§37. Development of Full-Scale Model of Target-Injection System for Inertial-Fusion Energy

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Laser-fusion research is now in a stage where reactor engineering is important. In laser fusion, a cryogenically-cooled fuel capsule, which we call a target, is injected into the center of a reactor at high speed, and then irradiated by laser beams. Therefore, a unique target-injection system is needed to be developed. A target-injection system must inject a target

(1) at required flight speed,
(2) to required position,
(3) with required target attitude, and
(4) diagnose the flight condition of the target quickly, and
(5) send the flight data to the final-mirror drive unit for laser irradiation.

In a target-injection system, a target with a sabot is accelerated first by some means. After the acceleration to the required speed, the sabot is removed. After that, the flight condition of the target is diagnosed, and the flight data is sent to the final-mirror drive unit for laser irradiation. That is, a target-injection system is generally composed of the acceleration module, the sabot-removal module, and the diagnostic module. So far, each module was developed separately. A gas gun as a main target-accelerating device was developed at Hiroshima University,[1] a coil gun as a flight-speed adjuster and a sabot remover was developed at Gifu University,[2] and an optical diagnostic system was developed at Ibaraki University.[3] This joint research was started intending to integrate such individual researches. The objectives of this research are to join the individually-developed technologies, construct a full-scale target-injection system, and demonstrate the feasibility of repetitive laser irradiation of targets. This year, we moved the gas gun developed at Hiroshima University to Institute of Laser Engineering (ILE), Osaka University, and reconstructed it.

The experimental area in ILE is 3 m x 14 m. We moved a high-pressure gas reservoir whose volume is 17 liters (Fig. 1), an acceleration tube whose length and inner diameter are respectively 2193 mm and 10.21 mm (Fig. 2), and a diagnostic chamber whose length is 2 m (Fig. 3), and set them as shown in Fig. 4. The target-injection system is still in the start-up stage. We are planning to add some magnets around the ending part of the acceleration tube and to carry out experiments on sabot removal in the next year.

1) Sakae, S., Hayashi, H., Kitabatake, T., Matsumura, T., Endo, T., and Norimatsu, T.: Plasma and Fusion Research **4** (2009) S1006.
2) Yoshida, H.: Annual Report of ILE Joint Research (2010) 61.
3) Sakauchi, H. and Tsuji, R.: Plasma and Fusion Research **4** (2009) S1012.

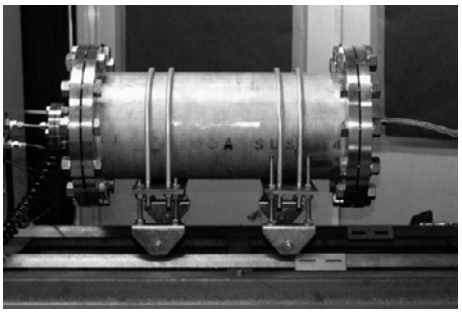

Fig. 1. High-pressure gas reservoir for gas gun.

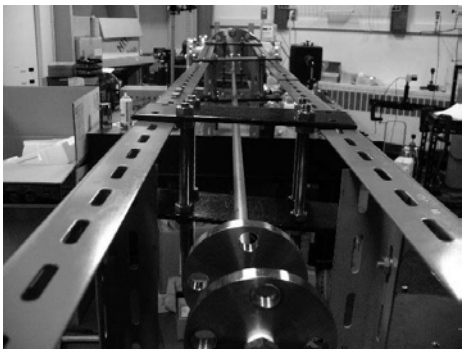

Fig. 2. Acceleration tube for gas gun.

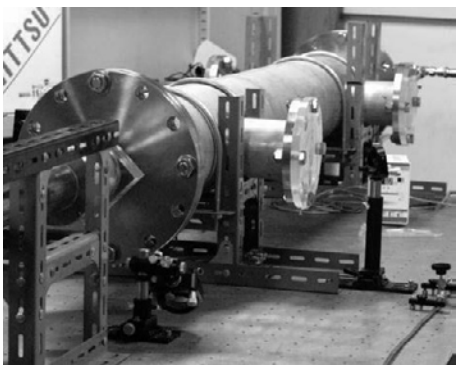

Fig. 3. Diagnostic chamber.

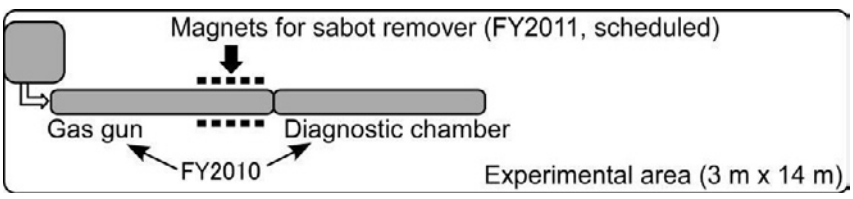

Fig. 4. Target injection system which we are constructing.