ELECTRON DENSITY DETERMINATION INSIDE THE AURORAL AND PLASMAPHERIC REGIONS FROM INTERBALL-2 AND CLUSTER WAVE MEASUREMENTS

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ABSTRACT

INTERBALL 2 and CLUSTER tetrahedron cross various regions where the electron density can be low i.e.: the plasma frequency Fp is less than the electron gyrofrequency Fce. Electron population is so weak (less 1 particle per cm^3) that the determination of the density is often difficult.

Both the MEMO and NVK ONCH experiments onboard the auroral probe INTERBALL-2 perform simultaneous VLF waves measurements in the frequency range from 10 Hz to 20 kHz. Analogic NVK ONCH data are continuously recorded for two components : one electric component Ey and one magnetic component Bx. MEMO experiment is able to snap up several time intervals with the full waveform of the three magnetic components and two electric components.

The Wave of High frequency and Sounder for Probing of Electron density by Relaxation (WHISPER) performs the measurement of the electron density on the four satellites of the CLUSTER project. The two main purposes of the WHISPER experiment are to record the natural waves and to make a diagnostic of the electron density using the sounding technique. The various working modes and the fourier transforms calculated on board provide a good frequency resolution obtained in the bandwidth 2-83 kHz and a well instrumental adaptability to determine the electron density in various plasma.

The natural wave recorded by the both projects (INTERBALL 2 and CLUSTER) exhibit various lower and upper cut-off which correspond at local characteristics frequencies of the wave propagation. A careful examination of the natural wave propagation characteristics can give us information about the plasma dispersion. It is well-known that some regions of the frequency/wave number (w, K) domain are forbidden to wave propagation. The limits of these forbidden regions depend strongly of the magnetic field and the plasma density. Reflection and absorption processes take place close to these limits and point out the plasma properties. In particular with the condition Fp < Fce the extraordinary wave propagating with Z polarisation become evanescent and has a cut-off frequency below the plasma frequency.

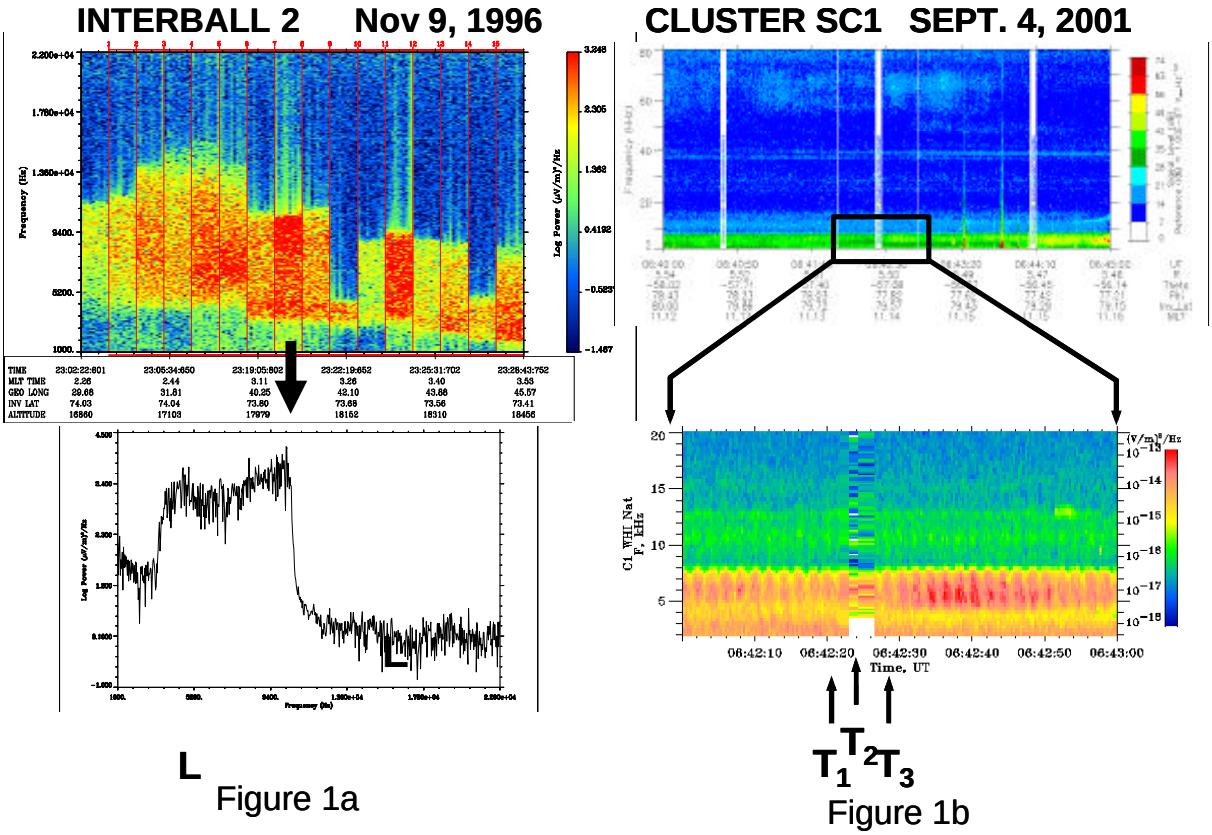

Figure 1a

Figure 1b

Figure 2a and 2b show examples of INTERBALL and CLUSTER data where waves exhibit clearly shape upper and lower cutoffs. Using the waveform of the INTERBALL data, the waves close to the lower cutoff are detected with a left-handed polarization while the waves close to the upper cut-off are right-handed polarized. This result is perfectly consistent with the Z mode propagation.

Moreover, at highest frequency, it exists at each Fce harmonic *n* a forbidden band between Bernstein mode Fq*n* and a frequency cut-off Fco*n*. The value of theses cut-off frequencies is dependent on the plasma frequency. So, the identification of these limits allows us to deduce electron density estimation The waveform data recorded by INTERBALL and the determination of the Fpe given by the WHISPER/CLUSTER sounder are used to understand the VLF waves feature. An interpretation is proposed with the aim to determine an estimation of the local electron density using the natural waves.