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Investigations of Plasmoid Formation and Flux Closure in Transient Coaxial Helicity Injection on HIST

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Transient Coaxial helicity injection (T-CHI) has been examined in the Helicity Injected Spherical Torus (HIST) device for solenoid-free plasma startup in a ST. Here, we report the formation process of T-CHI start-up plasma including flux-surface closure and fast magnetic reconnection. Experimental observation shows that (i) two or three plasmoids or islands are generated in elongated toroidal current sheet, (ii) For the stable discharges, the plasmoids merge and straightforwardly develop to a large-scale flux structure due to inward current diffusion during the decay phase, and (iii) For the discharges with the n=1 kink instability, the distorted magnetic configuration relaxes back to an axisymmetric state during the decay phase, leading to generation of a sufficiently large closed flux. These findings could verify that the plasmoid instability in the elongated current layer and/or MHD relaxation with flux conversion during the nonlinear evolution of the kink mode in the presence of the strong toroidal (guide) field allows the formation of an X-point and the fast flux closure via magnetic reconnection in the T-CHI plasma start-up process.

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