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ULF waves and plasma stability in different regions of the magnetosheath

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We present a statistical study of the occurrence and properties of ultra low frequency waves in the magnetosheath and interpret the results in terms of the competition of mirror and Alfvén-ion-cyclotron (AIC) instabilities. Both mirror and AIC waves are generated in high beta plasma of the magnetosheath when ion temperature anisotropy exceeds the threshold of the respective instabilities. These waves are frequently observed in the terrestrial and planetary magnetosheaths, but their distribution within the magnetosheath is inhomogeneous and their character varies as a function of location, local and upstream plasma parameters.

We studied the spatial distribution of the two wave modes in the magnetosheath together with the local plasma parameters important for the stability of ULF waves. This analysis was performed on a dataset of all magnetosheath crossings observed by Cluster spacecraft over two years. For each observation we used bow shock, magnetopause and magnetosheath flow models to identify the relative position of the spacecraft with respect to magnetosheath boundaries and local properties of the upstream shock crossing. A strong dependence of parameters characterizing plasma stability and mirror/AIC wave occurrence on upstream Θ_{Bn} and M_A is identified. The occurrence of mirror and AIC modes was compared against the respective instability thresholds and it was observed that AIC waves occurred nearly exclusively under mirror stable conditions. This is interpreted in terms of the different character of non-linear saturation of the two modes.