Core heating dynamics in magnetized fast ignition

Tomoyuki JOHZAKI[1], Hideo NAGATOMO[2], Yasuhiko SENTOKU[2], Atsushi SUNAHARA[3], Toshihiro TAGUCHI[4], Hitoshi SAKAGAMI[5], Shinsuke FUJIOKA[2], Shohei SAKATA[2], Seungho LEE[2], Hiroyuki SHIRAGA[2] and FIREX project

1) Hiroshima university, Japan

E-mail: tjohzaki@hiroshima-u.ac.jp

2) Institute of Laser Engineering, Osaka University, Japan

3) Purdue University, USA

4) Setsunan University, Japan

5) National Institute for Fusion Science, National Institutes of Natural Sciences, Japan

The theoretical and experimental research in FIREX–I, in the past decade, revealed that the large angular divergence of electron beam is one of the critical problem inhibiting the efficient core heating in electron-driven fast ignition [1]. To solve this problem, the beam guiding using externally applied kilo-tesla class magnetic field has been proposed [2], and its availability has been numerically demonstrated [3]. Also, the integrated experiments at ILE, Osaka university in 2016, the core heating efficiency of ~5 % and heated core temperature of 1.7 keV were achieved, where the kilo-tesla class magnetic field was applied to a cone-attached Cu(II) oleate solid ball target by a laser-driven capacitor-coil, and the target was imploded by G-XII long-pulse laser and heated by the PW-class LFEX laser [4]. The heating efficiency was evaluated by the number of photons emitted form Cu-Kα process [5]. The heated core temperature was estimated by the X-ray intensity ratio of Cu Li-like and He-like emission lines. To understand the detailed dynamics of core heating process, we carried out integrated simulations using FI^3 code system. The implosion was simulated by 2D MHD Radiation-hydro code PINOCO. The core heating was simulated by 2D Hybrid code FIBMET, where the experimentally observed fast electron profile was used. The REB injection timing and the strength of external magnetic field are varied. In the conference, we will show the effects of magnetic fields on the implosion and electron beam transport, the detailed core heating dynamics and the resultant heating efficiency and core temperature. We will also discuss the prospect for the ignition-scale design of magnetized fast ignition using solid ball target.

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