§66. Research on Attitude Stabilization of Fast Ignition Target

Norimatsu, T. (Institute of Laser Eng., Osaka Univ.)

In a fast ignition laser fusion reactor, non-spherical targets with guide cones are injected into the center of the reaction chamber. Targets should satisfy following conditions: ±1 mrad in the pointing, ±20deg/s in the "tumbling speed" or yawing and pitching, 100±1m/s in the injection speed, and at the repetition rate of 4Hz. Our goal is to demonstrate such injection at a single-shot-base. Tumbling speed was not achieved in previous work.

In 2014, it was revealed that magnets for sabot removal probably affect the attitude of the target. If the target passes through magnets area with initial tumbling angle, the balance of moment of the electromagnetic force is broken. That imbalance causes torque to accelerate tumbling speed. A simulation shows if the target has initial tumbling angle by 2deg, the angle increases by 0.555deg after the target goes through magnets area [1].

In 2015, we tried to observe the instance of the target leaving the sabot. A slit was made at the end of the acceleration tube, just magnets are located. The target was directly observed through the slit with a high speed camera (**Fig.1**).

To calculate tumbling angle, the axis of the target was detected by analyzing brightness change. Change in tumbling angle was analyzed every 0.1ms while the target passes through magnets area. The result is shown in **Fig.2**. This result suggests that tumbling angle is within ±15deg in magnets area. The attitude of the target is not roughly disturbed at this area. The resolution is 0.78mm. It was difficult to evaluate detailed change in tumbling angle at this resolution. Nevertheless, tumbling angle is likely to increase in magnets area by qualitative analysis comparing the static image just after removed from the sabot and the last image.

In conclusion, tumbling angle of the target is within ±15deg in magnets area. Tumbling angle is likely to increase after the target passes through magnets area, but it is not sure how much magnets accelerate the target's tumbling speed.

In 2016, we will improve the resolution and observe the instance of the target leaving the sabot again. For example, reduce the backlight to make boundary between the target and background clear. In addition, we will focus on initial tumbling before the target removed from the sabot. It is suspected that the clearance gap between the sabot and the acceleration tube induces vibration to cause initial tumbling of the target.

[1] Yoshihiro Kajimura, private communication

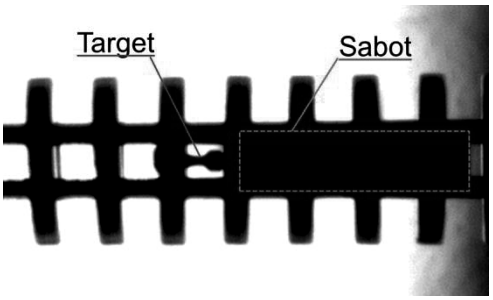

Fig.1 The instance of the target leaving the sabot

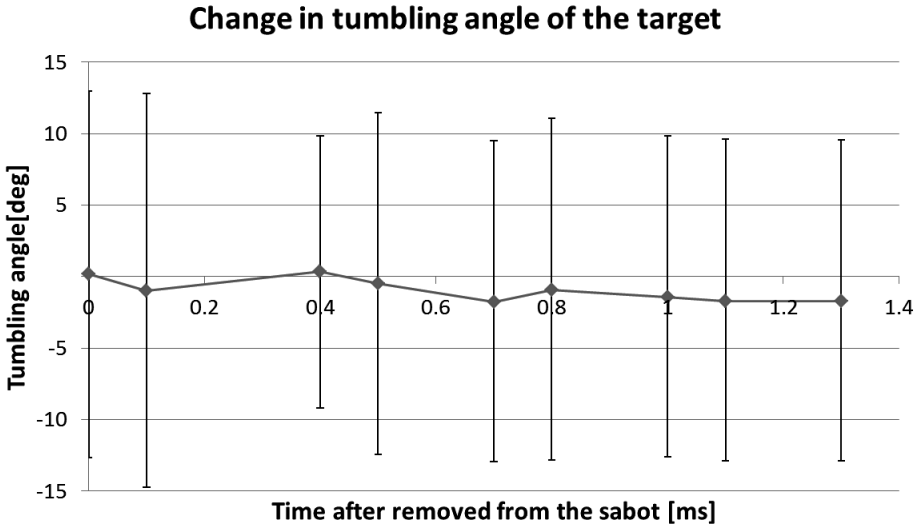

Fig.2 Change in tumbling angle of the target while the target passes through magnets area