

Quarter Waves Localized in the Plasmasphere

OBANA, Yuki^{1*}; WATERS, Colin L.²; SCIFFER, Murray D.²; MENK, Frederick W.²; LYSAK, Robert L.³;
MOLDWIN, Mark B.⁴; MANN, Ian R.⁵; BOTELER, David⁶; ANGELOPOULOS, Vassilis⁷;
RUSSELL, Christopher T.⁷

¹Osaka Electro-Communication University, ²The University of Newcastle, ³University of Minnesota, ⁴University of Michigan,
⁵The University of Alberta, ⁶Natural Resources Canada, ⁷UCLA, IGPP

The latitudinal distribution of quarter-wave mode ULF pulsations was investigated. We examined the diurnal variation of the local field line eigenfrequency over the latitude range $L=1.7-6.8$ using cross-phase analysis of magnetic data from the MEASURE, THEMIS, CANMOS, and CARISMA magnetometer arrays. The detected eigenfrequencies for L-shell in middle latitudes were remarkably low (1.5-2 times lower than usual daytime value) 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 the typical value is approx. 10. The ionospheric conductances in this study seem to have satisfied this generation condition for stations at all latitudes. Therefore another condition may be necessary to explain the latitudinal localization of the waves. Some properties of quarter wave modes were examined using computer simulations. Our simulation results suggested that the resonance properties of heavily damped quarter mode waves may be masked by cavity mode energy when the cavity resonance is effective. This may control localized distribution of the quarter waves.

Keywords: ULF, magnetosphere-ionosphere coupling, plasmasphere, field line resonance