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Field-aligned currents caused by acceleration of PSBL ion beams. Cluster observations.

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Field-aligned high-velocity ion beams are frequently observed in PSBL and it is naturally to expect the associated field-aligned currents streaming in the lobe-PS interface. Despite the common feature of PSBL ion beams – field-aligned velocity distribution at the lobeward edge of PSBL - our analysis of ion and electron velocity distribution functions revealed two different types of ion beams which are related with two different regimes of CS acceleration. The first type represents energy collimated and spatially localized ion beams having a rather long duration (up to 20 min) and energies $\leq$ 20 keV which are observed during quiet geomagnetic periods (|AL| < 200 nT) together with isotropic electron velocity distributions. These features indicate on ion acceleration in spatially localized resonant sources located in distant CS in the region of closed magnetic field lines (with finite Bz>0) and rather far from the distant X-line. Another type represents powerful (up to 140 keV) field-aligned ion beams with large parallel temperatures. They are observed along with the anisotropic electron velocity distributions. This feature indicates that ion beam acceleration takes place near the X-line. Such type of ion beams is peculiar to active periods (|AL| > 500 nT). On the basis of analysis of 200 PSBL crossings by Cluster spacecraft (during its 2003 magnetotail season) we performed a statistical analysis of field-aligned currents associated with both types of ion beams observed in these crossings. To select PSBL crossings in Cluster data we used Automated Multi-Dataset Analysis Tool (AMDA), a new service opened at CDPP which allows to analyze on-line space physics data and to perform parameter computation or data extraction. We revealed that during intervals of Type-I ion beam observations field-aligned currents of small current density $\leq$ 4 nA/m2 (estimated by curlometer method) are registered. These currents are carried mainly by beam ions. On the contrary, during the intervals of Type-II ion beam observations the strong field-aligned currents with current densities $\tilde{1}$0 nA/m2 and sometimes more, are registered. These currents are carried by electrons. During such PSBL crossings the changes of sign of field-aligned currents are always registered: near the lobeward edge of PSBL outward field-aligned current is observed while inside PSBL field-aligned current is directed towards the acceleration source. This feature confirms our suggestion that during intervals of Type-II ion beam observations the PSBL is formed by plasma accelerated near the reconnection region which can be located closer to the Earth (at |X| < 50 Re).