Detection of Hall-current carrying electrons at the lobe-plasma sheet boundary in the near-Earth tail

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Recent studies have shown that the Hall (ion inertia) effects cannot be neglected in the magnetotail reconnection and the Hall current generated can be of significant intensity. In this paper we show that the lobe-plasma sheet boundary in the near-Earth tail (R < 15 Re, MLT=21-03) crossed in association with dipolarizations often accompanies electrons flowing tailward collimated in the field line direction. Since the ions are mostly stagnant or flowing even sunward, the velocity differences result in earthward (downward, seen from the ionosphere) field aligned currents (FACs), in cases, as strong as 30 nA/m*m, which would be amplified to > 10 micro A/m*m at ionospheric altitude. The differences in the parallel velocities are typically 0.4 times the local Alfven speed. Since the amplitude of magnetic field fluctuations are smaller than 0.4 times the total field intensity, it is suggested that the spatial scale of the FAC layer is comparable to the ion inertia scale, that is, the current is likely to be of the Hall term origin. The strong intensities at these near-Earth locations suggest that the Hall currents are making significant contributions to the magnetosphere-ionosphere coupling via FACs.