§37. Sabot Separation and Target Stability in an Injection System for Fast-Ignition Targets

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The fast-ignition laser fusion requires higher stability of the attitude of the injected target compared with the central-ignition laser fusion. This is because the target used in the fast-ignition laser fusion is not spherically symmetric. Accordingly, it is important to carry out target-injection experiments using a system similar to the real-scale reactor system and to prepare a database for the design of the real-scale reactor system. Since FY2010, we have been developing a real-scale target-injection system for the fast-ignition laser fusion at the Institute of Laser Engineering, Osaka University. The current objective is to demonstrate the adequately-precise target injection in the single-shot mode at room temperature. In FY2012, we tested the sabot-separation system by an array of permanent magnets.

Figure 1 shows the experimental arrangement. The injection system is basically a gas gun. A target is set in a sabot, and the target is accelerated together with the sabot by gas pressure. In order to decelerate the sabot and separate it from the target after the required acceleration, an array of permanent magnets was installed at the end portion of the acceleration tube. We placed 20 doughnut-type magnets as shown in Fig. 1.

Figure 2 shows raw images obtained by the high-speed camera. The sabot was observed after the target passage by 1.55 ms. That is, the sabot was successfully separated from the target although the attitude of the target was not precise enough. In order to investigate the preciseness of the target injection, we repeated the experiments. As a result, the flight speed was 114 ± 23 m/s, the preciseness of the flight direction was ± 1.97 mrad, and the rotation speed, whose axis is perpendicular to the flight direction, of the target was 10 ± 43 rad/s. The goals of these are currently 100 ± 1 m/s, ± 1 mrad, and 0 ± 0.7 rad/s, respectively. In conclusion, the rotation speed of the target, namely the preciseness of the target attitude, should be considerably improved in future.

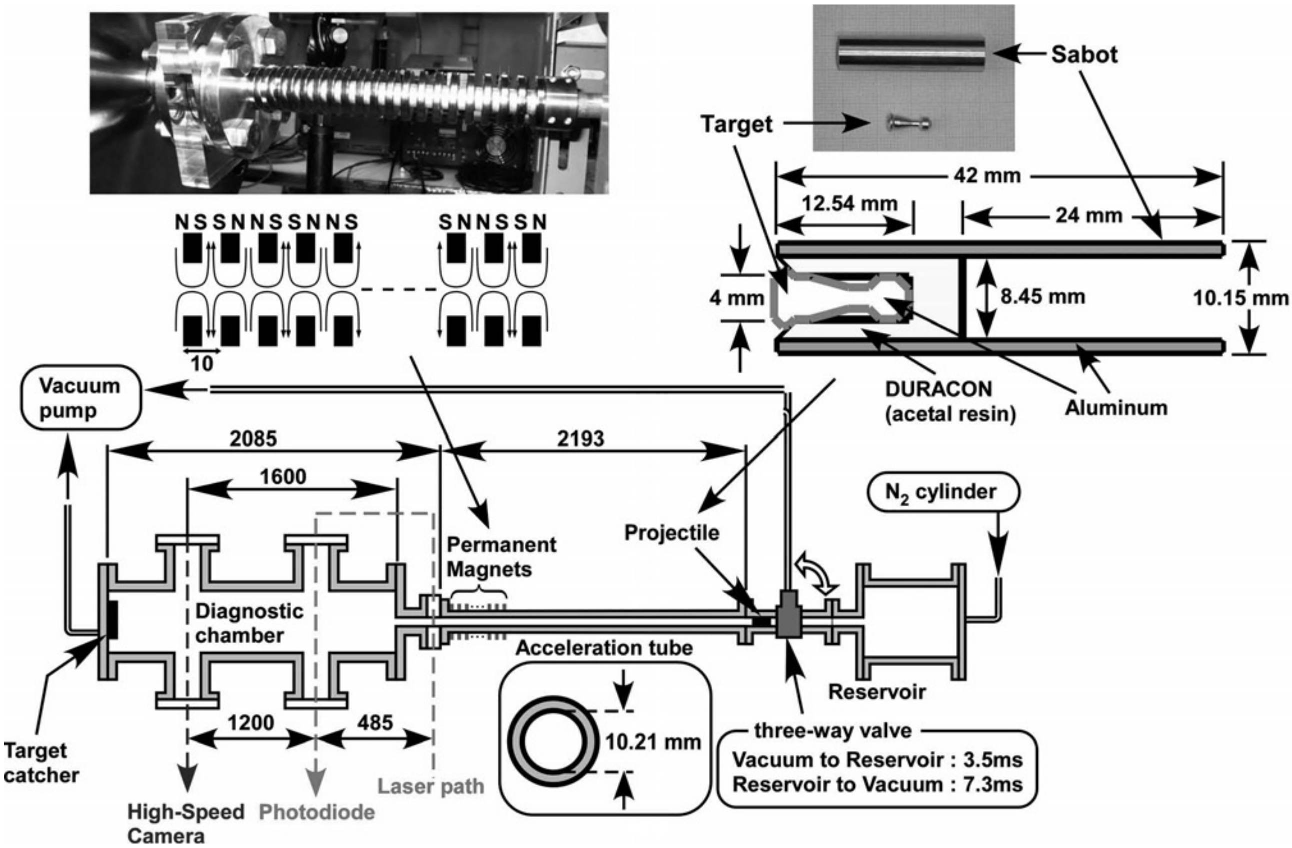

Fig. 1 Experimental arrangement.

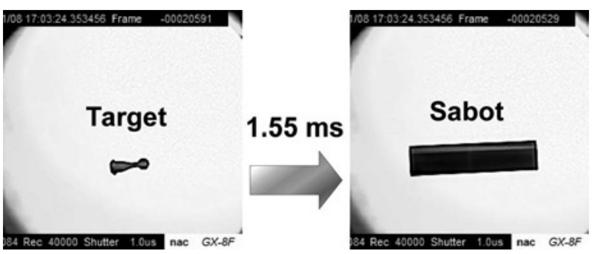

Fig. 2 Images obtained by the high-speed camera.