

Sharp Boundaries of the Energetic Particles Observed by the Cluster during the Substorm

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The behavior of the energetic particle between the outer plasma sheet and inner magnetosphere has been studied during the substorm by presenting evidences from the energetic particles, plasma and field instruments by the Cluster satellite. Sharp boundaries of energetic particles were observed by the Cluster constellation. Three clear boundaries from the near Earth tail to the inner magnetosphere are observed by the Cluster on February 2, 2003 associated with a strong ($AE \sim 1000nT$) substorm. The Cluster crossed the first boundary as signaled by the appearance of higher energetic particle fluxes and the variations of the plasma data. This spatial boundaries detected by 4 spacecrafts are corresponding to the last closed magnetic field line formed by the reconnection in the near earth during the substorm expansion phase in the distance range 10 to 14 R_e . The second boundary corresponding to the substorm injection boundary was produced first near the geosynchronous orbit or more close to Earth region and then expands outward. The last sharp boundary was the outer boundary of the stable radiation belt flux region, which has a good correlation with the inner edge of the plasma sheet.