VARIATION OF RELATIVISTIC ELECTRON FLUXES IN THE OUTER RADIATION BELT DURING GEOMAGNETIC STORMS

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Abstract:

Understanding the role of the different mechanisms involved in the acceleration of relativistic electrons in the Earth's outer radiation belt (ORB) is one of the key open problems in inner magnetosphere physics. During geomagnetic storms, the acceleration of ORB electrons starts with the formation of a ''seed'' population injected during geomagnetic substorms. Nonetheless, This seed population needs to be accelerated up to relativistic energies, and the specific mechanisms of electron acceleration and their importance are still under debate. We analysed data from the Van Allen Probes and THEMIS missions during the 1 June 2013 geomagnetic storm and showed that the plasma pressure increased by one order of magnitude during the storm reaching a maximum value towards the end or slightly after the main phase of the storm. At the same time, the location of the maximum pressure moved towards the Earth, reaching the closest distance at L ≈ 3.7. Relativistic electron fluxes show that the location of the peak fluxes also move closer to the Earth reaching the same L as the maximum of plasma pressure. In order to study whether the adiabatic mechanisms are relevant to explain the behavior of relativistic electrons, we analyzed the electron fluxes in the energy range from 1.8 to 4.2 MeV and found that the electron spectra fits well to a power law function. For a fixed L−shell, the power law index is conserved during the pre-storm time, increases during the main phase, and presents little variation again during the recovery phase, but the power law index calculated during the recovery phase is larger than during pre-storm phase. A strong depletion of electron fluxes during the main phase of the storm is also measured, with fluxes returning to the pre-storm level afterwards. The conservation of the slope of the electron spectra during a long time can be considered as an evidence of a dominant contribution of adiabatic processes, as it is difficult to explain this effect as other processes such acceleration and losses of relativistic electrons. An increase of the power law index towards the end or right after the main phase of the storm

can be related to the increase of the losses with the electron energy, and/or to the processes of thermalization (relaxation) of the electron distribution functions.

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