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Control of an FRC translation velocity by resistive metal liners

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ABSTRUCT

Successful translation experiments on a field-reversed configuration (FRC) plasma have been achieved in several facilities. In such experiments, translation velocity is adjusted by a magnetic field of a translation region. An internal energy of the plasma is converted to the kinetic energy of the translation plasma. The translated plasma is settled down by inelastic reflections of a magnetic mirror. Though a part of kinetic energy is thermalized and the plasma temperature increases at the reflection, the internal energy of the FRC plasma doesn't conserve in the translation. It is necessary to improve the translation technology without the loss of the internal energy.

We propose a translation experiment using resistive metal liners for an acceleration and a deceleration. The metal liner is installed in a theta pinch coil to control a magnetic reconection and to ensure a position of the plasma formation. By adjustments of a penetration time and the position of the metal liner in the coil, uneven magnetic reconnection is triggered and the axial motion is initiated. The velocity is dependent on the penetration time and the field strength and configuration of the coil at the liners. In preliminary experiment, a plasma with the mass of $2x10^{-8}$kg and the radius of 5cm and the length of 60cm is accelerated to the velocity of10-40km/s by SUS304 liners with the thickness of 0.3mm, the diameter 127mm and the penetration time of about 5-15μs.

When the plasma injects in the liner with the penetration time, which is much longer than a plasma transient time through the liner, a magnetic field excluded by the plasma is anchored to the liner. A current flow is also induced in the metal liner. The plasma is decelerated by the energy loss worked by the magnetic pressure and the joule heating loss of the liner. From the simple model calculation, the FRC plasma with the velocity of about15km/s and the above plasma parameters will be settled down by the above metal liners of 0.3m length located in the magnetic field of 0.35T.