１／４波長モード磁力線共鳴振動の空間分布と共鳴特性について

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A Study of Quarter-Wave ULF Pulsations: Latitudinal Distribution and Resonance Characteristics

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Quarter wave (QW) is one of the modes of standing MHD Alfven waves. This mode is predicted under the condition in which the ionosphere has a strong conductance asymmetry between the two ends of the field line. We have examined the diurnal variation of the local field line eigenfrequency at L = 2.6 using cross-phase analysis of geomagnetic field data. On 27 June 2001 the eigenfrequency was remarkably low near the dawn terminator, and later in the morning, gradually increased to the normal daytime value. The resonance width and damping rate were also estimated from the field line resonance signature. The extraordinarily low eigenfrequency event showed wide resonance width and highly damping.

We compared these observations with simulations of MHD wave modes in a model magnetosphere bounded by realistic ionospheres. For the dawn condition, the wave structure is strongly distorted, which is consistent with the predicted structure of QWs. Its frequency and highly dumping agree with observation well. For these results, the extraordinarily low eigenfrequency event was suspected to be QW.

We have also studied the latitudinal distribution of the quarter-wave modes using data from the MEASURE, THEMIS, CANMOS, and CARISMA magnetometer arrays. The detected eigenfrequencies for L-shell in middle latitudes were remarkably low near the dawn terminator. This occurred when a field line was mapped into the plasmasphere, and one end of the field line was sunlit while the other end was in darkness. However, the eigenfrequencies for higher L-shells were not extraordinarily low. These results suggest that resonant quarter-wave modes were localized in the mid-latitude region, in the plasmasphere, but were not generated at high latitudes even though the ionospheric conditions were strongly asymmetric there. Our previous study showed that the mode transition from quarter wave to half wave depends on the ratio of ionospheric Pedersen conductances between sunlit and dark sides, and is approximately 10. The ionospheric conductances in this study seem to have satisfied this quarter wave generation condition for stations at all latitudes. Therefore another condition may be necessary to explain the latitudinal localization of the quarter wave mode. We relate these findings to the latest results of studies of magnetosphere-ionosphere coupling.