Generation and Nonlinear Property of ESCH Waves inside Plasmasphere

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Within dynamic spectra of plasma waves and sounder experiment (PWS) on board the Akebono satellite, electrostatic electron cyclotron harmonic waves are frequently observed inside the plasmasphere. After the discovery of the natural (n+1/2)fH emissions in the magnetosphere by the OGO-V spacecraft (Kennel et al., 1970) and interpretation with nonlinear wave particle interaction of ESCH wave (Oya, 1972), generation and nonlinear property of ESCH waves have been recognized as the high temperature and turbulent property of the plasma environment in the magnetosphere with many satellite observations; for example, they are S3-A, IMP-6, Hawkeye-1 and CRESS. On the other hand inside the plasmasphere, ESCH waves inside the plasmasphere has not been studied until the first discovery of plasmaspheric (n+1/2)fH emissions associated with a large geomagnetic storm by the Akebono satellite (Oya, 1991). These plasmaspheric (n+1/2)fH emissions were thought to be generated by the large temperature anisotropy of plasma distribution function caused by the geomagnetic storm.

This paper describes a new type ESCH waves which are observable even in a moderate or quiet state of the geomagnetic activity in the equatorial region of the plasmasphere, with the propagation blanch of the electrostatic resonance (fQn) waves that have been identified by Warren and Hagg (1966) in the topside sounder ionograms. These ESCH waves are named as the equatorial plasmaspheric ESCH (EP-ESCH) waves, because they are mainly observed near the equatorial region of the plasmasphere with a nature of very narrow frequency bandwidth.

As the interesting fact, the EP-ESCH waves are sometimes accompanied by electrostatic plasma waves with a similar character with fDn waves inside the plasmasphere revealing a nonlinear wave particle interaction. The plasma waves are named as fOH emissions. In many cases, the frequency gap between fOH emission and EP-ESCH emission coincides with the electron cyclotron frequency. After the discovery and identification of the diffuse resonance (fDn) (Nelms and Lockwood, 1966; Oya, 1970) and following research for the generation mechanism of the sequence of diffuse resonance (fDn) (Oya, 1971), this wave signature has been understood as the results of nonlinear wave particle interaction of ESCH waves.

The present nature of generation and nonlinear wave particle interactions of ESCH waves and fOH waves gives a new picture for the plasma state inside the plasmasphere. Existence of the nonlinear wave particle interaction reveals a new picture of the plasmasphere with more active and turbulent nature than it has been recognized. Especially, the occurrence probability of EP-ESCH waves near the 2h MLT sector shows almost 100 % of the occurrence of EP-ESCH waves. This tendency is almost the same even in the quiet time plasmasphere condition. Then, it is strongly suggested that there is source of supra-thermal or energetic electrons in the nightside region of the plasmasphere. This generation mechanism should be effective even in the quiet time period of the solar and geomagnetic activities.