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Mapping 300 eV electrons at Saturn with the Cassini RPWS Langmuir probe

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Abstract

The Cassini Langmuir probe (onboard RPWS experiment) has provided wealth of information about the kronian cold plasma environment since the Saturn Orbit Insertion in 2004. The usage of the Langmuir probe is based on the fitting of the current-voltage curve which brings information on several plasma parameters in cold and dense plasma regions. The ion part of the I-V curve may however be influenced by energetic particles hitting the probe, leading to an enhanced ion current measured. We report here the influence of 300 eV electrons on the probe current, with a current belt observed between Dione and Rhea.

1. Introduction

The mapping of the ion current measured by the Langmuir probe during 4 years of mission revealed a belt feature (Fig. 1) near the Dione-Rhea L shells. This feature is related to the current induced by secondary electrons removed from the probe by the impact of energetic particles (electrons or ions).

2. A belt induced by suprathermal magnetospheric electrons

The identification of the particles leading to the belt observed needs two steps : extracting the current induced by the impact of energetic particles from the total current measured, and looking for correlations with plasma data.

The extraction of the "energetic current" was performed during several events, where dust or thermal ion contributions could be avoided or estimated. The analysis of CAPS and MIMI data revealed a strong correlation between this current and the 300-400 eV electrons fluxes.

3. Why such a belt ?

The analysis of suprathermal electrons shows a maximum density/temperature region at the same L shells (6-10 Rs), inducing strong fluxes and thus explaining the feature observed with the probe.

This corresponds to a key boundary region connected to the Saturn ionosphere through field-aligned currents with an associated UV auroral oval recently observed (Grodent et al., 2010).

4. Figures

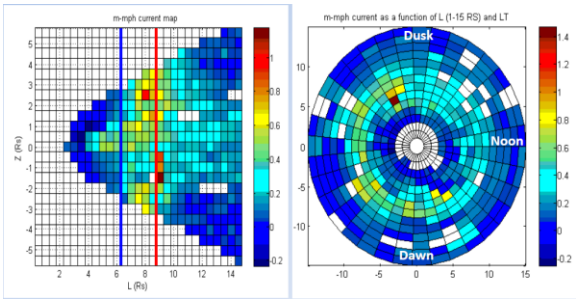

Figure 1: Mapping of ion current as a function of L shell (left) or local time and L (right)

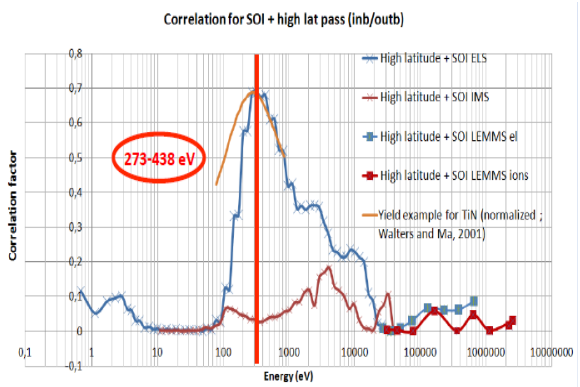

Figure 2: Analysis of the correlations between the variabilities of the LP ion current measured and the ambient electron/ion fluxes (CAPS and MIMI)

5. Summary and Conclusions

The Langmuir probe onboard Cassini is not only sensitive to cold plasma, but also to the impact of energetic particles (300-400 eV electrons) leading to a current driven by secondary electrons. The slope of the I(V) curve appears as a useful criteria to identify the perturbed regions. An energetic "current belt" is observed where the flux of suprathermal electrons is maximum (around Dione and Rhea L shells), in a key region related to the Saturn ionosphere through field aligned currents. The maximum electron yield couls be estimated during several events. This ongoing work will be useful for several missions with similar probes (Rosetta, JGO, BepiColombo).

References

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[3] Grodent et al., On the origin of Saturn's outer auroral emission, Journal of Geophysical Research, Volume 115, 2010.