EPSC Abstracts
Vol. 8, EPSC2013-301, 2013
European Planetary Science Congress 2013

Night-time emission from Jupiter's ionosphere

T. Stallard(1), H Melin(1), S. Miller (2), S. Badman(1), K. Baines(3), J. Blake (1) and J. O'Donoghue (1)
(1) University of Leicester, UK (tss@ion.le.ac.uk), (2) University College London, (3) University of Wisconsin

Abstract

We present H_3^+ nightside emission from Jupiter, using data taken during the Cassini flyby in 2000-2001, showing that the auroral region appears broadly similar to the dayside H_3^+ emission, while the sub-auroral regions have a significantly different intensity. We conclude dayside mid-to-low latitude emission is largely the product of a ∼300K temperature gradient between the auroral region and the equator. We also provide the first measurements of nightside temperatures in the upper atmosphere, which are broadly similar to the dayside, highlighting the importance of auroral heating to the total neutral temperature.

1 Introduction

Although emission from Jupiter's main auroral features are well understood, the H_3^+ emission seen equatorward of the Io spot and trail are far less well explained. This emission, described as 'mid-to-low latitude' emission was first detected by Lam et al [1997]. Miller et al. [1997] made a more detailed analysis of this region and showed that emission levels are strongly dependant upon latitude and longitude and the existence of H_3^+ at these latitudes are likely to be explained only by either transport from the auroral regions, or in situ particle precipitation. Since transport of H_3^+ appears difficult over a wide region of Jupiter's ionosphere, most papers have evoked the latter explanation of how 'mid-to-low' latitude emission is formed.

2 Observations

The Cassini spacecraft passed Jupiter on its way to Saturn, with Cassini reaching closest approach on the dawn flank of the planet, close to the equatorial plane on Dec. 30, 2000, at a distance of 136RJ. During this flyby the VIMS instrument took data of Jupiter between Nov. 16, 2000 and continued until February 28, 2001 Our study combines these individual images, like those shown in Figure 1 into a longitude-latitude map of H_3^+ emission measured on the night side of the planet, as shown in Figure 2.

Using this mapped H_3^+ emission from multiple IMS wavelength bins, it is then possible to combine them into latitudinal profiles of both emission and temperature.

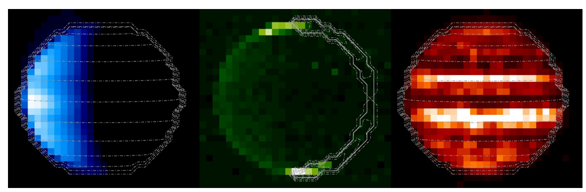

Figure 1: An example set of three images, taken at three wavelengths: 2.70 micron (left, reflected sunlight), 3.42 micron (centre, H_3^+ emission) and 5.04 micron (right, thermal emission).

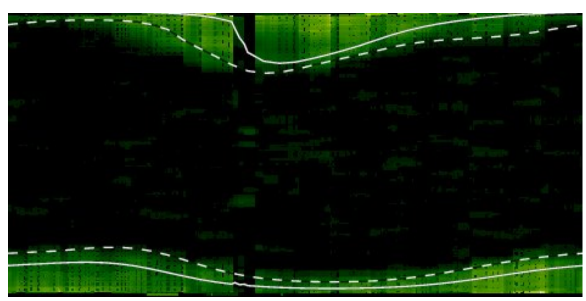

Figure 2: Intensity maps of the nightside H_3^+ emission, gridded in longitude in the x-axis and latitude in the y-axis (with a pixel representing one degree in each dimension). Magnetic mapping for the main oval and Io spot are also shown.

3 Profiles of intensity

Scaling the VIMS H_3^+ latitudinal profiles allows us to directly compare the nightside latitudinal profile with both the integrated dayside profile and each individual H_3^+ emission component modelled by Rego et al. [2000] (Figure 3). The broad-scale structure of each dataset are morphologically similar, as both are dominated the main auroral emission. The nightside emission appears to be strongly correlated to the mapped locations of the main aurora and Io spot. In sub-auroral regions, there are significant differences in the equatorial emission on the dayside and nightside. The min difference occurs in the lack of EUV ionisation, but the region in which the mid-to-low latitude emission exists on the dayside has comparatively little emission on the nightside, with a very weak mid-to-low latitude emission observed.

We also measure temperatures that represent the auroral average temperatures over an extended period of 16 days, with the north pole having an average temperature of 1116K, and the south pole an average of 957K.

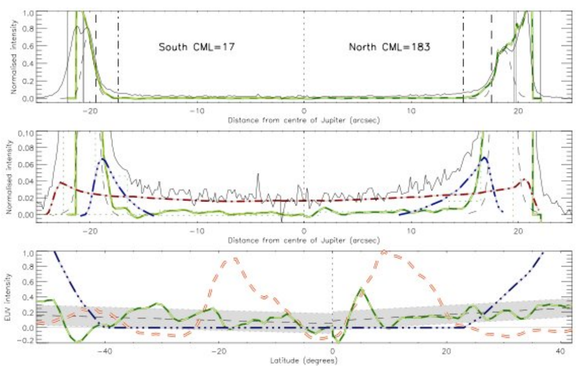

Figure 3: The profile of H_3^+ emission along the rotational axis of the planet at three different scalings, normalized (top), at 10% peak emission (middle) and normalized to the EUV emission on the dayside (bottom). This figure also shows the different contributions modeled by Rego et al. [2000].

4 Conclusion

We conclude that the dearth of H_3^+ on the nightside is not inconsistent with dayside mid-to-low latitude emission, if such emission is generated by H_3^+ ions produced by solar EUV, then heated by auroral processes. There is also a small particle precipitation source of H_3^+ on the nightside of the planet, but this results in a maximum of 40% of the H_3^+ emission measured on the dayside of the planet.