Ion Flux Oscillations and ULF Waves Observed by ARASE Satellite and Their Origin

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The ARASE satellite, which was launched on December 20, 2016, is now observing the nightside inner magnetosphere. The inclination of the orbit is larger than those of other recent spacecraft flying in the inner magnetosphere such as THMEIS and Van Allen Probes. This unique orbit provides us new information on ULF waves since ULF waves have latitudinal structure and the antinode of magnetic fluctuations of fundamental mode is at high magnetic latitudes, where the previous satellites did not pass.

Although Pc pulsations are predominantly observed on the dayside, ARASE satellite sometimes observes Pc4-5 pulsations on the nightside. Some of these waves are accompanied with energetic particle flux modulations. We found 6 events of the particle flux modulations accompanying Pc pulsations on the dawnside and nightside. Theoretical studies suggest that ULF waves detected at afternoon are generated by (internal) plasma instabilities like drift-mirror instability [Hasegawa, 1969] and drift-bounce resonance [Southwood et al, 1969]. These instabilities cause plasma pressure disturbances or flux modulation of ions. Non resonant ion clouds injected on the duskside also considered to be one of the candidates of ULF wave driver [Zolotukhina, 1974]. We therefore discuss whether the ULF waves observed by ARASE satellite are generated internally or externally, and the flux modulations are created by plasma instabilities or the other non-resonant effects such as a gradient of phase space density in space and energy, or oscillating plasma flow.

On March 31, 2017, Medium-Energy Particle Experiments - Ion Mass Analyzer (MEPi) onboard ARASE detected ion flux oscillations at 12-70 keV with a period of ˜120 seconds in the normal (NML) mode observation. NML mode observation provides details of the direction of particle movements. The pitch angle distribution of proton flux showed isotropic flux oscillations. At the same time, Pc4 pulsations with the same oscillation period were observed. These ion flux and field perturbations were seen on the dawnside (4.3-5.9 MLT).

ARASE found oscillations of ion count with a period of ˜130 seconds in the time-of-flight (TOF) mode observation at midnight on May 29, 2017. Because the TOF mode degenerates the azimuthal resolution from 16 bins to 4bins, it is difficult to calculate a pitch angle distribution with a sufficient angle resolution. Therefore, we used the list data, that is created for onboard calibrations, to make a pitch angle distribution of ion counts. The pitch angle distribution did not have clear fluctuations, so that the oscillations in ion count may be attributed to non-gyrotropic particle distributions.