Sudden enhancements of electron cyclotron harmonic waves observed by the Arase satellite

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Electron cyclotron harmonic (ECH) waves are commonly observed in the low latitude region just outside the terrestrial plasmapause. They are purely electrostatic and their frequency spectra show harmonic structures. The harmonic structures are believed to depend on the temperature and density ratio between cold and hot background electrons. The Plasma Wave Experiment (PWE) onboard the Arase satellite has observed ECH waves since the start of its operation. The observed ECH waves are classified into two types. They are the diffuse ECH waves and the enhanced ECH waves. The diffuse ECH waves are weak and they appear as continuous emissions that last for more than a few minutes. The enhanced ECH waves are the sudden enhancements of the diffuse ECH in shorter periods. The present paper focuses on the enhanced ECH waves observed by the Arase satellite.

Kazama et al. (2018) introduced the event that the repeated enhancement of ECH waves is associated with density depletions near the plasmapause. They succeeded in revealing the good correlation of the enhancement of the ECH waves and the sudden decrease of the cold electrons with energies lower than the lowest energy limit of the particle detector. The observed electron features are clear in the relation to the enhancement of ECH waves, but the mechanism of the enhancement is still unclear. We searched for such events of the enhanced ECH waves and examined the correlation of wave intensities, spacecraft potentials and electron velocity distributions observed by the Arase satellite. Some of the events show the features similar to those of Kazama et al. (2018), but there are also many other events with no correlation between the enhancements of the ECH waves and the density depletions. In the present paper, we examine velocity distribution functions of electrons observed by the low-energy particle experiments-electron analyzer (LEPe) onboard Arase. Velocity distribution functions allow us to examine temperature anisotropies of electrons and calculate linear dispersion relations for the ECH waves. Once we get electron temperatures, resonance velocities are calculated. On the other hand, since the wavelength of the ECH waves is very short, the relation of the wavelength and the length of the Arase electric field sensors is also important in evaluating the time variations of the ECH wave intensity. We study the enhanced ECH waves in various viewpoints using wave and electron data observed by the Arase satellite and discuss the generation mechanism in the present paper.

