



## The occurrence of upstream waves in relation with the solar wind parameters

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The occurrence of upstream waves in the foreshock region and their relationship with the solar wind and interplanetary magnetic field parameters are studied from a statistical point of view.

A method for a careful identification of the upstream wave events was developed and applied on Cluster data (2003–2010 years). The results of the statistical analyses confirm that the angle between the bow shock normal direction and the interplanetary magnetic field is the key element for the wave generation; the wave occurrence shows clearly the dependence on the solar wind speed and density.

Moreover, the results show that the foreshock region, where we can observe ULF waves, is characterized by an effective size that decreases with the increase of both the solar wind speed and the wave frequency. In particular, the relationship between the solar wind speed and the wave frequency suggests that the foreshock size is simply a function of the solar wind speed: it becomes smaller when the solar wind speed increases, and, then, the occurring higher frequency upstream waves are confined in a more restricted region.