Subject: 7) Physics of stochastic edge plasmas with respect to error fields, locked modes and resistive wall modes.

Plasma vortexes induced by an external rotating helical magnetic perturbation in tokamaks

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The creation of magnetic perturbations (force reconnection) on the plasma edge rational magnetic surfaces by an external rotating low frequency helical magnetic field is investigated in TEXTOR-DED [1] and HYBTOK-II [2] tokamaks. The control of plasma edge behavior is the main purpose of these experiments.

Direct observations of tokamak plasma responses to an externally applied rotating helical magnetic perturbation have been performed only on a small tokamak HYBTOK-II (R=0.4m, a=0.11m) in order to clarify the process of penetration of this external magnetic perturbation into tokamak plasmas [2]. A comparison of the calculated magnetic perturbation profiles [2, 3] with these HYBTOK-II experiments shows a good qualitative agreement.

That is why in the present paper a more detailed theoretical study of the plasma response motion to the external perturbation is studied on the base of two-fluid MHD equations in a cylindrical approximation. Only the main HYBTOK-II resonant mode $q(r_{res}) = m/n = 6/1$ is investigated near the resonance surface $r_{res} = 8.5cm$ ($q(r)$ is the safety factor, m is the poloidal and n is the toroidal mode numbers). The typical for HYBTOK-II parameters are used: plasma current I_p = 5 kA, the toroidal magnetic field B_t = 0.27 T, the edge electron density $n_e = 1.5 \times 10^{18} m^{-3}$ and the electron temperature T_e = 25 eV.

Two plasma vortexes or the formation four ones are found per one poloidal period of the external perturbation ($\Delta\theta = \pi/3$). The amplitude of poloidal velocity in the plasma vortexes has the order of 2-8 *km/s*. The radial size of the vortexes is about 1-3 *cm*.

[1] M.W. Jakubowski, S.S. Abdullaev, K.H. Finken, Nucl. Fusion **44** (2004) S1.
[2] Y.Kikuchi, Y. Uesugi, S. Takamura and A.G.Elfimov, Nucl. Fusion **44** 2004) S28.
[3] I.M. Pankratov, A.Ya. Omelchenko, V.V. Olshansky, K.H. Finken, Nucl. Fusion **44** (2004) S37.