Feasibility of fueling method by smaller-torus plasma translation to ST

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Recent nuclear fusion reactor design has a strong demand for a core fueling technique to a high-temperature fusion burning plasma in order to attain steady-state operation. Mitarai et al. has proposed a merging fueling technique where an axially injected secondary torus plasma would be merged with a main spherical tokamak (ST) plasma via a magnetic reconnection process [1].
In the present study, 3-dimensional magnetohydrodynamic (MHD) simulation has been carried out to investigate feasibility of the core merging technique for a burning plasma. Our simulation treats head-on collision between two ST plasmas and assumes a relatively small ST plasma is accelerated by the control of the external magnetic field. Although a ballooning instability occurs during transient phase, our simulation shows a ST merging process completed. In this merging process, the coupling between the magnetic surfaces of the two plasmas and the fueling by the particle trajectory simulation were confirmed.

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[1] O. Mitarai et al., Fusion Engineering and Design 109-111 B, 1365 (2016)