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Automatic identification of coherent EMIC rising tones

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Density gradients, as observed at the plasmapause, have been known for a long time to enhance growth of ElectroMagnetic Ion Cyclotron (EMIC) waves. When the linear amplification saturates, non linear processes lead to formation of wave packets with increasing frequency. Such EMIC triggered emissions are also called EMIC rising tones according to their frequency-time dispersion. EMIC triggered emissions with the largest dispersion are found in the vicinity of the plasmapause and plasmaspheric plumes. In addition to their typical shapes, EMIC rising tones have been shown to be more coherent than the surrounding EMIC waves.

We propose here an automatic detection technique for EMIC triggered emissions based on these two aspects: enhanced coherence value and rising tone shape. We consider two data sets from different instruments onboard the four Cluster satellites: STAFF-SC (magnetic search coils) and FGM (fluxgate magnetometers). EMIC can be observed in the frequency range covered by these two instruments (with an overlap). First, spectral matrices are obtained from magnetic waveforms. Second, the polarization plane is obtained by the singular value decomposition method. Finally, the coherence in that plane is calculated as abs(R12)/sqrt(R11*R22) where R12 is the cross-power spectrum and R11 and R22 are the auto power spectra calculated over several bins of the spectral matrices. The specificity of our method is to consider a rising-tone shape for the coherence value estimation.

Time intervals where rising tones have already been observed are considered to define the most appropriate shape and thresholds for coherence and for the total magnetic field power spectral density. Outputs obtained from the two data sets and newly reported cases of EMIC coherent rising tones are discussed.