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Earthward electrostatic field in thin current sheet.

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We provided experimental evidence for the existence of the earthward electric field in a thin current sheet of the Earth's magnetotail. This field plays an essential role in redistribution between ion and electron components of the cross-tail current via the cross-field drift. We use the statistics of 59 crossings of thin current sheet by CLUSTER spacecraft to show that curvature and diamagnetic drifts of electrons can explain only a half of the observed electron bulk velocity across the tail. This difference of electron velocities is attributed to the Earthward electric field of the order of 0.05 mV/m, because in the central region of the realistic current sheet the analogous effect of vertical electric field vanishes due to non-zero normal component of magnetic field. The corresponding effect is also manifested in the structure of ion distributions owing to the negative shift of cold core of the ion distribution. We also present the theory of earthward electric field formation based on difference of motion of magnetized electrons and unmagnetized ions in the model of thin 2D current sheet.This work is supported by RFBR grant 10-05-91001, NIII-472.2008.2 and programm OFN-15.