

§59. First Fuelling Experiments by CT injection on QUEST

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Injection of an accelerated compact torus (CT) has been devised for fuelling fusion reactors. The CT injection experiments have been successfully demonstrated in the middle-class tokamaks. Under the NIFS Bidirectional collaborative research, in Kyusyu University, CT injection was conducted on the compact PWI experimental device of CPD in order to study dynamics of CT plasmoid in the penetration process and to trial CT plasma exposure on wall materials. Moreover CT injection experiment has been prepared to study on advanced fuelling into spherical tokamak (ST) plasmas on QUEST.

The UH-CTI injector to be installed on QUEST has achieved central penetration in the JFT-2M tokamak at $B_T = 0.8$ T. The ST device of QUEST is designed for operation at $B_T = 0.25$ T for a steady-state mode ($B_T = 0.5$ T for a pulse mode). Thus the UH-CTI has a sufficient performance to penetrate a CT plasma deeply into QUEST. This allows us to conduct the CT injection experiment planned for the following purposes; 1.Exploration of possibilities to control CT penetration depth and particle deposition point by varying CT parameter, and the technological establishment for deep fuelling, 2.Research on interaction between a high-temperature plasma and a CT plasmoid (magnetic reconnection, helicity conservation, excitation of waves), 3.Investigation of ability of CT injection to assist ST plasma current start-up, 4.Attempt to drive plasma flow by tangential CT injection on poloidal or toroidal planes in ST.

In the last fiscal year, in order to launch the CT experiment, the CT injector had been moved from CPD and set on a sliding stage by QUEST in such a way as to be

installed perpendicularly on the magnetic axis on the midplane. In this fiscal year, we prepared to move the power supply unit 1 and 2 for CT formation and acceleration to near the CT injector. In the units, total inductance of the discharge cables has a considerable influence on CT formation and acceleration currents. The units are optimized, each having 24 coaxial cables with only 12-m long. Therefore the units should be moved as near as possible to the CT injector. The unit 1 should be also put on top of the unit 2, owing to limited footprint. The setting did not, however, meet the quake-resistance standards. the piled-up units have to be provided with a seismic strengthening structure. We thus designed a stage having a reinforced structure to hold up the unit 1 over the unit 2, and made the seismic analysis. We also reviewed other arrangement of the units on the laboratory floor. Ultimately, we attached importance to the safety of settings, resulting in separation of unit 1 and unit 2 as shown in fig. 1. The units have been already placed and connected to the CT injector. The adverse effect of the separate units were limited. CT formation and acceleration currents are predicted to achieve 350 kA and 400 kA, respectively, both with a rise time less than 10 μ s.

A drift tube to be attached between the CT injector and QUEST was designed and manufactured. Measurement systems in CT injection experiments have been also prepared. After these preparations, we intend to install the CT injector on QUEST and conduct the initial test of CT injection in the next fiscal year.

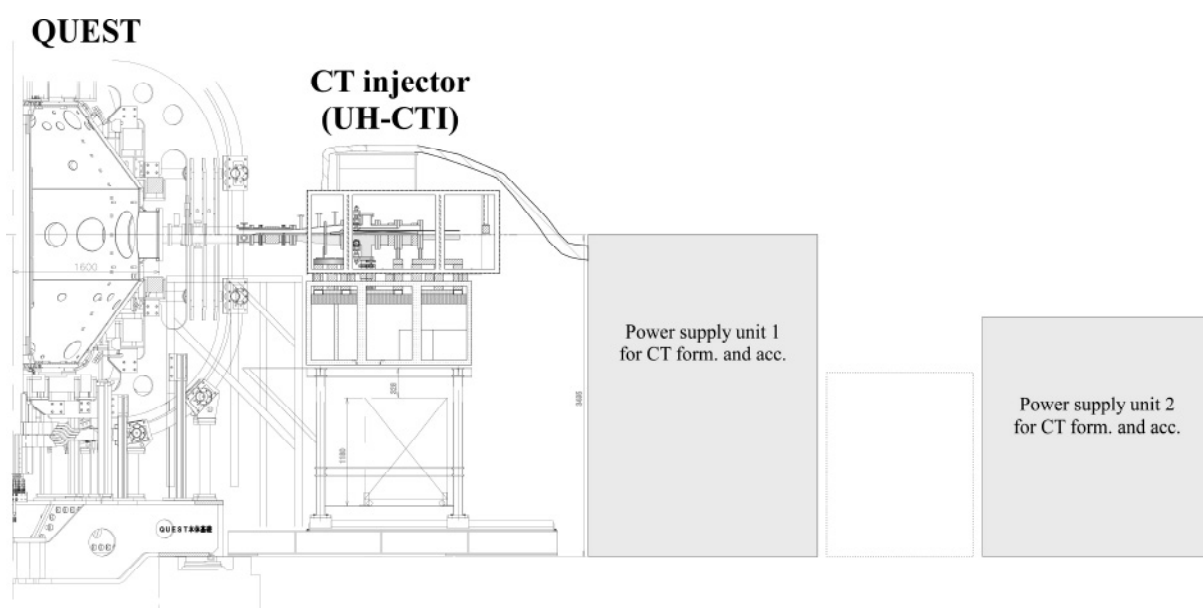


Fig. 1 UH-CTI installed on QUEST and the power supply units for CT formation and acceleration.