Energy and L dependence of relativistic electron variations in the outer radiation belt during the recovery phases of magnetic storms: Arase/XEP observations

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Understanding of acceleration and loss mechanisms of relativistic electrons in the outer radiation belt has been one of the outstanding problems in the magnetospheric physics. Previous studies indicate that geomagnetic storms intensify or decrease the relativistic electron fluxes in the outer radiation belt [e.g., Reeves et al., 2003]. After the flux dropout during the storm main phase, recovery and sometimes increase of the electron flux occurs during the recovery phase. There are two major candidate processes of the electron accelerations to cause the flux enhancement. The first one is the adiabatic acceleration due to radial transport of electrons from the plasma sheet to the inner magnetosphere. Interaction with ultra-low-frequency (ULF) Pc5 waves are a plausible candidate to drive the radial transport. Another acceleration process is the non-adiabatic acceleration of sub-relativistic electrons to the relativistic energies in heart of the radiation belt. The interaction with VLF waves is considered to play an important role in the internal acceleration. However, the relative contribution of the two processes are far from understood.

In order to investigate the electron acceleration processes, we examine variations of relativistic electrons based on observations by the extremely high-energy electron experiments (XEP) onboard the Arase satellite during six geomagnetic storms that occurred on March 21, March 27, April 4, May 28, September 8 and September 27 2017, respectively. XEP onboard Arase measures electrons in the energy range from 400 keV to 20 MeV. In this study, we focus on time variations of the flux profile of the fixed magnetic moments as a function of the geocentric distance at the magnetic equatorial plane (L), which gives the essential clues to understand the acceleration locations [e.g., Green and Kivelson, 2004]. In events on March 21 and on September 27, relativistic electrons in the outer belt showed a typical time variation, i.e., decrease in the main phase and then increase in the recovery phase under 1.2 MeV. In events on March 27, on May 28 and on September 8, relativistic electrons in the outer belt showed a typical time variation, i.e., decrease in the main phase and then increase in the recovery phase for all energies up to 5MeV. In events on April 4, flux of electrons in the recovery phase is equal to flux before geomagnetic storm.

The timing and location of the flux recovery/increase during the recovery phases depend on storms. Detailed characteristics such as the energy and L dependences and their comparison between the geomagnetic storms will be also reported.

References:

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