Target implosion uniformity in heavy ion inertial confinement fusion

Takahiro KARINO[1], Shigeo KAWATA[1], Shunsuke KONDO[1], Takuya IINUMA[1], Takeaki KUBO[1], Hiroki KATOH[1], Alexander I. OGOYSKI[2]

1) *Graduate School of Engineering, Utsunomiya University, Japan*
E-mail: dt167105@cc.utsunomiya-u.ac.jp
2) *Department of Physics, Varna Technical University, Bulgaria*

Accelerators for heavy ion beams (HIBs) have a high controllability, a high driver energy conversion efficiency and a high repetition rate. Wobbling HIBs are available as the energy driver in inertial fusion. Our previous studies have shown that spiral wobbling HIBs mitigate the illumination non-uniformity [1]. Figure 1 shows a schematic diagram for the spiral wobbling beam. For the spiral wobbling beam the beam radius changes from 3.1 mm to 3.0 mm at t=1.3τ. Here τ is the time for one rotation of the wobbling beam axis. The beam rotation radius becomes 2.0 mm at t=2.0τ. If we actively impose the perturbation by the driving beam wobbling or oscillation, and so if we know or define the phase of the perturbations imposed actively, the perturbation growth can be controlled in a similar way as the feedback control mechanism. The wobbling HIBs define the perturbation phase. This means that the perturbation phase is known, and so the perturbations successively imposed are superposed in the plasma. The HIBs accelerate the fusion target fuel with a large acceleration in inertial fusion. The wobbling HIBs would provide a small oscillating acceleration perturbation in the target implosion. So the Rayleigh-Taylor instability growth would be reduced by the phase-controlled superposition of the HIBs perturbations in heavy ion inertial fusion [1]. The purpose of this study is to evaluate the mitigation of the implosion non-uniformity by the spiral wobbling HIBs.

Figures 2 show a successful non-uniformity smoothing effect on the target temperatures for (a) the case without the wobbling HIBs and (b) that with the spiral wobbling HIBs. Figures 2 confirm the mitigation of the implosion non-uniformity by the spiral wobbling HIBs.

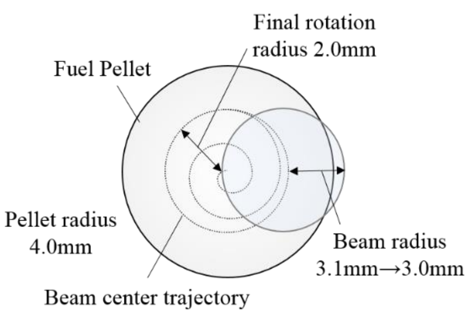

Figure 1: Schematic diagram for the spiral wobbler.

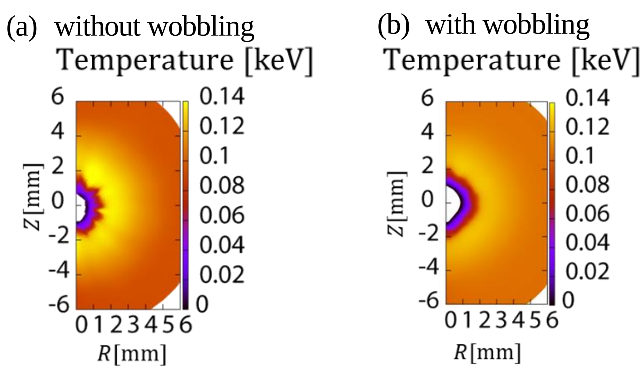

Figure 2: Non-uniform implosion (t=34.0ns)

References

[1] S. Kawata and T. Karino, Phys. of Plasmas **22**, 042106 (2015)