STUDY OF FAST ELECTRON GENERATION USING MULTI BEAM OF LFEX PETAWATT LASER

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Fast Ignition Realization Experiment project phase-I (FIREX-I) [1] has been being furthered in Institute of Laser Engineering, Osaka University. In this project, the four-beam bundled high-energy petawatt laser (LFEX) has been operating. There is flexibility on method of multi-beam irradiation, e.g. temporally sequential irradiation or spatially overlapped irradiation. According to previous computational research [2], the spatially overlapped irradiation causes structure generation on target plasma surface via interference pattern and therefore it affects following laser-plasma interaction. However, the simulation time is less than 700 femtoseconds in that study. Features of the LFEX, which are high power, long pulse, and spot diameter much larger than the diffraction limit, are considered to cause interesting results that differ from many usual researches, where the laser is ultrahigh intensity, but femtosecond and small-spot size close to the diffraction limit. Kemp et al. [3] reported that a high-power long-pulse laser such as the LFEX creates a large underdense plasma during first one picosecond, after that the laser interacts with the self-generated large underdense plasma, and the effective temperature becomes high even in the case of initially no pre-plasma. Therefore, large-scale simulations using realistic laser and target parameters are strongly desired. Further, effects of temporally sequential irradiation have not been clarified yet, especially in the case of cone-guided target. Therefore, we study the effects of multi-beam irradiation on high-intensity picosecond laser plasma interaction.

In the case of temporally sequential irradiation, the pulse duration becomes so long. This pulse, of course, causes the self-generated underdence plasma and it affects the fast electron characteristics. We have performed preliminary large-scale simulation of cone-guided target, where the size of the target is about 200 μm square and the pulse duration is set to 3.5 picoseconds. In this simulation, the expansion of the self-generated underdence plasma was observed and the effective temperature of generated electrons increased with time as with Kemp's results, in spite of lower laser intensity of 10^{19} W/cm^2.

In the case of the spatially overlapped irradiation, the interference effects are important. We have simulated somewhat longer simulation compared to previous research. Interference of laser beams made the structure, but the structure was broken after a while. The detail will be reported in the presentation.

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