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PECULIARITIES OF CURRENT SHEETS' STRUCTURE AND SYMMETRY IN THE PRESENCE OF HALL CURRENTS AND REVERSED CURRENTS *)

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We discuss a structure of current sheets, peculiarities of their symmetry, and modifications of their structure and symmetry as a result of dynamic processes evolving in real plasmas. Current sheets with a translational symmetry were formed in two-dimensional (2D) magnetic configurations with a null-line of the *X*-type, on the base of the set-up CS-3D. The symmetry of both the magnetic configuration and current sheets was a typical property of these experiments.

At the initial stage the magneto-sonic wave of a cylindrical symmetry propagates from the outer plasma boundaries toward the null-line of the magnetic field. Non-linear stage of the wave propagation gave rise to formation of a 2D current sheet with two different dimensions, $2\Delta x$ and $2\Delta y$, at the plane normal to the direction of the plasma current J_z. As a result of the current sheet formation the electric current and plasma were effectively compressed into the sheet, and an excessive magnetic energy was accumulated in a vicinity of the sheet. In this case, the current sheet displayed the symmetry about two mutually perpendicular planes (x=0) and (y=0).

In many cases there was observed excitation of the Hall currents at the plane (x,y) inside the current sheets. The Hall currents gave rise to the out-of-plane magnetic fields B_z of the quadrupole structure. As a consequence, the magnetic fields and plasma currents transformed into 3D, the structure of the 2D planar current sheet became more complicated, and the current sheet symmetry was essentially changed.

It is necessary to point out that even simplest 2D current sheets are dynamic objects with intensive plasma flows. When moving in the transverse magnetic fields, high-speed plasma flows generate inductive electric fields and currents of the opposite directions as compared to the basic current in the sheet. The inverse currents of the maximal amplitudes arise at the side edges of the sheet..

An important effect caused by inverse currents consists in appearing the Ampere's forces of the opposite directions as compared to the forces at the central region of the sheet, which formed accelerated plasma flows. The braking forces at the side edges of the current sheet should effectively slow down plasma flows, which were accelerated previously. As a result, the high-speed plasma jets become limited in time and in space.

Hence the structure of simplest current sheets formed in the 2D magnetic fields with the null-lines becomes much more complicated under the action of dynamic processes in the real plasma, which brings about to deterioration of a planar symmetry of the current sheet.

*) abstracts of this report in Russian