Nonlinear wave particle interactions of ESCH waves inside plasmasphere

Takayuki Ono[1]; Atsuki Shinbori[2]; Hiroshi Oya[3]

[1] Department of Astronomy and Geophysics, Tohoku Univ.; [2] Geophys. Inst., Tohoku Univ.; [3] Space Commu. Fukui Univ.

Abstract

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. In many cases, observed ESCH waves reveal a strong nonlinear wave particle interactions as it have been clarified in the topside ionograms as well as in the active plasma in the magnetosphere. 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. Although it has not been recognized as the active plasma region, the plasma wave observations inside plasmasphere reveal strong ESCH emissions, which are thought to be generated by a large temperature anisotropy of plasma distribution function even in a moderate condition of geomagnetic activity. Based on the Akebono satellite observation inside plasmasphere region, we have identified equatorial plasmasphere ESCH (EP-ESCH) wave group, which consists of fQn waves, nfH waves, (n+1/2)fH waves, 1.2 fH waves, and fDn-m (n=2,3,4,; and m=1,2,3) waves.

This paper clarifies the nonlinear wave particle interactions which are taken place inside the plasmasphere, strictly satisfying following frequency relationships; namely,

fDn-m= fQn - mfH (case 1) or fDn-m = fQn - m(1.2 fH) (case 2),

where n and m are integer values satisfying pogitive n-m value.Interesting fact is that the fDn-m waves of case 1 gives the same relation as the nonlinear wave particle interactions which are verified by Oya (1971, 1972) for the plasma turbulence cased by the topside sounder RF pulse injection and magnetospheric active plasma conditions. The different character of present phenomena from those found in the topside ionosphere and deep magnetosphere is relationship of the number n and m. fDn-m waves with m=1 condition gives major occurrence character comparing m=2. The fDn waves of case 2 has not been clarified in the previous plasma wave observation results in the space plasma, however, present results found in the plasmasphere shows quite clear relationship among three wave frequencies in the spectra obtained by the Akebono satellite.

The present nature of generation and nonlinear wave particle interaction of EP-ESCH 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.