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P4.1049 Analysis of the initial phase of current quenches in the DIII-D tokamak

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In this study, we analyzed current quenches in 3 types of DIII-D disruptions (low-q, error field and shell pellet injection) to investigate the determination mechanism responsible for the initial phase of current quench in DIII-D tokamak. Disruptions are one of the most critical issues for realization of DEMO reactor. During the current quench (CQ), the plasma current (Ip) decays rapidly because of the sudden in increase in plasma resistance following the thermal quench. The rapid
current decay generates potentially damaging eddy
currents and electromagnetic force in conducting materials around plasma. To reduce these effects, Massive Gas Injection (MGI) and Shattered Pellet Injection (SPI) are candidate methods to mitigate the effects of thermal quench and CQ in ITER [1]. In this study, we focused on the initial phase of the CQ (between 100% to 80% of maximum Ip in CQ) to determine the mechanism governing the CQ decay time. In a previous study of JT-60U, it was found that there was also fast current decay during the initial phase of CQ in a high electron temperature Te disruption discharges (Te at the plasma center: over 100eV) and Ip decay varied with the change in plasma inductance Lp during the CQ, especially internal plasma inductance Li [2]. In this study, we analyzed CQ in 3 types of DIII-D disruptions to confirm the impact of the time evolution of the Li on the decay time of the CQ. To evaluate the Li during the initial phase of the CQ, we used the CCS method. Fig.1 shows the relationship between time derivative of Li and CQ time during the initial phase of the CQ. It is found that dLi/dt is increased with decrease of CQ time as same to JT-60U results. To investigate the mechanism of increase of Li, we are simulating the CQ waveform by using DINA [3]. We will show results of DINA analysis in presentation. This material is based upon work supported by the US Department of Energy under Award Number(s) DE-FC02-04ER54698.

[1]T.C. Hender, et. al., Nucl. Fusion 47 S128-202 (2007). [2] Y. Shibata, et. al., Plasma Phys. Cont. Fusion56 045008 (2014). [3] R. Khayrutdinov and V. Lukash, J. Comput. Phys. 109 193(1993).

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