EPSC Abstracts,
Vol. 4, EPSC2009-794, 2009
European Planetary Science Congress,

The remote sensing of plasma density fluctuations by multi spacecraft Cluster observations of chorus emissions

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Abstract

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Plasma density irregularities are ubiquitously present in the magnetosphere. They occur at scale lengths ranging from a few meters to several hundred kilometers and even larger. These density irregularities result in fluctuations of the refractive index of whistler waves. Inter-satellite cross correlation signal analysis of whistler wave's phases and amplitudes allows one to propose the method of restoration of the statistical properties of the refraction index fluctuations in plasma that opens the way of reconstruction of similar properties of density fluctuations. We demonstrate here an application of this technique using Cluster WBD measurements of chorus type whistler waves. Using correlations between the same chorus elements observed in different points of space we obtain statistical characteristics of plasma density fluctuations and evaluate the properties of the spatial distribution of irregularities. The cross correlation analysis technique gives an opportunity to estimate characteristic spatial scale of a source region of chorus generation. The results obtained are in a good agreement with the Cluster EWF plasma density variations measurements. The proposed technique is of a special interest when any additional information is not available. Thus whistler waves multi-point studies can be used as a powerful tool for remote sensing of statistical properties of plasma irregularities.