peculiarities of current sheets formed in magnrtic configurations with the *X*-line, in the presence of the longitudinal magnetic field component (guide field) [[1]](#footnote-1)\*)

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A review is presented on experimental results related to investigations of distinctive features of the structure and evolution of current sheets formed in three-dimensional (3D) magnetic configurations with an X line, in the presence of a longitudinal magnetic field component (guide field) directed along the X line. It is well known that the magnetic fields are three-dimensional in both the space objects and laboratory devices for plasma confinement and heating. Hence investigation of possibilities for current sheets’ formation in 3D configurations, as well as an analysis of the structure of such current sheets is of a fundamental importance for the magnetic reconnection problem. Among the variety of 3D magnetic configurations, the ones with singular lines of the X-type lines are of a particular interest, due to the role of these configurations in the formation of current sheets and in magnetic reconnection phenomena. The simplest magnetic configuration with the X-line on the 0*z*-axis may be presented as: ***B*** = {*h⋅y;h⋅x;BZ0*}, where *h* is the magnetic field gradient in the plane (*x*, *y*), and *BZ0* is a uniform guide field. The current sheet formation may be realized when the plasma current *JZ* is excited along the X-line. We have considered the structural features of current sheets, formed in 3D magnetic configurations with the X-line under the various relations between the gradient *h* and the guide field *BZ0* including the *BZ0* changes between 0 and 6 kG (see [1] and references therein). The experimental results were obtained using the CS-3D setup (GPI RAS).

It is shown that an enhancement of the guide field takes place within the sheet in the course of the current sheet formation. The excessive guide field is supported by plasma currents that flow in the transverse plane relative to the main current in the sheet. As a result, the currents’ structure becomes three-dimensional.

An increase of the initial value of the guide field *BZ0* brings about decreasing the degree of compression into the sheet of both the electric current and plasma. This effect is caused by change of the pressure balance in the sheet when an excessive guide field appeared in it.

Deformation of plasma current sheets, namely, the production of asymmetric and tilted sheets in the 3D magnetic configurations, results from excitation of the Hall currents and their interaction with the guide field.

It is shown that the formation of current sheets in 3D magnetic configurations with an X line is possible in a relatively wide, but limited range of initial conditions.

References

1. Frank A.G., Applied Physics Uspehi, **9**, 464 (2021). (In Russian)

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLIX/Lt/ru/EE-Frank.docx) [↑](#footnote-ref-1)