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Advanced Fueling in Spherical Tokamak by Compact Toroid Injection on QUEST

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Compact toroid (CT) injection was conducted on several middle-class tokamaks in the previous experiments for development of an advance fueling method. We have carried out CT injection in a Spherical Tokamak (ST) plasma, for the first time, on QUEST equivalent to the tokamaks in facility size. The primary aim of the experiment is to produce a high-density ST plasma and control its density profile by CT fueling. The QUEST is designed for a ST confinement at the toroidal field $B_T = 0.5$ T for a pulse mode. The UH-CTI injector has a sufficient performance to penetrate into a ST plasma at $B_T = 0.8$ T. However the CT traveling distance from the injector nozzle to the separatrix on QUEST is 1.525 m, which is longer by about 1 m than that in the previous experiment on JFT-2M. It is also our objective to investigate the long CT transport with a drift tube. In the experiment, a CT plasma with a high density up to the order of 10^{21} m^{-3} at more than 200 km/s was injected perpendicularly on the magnetic axis on the midplane. Plasma responses to CT injection was obtained in an OH-ST plasma at $V_{\text{form.}} = 17$ kV and $V_{\text{acc.}} = 25$ kV for the CT formation and acceleration banks respectively. Plasma current had no adverse effect of CT injection. A line averaged electron density increased just after CT injection. Thus the long CT transport and the non-disruptive CT injection are successfully made. Electron density profile was also measured by Thomson scattering. The trigger system is set up to observe electron density profile at any given timing in the order of microseconds after CT injection. At the rather fast time of 0.5ms after CT injection, increment in electron density was observed on the peripheral channels. In this experimental research, we have successfully conducted CT injection in a ST plasma on QUEST. Non-disruptive CT fueling in an OH-ST plasma is obtained. Peripheral fuel particle deposition is observed by Thomson scattering.

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