

Development of target fabrication and injection for Laser Fusion in Japan

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At ILE Osaka University, the FIREX-1 project (Fast Ignition Realization Experiment) is in progress aiming heating of compressed plasma to the ignition temperature 10 keV. Targets used in this experiment have been developed with collaboration of National Institute for Fusion Science (NIFS), Fukuoka University, Levedev Physical Institute through ISTC project and General Atomics through Japan-US collaboration. Injection and tracking of fast ignition (FI) target are studied at the Hiroshima University and the Gifu University.

Up to date, accuracy requirements for the sphericity, thickness uniformity of the layers of the FI target are not clear. They are, however, considered to be much relaxed than those for a central ignition target. In previous experiment at ILE, 600 times solid density was achieved using a deuterated, tritiated polystyrene shell while simulation on the hydrodynamic instability indicated that the imploding shell broke before it reached its final stagnation¹. The FI target would accept certain low and middle mode non-sphericity. Figure 1(a) illustrates the fast ignition target for FIREX-1. The target consists of a low-density foam-layer saturated with solid deuterium and tritium (DT), a gas barrier, and a guide cone for additional heating laser. The fuel is fed through a capillary tube from a reservoir located outside the target chamber. This scheme reduces the burden related to use high pressure DT gas.

Figure 1(b) is designed for a reactor. This target has a thermal insulator outside and a heavy cone whose inner surface is paraboloid to help focusing of the additional heating laser to the compressed core.

Technical challenges to make these targets are; to make low density foam (10mg/cc), to make a hole for cone assembling on a fragile shell, to make a thin capillary, disassembling of parts due to different thermal expansion coefficient at low temperature and characterization of solid DT layer.

A cryostat to demonstrate proof of principle of foam method for the cone target is now being assembled at NIFS.

At the Hiroshima University, pneumatic injection with rifling is studied and the tracking of FI target with cone was developed at the Gifu University using matched filter method that can eliminate the image processing during detection.

Detail of these activities will be reported at the meeting.

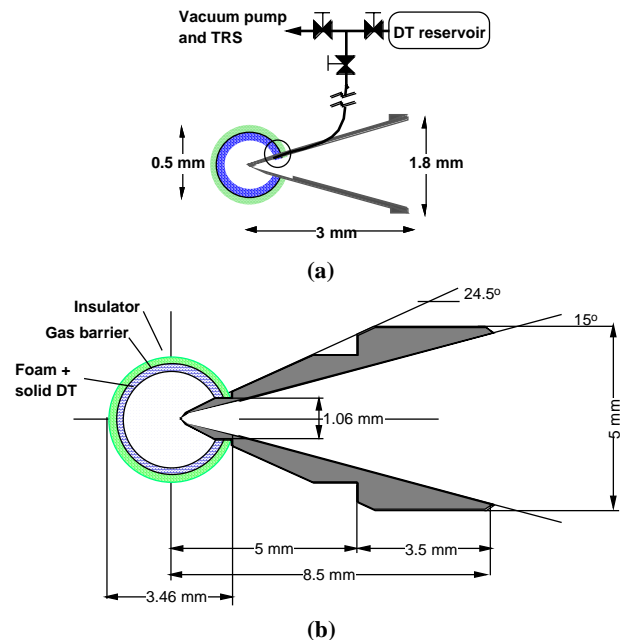


Fig. 1 Cone guided FI target for FIREX-1 (a) and a reactor (b)

¹ T. Yamanaka, et al., Particle Accelerators, 37 534 (1992)