

Experimental investigations on plasma current quench during disruptions in the KSTAR tokamak

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The study on the plasma current quench in the phase of disruptions are carried out for the plasma current I_{p0} of 0.4 -1.0 MA in the KSTAR tokamak. The disruption data in the experimental campaign of 2012 - 2017 are used for the study. Firstly, the relationship between instantaneous current quench rate (ICQR) and the pre-disrupted plasma current $I_{p,pred}$ is investigated by using the ICQR obtained from the time derivative of plasma current at the phase of current quench (CQ). The magnitude of the ICQR is up to ~ 200 MA/s and the increment of the ICQR becomes smaller for higher value of $I_{p,pred}$, which means that the relationship between ICQR and $I_{p,pred}$ is not linear. Secondly, several linear (or averaged) current quench rates (LCQRs) are evaluated from the linear fits for several ranges (for an example, 90 % - 60 % level of I_{p0}) in the time evolution of plasma current during the CQ, and the best linear fit for evaluating the LCQR can be selected from the comparison between the ICQR and the LCQRs. From the investigation of the CQRs, the minimum current quench time is evaluated as ~ 2 ms. Thirdly, the characteristics of the toroidal vessel current I_{VC} and eddy current I_{PS} induced on the passive stabilizer as a conducting shell used for plasma control are investigated by using experimental data in the phase of the CQ. The magnitude of I_{VC} is up to ~ 60 % of $I_{p,disrup}$. There is a correlation between the CQR and magnitudes of both I_{VC} and I_{PS} . In addition, the vertical growth rate and shrink rate of plasma size during the vertical displacement events (VDEs) are investigated by using the EFIT reconstructed data in the phase of the CQ. There is a weak linear correlation between the vertical growth rate and the shrink rate of plasma size.

In this work, the results from the further investigations on plasma current quench during disruptions in the KSTAR comparing to the previous work presented at the 44th EPS meeting, together with behaviors during the VDE in the phase of the CQ, are reported.