P141

Application of multi-physical states injection technology in fusion plasma disruption mitigation

Yunbo Dong[1], **Chengyuan Chen[1]**, **Yipo Zhang[1]**

[1]*Southwestern Institute of Physics, Chengdu, China*

Disruption mitigation is considered an essential part of the control system in tokamaks and fusion reactors. The goal of massive impurity injection is to dissipate the stored thermal and poloidal magnetic energy of the plasma radiatively over the entire surface of the first wall, avoiding the concentrated heat load near the strike point on the divertor that occurs when confinement is lost in an unmitigated disruption. At present, the massive gas injection (MGI) and shattered pellet injection (SPI) techniques are regarded as the primary injection methods for disruption and RE mitigation. Both of them have their own character and can be used in different applications. In order to combine the advantages of gas injection and pellet injection for avoidance and mitigation of disruptions, a new hybrid injection system, which including an MGI system and Li pellet injection system, had been developed successfully on HL-2A tokamak. It can realize the global simultaneous cooling of the plasma core and boundary. This impurity injection method is more conducive to enhance the mixing effect of impurities. The hybrid injection system is installed at the midplane port on HL-2A. The MGI injector with a short response time (0.25 millisecond), and adjustable throughput ($10^{21} \sim 10^{23}$) allows to meet the requirement of disruption mitigation. The Li pellet injection system has automatic supplying system and turntable adjustment system to adjust the number of Li pellet. The Li pellet can be injected with a speed of 200 – 400 m/s. Several different injection scenarios were performed using different gases and Li pellet in various amounts on HL-2A. Gas (He, Ar) and pellet Li injected into steady (non-disrupting) discharges are shown to mix into the plasma core dominantly via magnetohydrodynamic activity during the plasma thermal quench (TQ). Mixing efficiencies of injected impurities into the plasma core are measured to be of order 0.05 – 0.4. At this large amount of injected impurities, the fuelling efficiency (F_{eff}) remained at the level of 30 % for plasmas with a modest thermal energy ($E_{\text{th}} < 0.4$ MJ). The preliminary experiments, presented in this contribution, show that the new hybrid injection system has a significantly higher F_{eff} than the MGI.

Presenting Author Email Address: *caroldyb@swip.ac.cn*