Steepening and Formation of Solitary Dipole Radial Distribution of Electrical Field, Leading to Maximal Shear

V.I.Maslov, O.M.Svystun[a]

NSC Kharkov Institute of Physics & Technology, 61108 Kharkov, Ukraine
[a] Kharkov National University by V.N. Karazin, Kharkov, 61108, Ukraine

e-mail: vmaslov@kipt.kharkov.ua

Now maximal shear formation is widely investigated problem [1-6]. The maximal shear is formed in nuclear fusion devices when the radial electrical field is distributed on radius in dipole - kind. Thus the electrical field should be distributed in narrow dipole – type (and electrical potential in narrow soliton – type). In other words, steepening of the radial distribution of the electrical field should be realized.

In this paper steepening of the radial distribution of the electrical field is considered. Also the reasons that the electrical field approximately equals zero near axis of the system and in peripheral region are considered in this paper. Reasons of the solitary dipole radial distribution of the electrical field are considered. The electrical solitary perturbation can be formed in nuclear fusion devices with dense core plasma and with strong anomalous transport in peripheral region. The strong anomalous transport in peripheral region can be realized due to steepening of plasma parameters appeared after transport barrier formation. The perturbations are not excited near axis of the dense plasma due to strong collisions. Also electrons easily follow for ions due to strong collisions. This leads that the electrical field approximately equals zero near axis of the system. Owing decrease of the plasma density on the large radius the electrons worse follow for ions. This leads to electrical field formation in this region. In peripheral region the perturbations are excited. If anomalous transport, determined by these perturbations are strong, the electrons easily follow for ions and the electrical field can be small in peripheral region.

The radial place of strong shear localization, determined by electrical solitary perturbation, can be control by poloidal chain of narrow magnetic islands. At sufficient plasma electron heating [4-6] they start to miss the region of magnetic islands during their radial shift and do not penetrate into the islands but plasma ions move through islands. This leads to ion accumulation in islands, to plasma rotation in crossed electrical and magnetic fields. At large ion accumulation the solitary dipole radial distribution of the electrical field, leading to maximal shear, can be formed. The expression for connection of optimal plasma parameters, when maximal shear is formed, is derived.

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