

The Origins of Patchy Aurora at Jupiter

A. Daly¹, W. Li¹, Q. Ma^{1,2}, X.-C. Shen¹, V. Hue³, G. Clark⁴, T. K. Greathouse⁵, G. R. Gladstone^{5,6}, B. H. Mauk⁴, W. S. Kurth⁷, G. B. Hospodarsky⁷, F. Allegrini^{5,6}, and S. J. Bolton⁵

¹Center for Space Physics, Boston University, Boston, MA, USA.

²Department of Atmospheric and Oceanic Sciences, University of California, Los Angeles, CA, USA.

³Aix-Marseille Université, CNRS, CNES, Institut Origines, LAM, Marseille, France.

⁴The Johns Hopkins University Applied Physics Laboratory, Laurel, Maryland, USA.

⁵Southwest Research Institute, San Antonio, Texas, USA.

⁶University of Texas at San Antonio, San Antonio, Texas, USA.

⁷Department of Physics and Astronomy, University of Iowa, Iowa City, IA, USA.

Content

Supplementary Notes

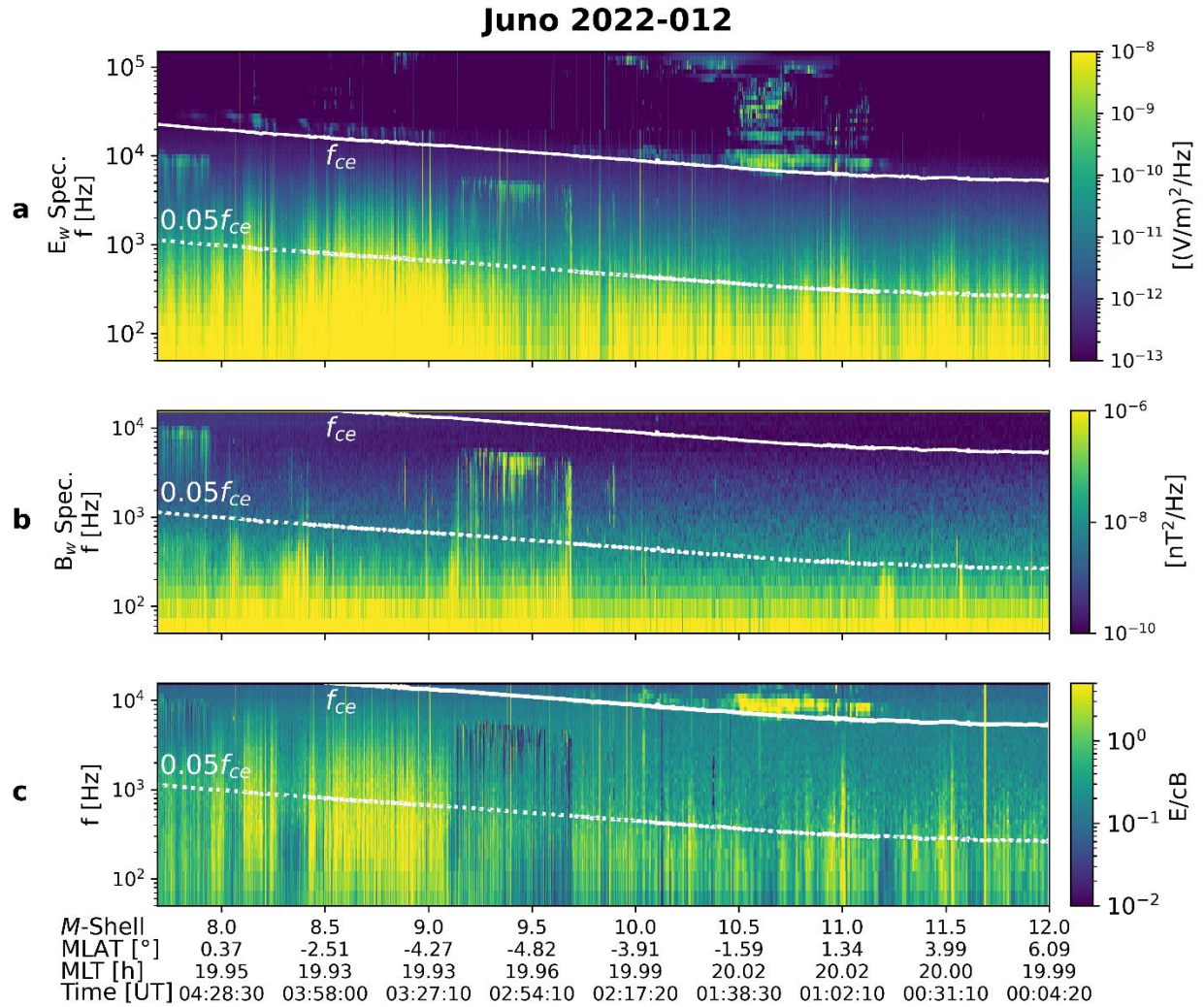
1. Equatorial observations of plasma waves on 12 January 2022

Supplementary Fig. 1 shows the wave electric spectrogram, wave magnetic spectrogram, and E/cB ratio for equatorial observations on 12 January 2022. Here, E/cB represents the ratio of wave electric to magnetic power (where c is the speed of light) from 50 Hz to 20 kHz. For electromagnetic whistler-mode waves propagating parallel to the magnetic field with right-hand polarization, E/cB is expected to be less than 1. The identification of whistler-mode waves by E/cB is also in agreement with the frequency range of the observed waves, falling between $0.05 f_{ce}$ and f_{ce} for whistler-mode chorus waves, and below $0.05 f_{ce}$ for whistler-mode hiss waves.

2. UVS observations of auroral patches over a 97-minute period during PJ 39

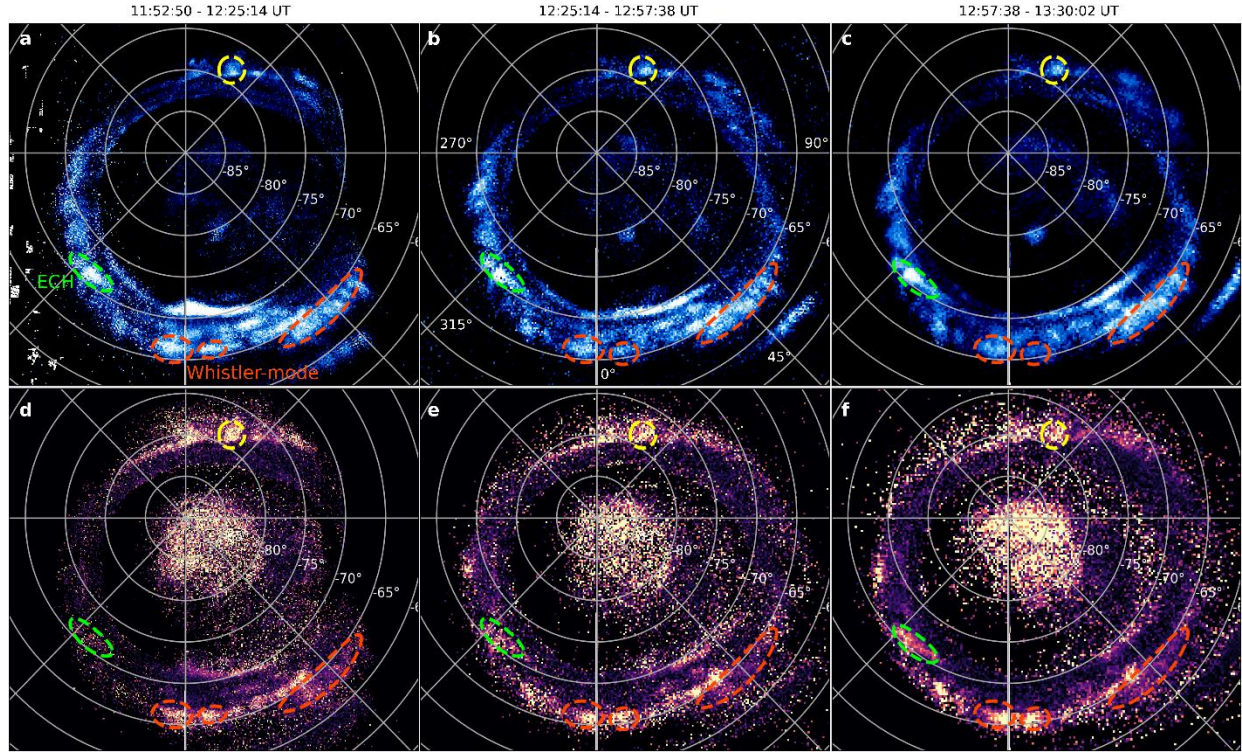
Supplementary Fig. 1 shows the evolution of auroral brightness and color ratio from 11:52:50 UT to 13:30:02 UT on 12 January 2022. During this interval, the auroral patch associated with ECH waves remains persistent, as reflected in both brightness and color ratio maps. Similarly,

auroral patches associated with whistler-mode waves also persist, although their brightness diminishes over time. These observations suggest that the auroral patches are relatively stable features with lifetimes of at least a few hours, albeit with some variation in their brightness. This persistence supports the assumption that corotation is maintained during the 7–12 hour separation between the equatorial and UVS observations.



Supplementary Fig. 1. Equatorial observations of plasma waves on 12 January 2022.

a Wave electric spectrogram from 50 Hz to 150 kHz, with solid and dotted white lines representing f_{ce} and $0.05f_{ce}$, respectively; **b** Wave magnetic spectrogram from 50 Hz to 20 kHz; **c** Ratio of wave electric to magnetic power (E/cB , where c is the speed of light) from 50 Hz to 20 kHz as a function of M-shell.



Supplementary Fig. 2. UVS observations of auroral patches over a 97-minute period during PJ 39. **a-c** Averaged auroral brightness during the time intervals 11:52:50–12:25:14 UT, 12:25:14–12:57:38 UT, and 12:57:38–13:30:02 UT, respectively, shown in left-handed System III coordinates. Relevant auroral patches are marked by circles: green for ECH wave-associated patches, red for whistler-mode wave-associated patches, and yellow for patches related to low-altitude observations. **d-f** Corresponding averaged color ratio maps for the same time intervals as **a-c**.