Geophysical Research Abstracts, Vol. 7, 01618, 2005
SRef-ID: 1607-7962/gra/EGU05-A-01618
© European Geosciences Union 2005

Small-scale spatial and/or temporal structures accelerated at separatrix layers between open and closed magnetotail field lines.

E.E. Grigorenko (1,2), A.O. Fedorov (3), R.A. Kovrazhkin (1), J.-A. Sauvaud (3), L.M. Zelenyi (1)

(1) Space Research Institute, Russia, (2) Skobeltcyn Institute of Nuclear Physics MSU, Russia, (3) CESR, France

Very complicated non-linear processes of energy dissipation and particle acceleration occurred in the current sheet of the Earth's magnetotail are manifested as localized and transient accelerated plasma structures. The observational pattern of these structures in the PSBL depends on spatial and/or temporal scales of the acceleration sources operating in the current sheet. During the last decades great efforts have been devoted to the study of the fine structuring of PSBL beams and considerable progress have been achieved. But only multipoint Cluster observations performed in the magnetotail and auroral BL make it possible to distinguish spatial and temporal effects in observation of transient plasma structures and reliably identify at least two of their types differing in the morphology, source locations and the nature of acceleration. The first type corresponds to the spatial structures, which are observed in the PSBL mostly during quiet periods. They represent high velocity (up to 1500km/s) field-aligned ion beams (beamlets) with pronounced temperature anisotropy (Tpar$>>$Tper), usually without noticeable velocity dispersion. Detailed analysis of Cluster observations in the magnetotail discovered that beamlets are strongly elongated along magnetic field. Their field-aligned and transverse ($<$1 Re) scales differ at least at two orders of magnitude and as was found by Cluster have larger duration (˜10min) than it was assumed before relying on 1-point observations. Another new feature revealed by Cluster is a "snake-like" shape of beamlets formed due to the development of fire-hose instability, which develops when beamlets are emerging from the distant regions of the current sheet. The lower bound of beamlet source distance is about 80Re. Thus, during the quiet periods ions are mainly accelerated at the spatially localized sites near in the separatrix

layer between open and closed magnetic field lines in the distant tail. The characteristic time of acceleration process is about 10-15 min, so that beamlets observed in the PSBL have rather spatial than temporal nature. Very different observational pattern takes place at active periods. Cluster observations performed in the high-latitude auroral region have shown that during these periods the recurrent sporadic structures in H+ (and also O+) with a quasi-period of ˜3 min and a duration of ˜1-3 min are frequently observed. These ion structures, named TDIS, have pronounced energy dispersion (high-energy ions arrive first). From the slope of the (1/velocity) versus time it was defined that these structures have a sporadic source located at the outer boundary of the central plasma sheet, at distances ˜8-40 Re from the Earth. Thus, TDIS may be classified as temporal ion structures. Sharp distinction between two mentioned types of plasma structures observed near the plasma sheet boundary reflects a dramatic changes in magnetotail dynamics which occur in transition between quiet and disturbed states.