OBSERVATIONS OF NATURAL WAVES CLOSE TO MAGNETIC EQUATOR INSIDE PLASMASPHERE BY WHISPER/CLUSTER.

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I. INTRODUCTION

Plasmasphere is a large toroïdal region of the inner magnetosphere, composed by dense (10–1000 particles/cm^3) ion and electron populations of ionospheric origin trapped along magnetic field lines. At the magnetic equator, its typically extends out to distances of a few Earth radii (4-5R_E). At this distance, the plasmasphere terminates abruptly over a narrow boundary layer where the density decreases from 100–1000 particles/cm^3 to a few particles/cm^3 known as the plasmapause [1].

In the equatorial region, the plasma is non-collisionness and the energy transfer between different particle populations can happen only through the waves. The magnetic field varies slowly, so it is a favoured area were wave-particle interaction and wave generation can take place.

Several kinds of natural emissions were observed in this region by previous missions, GEOS [2], Dynamic Explorer [3], such as plasmaspheric hiss and chorus which appear below the electron gyrohamonic f_{ce}, or bandwidth emission at (n+1/2) f_{ce}. In this work, we are particularly interested by the (n+1/2) f_{ce} emissions using WHISPER/CLUSTER observations.

II. WHISPER OBSERVATIONS

CLUSTER mission [4], launched in July-August 2000, is a constellation of four identical satellites in a tetrahedron layout with a polar orbit (perigee at 4 R_E, apogee at 19.6 R_E). The perigee passes provide excellent opportunities to study plasmapause equatorial regions. The Wave of HIgh frequency and Sounder for Probing of Electron density by Relaxation (WHISPER) instrument [5] records the natural waves and make a diagnostic of the electron density n_e using the sounding technique in the bandwidth 2-83 kHz, the electron density is related to the plasma frequency by $f_p(khz) = 9\sqrt{n_e(cm^{-3})}$. Comparing with other studies in these regions, the CLUSTER fleet allows us to do a spatial study of the structure of theses emissions.

In this work, we are studying natural emissions observed by the Cluster fleet near the magnetic equator. An example of a plasmasphere crossing with (n+1/2) fce emission is presented in the WHISPER spectrogram (fig. 1). In the 19 July 2003 case event, Cluster 3 spacecraft crosses the plasmasphere from 6h00UT to 9h00 UT. Near 7h30 UT intense emissions are observed at a few degrees of magnetic latitude, below the local plasma frequency as shown in the figure with white colour. These emissions appear as bandwidth emissions in an harmonic feature. Their frequency separation is about the local gyrofrequency f_{ce}.

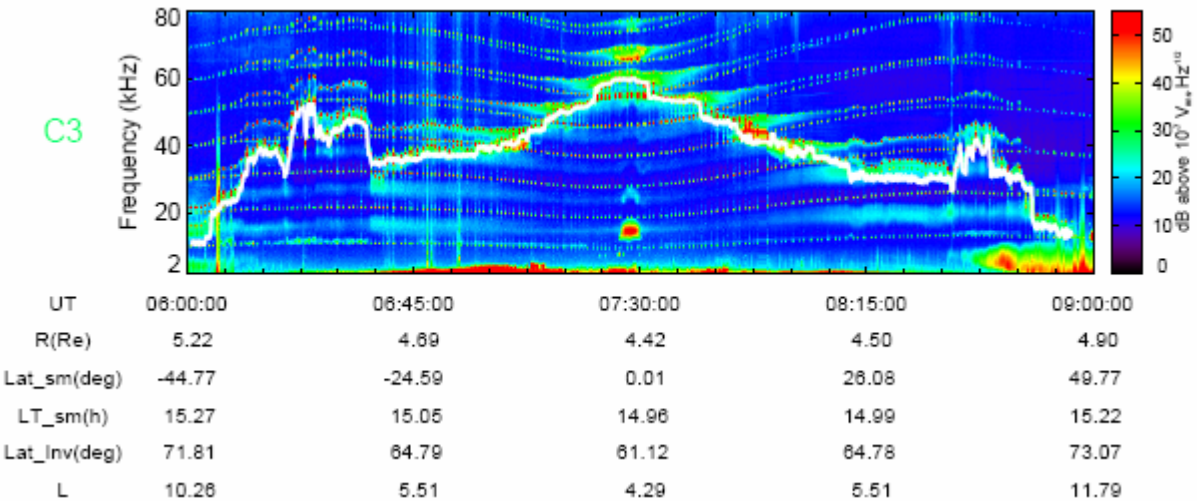

Fig. 1 WHISPER spectrogram by SC3 on the 19 July 2003 plasmasphere crossing.

III. STATISTICAL STUDY .

A statistical study of the location of these intense waves is presented. Their L shells distribution and their magnetic local time dependence are shown. For this work, data of the years 2002, 2003, 2004 have been used, where the four satellites have various radial separations distance from 100 km to 1000 km.

The satellite SC3 is chosen as reference, on a total of 397 plasmasphere crossings, 254 observations of intense waves are observed so 63.22%. The occurrence probability of these emissions is shown on figure 2 with an R-LT segment representation. The observations are normalized to the location of the SC3 orbit. The probability appears as a coded color bar. The white crosses are the observed events and the black circles correspond to a perigee pass without observation.

As we can see, the maximum probability occurs at the morning sector, according to previous observations [2, 3], with an apparition at all magnetic local time LT, the R location corresponds to the CLUSTER fleet perigee pass.

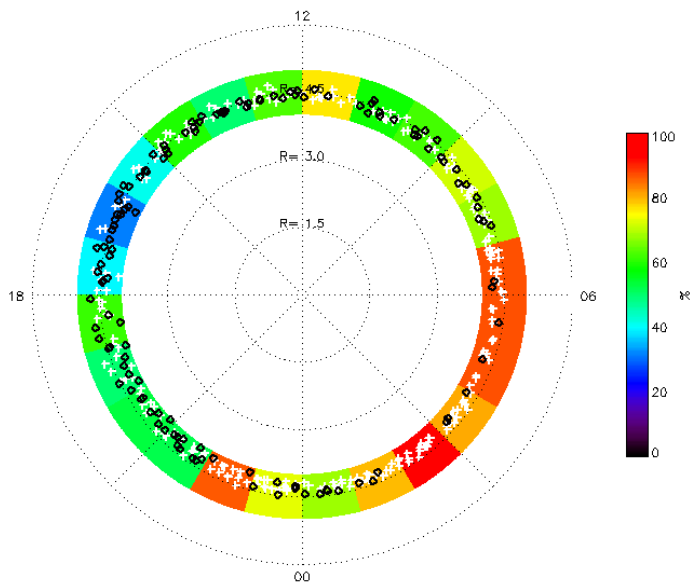

Fig. 2 R-LT distribution of (n+1/2)fce.

IV CONCLUSION

The good sensitivity of the WHISPER instrument and the well adapted orbit of the cluster missions allow a precise study of the waves near magnetic equator. First, the frequency feature of the waves has been recognized, with a frequency separation about the local gyro frequency. Then geophysical behaviour has been established, maximum occurrence of the apparition of the (n+1/2) emissions occurs in the morning sector according to previous observations.

SAMPLE REFERENCES

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