order of several tens of km. MEX MARSIS also observed a non-auroral ionospheric enhancement with a wider spatial extent than the local auroral enhancement, suggesting alternative sources of the enhanced nightside ionosphere such as plasma trans-



- Christophe : Nantes (France, +47◦ 12 N, 1◦33 W) 305mm (12’’) f/5 Newtonian telescope altazimuth mont, camera ASI290MM monochrom and ASI224MC colour CMOS, 5 à 100 ms
- Emmanuel : Palaiseau (France, +48◦7 N, 2◦23E) 356 mm (Celestron 14) Schmidt-Cassegrain mont Astrophysics 900, camera ASI290MM, 2.5 à 8 ms

Traquer les aurores

Emmanuel Beaudoin

Mars, opposition de 2020

Mars, opposition de 2020

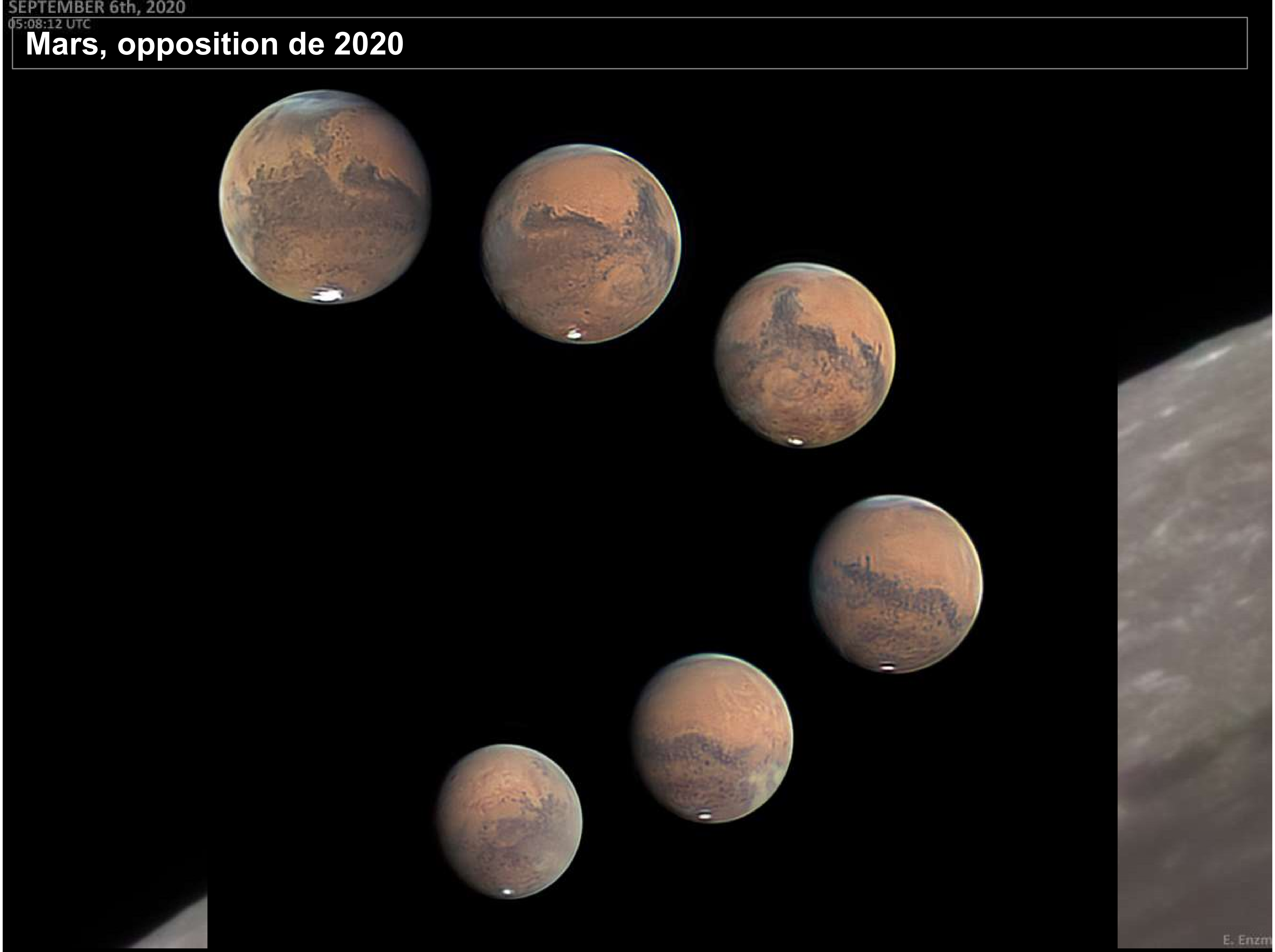
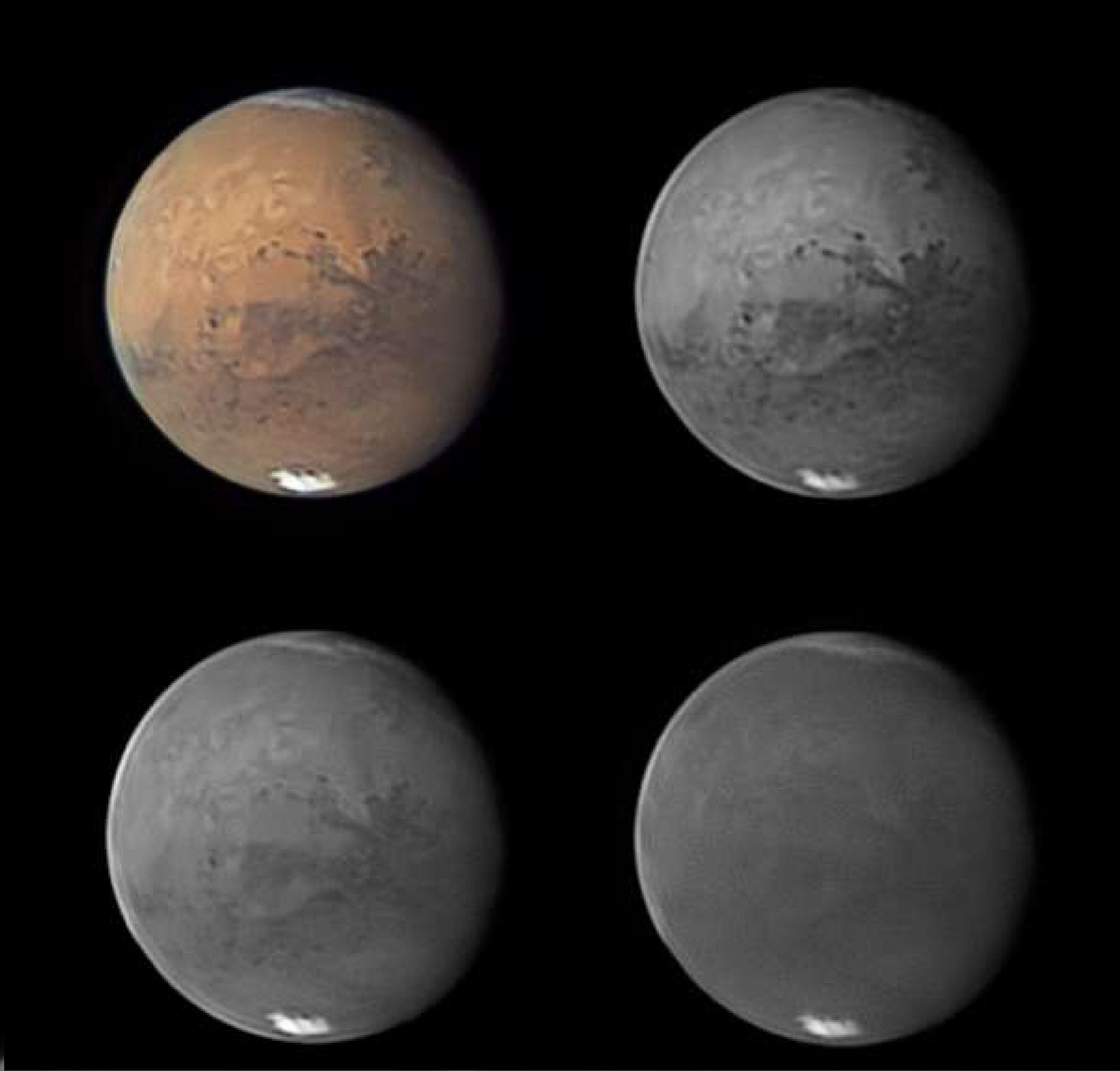


Photo planétaire en RGB

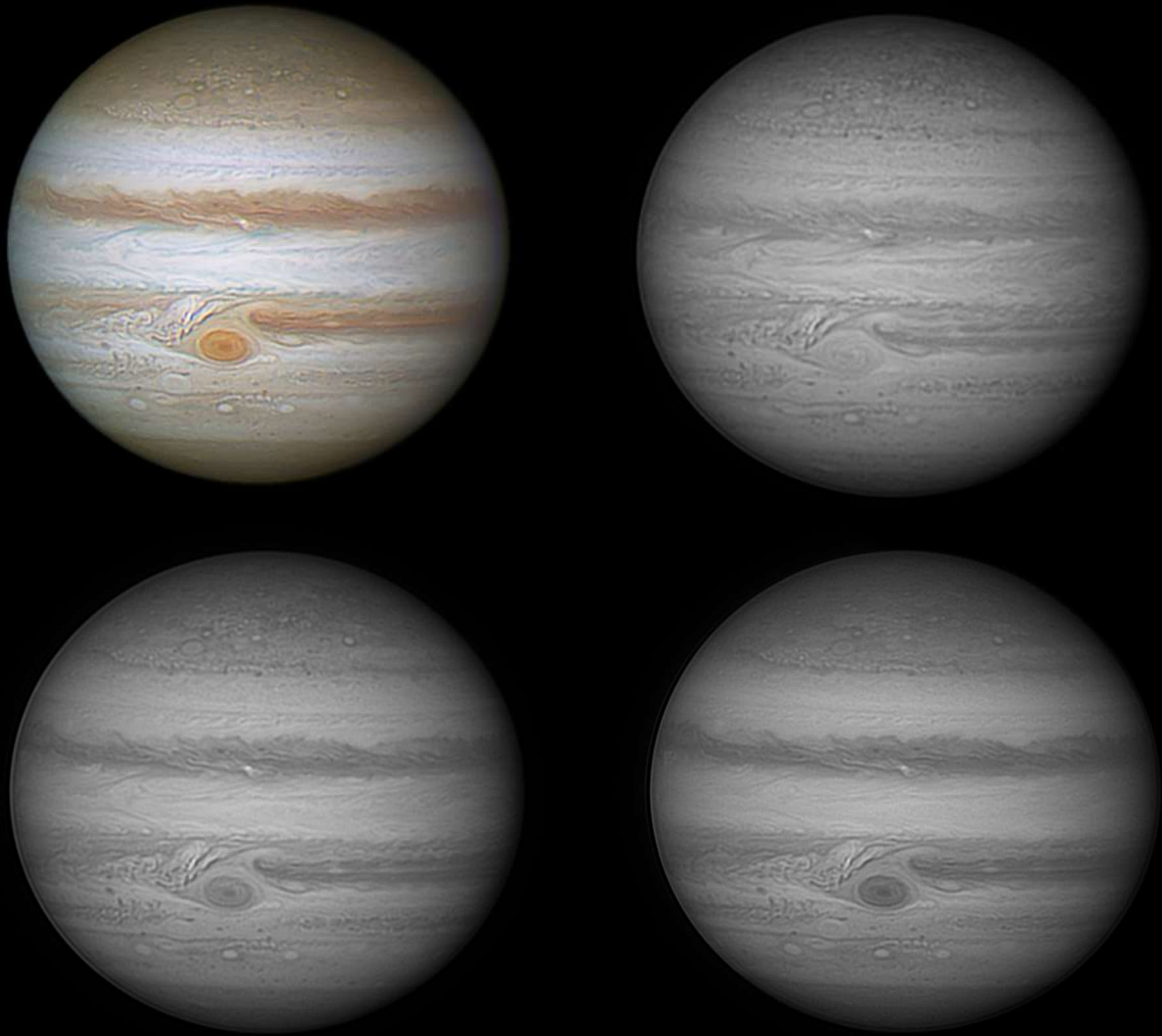


Notre nuage-aurore de novembre 2020

Site d'observation à mon université

SEPTEMBER 6th, 2020
05:08:12 UTC

En attendant Mars



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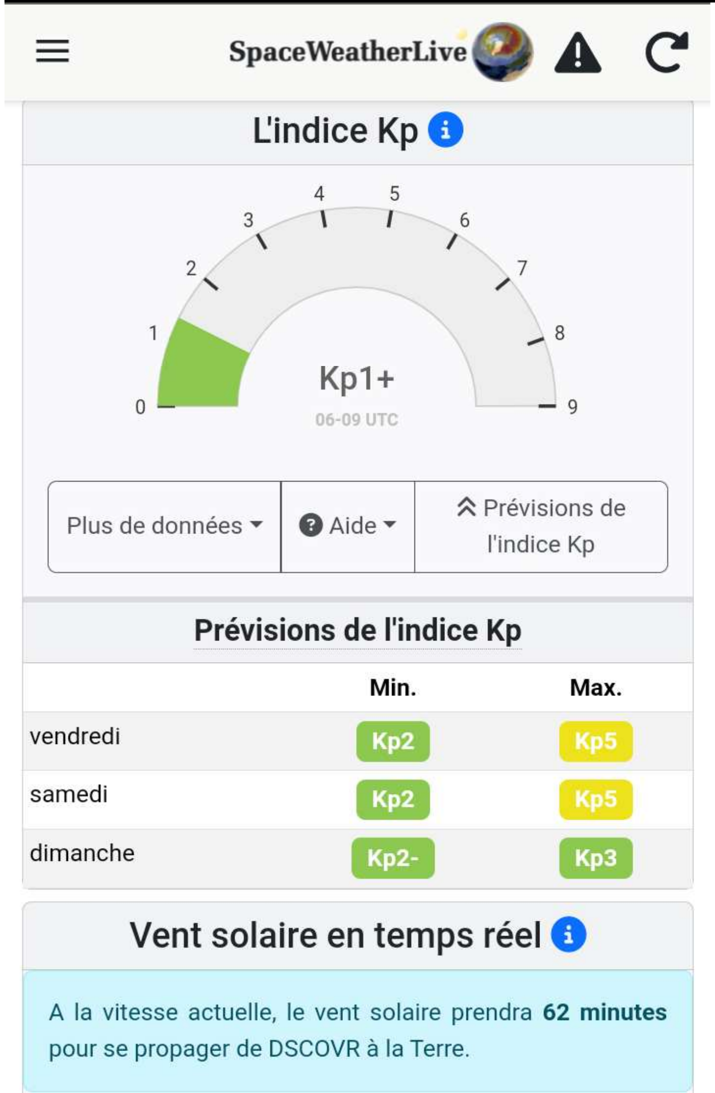
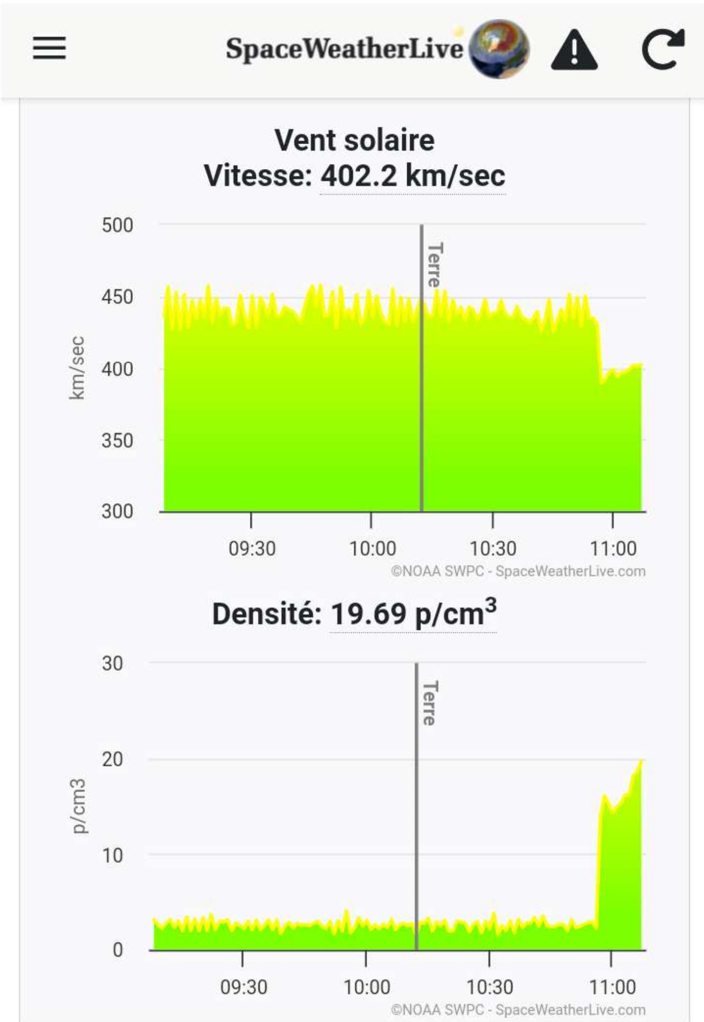
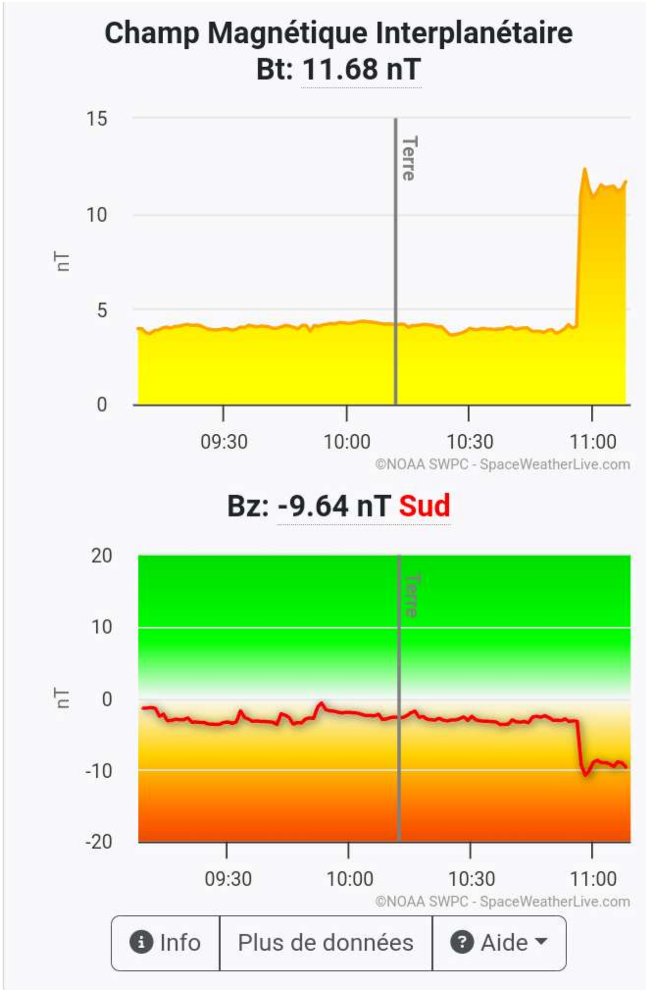
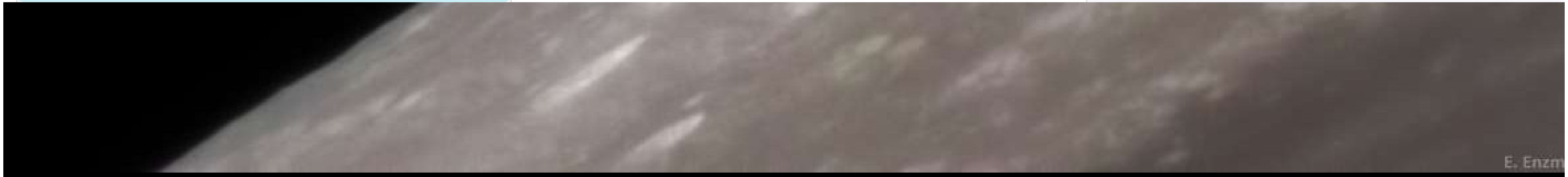
05:08:12 UTC

Les aurores bleues







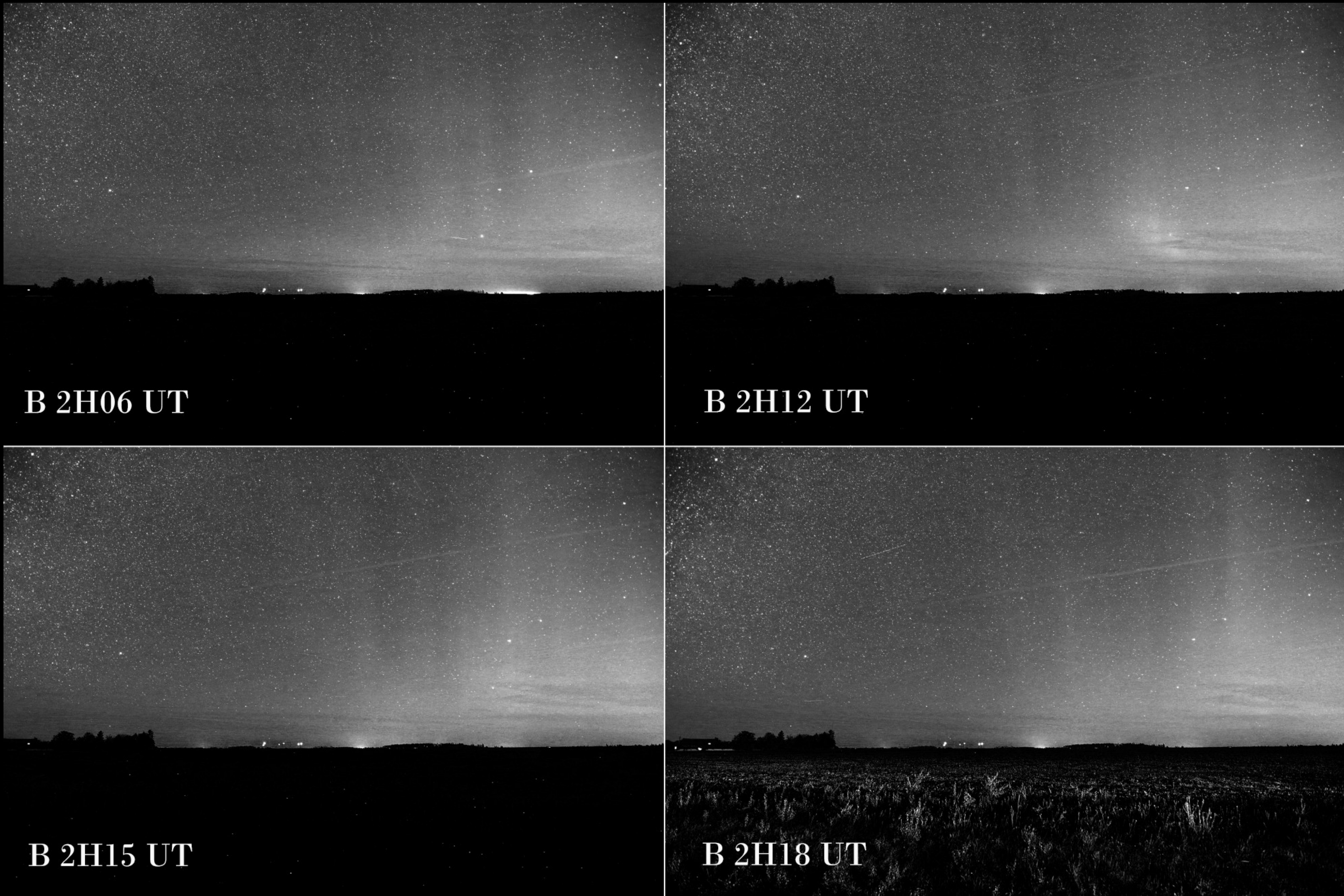


Nuit du 24-25 septembre 2023

Vers 1h du matin

SEPTEMBER 6th, 2020
05:08:12 UTC

L'aurore bleue

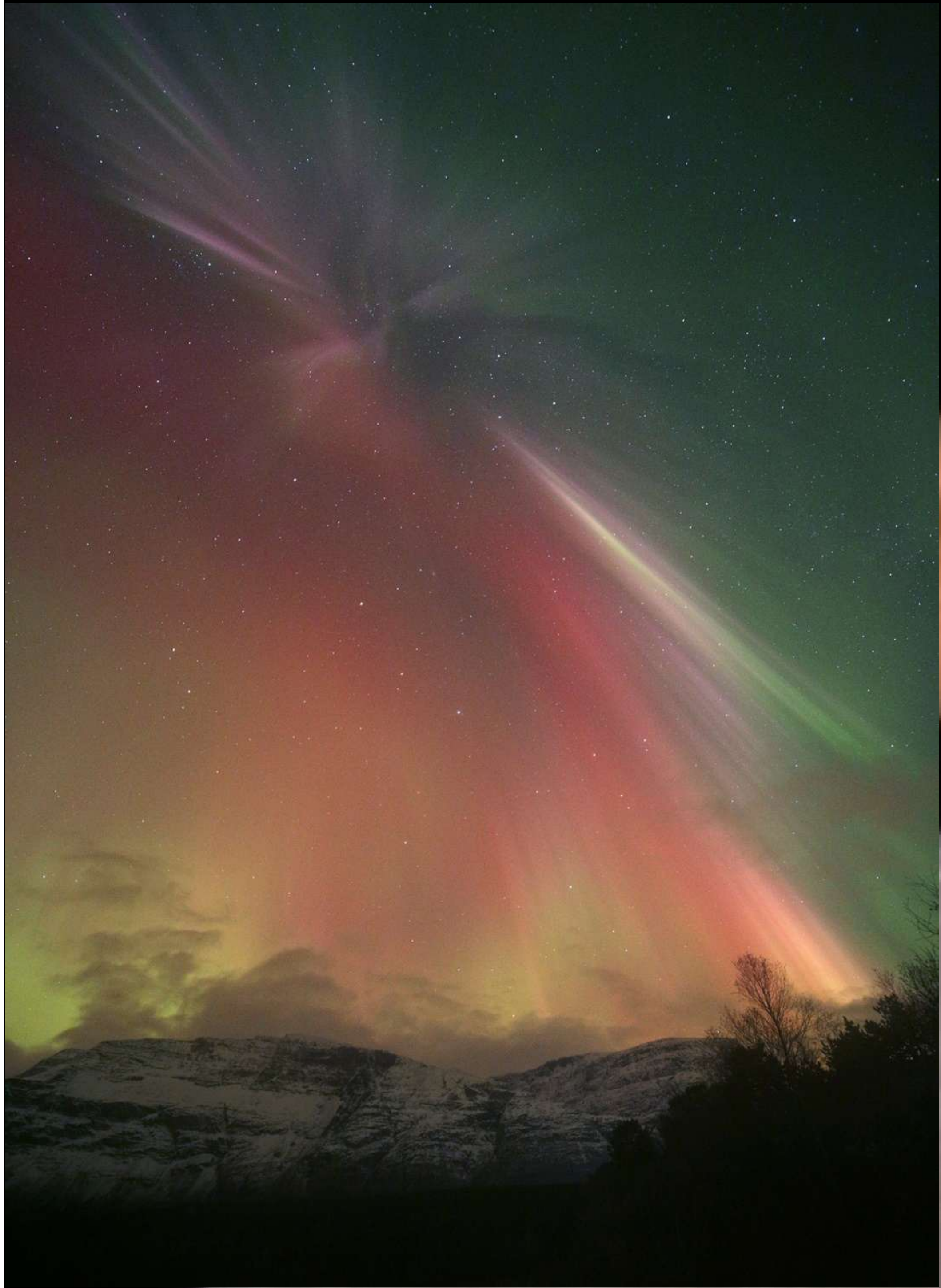


(contraste couche bleue poussé)

E. Enzm

SEPTEMBER 6th, 2020
05:08:12 UTC

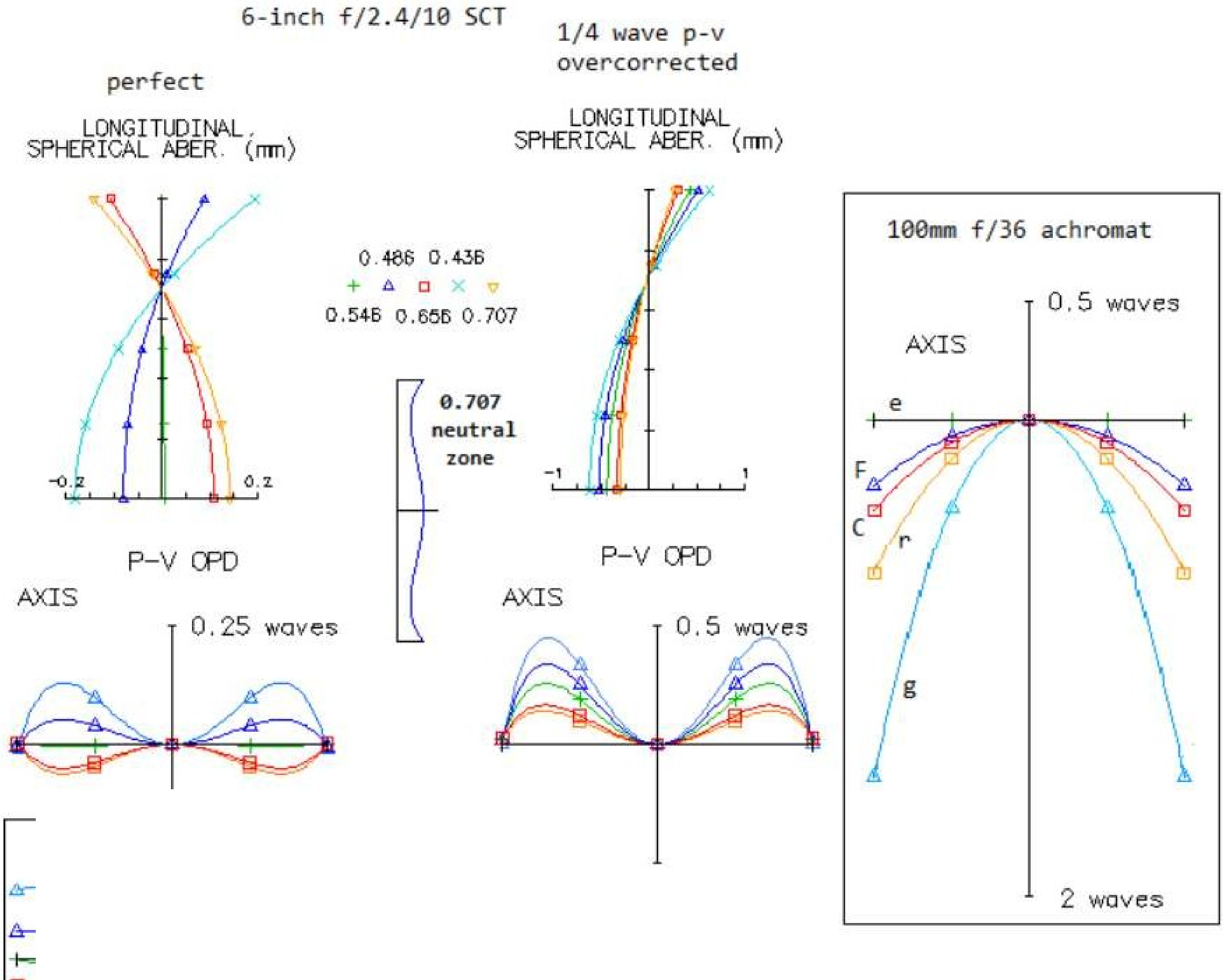
Pas besoin d’être à haute latitude



SEPTEMBER 6th, 2020
05:08:12 UTC

L’aventure continue !


SEPTEMBER 6th, 2020
05:08:12 UTC
E. Enzm


6-inch f/2.4/10 SCT
perfect
LONGITUDINAL SPHERICAL ABER. (mm)
-0.2
0.2
P-V OPD
AXIS
0.25 waves
0.486 0.436
0.546 0.656 0.707
0.707 neutral zone
1/4 wave p-v overcorrected
LONGITUDINAL SPHERICAL ABER. (mm)
-1
1
P-V OPD
AXIS
0.5 waves
100mm f/36 achromat
0.5 waves
AXIS
e
F
C
r
g
2 waves