

Juno-UVS and Chandra Observations of Jupiter's Polar Auroral Emissions

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Abstract

The Juno spacecraft polar orbit provides an excellent platform for observing Jupiter's bright and transient polar auroral emissions [1]. These emissions occur as flares at far-ultraviolet (FUV) wavelengths [2], which have been associated with X-ray bursts [3]. During 2017, joint Juno-UVS and Chandra HRC-I observations are being executed during four Juno perijoves to further investigate these polar auroras.

1. Polar Emissions

Ultraviolet and X-ray observations of Jupiter's auroras have provided valuable insights into the fundamental processes of charged particle acceleration and the resulting currents in Jupiter's magnetosphere [4]. The cusp or active regions of Jupiter's polar auroras are the site of highly-variable X-ray, FUV, and thermal-IR auroral emissions. The northern hot spot is typically found near a system III longitude of 170° and latitude of 65° (easily seen from Earth), and the corresponding southern region is visible when conditions are favorable, as they are during the Juno mission when the sub-Earth latitude is as far south as it can be).

2. Juno-UVS and Chandra Support

Juno-UVS is an imaging spectrograph with a bandpass of $70 < \lambda < 205$ nm [5]. This wavelength range includes important far-ultraviolet (FUV) emissions from the H₂ bands and the H Lyman series which are produced in Jupiter's auroras, and also the absorption signatures of aurorally-produced hydrocarbons. A flat scan mirror situated near the

entrance is used to observe at up to $\pm 30^\circ$ perpendicular to the Juno spin plane. Tantalum surrounds the spectrograph assembly to shield the Juno-UVS MCP detector and its electronics from high-energy electrons. The purpose of Juno-UVS is to remotely sense Jupiter's auroral morphology and brightness to provide context for in situ measurements by Juno's particle instruments.

Using Chandra's HRC-I camera, we are monitoring auroral X-ray emissions from Jupiter when the cusp region is in a good location for simultaneous observations by Juno-UVS and Chandra. Half the observations are planned to focus the northern cusp and half on the southern cusp. Our primary goal is to study the morphology of the cusp region emissions, comparing simultaneous high-spatial resolution Chandra HRC-I observations with very-high spatial resolution Juno-UVS observations to test different physical theories of the source of the emissions.

During 2017, joint Juno-UVS and Chandra HRC-I observations are planned for PJ4, PJ5, PJ6, and PJ7, and the results of observations through PJ8 will be presented at EPSC.

3. Initial Results

Initial results for PJ4 are shown in Figs. 1-3, where transient southern polar FUV emissions decrease markedly in brightness during the same period as a large decrease in auroral X-ray brightness. Maps of the X-ray emissions will be compared with the FUV maps to investigate these polar auroras further.

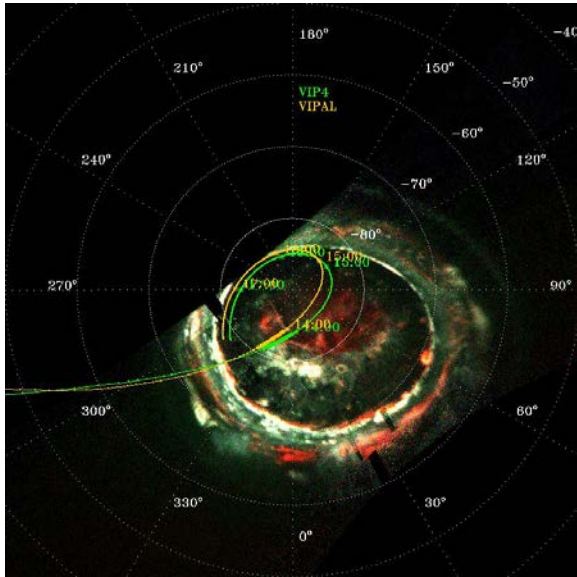


Figure 1: False color map of the southern aurora observed by Juno-UVS in during PJ4 on 2 February 2017 13:50-14:00. Red colors indicate high FUV color ratios. Juno magnetic footprints according to VIP4 and VIPAL are indicated by green and yellow lines, respectively, which are thicker for the 10-minute period when Juno-UVS data were taken.

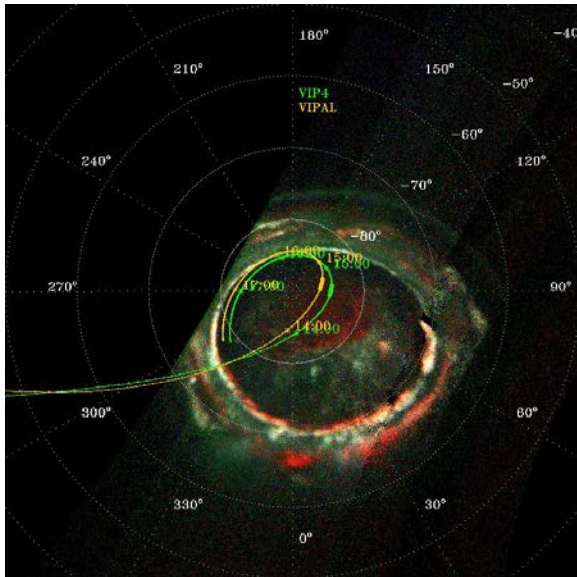


Figure 2: As in Fig. 1, but for 14:30-14:40. The polar emissions are distinctly fainter at this time than during the 40-minute earlier period of Fig. 1.

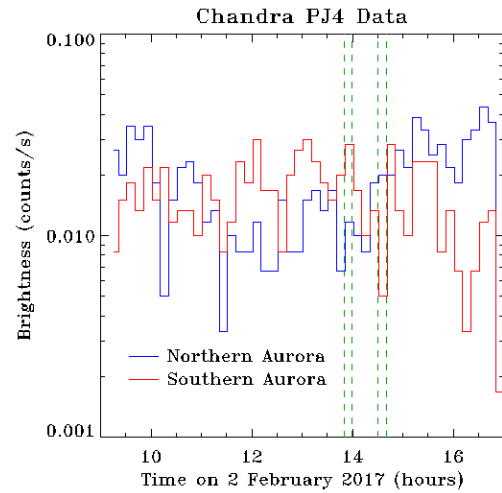


Figure 3: Histograms of X-ray count rates from the northern and southern auroras as observed by Chandra HRC-I during PJ4, corrected for one-way light time. The left and right pairs of vertical dashed green lines show the times presented in Figs. 1 and 2, respectively. Note the $\sim 6\times$ drop in X-ray brightness between these two periods, consistent with the drop in FUV brightness.

Acknowledgements

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