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Nonlinear MHD simulation of magnetic relaxation during DC helicity injection in spherical torus plasmas TAKASHI KANKI, Japan Coast Guard Academy, MASAYOSHI NAGATA, University of Hyogo, YASUHIRO KAGEI, RIST — Recently, the intermittent plasma flow has been observed to be correlated with the fluctuations of the toroidal current I_t and n=1 mode in the HIST spherical torus device. During the partially driven phase mixed with a resistive decay, the toroidal ion flow velocity ($\sim$ 40 km/s) in the opposite direction of I_t is driven in the central open flux region, and the oscillations in n=1 mode occur there, while during the resistive decay phase, this flow velocity reverses and results in the same as that of I_t, and the oscillations in n=1 mode disappear there. The purpose of the present study is to investigate the plasma flow reversal process and the relevant MHD relaxation by using the 3-D nonlinear MHD simulations. The numerical results exhibit that during the driven phase, the toroidal flow velocity ($\sim$ 37 km/s) is in the opposite direction to I_t, but in the same direction as the $\boldsymbol{E}\times\boldsymbol{B}$ rotation induced by an applied voltage. This flow is driven by the magnetic reconnection occurring at the X-point during the repetitive process of the non-axisymmetric magnetized plasmoid ejection from the helicity injector. The oscillations of poloidal flux Ψ_p are out of phase with those of toroidal flux Ψ_t and magnetic energy for the dominant n=1 mode, indicating the flux conversion from Ψ_t to Ψ_p. The effect of the vacuum toroidal field strength on the plasma dynamics is discussed.

Takashi Kanki
Japan Coast Guard Academy

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