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# §35. Researches on Compression and Heating of Cryogenic Target and Related Physics

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**FIREX project**

In the April of 2003, the construction of heating laser of 10 kJ/10 ps/1.06 μm (Laser for Fusion Experiment; LFEX), for FIREX-I (Fast Ignition Realization Experiment) has started. [1] The present outlook of the LFEX laser is shown in Fig.1. Target fabrication and irradiation system of foam cryogenic target are developed as the collaboration program between Osaka University and NIFS (National Institute for Fusion Science), see Figure 2. After the completion of LFEX, we will irradiate a foam cryogenic cone shell target with LFEX in late 2007. The target fabrication technology is further developed to reduce the foam density to less than 20mg/cc by the end of FY2006.

**Plasma experiment**

In order to investigate implosion dynamics, planer cryogenic foam layer targets are irradiated with GEKKO XII laser. As a result, we found that a deuterium layer is compressed and accelerated by ablation pressure as expected in simulations. We also irradiated a foam cryogenic deuterium layer with the peta watt laser to find that the fast electron is strongly shielded by self generated E-M fields on the plastic-cryogenic layer interface. As an alternative fast heating scheme, the impact of a highly accelerated foil has been proposed and the ablative acceleration to $6.5 \times 10^7$ cm/sec was achieved.

**Integrated simulation of fast**

The cone target implosion and heating processes are studied by using the Fast Ignition Integrated Interconnected code ($FI^3$ code) which connects a radiation hydro code (PINOCO), a collective PIC code, and a Fokker Planck code. The $FI^3$ code has been used to analyze cone target experiments. 2D hydro simulations for cone-shell target implosion by PINOCO well reproduce experimental results.

**Summary**

Toward FIREX-I experiment, laser construction, target fabrication, plasma experiment for preparation, and integrated simulation studies are in advance. In the test operation of LFEX, out put of 3kJ/beam/1.06 μm was achieved recently. A conceptual reactor design is completed which discloses future issues of fast ignition research. [2]

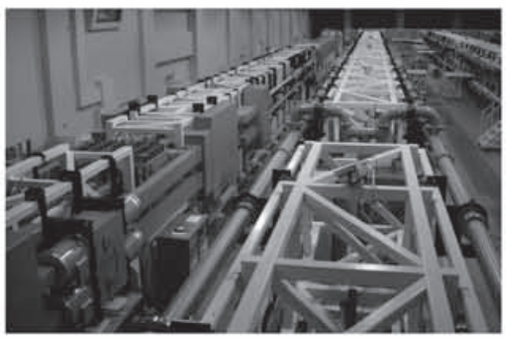

Fig.1 Present outlook of LFEX (heating laser for FIREX-I.

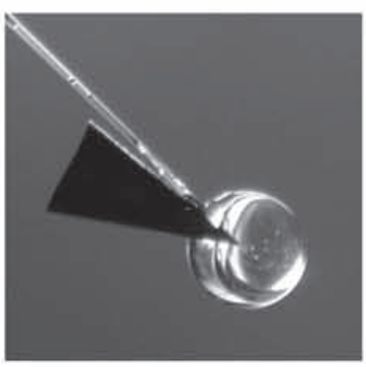

Fig. 2, liquid H2 filed plastic shell with cone
This is developed by the collaboration with NIFS

[1] K. Mima, *et al*, Proceedings of Inertial Fusion Science and Applications 2005
[2] K. Tomabechi *et al.*, Proceedings of Inertial Fusion Science and Applications 2005