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Comment on "Wall Forces Produced During ITER Disruptions" By H.R. Strauss, R. Paccagnella, and J. Breslau (Physics of Plasmas 17, 082505 (2010)

Leonid E. Zakharov

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Leonid E. Zakharov

Princeton University, Princeton Plasma Physics Laboratory, Princeton NJ

(October 13, 2010)

The paper by H.R. Strauss presents numerical simulations, which pretend to describe the disruption instability in ITER device. The simulations were performed with numerical code M3D, described in Ref.[7] of the paper.

Unfortunately, neither the paper nor Ref.[7] mention a very important detail in simulations, i.e., the boundary condition for the plasma velocity at the wall surface

$$\vec{V}_{normal} = 0. \quad (1)$$

Necessary for the particular numerical scheme of M3D, this boundary condition would be right for magneto-hydrodynamics (MHD) of liquid metals or salt water, but is wrong for a tokamak plasma. Unlike fluid, the plasma has no restriction such as $\vec{V}_{normal} = 0$. In fact, plasma flow to the wall is neutralized and may return back to the volume as a neutral gas, not participating in MHD. In fact, the interaction of the plasma with the wall is a separate, complicated problem going far beyond the MHD model.

The boundary condition (1) was artificially introduced in the 1970s because of the chosen numerical approach, and since that time is used in many 3D codes. This long lasting flaw at such a fundamental level raises the very issue of applicability of this widespread numerical scheme to the plasma MHD.

Because of the erroneous boundary condition (1), preventing plasma flow to the wall and affecting the entire dynamics, the simulations of the Strauss paper as well as its M3D code are irrelevant for ITER and to tokamak plasma dynamics in general.

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Information Services
Princeton Plasma Physics Laboratory
P.O. Box 451
Princeton, NJ 08543

Phone: 609-243-2245
Fax: 609-243-2751
e-mail: pppl_info@pppl.gov
Internet Address: http://www.pppl.gov