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Disruption mitigation by multiple injection of shattered pellets in KSTAR

ITER adopts a strategy that distributes radiated power evenly during the disruption mitigation and reduces the time to prepare pellets, using simultaneous multiple shattered pellet injections (SPIs) [1]. However, since there were no existing devices with perfectly symmetric SPIs, as planned in ITER [2], sufficient studies have not been conducted on the effects of simultaneous multi-injections. To verify the feasibility of the disruption mitigation strategy of ITER, KSTAR installed two SPIs with the exact same design at toroidally opposite locations. We mainly examined the difference in disruption mitigation by intentionally changing the arrival times of two SPIs to assess possible jitter effects among multiple SPIs. The current quench rate changes proportionally as the time difference varies from several percent to several tens of percent of the thermal quench (TQ) duration (1˜2 ms). This experimental result demonstrates that more energy can be radiated when multiple SPIs are injected simultaneously. In the case of dual SPIs, the measured peak density is $1.2 \times 10^{21} m^{-3}$ near TQ end, which is almost twice the value of single SPI. Among the various themes of DMS, we plan to focus firstly on the multi-injections from different toroidal positions as well as multi-barrel injections from the same poloidal/toroidal position in accordance with the plan of ITER DMS. For the purpose, the largest size barrel will be changed to middle size one to simulate ITER SPIs, which have all the same size barrels. It is expected to provide the data that underlie the design of the ITER DMS.

References:
[1] L.R. Baylor et al., 2009 Nucl. Fusion 49 085013.
[2] M. Lehnen et al., 2018 IAEA fusion energy conference

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