Determination of spatial structure of current sheets on a basis of external magnetic measurements [[1]](#footnote-1)\*)

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We discuss a problem related to determination of current sheet parameters on the base of measurements with several magnetic probes located outside the vacuum chamber, where a current sheet is formed. The signals of magnetic probes are calculated under various parameters of current sheets. For this purpose we use the data about distributions of surface current density Iz(x) = ∫j(x,y)dy of real current sheets. These data were taken from previous measurements with magnetic probes inserted into vacuum chamber (see e.g. [1]). Here x is a coordinate along the width, i.e. a larger transverse size of the sheet, while y is a coordinate along the lesser transverse sheet size.

To determine the width of methastable current sheets we approximated the current distributions Iz(x) either by polynomials of six degree, or by functions in the form cos (π∙x / L), where L is the current sheet width. Then we calculated the signals of different magnetic probes in dependence on the L value. Comparing the signals of probes located at various angles relatively the sheet mid-plane we can derive the sheet width by the use of both approximations of the current distributions Iz(x).

Of the most interest is a possibility to reveal the current sheet disruption on the base of measurements with external magnetic probes. It has been established earlier that, as a rule, the disruption comes to play at the sheet central region (x ≈ 0): here an increase of the magnetic reconnection rate starts, and it is accompanied by a sharp fall of the current density (see [2] and references therein). In the wake of the disruption start the region of low current density expands rapidly (with super-Alfven velocity) along the x-axis, from the center to both side edges of the sheet. To perform calculations for the case of a current sheet with a disruption, we approximated the distribution Iz(x) by superposition of the “positive” current of the methastable current sheet (see above) and additional “negative” current ~ e^(-x2 / 2σ) in the central region. Here parameter σ describes a half-width of the region with lower current density. We obtained relationships among the magnetic probe signals in dependence on the σ value, from where an estimation of the disruption width may be extracted.

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References

1. A.G. Frank, S.N. Satunin // Plasma Physics Reports. 2011. V. 37. P. 829.
2. A.G. Frank // Physics-Uspekhi. 2010. V. 53. P. 941.
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVII/Lt/ru/FS-Frank.docx) [↑](#footnote-ref-1)