

Modelling of wall currents excited by plasma wall-touching kink and vertical modes during a tokamak disruption, with application to ITER

C.V. Atanasiu¹, L.E. Zakharov², K. Lackner³, M. Hoelzl³, J. Artola⁴, E. Strumberger³, X. Li⁵

¹National Institute for Laser, Plasma and Radiation Physics, Bucharest, 077126, Romania

²LiWFusion, Princeton, PO Box 2391, NJ 08543, US

³Max Planck Institute for Plasma Physics, Garching b. M., 85748, Germany

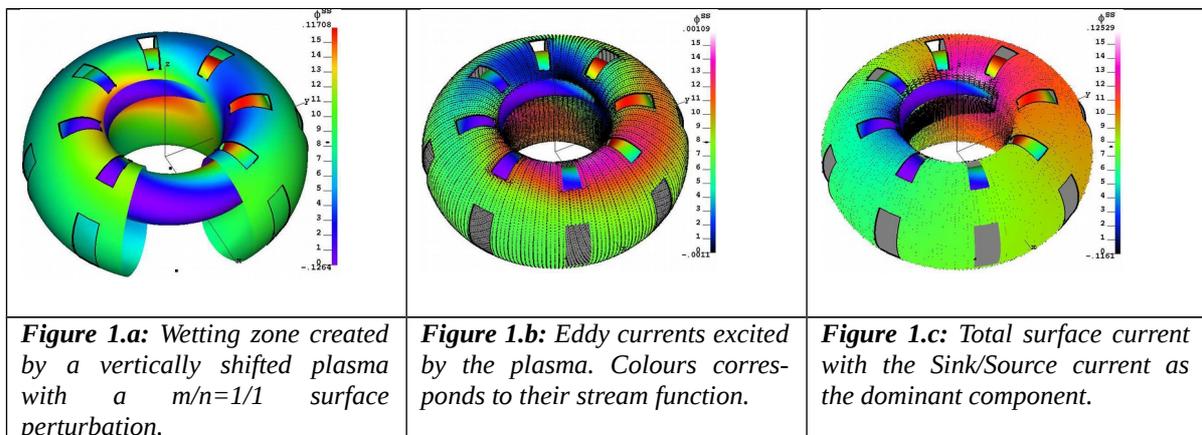
⁴Aix Marseille Université, Marseille, France

⁵Academy of Mathematics and Systems Science, Beijing 100190, P.R. China

To understand plasma disruptions in tokamaks and predict their effects, realistic simulations of electric current excitation in three-dimensional vessel structures by the plasma touching the walls are required. The Wall-Touching Kink Modes are frequently excited during vertical displacement events and cause large sideways forces on the vacuum vessel which are difficult to withstand in large tokamaks like ITER [1]. The amplitude and localization of the sideways force are determined by the sharing of electric current between the plasma and the wall.

The present paper describes a wall model that covers both eddy currents, excited inductively, and source/sink currents due to current sharing between the plasma and the thin conducting wall of arbitrary three-dimensional geometry [2, 3]. The developed *sssec* code (standing for “source/sink and eddy current” code) calculates the electromagnetic wall response to perturbation of magnetic fields and to current sharing between the plasma and the wall. The code accepts the vector \mathbf{j}_{perp} of values of current density entering/exiting the wall surface from the plasma at each vertex and the time derivative of the magnetic vector potential $\partial A^{pl}/\partial t$ at each vertex. The third input vector is the set of space points in which *sssec* returns the magnetic field \mathbf{B}^{wall} and its vector potential \mathbf{A}^{wall} from the wall currents. The numerical results have been checked against analytical examples [2, 4] and for a high-resolution mesh (16384 triangles on the wall surface) a relative accuracy of 0.001 has been found. Figure 1 presents the results of calculation of eddy and source/sink currents in the tokamak wall.

Using this approach, JOREK-STARWALL [5, 6] presently limited to eddy currents, will be extended to self-consistent non-linear MHD simulations including eddy and source/sink currents.



References

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