The theory and numerical modelling of falling frequency VLF emissions in the Magnetosphere

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Abstract

Recently a lot of progress has been made in the numerical simulation and theoretical understanding of rising frequency triggered emissions and rising frequency chorus. Both PIC[3,4,5] and Vlasov[1,2] codes produce risers in the negative inhomogeneity region downstream from the equator. Attempts to simulate falling tones have been less successful however. In this paper using a Vlasov VHS simulation code[1] we confine the interaction region to be the positive inhomogeneity region upstream from the equator, thus suppressing the tendency of the code to only trigger risers. The emission generation region is in reality a thin cylindrical field aligned from which the generated fields radiate out. It is unreasonable to assume the fields radiated from a faller GR are transmitted to the downstream region without spreading loss or damping.

With this change it is found that the VHS code easily and reproducibly triggers falling tones. We present one example for detailed analysis. In accordance with the theory of Omura [3] we find that the sweeping frequency is due entirely to the advective term. It has recently been shown [5] that the non linear resonant particle current component Jb plays a key role in setting up the required spatial gradient of frequency. The plots of in phase current in z/t space point to a generation point upstream from the equator where initial sweep rate is determined by the maximum power relation, namely that inhomogeneity there S=~+0.4. In the generation region itself we find that the current component parallel to Bw (Jb) is positive, whereas it is negative for risers. In addition examination of the resonant particle distribution function reveals an enhanced distribution function 'hill' in the resonant particle trap, which is as expected for positive inhomogeneity factor S, again in contrast to the riser case where one has a 'hole' in velocity space.

References

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