IMPLICATION OF ALFVÉN WAVES DETECTION IN THE HIGH-ALTITUDE POLAR CUSPS

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ABSTRACT

The magnetospheric polar cusps are located on opened field lines. Thus, they are key regions for transfer of mass and momentum from the magnetosheath to the Earth magnetosphere. Shocked solar wind particles can directly access to the ionosphere through it. Magnetic reconnection process in an open magnetosphere model creates newly opened field lines that are firstly populated with earthward magnetosheath ions. Later, upgoing ions that have been mirrored before reaching down to the ionosphere are also present on these convected lines. The high-altitude cusp is adjacent to the magnetosheath and thus closer to reconnection sites than lower altitude cusp regions known as cusp proper or cleft regions. Cluster mission provides with numerous crossings a real opportunity to characterize this region (Lavraud et al., 2004).
This region presents a strong but not permanent ULF (Ultra Low Frequency) electromagnetic activity. This broadband electromagnetic activity is commonly told to have a local origin suggesting that plasma beams could generate it. Conversely, ion injections from inferred reconnection site are detected in close simultaneity with broadband ULF electromagnetic waves. Even if the plasma distribution function evolution, similar to diffusion process, is well explained by time of flight effect and by latitude dispersion, it has been found traces of heating in mirrored ion distribution function reinforcing the idea that interactions between electromagnetic waves and the plasma take place in this region (Grison et al.).
We applied the k-filtering analysis when the four spacecraft of the Cluster fleet were in small separation in the high-altitude polar cusps (during spring 2002). In many of these bursts, we found that the low frequency part of the electromagnetic spectrum (from 0.1 to 1Hz) is alfvénic. More accurately these waves are kinetic Alfvén waves that have been locally generated. In the auroral regions, downgoing SKAW (Solitary Kinetic Alfvén Waves) are commonly detected, but their origin is not well established. The possibility of the kinetic Alfvén waves generated in the high-altitude cusps to have a causal link with the ones detected at lower altitudes will be presented.
On the other hand, Alfvén waves are also identified, not in the kinetic range, in the electric and the magnetic waveforms and their presences are confirmed with plasma observations. The local origin is not so obvious in this case. The theory of reconnection predicts the generation of an Alfvén wave along a newly reconnected tube, but the simultaneity of wave detection and injected ion detection leads to an apparent paradox because of the difference of time of propagation. Further works are under progress to highlight this point.

References:
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