Simulation of a field-reversed configuration plasma controlled by external magnetic field

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The FRC plasma is a singly connected plasma with the highest β value in the existing magnetic confinement plasma. Since there is the field-null point inside the separatrix, the averaged Larmor radius is about the same as the plasma radius. Characteristically, it is that betatron particles that move so as to encircle the geometric axis are present inside the plasma, and it is experimentally stable against the tilt mode instability that should appear in the MHD prediction. By tangentially injecting a neutral beam particle in the same direction as the plasma current, the confinement of FRC tends to be improved because it enhances the kinetic properties. On the other hand, due to time-varying electromagnetic fields including waves, there are few application examples of heating and current driving, and it can be said that research from now on is a subject to be advanced in FRC. FRC's singly connected structure enables axial translation, and it also leads to a wide range of applications such as reactor design in which the formation chamber and confinement chamber are separated, two FRCs collision and merging experiments, material research using magnetized plasmas. In this presentation, we summarize and report the simulation results of FRC plasma controlled by external magnetic field.

Simulation of translation and merging is carried out using two-dimensional resistive MHD simulation. The external magnetic field is set so as to push the FRC in the axial direction by temporally changing the assist coil current. Although the magnetic lines of force in the vicinity of the separatrix are partly magnetically reconnected after collision, the two field-null circles of the translated FRC are maintained, and the pressure distribution maintained the double peak shape. Although the calculation mesh is refined in the magnetic reconnection region, it did not lead to promotion of the merging process. In order to investigate low-frequency wave heating and current drive using a center solenoid coil, a 3-dimensional hybrid simulation code is developed. The Cartesian coordinate system is employed, and Coulomb collision is reproduced by the Monte Carlo method. We will discuss details of this calculation in our presentation.

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