# Characteristics of Halo Current in the KSTAR Tokamak

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The characteristics of the thermal/current quench and halo current (HC) during VDEs were investigated in the KSTAR tokamak by using experimental data obtained in the experimental campaigns of 2015 and 2016. There was the linear correlation between the values of $-(dI_p/dt)_{max}$ and $I_{p0}$ (its slope = 178.5 $s^{-1}$), and the minimum value of $\tau_{CQ}$ was estimated to be about 5 ms that was also checked by evaluating quench times from the $I_p$ data. The magnitude of $\gamma_Z$ (mostly, 30 – 100 $s^{-1}$) was in inverse proportion to the value of $\tau_{TQ}$, but there was no correlation between $\gamma_Z$ and $\tau_{CQ}$. In the parametric dependence of HC, the values of both f and TPF became smaller for higher $I_{p0}$ ($I_{p0}$ = 0.4 - 1.0 MA), higher value of $I_{h,tot\ amx}$ was obtained for higher value of both $\kappa$ ($1.2 \leq \kappa \leq 1.9$) and $\beta_p$ ($0.4 \leq \beta_p \leq 1.3$). The value of the TPF × f was lower than 0.58, and the maximum value of f was was up to 45 % of $I_{p0}$. The upper limit of the HC was able to be estimated as $I_{h,max}$ = ~ 1.4 $I_{p0}/q_{95}$ by using the $I_{p0}/q_{95}$ scaling. In addition, the magnitude of the HC was able to be reduced to ~ 58 % when the amount of $D_2$ gas puff at the divertor region was higher than 1.0 $\times 10^{22}$ D/s, and the toroidal distribution of the local HC was able to be changed by applying external NMP field ($n$ = 1 and -90 phasing) at the edge region. Finally, the rotating HCs were observed during VDEs and its rotation frequency was 0.6 – 2.0 kHz during only one revolution in the counter-$I_p$ direction during downward VDEs. Interestingly, few rotating HCs in the co-$I_p$ direction (0.8 – 2.5 kHz) were also detected. For the further study on this rotation, the investigation on the toroidal variation of the local HC will be carried out by using fitting procedure as mentioned in Ref. 1.

**References**.

[1] GERHARDT, S.P., et al., "Dynamics of the disruption halo current toroidal asymmetry in NSTX", Nucl. Fusion **53** (2013) 023005.