Topological Transition and Inductive Current Drive of a Translated Field-Reversed Configuration

T. Asai[1], J. Sekiguchi[1], M. Arai[1], S. Katayama[1], T. Edo[1], J. Ishiwata[1], Ts. Takahashi[1], M. Inomoto[2], To. Takahashi[3], L.C. Steinhauer[4], Y. Narushima[5], H. Gota[4]

1) College of Science and Technology, Nihon University, Tokyo, Japan

2) Graduate School Frontier Sciences, the University of Tokyo, Kashiwa, Japan

3) Graduate School of Engineering, Gunma University, Kiryu, Japan

4) Tri Alpha Energy, Inc., Foothill Ranch, USA

5) National Institute for Fusion Science, Toki, Japan

Because of its high-beta nature, effective additional heating technique for a FRC is primarily limited to a neutral beam injection. However, the FRC formed by a field-reversed theta-pinch (FRTP) method, the most effective formation technique of FRC, may not have enough poloidal flux to confine tangentially injected fast beam ions. In fusion experiments, center solenoid (CS) coil is widely employed in tokamak and RFP devices, while it requires torus-like plasma shape because the CS coil must locate inside of the plasma. There, topological transition of FRC from simply-connected to torus structure has been demonstrated for inductive current drive by a CS coil using the axial translation technique of FRC.

The series of experiments have been performed on the FAT facility at Nihon University. In the experiments, a “cantilever” CS with a conical point is installed on the geometrical axis of a quasi-spherical confinement region. The FRTP-formed FRC is translated into the confinement region with torus boundary at translation velocity in the range of Alfven velocity (100–200 km/s). Then it experiences a topological transition of magnetic configuration from a simply-connected to a torus structure. After this process, toroidal current is expected to be amplified by the loop voltage induced by applied CS current.

This dynamic translation/transition and poloidal flux amplification have been demonstrated successfully. The proposed technique may expand designing versatility of a FRC-based fusion reactor. Transiently observed toroidal magnetic field in the translated FRC will also be discussed.