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Observations of Jupiter by the Juno Ultraviolet Spectrograph (Juno-UVS)

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Abstract

We present an overview of the science performed by Juno's Ultraviolet Spectrograph, UVS, over the first 11 successful perijove sequences performed since orbital insertion on July 4th, 2016. In particular, we will discuss 1) the measured local time dependence of Jupiter's polar auroral emissions, 2) simultaneous UV and H_3^+ observations and their correlations or lack thereof, 3) the evolution and morphology of Io's magnetic footprint in Jupiter's atmosphere, 4) measurements concerning the spatial and temporal variation of high energy particles (>10 MeV) in the polar regions of Jupiter's magnetosphere, and 5) the production of an all sky UV stellar atlas at wavelengths between 68 and 210 nm.

1. Introduction

Juno [1] is a NASA New Frontiers mission currently on a highly elliptical polar orbit around Jupiter, since 4 July 2016, and has successfully gathered science data during 11 perijove sequences. It offers a unique opportunity to measure in situ particles and fields simultaneously with remote sensing of H_3^+ and UV auroral emissions. These emissions serve as a viewing screen for the events and dynamics occurring throughout much of the Jovian magnetosphere. The Juno Ultraviolet Spectrograph (UVS) [2] is a UV spectrograph, with a bandpass spanning 68 to 210 nm, designed to characterize Jupiter's UV emissions. In this presentation we offer an overview of results obtained from using UVS through the first 11 perijoves of the mission.

2. Results

2.1 Local time variations of auroral polar emissions

Juno-UVS measurements of the night side aurora have revealed a pronounced local time effect on polar auroral emissions, i.e., within the main auroral oval. Previous ground-based observing campaigns have shown that this polar auroral region is very structured, with distinct regions characterized by high color ratios (i.e. deeper UV emissions). Juno allows us to characterize, for the first time, the day/night variations of these polar auroral emissions, providing insights on the ionospheric / outer-magnetospheric coupling.

2.2 Comparisons of UV emissions and Near-infrared H_3^+ emissions

Simultaneous views of the entire Jovian aurorae at high spatial resolutions in the UV and NIR shed light on correlations between these two types of emission [3]. Although both auroras ultimately result from the precipitation of energetic electrons, the prompt nature of the H_2 and H UV transitions versus the more circuitous H_3^+ emission mechanism leads to some very distinct differences between them.

2.3 Variability of Io's footprint

Previous observations by the Hubble Space Telescope allowed the characterization of the Io footprints as a function of Io's centrifugal latitude, despite the observational bias of Earth-based viewing. Juno's unique vantage point in the Jovian system removes these biases allowing UVS access to the full range of Io's centrifugal latitude for all possible local time geometries. We will present results on the

variability of the footprint emitted power as a function of Io's system III longitude and local time.

2.4 High Energy radiation in Jupiter's polar environment

Juno-UVS is sensitive to high-energy electrons and gamma-rays (>10 MeV) providing another way for Juno to probe Jupiter's radiation environment. These measurements are used to (i) refine radiation models of Jupiter, (ii) improve future Juno-UVS observation planning by providing an empirical model of the radiation levels and (iii) to provide high-cadence measurements of the radiation in the polar auroral region, in support of Juno's particle instruments.

2.5 All sky map in the Ultraviolet

As a side effect of Juno's spin, Juno-UVS also provides a rich dataset of the stellar and galactic UV emission in the 68 to 210 nm bandpass. More than 99% of the sky has been mapped since launch, with an accumulated integration time greater than 1 hour in several regions of the sky.

3. Summary and Conclusions

During its first 11 of the planned 32 orbits, Juno has produced a treasure trove of new results, baffling scientific conundrums, and exquisite imagery sparking the imagination. We look forward to how the future orbits of Juno will further inform our understanding of Jupiter's atmosphere and magnetosphere.

Acknowledgements

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References

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