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Counter Implosion of 500-μm Diameter CD Shell and Fast Heating of its Core Plasma by Tailored DPSSL-Pumped Laser

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Laser fusion experiment extracts net energy from fuel on the National Ignition Facility (NIF) by using 1.8 MJ, 500 TW single shot laser. Following an effort of this scientific proof of ignition, engineering development needs to start on Inertial Fusion Energy (IFE) by using a repetitive fusion driver. To realize the IFE power plant, one key issue is a high-repetition-rate laser of kJ-class or greater. Others are the fuel fabrication and high-repetition injection, and ignition-high gain physics. And also, Power plant technology, such as innovative wall materials, will need to be developed. So, we are researching and developing to aiming at the early realization of a compact laser fusion experimental mini-reactor. In the latest results of our research, the basic experiment of the fast-ignition scheme with the counter-illumination was obtained a core overheating by Diode Pumped Solid State Laser (DPSSL) system in a small laboratory. For the purpose of high-repetitive implosion and heating of 500 μm in diameter shell targets, we, for the first time, developed a fast-ignition scheme tailored pulse DPSSL system. The tailored implosion beam consists of a preceding foot pulse "K"from KURE-1 (4.4 J, 1053 nm, 15.2 ns) and a main chirped pulse from HAMA (1.4 J, 800 nm, 300 ps). The heating beam "S"is a pulse-compressed beam "L"from HAMA (1.0 J, 800 nm, 192 fs). We divide each beam into two counter beams. The target is a deuterated polystyrene (CD) shell-target of 500 μm in diameter and 7 μm in thickness. Two counter tailored beams successfully imploded the shell to form a core plasma, which S-Beam heated and yielded DD neutrons of 10^4 n/4 pi sr. The system works each 10 ms. STAR1D hydrocode well predicted the results. In this presentation, we will describe the tailored HAMA laser system for the shell implosion and heating and the preliminary results, as well as the simulations.

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