26pB07

外縁点火に伴う向心爆燃波
Optimization of Converging Shock Waves in Non-uniform Solid Target

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1. Introduction

With laser techniques developing, Inertial Confinement Fusion (ICF) is proceded. But it has some problems to improve, which are Rayleigh-Taylor Instability prevent a fuel core from being imploded etc. Fast Ignition scheme which bypasses the problem by performing the imploded process and the heating process separately is researched. It is important to achieve the ignition condition (ρR=0.4[g/cm^2]、T=5KeV).

In ICF experiment, the DT solid shell surrounding DT gas is mainly the target.

In our study, we assume that there is DT solid core in the center of the shell target. We aim at being increased the ρR value and the hot spot temperature by the promising target.

In this report, for preliminary physics, we optimize the DT solid core having non-uniform density distribution by comparing the uniform core.

2. Simulation Model

In our study, we simulate the dynamics of shock waves bounding for the center of the solid target in preliminary physics. The unique idea is the fuel core having non-uniform density distribution in order to increase the ρR value.

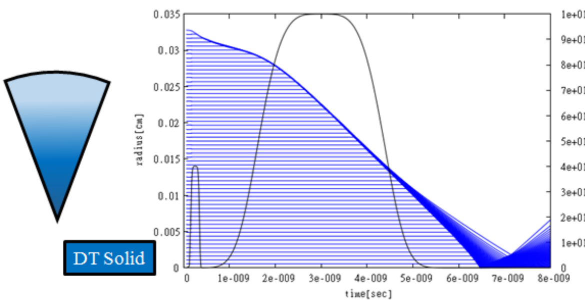

fig.1 simulation model

3. Calculation

We assume two-temperatures and one-fluid model of the plasma, and analyze the dynamics under the Eqs. (1), Eqs. (2), Eqs. (3) and Eqs. (4). Note that ρ, t, u, $p_{e(i)}$, $c_{ve(i)}$, $T_{e(i)}$, $\kappa_{e(i)}$, ω_{ei}, S_r, $S_{e(i)}$ are density[g/cm^3], time[s], velocity[cm/s], pressure[erg/cm^3], heat capacity, temperature[eV], heat conduct coefficient[erg/cm-sec-K], electron-ion energy exchange coefficient, heat loss, heat source.

$$\frac{\partial\rho}{\partial t}+\nabla\cdot\rho u=0 \qquad (1)$$

$$\rho\left(\frac{\partial}{\partial t}+u\cdot\nabla\right)u=-\nabla p \qquad (2)$$

$$\rho c_{ve}\left(\frac{\partial}{\partial t}+u\cdot\nabla\right)T_e=\nabla\cdot\kappa_e\nabla T_e-p_e(\nabla\cdot u)-\omega_{ei}(T_e-T_i)+S_e-S_r \qquad (3)$$

$$\rho c_{vi}\left(\frac{\partial}{\partial t}+u\cdot\nabla\right)T_i=\nabla\cdot\kappa_i\nabla T_i-p_i(\nabla\cdot u)-\omega_{ei}(T_i-T_e)+S_i \qquad (4)$$

Fig. 2 is presented the time evolution of the max temperature and the ρR value of the uniform target and non-one.

In the future work, we optimize the laser pulse shape to enhance the max temperature and the ρR value moreover.

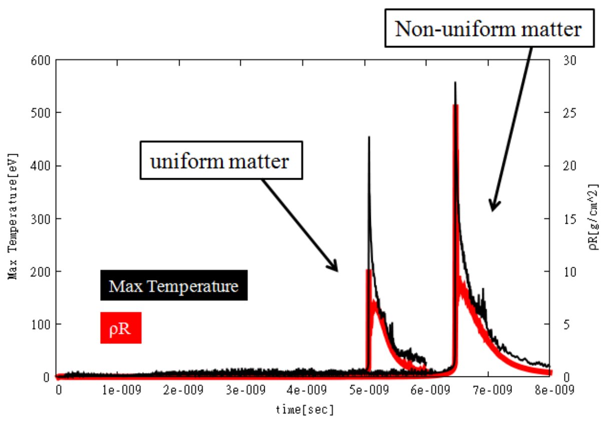

fig.2 Max temperature & ρR

4. Reference

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[2] S. Atzeni *et al* 2015 Plasma Phys. Control. Fusion 57 014022