TITLE

Development of 3D ferromagnetic model of tokamak core with strong toroidal asymmetry

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PAPER

Effect of presence of ferromagnetic material in assembly of magnetic fusion devices is conventionally investigated as an influence of tokamak iron core on plasma equilibrium, under assumption of full toroidal symmetry. However, such an approach is insufficient to characterize influence of tokamak core or of ferromagnetic inserts on toroidal asymmetries of tokamak magnetic fields (e.g. resonant magnetic perturbations or toroidal field ripple), which are in the center of current interest.

In previous work [1], toroidally symmetric iron core model was introduced for tokamak GOLEM, together with constraints of its applicability. Proposed contribution presents newly-developed 3D model of arbitrary ferromagnetic elements, based on the same physical principles – screening of currents along ferromagnetic boundary [2]. Model is benchmarked using series of new measurements of magnetic fields affected by influence of strongly-asymmetrical tokamak core. Due to presence of magnetic flux leaks from tokamak core, effect of stray fields on measurements and implementation of gaps into model are discussed as well. Moreover, principal results from previous work [1] are re-examined from the viewpoint of 3D geometry.

[1] T. Markovič, M. Gryaznevich, I. Ďuran, V. Svoboda, G. Vondráček, Evaluation of applicability of 2D iron core model for two-limb configuration of GOLEM tokamak, Fusion Engineering and Design 88 (2013).
[2] M. Gryaznevich, T.G. Kilovataya, V.N. Pyatov, Effect of ferromagnet on the equilibrium of a tokamak plasma, Soviet Journal of Plasma Physics 9 (1983).