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Statistical study of ULF wave fluctuations at the magnetopause: latitude and local time dependences, as an input for understanding the ULF role in particle penetration from the solar wind into the magnetosphere

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Strong ULF wave activity has been observed at magnetopause (MP) crossings since a long time. Those turbulent like waves are possible contributors to particle penetration from the Solar Wind to the Magnetosphere through the magnetopause.

A previous Cluster study on this subject by Attié et al. [2008] relies on this analysis of 130 magnetopause crossings undergone by the Cluster fleet during the time period July 2001 June 2003. This work clearly shows the key role played by the rotation of the magnetic field in the boundary. The other outcome of this statistical study is the role of the solar wind pressure on the ULF wave power density. It has been shown that the level of fluctuations at the magnetopause is larger for higher solar wind pressure and that this correlation persists even when the fluctuation level is normalized to the DC magnetic field, allowing removing the effect of the direct compression of the magnetosphere under conditions of higher ram pressure. This reinforces the idea that the ULF waves observed at the MP have an external source. Due to the polar orbit of Cluster, this study fails to give any conclusion on the dependence of the wave amplitude with either local time or latitude and those with solar wind parameters, the crossings being at variable and high latitude. This is why another study by Cornilleau-Wehrlin et al (2008) has been performed, combining Cluster and Double Star (TC2) data, TC2 orbit being in the equatorial plane. Only 11 events have been found to be coordinated during years 2004 and 2005,$i.e.$ crossing the magnetopause at the same Local Time (LT), within less than 3 hours in UT. From this comparison, no clear dependence in LT has been found; in particular the wave power density is not stronger at noon, in the vicinity of the sub-solar point, than at other LT, the morning hour data showing more dispersed values than afternoon ones. For most of the events occurring at the same Local Time, the wave power density measured by Double Star (at low latitude) is stronger than the one measured by the Cluster spacecraft (at much higher latitude).

In order to confirm or not those results, we take the opportunity of the evolution of Cluster orbit during its prolongation phase, mainly in 2008, to re-investigate the amplitude of ULF waves at low latitude magnetopause crossings as measured by the Cluster STAFF experiment, at different local times, and see how those data organise with solar wind parameters. These results should give inputs for the interpretation of the possible role of the strong ULF waves at the magnetopause in mass and momentum transfer trough the magnetopause.