Generation Mechanism of the Fundamental and the Second Harmonic Terrestrial Hectometric Radiation

Masahide Iizima[1], Hiroshi Oya[2]

[1] Geophysical Inst., Tohoku Univ., [2] Space Commu. Fukui Univ.

In the spectra of terrestrial hectometric radiation (THR) observed by PWS onboard the Akebono satellite, intense discrete components have been frequently observed in two frequency bands, from 1.3MHz to 2.1 MHz (1.7MHz band) and from 2.6MHz to 4.2MHz (3.4MHz band) forming a harmonic relation in the frequency. Polarization measurements of such discrete THR have shown that the fundamental band emission shows the nature of the L-O mode wave and the second harmonics emission reveals the nature of the R-X mode wave. The same polarization characteristics have been found for the case of auroral kilometric radiation (AKR) (Oya, 1990), i.e., the fundamental and the second harmonic AKRs are generated in the form of the L-O mode wave and R-X mode wave, respectively. This result suggests that there is a common polarization feature in the harmonic generation of the planetary radio emission. The polarization feature of the fundamental and the second harmonic THR and AKR can be understood by the linear and nonlinear mode conversion processes from UHR mode waves into L-O and R-X mode electromagnetic waves: That is, at first, the strong UHR mode waves whose wave normal directions are nearly perpendicular to the local magnetic field are excited in the auroral electron beams through the cyclotron type wave-particle interactions. Then, the UHR mode waves are converted into L-O mode electromagnetic waves through the linear mode conversion process. These waves are observed as the fundamental emission. The origin of the second harmonic radiation includes the nonlinear wave-wave interaction processes of excited UHR mode waves. The theoretical calculations of energy conversion rates in this nonlinear mode conversion process have shown that the energy conversion rates from UHR mode waves into R-X mode electromagnetic waves are 20dB larger than those of L-O mode waves; that is in good agreement with the observations. Thus, the observed polarization characteristics of the fundamental and the second harmonic THR and AKR can be explained by the linear and nonlinear mode conversion processes from UHR mode electrostatic plasma waves into L-O mode and R-X mode electromagnetic waves.