Studies of two-fluid relaxation and plasmoid reconnection in CHI-driven plasmas on HIST

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The coaxial helicity injection (CHI) method using the magnetized coaxial plasma gun is a promising candidate for the non-inductive plasma formation. The CHI provides a good platform for pursuing MHD relaxation and magnetic reconnection physics. Magnetic reconnection is an essential element in understanding of self-organization phenomena such as sawtooth oscillations and Taylor relaxation in fusion plasmas and also eruptive mass ejection of solar flares in astrophysical plasmas. Understanding the physics of the flux closure and the relevant magnetic reconnection during CHI still remains as a key issue which is the primary purpose of CHI experiments on HIST. Fast magnetic reconnection is required for the formation of X-points during the short time scale of the plasma start-up in the high Lundquist number *S* regime.

Experimental findings are as follows; (i) S-P like elongated current sheet created during the CHI process becomes unstable to tearing mode, leading to generation of multiple plasmoids in the reconnection layer, (ii) For the stable CHI discharges, the plasmoid driven reconnection proceeds and then develop to a sufficiently large closed flux, i.e., the formation of X-point, and (iii) For the CHI discharges with the n=1 kink instability during a driven-phase, the distorted magnetic configuration relaxes back to an axisymmetric state with a large amount of the self-generated toroidal flux during the decay phase due to the conversion from toroidal to poloidal current.

In this workshop, we will present the effect of the toroidal (guide) magnetic field and mass (H, D and He) on the current layer thickness and reconnection rates and ion heating.