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Magnetic field points descriptions for Asymmetric forces on the EAST plasma in Kink mode (n=1, m=1)

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Abstract:

Fusion energy is a durable source for future aspects and tokamak is most advance machine to sustain plasma. Major sideways force act on the plasma when plasma is in kink mode (n=1, m=2) and this effect also appear in horizontal and tilting positions. In addition, Halo current phenomenon rising when plasma interact to vacuum vessel in the presence of strong magnetic field force towords vessel in poloidal direction. In this paper, we have used the energy integral (δW) to calculate plasma inner, surface and outer region by mathematical techniques [1]. Therefore, we have examined the poloidal halo current by vertical displacement events up/down including magnetic field points of balancing sideways force.

Three dimensional Plasma energy and magnetic field points descriptions:

In this section, we have developed a new method for calculating plasma balancing/unbalancing sideways forces, plasma energy and analyzing of toroidal/poloidal halo current [2]. Up till now, many researchers have been published work on 2D plasma energy. In this paper, we have consider 3D plasma energy integral (δW) divided by three parts (Wp, Ws, Wv) and plasma internal region Vi, the boundary region S, and the external vacuum region Ve as well [3].

$$W = \frac{1}{2}\int_{v} \xi \cdot \hat{K}\xi dr = W_P + W_S + W_V$$

Where,

$$W_P = \frac{1}{2}\int_{V_i}\left(\frac{B_1^2}{\mu_0} - p_1(\nabla\xi) - \xi\cdot(j_0\times B_1)\right)dr$$

$$W_S = \frac{1}{4\mu_0}\int_{s}\xi_n^2\frac{\partial}{\partial n}\left(B_{0_e}^2 - B_{0_i}^2 - p_0\right)ds$$

$$W_V = \int_{v_e}\frac{B_1^2}{2\mu_0}dr$$

By using algebraic techniques, we can transform B_r and B_z in energy integral (δW) by perturb magnetic field. While the toroidal magnetic field is given as

$$B_{tor}(R) = 5.6T\frac{R_0}{R}$$

The transformation method have applied to calculate magnetic field points for each cross section area and these magnetic field points able to calculate whole plasma energy by partition of selected degree. However, we can calculate sideways balancing forces to analyze halo current in kink mode (n=1, m=1) [4].

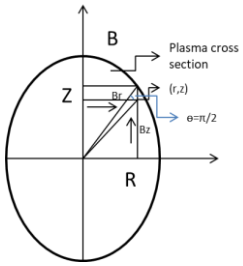

Fig.1 Plasma cross section area and magnetic field point description

Results and descriptions:

With this backdrop, the proposed method allows an effective way to study the main plasma behavior under controlled conditions. Firstly, we have successfully applied transformation method for magnetic field calculations and this transformation provides calculation of each cross section area by B_r and B_θ. Secondly, the method can provide the halo current percentages in different time steps. Thirdy, we have examined the poloidal halo current by vertical displacement events up/down including magnetic field points of balancing sideways force. The results obtained will be useful for equalizing the simulation and experimental results. The research will be extended to developed new models for other Fusion technology.

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