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Characteristics of Halo Current in the KSTAR Tokamak

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The investigation of poloidal halo current (HC) Ih flowing along the support structures for plasma facing components (PFCs) during the vertical displacement event (VDE) under the toroidal magnetic field BT is required for the estimate of Ih x BT force on the structures in the KSTAR tokamak because it can be expected that the force will cause damages on the structures in the KSTAR when plasma current and toroidal field will become higher than 1.0 MA and 3.0T, respectively, for achieving high performance.
The characteristics of the HCs during VDEs in the KSTAR are investigated by using the HCM measurements in the experimental campaigns of 2014 and 2015.In the measurements, the growth rate of the VDE gamma_z is 30 ˜ 200 s-1, and the maximum magnitude of the HC Ih,max is up to 20 % of the pre-disrupted plasma current Ip0. In addition, the value of Ih,max increases as the maximum value of the current quenching rate (dIp/dt)max becomes higher. From the experimental investigation of parametric dependences of the HC, it is found that higher value of Ih,max is obtained for larger value of kappa in the case of downward VDE. Secondly, the value of Ih,max slightly decreases as q95 increases, and the value linearly depends upon Ip, ne, Wtot and beta_p. Thirdly, the upper limit of the HC can be estimated by using the relationship as Ih,max ˜ 1.4 Ip0/q95 from the investigation. Finally, the trend of the toroidal peaking factor (TPF) versus halo fraction Ih,max/Ip0 in the KSTAR is obtained, and the maximum value of TPF x Ih,max/Ip0 is lower than 0.58. The magnitude of the HC can be decreased by adjusting the amount of gas-puff at the divertor region. The HC rotation can be observed in the KSTAR, and its rotation frequency is ˜ 1kHz during only one revolution in the counter Ip direction during a downward VDE. The toroidal distribution of local HC can be changed by applying the non-axisymmetric magnetic perturbation (NMP) field (n = 1 and -90 phasing) due to resonant magnetic perturbation coil at the edge region in the KSTAR.
In this work, the experimental investigations of the characteristics of the HC during the VDE and the HC rotation and effect of the NMP field on the toroidal distribution of the local HC in the KSTAR will be reported, and the preliminary results from analysis on toroidal variation of the local HC will be presented.

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