Kilometric radiation associated with plasmasphere disturbances

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Within an early period of data analysis phase of the plasma wave and sounder experiment (PWS) on board Akebono satellite, the Donkey Ear phenomenon was discovered as a significant density depletion region inside the plasmasphere near the equatorial region. Plasma wave observations inside the density depletion region revealed a radiation of electromagnetic waves within a frequency range of several hundreds kHz that seems to be trapped inside the density depletion region.

The purpose of this study is to understand the generation and propagation feature of the electromagnetic radiation filling inside the density depletion region of the plasmasphere. The electromagnetic wave is named as kilometric radiation since the wavelength is the order of kilometer scale length.

Statistical nature of the kilometric radiation was examined. There are 578 events of the kilometric radiation in the dynamic spectra of 11 years observation period. Dynamic spectra of the kilometric radiation were categorized into nine types referring relation with the structure of the density depletion region. It was shown that kilometric radiation is accompanied by the Donkey Ear phenomena in 41.3 % of the total events. The observation region is concentrated within plus/minus 50 degree geomagnetic range, and it appears in an altitude range more than 4000 km. The occurrence probability of the kilometric radiation showed clear relation with the variation of the solar activity. The occurrence probability shows significant concentration near the geomagnetic equator. This nature suggested that the source region of the kilometric radiation is located near the geomagnetic equatorial region. Kp and Dst dependencies were also investigated; it became clear that the kilometric radiation occurred in a condition of geomagnetic storm. To examine the relation with the progress of geomagnetic storms, correlation between occurrence of the kilometric radiation events and start time of the recovery phase of the geomagnetic storm was analyzed. 64 % of radiation events showed clear relation to geomagnetic storms that there was occurrence peak near the start time of the recovery phase of geomagnetic storms. The kilometric radiation sometimes spreads outside of plasmasphere through a window where plasma density is low comparing with the radiation frequency. The kilometric continuum observed by Geotail satellite [Hashimoto et al., 1999] can be interpreted as radiations propagating outside plasmasphere through the window.

For understanding of the generation mechanism of kilometric radiation, strong EPWAT waves generated near the equator region of the plasmasphere due to the wave particle interaction caused by the energetic plasmas is necessary to be considered for generation mechanism of kilometric radiation. Although the kilometric radiation of L-O mode can be well explained by the linear mode conversion theory, it is difficult to explain the strong R-X mode electromagnetic wave frequently identified in the dynamic spectra as well as dynamic polarization spectra of PWS observations. In order to solve the whole kilometric radiation phenomenon, the theoretical research on plasma physics and more detailed observation inside plasmasphere are needed. Especially, the problem on the kilometric radiation of R-X mode whose intensity sometimes exceeds that of L-O mode should be solved by applying a new wave particle interaction process or mode conversion theory in future study.