FIREX Project and Effects of Self Generated Electric and Magnetic Fields on Electron Driven Fast Ignition

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The fast ignition is a new scheme in laser fusion, in which higher energy gain with smaller laser pulse energy is expected. The required pulse laser energy depends upon the coupling efficiency between short pulse laser energy to the core plasma energy. At ILE, Osaka University, the POP experiment for the fast ignition is under way. The 10kJ/pico second heating laser: LFEX has completed, and integrated experiments with 1kJ have been carried out with one LFEX beam. It was found by the experiments that the coupling efficiency depends on the laser pre-pulse on which the relativistic electron generation, energy spectrum, and transport depend. The recent experimental results will be reviewed in the talk.

The cone target has been introduced for realizing higher coupling efficiency. Although, some experiments indicated the high coupling and enhancement of high neutron yield, the scaling laws of the coupling efficiency on heating laser energy and pulse duration toward ignition scale target are still open question. In this concern, the pre-plasma inside cone and the strong electric and magnetic fields associating with the high density relativistic electron generated by peta watt lasers play essential rolls. In this presentation, simulations on the laser pre-pulse effects and the large scale simulations on the electro-magnetic phenomena for double cone target will be presented. By the theory and simulation, it is found that a thin foil covers the entrance of a cone for reducing pre-pulse effects, and higher coupling efficiency is realized for the double cone. Namely, electro-magnetic fields around the vacuum layer and the cone-imploded plasma contact surface and in the pre-pulse laser plasmas are important. The power law spectrum of relativistic electrons will be also discussed in relation with the density profile steepening.