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Auroral and Ground Manifestations of PSBL Field-Aligned Plasma Structures

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The plasma sheet boundary layer (PSBL) is characterised by field-aligned high-velocity ion beams and it is naturally to expect associated field-aligned currents (FAC) streaming in the lobe-plasma sheet interface. Recent statistical analysis revealed two different types of ion beams. Ion beams typical for quiet and slightly disturbed geomagnetic periods (Type I) are collimated in energy and are accompanied by isotropic electrons. Under these conditions no FACs or FACs of very small current density are registered. In active periods, powerful field-aligned ion beams with large parallel temperatures are observed, along with anisotropic electron fluxes, with distributions bearing the signature of a separatrix. Electrons produce a pair of FACs: at the lobeward edge directed earthward, and inside PSBL - tailward. We studied statistically a database of 364 CLUSTER observations of PSBL ion beams. Their auroral and ground manifestation was investigated using POLAR and IMAGE UV images and magnetograms of appropriate ground stations. As a rule in cases of Type I ion beams CLUSTER footprints are in the region of diffuse aurora and the magnetograms exhibit no or small variations in the horizontal magnetic field component. In cases of Type II beams (with currents), CLUSTER footprints are located adjacent to the brightest auroral spot and the magnetograms exhibit large negative variations of the horizontal magnetic field component. However, in considerable number of cases PSBL currents are observed in quiet conditions. CLUSTER spectrograms for these cases reveal that the electrons are accelerated to energies lower than usually in substorm conditions. There are several noteworthy exceptions, when PSBL ion beams of Type I without currents are observed in quite active periods. This could imply energy deposition from the near tail coexisting with acceleration process on closed field lines in the distant tail.