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Low frequency wave dispersion relations in the outer cusp

derived from the Cluster magnetic field measurements.

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One of the most interesting and complicated tasks of the space plasma experimental study is getting of the information about the wave dispersion relations. The Cluster multi-point measurements of the field and plasma fluctuations gave a valuable contribution in resolving of the first (experimental) part of this problem. The second part includes the development of adequate data processing methods by means those one can extract the dispersion dependences from the measured waveforms. As it is known, such methods, based on the phase delays calculation, where developed and gave opportunity to identify wave modes in several specific cases. But these methods are very limited to applying. The analyzed wave number range was limited by the waves, which lengths where greater than the average inter-spacecraft distance (due to indefinite number of the complete periods which are keeping within the spacecraft separation space in the case of the shorter waves). However, as it was shown in [1] on the base of the analysis of real phase shift distributions, one can develop a suitable algorithm allowing to overcome this threshold and spread a wave analysis in a short wave region. The new phase difference method, based on this algorithm, was apply to processing of the Cluster magnetic measurements in the exterior Earth cusp region on February 13, 2001 from 19:54:00 to 20:16:00 UT. It was done for 90 s intervals, moved with the step 12 s inside the mentioned time interval, and the information about wave properties was obtained along of the Cluster trajectory from the outer cusp region till the magnetosphere. The dispersion relations were obtained for the first time in the wave number range from 0.002 to 0.20 rad/km (wave lengths from $\sim$ 3000 to $\sim$30 km, thou the

average spacecraft separation was $\sim$ 550 km, and minimal $\sim$ 375 km). The polarization and damping properties of all wave components have been also got. The founding wave properties, even those treated to one realization, show a vast variety. Some of the waves have phase velocities, polarizations and wave vector directions relatively to the background magnetic field near to those predicted by ideal MHD theory, the others can be compared with the two fluid and kinetic theories, but a considerable part of them represent the unknown type of waves. The last is especially treated to the high turbulent regions. Practically all of the getting results demonstrate that ion cyclotron resonance plays the important role in the formation of main wave structures in all of these regions.

[1]. S. A. Romanov. The founding of the low frequency wave dispersion in the space plasma by the results of multi-spacecraft measurements. August 2006. “Cosmic research” (in press)