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TJ-IIにおけるTESPEL入射実験
TESPEL injection experiment in TJ-II

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A tracer-encapsulated solid pellet (TESPEL), which can be considered as a double-layered impurity pellet in a simple term, has been developed at NIFS in Japan to promote detailed impurity transport studies in magnetically-confined high-temperature plasmas [1]. Recently, the TESPEL injection system has been established in the TJ-II stellarator at CIEMAT in Spain based on a collaboration between NIFS and CIEMAT [2]. In order to reduce the costs and work for the construction of a complete new system, we combined the TESPEL injector with the existing differential pumping and pellet diagnostics of the TJ-II cryogenic pellet injection system (PI), as shown in Fig. 1. Since the size of the TJ-II stellarator is similar to that of the Compact Helical System (CHS), which was utilized for the proof-of-principle experiment of the TESPEL, the size of TESPEL used for the TJ-II is similar to that used for the CHS: the outer and inner diameters of the TESPEL are about 300 μm and 100 μm, respectively. The TESPEL ejected from the injector travels along a guide tube, before entering and passing through the pellet gun box of the PI. By utilizing the PI injection line for the TESPEL injection, existing light sensitive diodes and a fast camera for the hydrogen ice pellet can be also used to follow the TESPEL ablation process in the plasma. The local deposition of the tracer impurity embedded in the TESPEL has been also confirmed in the TJ-II plasmas by the diode signals.

One of the advantages of the TESPEL is to introduce an extrinsic impurity into the magnetically confined plasma. Taking this advantage, spectral line database on sulfur ions has been extended in the TJ-II plasma by utilizing the TESPEL scheme [3]. Moreover, the unique arrangement in the TJ-II allows us to compare the ablation and penetration of polystyrene pellets and hydrogen pellets, as well as for contrasting subsequent pellet particle deposition and plasma perturbation under analogous plasma conditions. For instance, a significant increment of the electron density has been observed after the TESPEL injection, compared with the equivalent hydrogen pellet [4]. In this contribution, major achievements by the TESPEL injection experiments in TJ-II stellarator will be shown and discussed.

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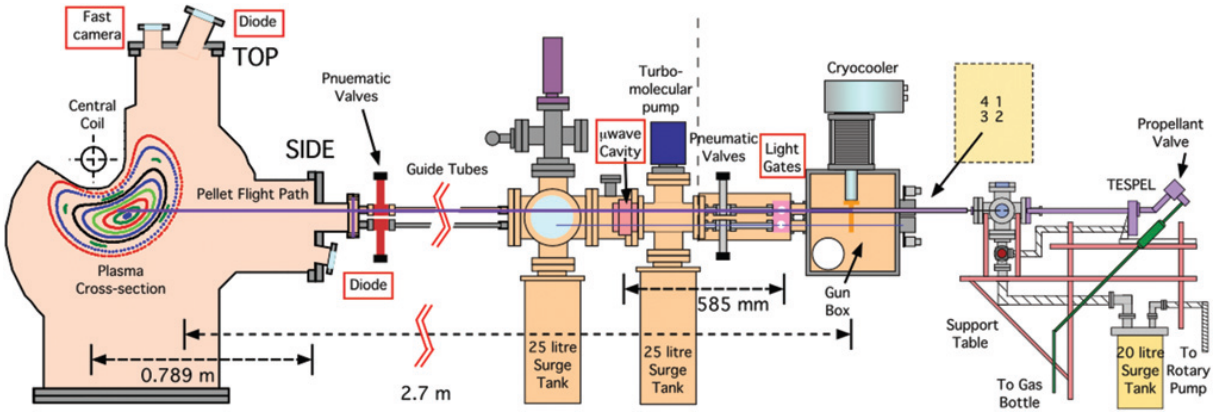

Fig. 1. Schematic view of the TESPEL injection system, which is piggybacked onto the TJ-II cryogenic pellet injector (PI). The injection line-4 of the PI is used for the TESPEL injection. The cross-section of the TJ-II machine and the closed magnetic flux surfaces for the standard configuration for the line 4 are also depicted [4].