Study of Pitch Angle Distribution in the Earth inner Magnetosphere; Clue of Magnetopause Shadowing

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The Earth's Radiation Belts consist of two regions, and these regions accommodate highly energetic electrons. Especially in the outer radiation belt, the energetic electron is highly variable during magnetic storm time. Energetic electrons sometimes cause satellite charging, resulting in gradual degradation of the instrument and devices of the satellite. It is, therefore, imp tant to understand basic physics of the energetic electron variation in the radiation belt from the space weather point of view. It is considered that the drastic change of outer radiation belt is the result of competition between each variation processes, i.e. Transport, Acceleration and Loss. However, each process has complex physical mechanisms and there remain still much outstanding questions.

In this study, we particularly focused on the Loss Process. As a possible loss process, (i)Precipitation to the atmosphere, (ii)Dst-effect and (iii)Direct Loss from the magnetopause (Magnetopause Shadowing) are supported. According to the recent study, it is reported that rapid depression of outer radiation belt's electron flux is the result of the sudden inward shift of Magnetopause and subsequent enhancement of outward radial diffusion (Turner et al., 2012). And the relationship between Magnetopause location and outer radiation belt is studied by Matsumura et al., 2011. However, the regions, where electrons will escape or the Magnetopause effect will reach, are still undefined questions. In order to understand the effect of Magnetopause, we used the theory of drift shell splitting. Due to the asymmetric configuration of Earth's Magnetosphere, charged particles which has different pitch angle drift different drift shell. This means that particle whose pitch angle is closed to 90 degree drifts more close to the Magnetopause. It is, therefore, expected that the pitch angle distribution will be the butterfly distribution, as a result of Magnetopause Shadowing. To confirm this theory, we used Solid State Telescope onboard THEMIS satellite and analyzed pitch angle distribution. Butterfly distribution is usually seen at night sector in magnetically quite time. However, our result shows clear differences of electron's pitch angle distribution between each magnetic storm phase. We consider that this change is caused by the effect of inward shift of magnetopause.