ELECTRON BEAM GUIDING BY EXTERNAL MAGNETIC FIELDS IN IMPLODED FUEL PLASMA

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One of the most crucial issues of electron-driven fast ignition is efficient core heating by laser produced fast electron beam. Two factors, which mainly degrade the efficient heating, are (1) too high electron energy, and (2) too large beam divergence. For improving the efficiency in FIREX project [1], we proposed the electron beam guiding by externally applied kT-class longitudinal magnetic fields generated by a capacitor-coil target [2] and evaluated its effects by 2D collisional PIC simulations [3]. It was demonstrated that the fast electron beam with a large divergence angle generated by a relativistic laser plasma interaction with a laser of intensity $3 \times 10^{19}$ W/cm² and duration 1ps can successfully focused by the moderately-converging fields (mirror ratio $R_M < 20$). In addition, formation of a magnetic-pipe like structure due to the resistive effects was shown, which indicates a possibility of the beam focusing even under the higher mirror fields that may be achieved in the ignition-scale or high-gain target implosion. However, in the implosion simulation [4] for a cone-attached CD shell target with B-field externally applied by a one-turn coil, the ratio of B-field strength at the cone tip to that in the region between cone tip and dense core reaches $R_M > 100$ at the maximum compression. In such a case, the fast electrons could not pass the very high $R_M$ region and could not reach the core, so that the core heating would be very inefficient. So it is critical to check the electron transport in more realistic configuration in the compression dynamics.

In the present paper, we discuss the core heating properties for the dense core with the converging magnetic field configuration appeared in the implosion of cone-attached targets with a help of the integrated simulations. In the simulations, two types of cone-attached targets are considered. One is a spherical solid target. For this case, the mirror ratio is moderate since the density compressibility stays low (~30) and the magnetic-field compressibility will also be low. The other is a spherical shell target, where the fuel is highly compressed and the mirror ratio becomes very high. In the conference, we will show the integrated simulation results for core heating by fast electron beam with large beam divergence under the compressed core and magnetic fields.

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