CD-O6 AAPPS-DPP2020

4th Asia-Pacific Conference on Plasma Physics, 26-31Oct, 2020, Remote e-conference

Development of 2D MHD simulation of the double null spherical tokamak formation in ST40 device

[1]Tara Ahmadi, [2]Yasushi Ono

[1] School of engineering, University of Tokyo, [2] School of frontier sciences, University of Tokyo

tara@ts.t.u-tokyo.ac.jp

The compact high beta spherical tokamak (ST40) is constructed to develop the spherical tokamak path to the commercial fusion power. The size of this device as well as the plasma current (1-2MA) lies in the range of ST devices. Beside these features, the toroidal field (3T) is higher than common ST devices which throw a challenge in the prediction of the ST40 performance due to the low plasma collosionality. As discussed in [1], the final products differ gradually at low plasma collisionality for ST confinement scaling. Consequently, it is difficult to predict the amount of the plasma heating achieved in ST40. Contingent upon this issue, the merging-compression, grants an efficient energy conversion of the magnetic energy into plasma heating via magnetic reconnection process. Another similar startup scenario, involving the magnetic reconnection, is Double Null Merging (DNM) [2]. DNM utilizes two pairs of external/internal poloidal field coils to form two ST plasmas that are then being merged. Because thee poloidal coils are outside the vacuum chamber, it does not increase the size of the ST device. Due to this fact the DNM startup scenario is preferred in ST40. Two dimensional resistive MHD simulation of this process in the tight-aspect ratio toroidal geometry is reported. Figure 1 demonstrates 4 in-vessel poloidal field coils and 2 external toroidal field coils with constant currents. As the current in PF coils is decreased (from 30kA to 0), the expanding force of the induced poloidal plasma currents cause them to separate from the coils and move together start merging in presence of the PF coils. The reversed PF coil current is used for the ST plasma compression. The perfect conducting wall boundary condition is applied to both **r** and **z** direction along with the condition of zero velocity as shown in Figure 1. The technical information about the coils and plasma parameters received from the reference [3].

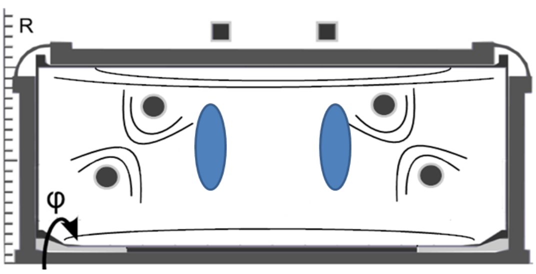

Figure 1 2D MHD simulation model for the ST-40 ST formation and merging

Currently, further endeavors to develop the code and eliminating the problems are necessary to predict the ST40 device performance.

DNM is considered to be an effective startup method in the ST40 device for generating two plasma rings. Then the flux ropes of the generated STs eventually merge into a single flux rope.

This work was supported by Grants-in-Aid for Scientific Research from JSPS (No. 19J21339).

References

[1] A Sykes et al, Nucl. Fusion 58 (2018) 016039
[2] T Yamada et al, PFR journal 5 (2010) S2100
[3] M.P. Gryaznevich and A. Sykes Nucl. Fusion 57 (2017) 072003