Relative location of the plasma sheet injection boundary to the outer radiation belt during magnetic storms: FAST observations

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A recent statistical study of relativistic electron response to the moderate and intense geomagnetic storms in 11 years shows that the fluxes of relativistic electrons were increased in about half of all storms, decreased in one quarter, and produced little or no change in another quarter [Reeves et al., GRL, 30(10), 2003]. The variety of the effect of geomagnetic storms on radiation belt fluxes is considered a result of a complicated balance between particle acceleration and loss.

Theoretically, many acceleration mechanisms of relativistic electrons have been proposed. Summers and Thorne [JGR, 108(A4), 2003] recently pointed out the importance of inclusion of loss processes in a quantitative treatment of radiation belt variation, suggesting that electromagnetic ion cyclotron (EMIC) waves during storms in a spatially confined zone within the duskside plasmapause can lead to intense electron precipitation. A main source of free energy for the EMIC wave excitation is the anisotropic distribution of ring current ions injected from the tail plasma sheet. On the other hand, the ring current electrons injected from the tail plasma sheet can excite whistler-mode turbulence. The stochastic acceleration by the whistler-mode waves is one of the promising candidates of acceleration mechanisms for storm-time relativistic electrons.

The Electrostatic Analyzer (ESA) onboard the FAST satellite had been operated in the mid-latitude regions above ~45 degrees for the past 5 years and observed ions below 30 keV. We can infer the location of the radiation belts from the radiation contamination in ESA data caused mainly by electrons with energies of 0.5-1.5MeV. It is known that the injection boundary of the plasma sheet electrons in the midnight to the morning local times often coincides with the plasmapause [e.g., Elphic et al., JGR, 104(A10), 1999]. In this paper, we examine the relative location of the outer radiation belt to the injection boundary of electrons and ions from the plasma sheet during the recovery phase of the magnetic storms using the FAST satellite observations.