

§8. Fueling Pellet Injector for LHD

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A fueling pellet injector has been designed [1,2] and it has been installed for LHD in the second campaign of LHD experiment. Over 3,000 hydrogen pellets has been formed and accelerated for the stand-alone test. The performance of this pellet injector is presented in outline.

Table I. show the basic specification of the pellet injector. Expansion chamber and cryogenic system of this pellet injector was designed for 10 barrel, one of them was installed at present.

Table I. Basic specification of the pellet injector

Fuel	H ₂ , D ₂
Pellet size (nominal)	3 mm ϕ × 3 mm ℓ
Pellet velocity	> 1000 m/s
Minimum operation cycle	< 3 min

Fig. 1. show the schematic drawing of the pellet injector and plasma vacuum vessel of LHD. The pellet injector has been installed on the B-stage and connected to the 3-O port of LHD. The pellet injector takes a pneumatic pipe-gun type barrel and therefor, high-pressure helium gas is employed for pellet acceleration. In order to prevent to flow helium gas into LHD plasma vacuum vessel, double expansion chambers with large capacity vacuum pumps and fast shutter valves were installed. A pellet is injected approximately on the apsides line of the plasma and the injection line pass through the center of the plasma. The divergence angle of injected pellet is within 2 degree, therefore the scatter of the pellets at the plasma center are within ± 15 cm.

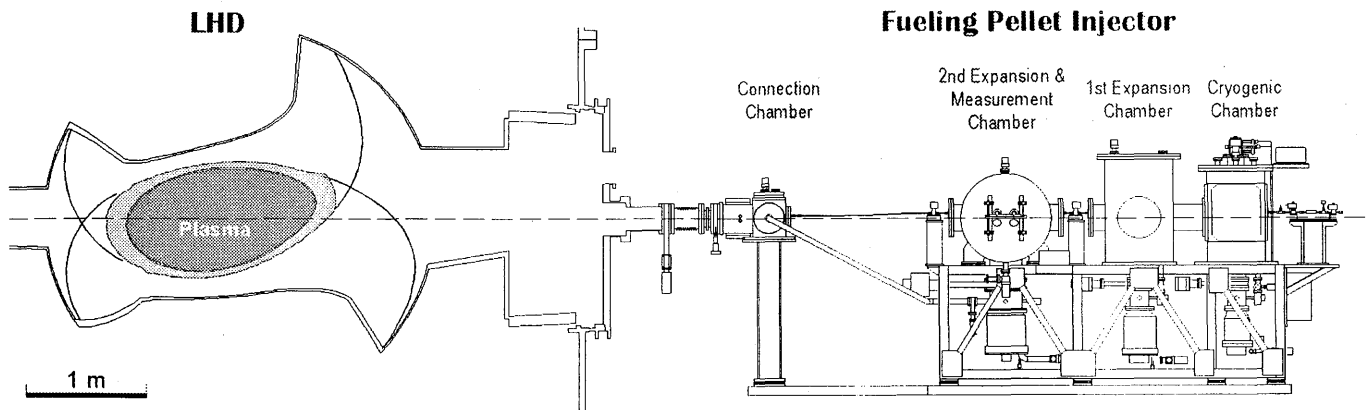


Fig. 3 Schematic drawing of the pellet injector.

Fig. 2. show a typical photo image of a pellet that was taken with a CCD camera and a fast flash lamp at the connection chamber. The mass of the pellet can be measured by the build-up of the connection chamber and the microwave mass detector. The mass, i.e. the particle number of a pellet can be changed within $0.8 \sim 1.1 \times 10^{21}$ atoms by varying the supply pressure of a hydrogen gas. The velocity can be changed within 850 ~ 1200 m/s by varying the pressure of a propellant gas.

The repeated injection test has been carried out with a period of 3 minutes over 4 hours under several conditions. There is no missing even a single shot. Regarding the measurement value of the velocity and mass, the scattering of the data is less than 5 %. This fueling pellet injector has high reliability and high stability.

In order to increase the fueling particle, 4 barrel will be added by the third campaign of LHD experiment. One of them will be used for advanced pellet injection, for instance, inner side injection and/or vertical injection.

Reference

- [1] Yamada, H. *et al.*, Annual Report of NIFS, April 1996- March 1997, 53(1997).
- [2] Sakamoto, R. *et al.*, Annual Report of NIFS, April 1997- March 1998, 41(1998).

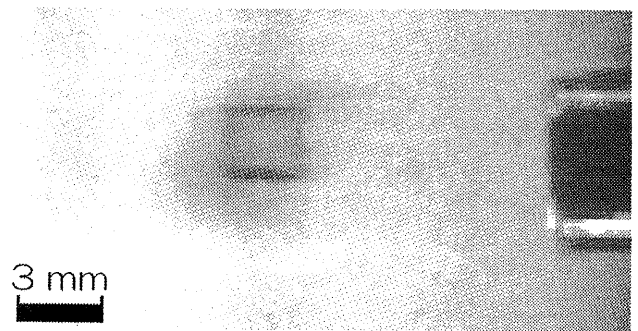


Fig. 2 Typical photo image of the hydrogen pellet.