Westward expansion of substorm activation in the magnetosphere

T.V. Kozelova[1], L.L. Lazutin[2], and B.V. Kozelov[1]
[1]*Polar Geophysical Institute, Apatity, Russia*
[2]*Moscow State University, Moscow, Russia*

In the near-Earth magnetosphere the energetic electron injection often delays relative to the proton injection. These events belong to the so-called 'p→e' class of dispersionless particle injections [Birn *et al.*, 1997]. [Birn *et al.*, 1997] examined the injection events with dispersions not exceeding ~ 2 min and assumed that the injection boundaries for energetic ions and electrons are not exactly identical but are displaced against each other. Then the 'p→e' events would occur when the boundaries expand azimuthally and Earthward. However in the paper [Lui *et al.*, 1988] was shown that the current disruption region consists of localized particle intensity enhancements (activation) with short duration (10-50 s). The spatial scale of these activations can be of the order of 1000 km [Ohtani,1998]. So, the schema of nonidentical ion and electron injection boundaries defined within the 72 s time resolution by [Birn *et al.*, 1997] can not be physical interpretation of the activity expansion.We investigate the dispersionless (with time resolution a few seconds) 'p→e' injections of energetic electrons >21.5 keV and protons > 37 keV and the dipolarization of the magnetic field during substorms on the CRRES when spacecraft was close to the magnetic equatorial plane and near midnight. The primary interest in this study involves the dynamics of the fine-scale structures of activation during a short interval around the local dipolarization moments. We examine the time evolution of the proton flux anisotropy on three particle detectors in order to determine qualitatively the location of the acceleration region relative to the CRRES position and to monitor the development of the active region.We found that on a geocentric distance of ~ 6 RE the short interval of 30-40 s consisted of the temporal sequence of the following phenomenons: the proton injection with dispersion in 2 s, the proton injection without dispersion, the electron injection without dispersion (simultaneously with local dipolarization onset), and at last the electron injection with dispersion. This sequence may be the signature of westward and Earthward expansion of the substorm activation when new localized regions of impulsive particle acceleration appear outside the position of the initial activation. The 4-6 s delay between the proton and electron injections may be associated with the growth rate of the cross-field current instability that trigger the current disruption.
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