IF-1 · Progress in Direct-Drive Inertial Confinement Fusion Research at the Laboratory for Laser Energetics

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Abstract: Significant theoretical and experimental progress towards the validation of direct-drive inertial confinement fusion (ICF) has been recently made at the Laboratory for Laser Energetics (LLE). Direct-drive ICF offers the potential for high-gain implosions and is a leading candidate for an inertial fusion energy power plant. LLE's base-line direct-drive ignition design for NIF is an "all-DT" design that has a 1-D gain of ~45. Recent calculations show that targets composed of foam shells, wicked with DT, can potentially achieve 1-D gains of ~100. LLE experiments are conducted on the OMEGA 60-beam, 30-kJ, UV laser system. Beam smoothing of OMEGA includes 1-THz, 2-D SSD and polarization smoothing. Cryogenic D2 and plastic shell (warm) spherical targets and a comprehensive suite of x-ray, nuclear, charged particle and optical diagnostics are used in these experiments. Future experiments will use cryogenic DT targets.

IF-2 · Recent Advances in Indirect Drive ICF Target Physics

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Abstract: The National Ignition Facility (NIF), currently under construction, will be used for the study of ignition physics in inertially confined targets, as well as basic and applied research in the field of high energy density science. In preparing for ignition on the NIF, the Lawrence Livermore National Laboratory's Inertial Confinement Fusion Program, in collaboration with Los Alamos National Laboratory (LANL), Sandia National Laboratory (SNL), the Laboratory for Laser Energetics (LLE), General Atomics (GA), and the Commissariat a l'Energie Atomique (CEA), is working to refine ignition designs, develop improved experimental methods, and fabricate and test cryogenic targets required for ignition. This paper will briefly review NIF construction progress, and summarize advances in these areas. This work was performed under the auspices of the U.S. Department of Energy by the University of California, Lawrence Livermore National Laboratory under Contract No. W-7405-Eng-48, and Los Alamos National Laboratory under Contract No. W-7405-Eng-36.

IF-3 · Fast Ignition Experimental and Theoretical Researches toward Fast Ignition Realization Experiment(FIREX)

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Abstract: In 2000, the output energy of the peta watt module added to Gekko XII reached a level of 100 J in one pico-second. CD plastic shell pellets with or without cone guide are imploded by a few kJ / 1 ns green beams of the Gekko XII laser, which are heated by the PWM laser. By the experiments, we found that D-D neutron yields are enhanced by one order of magnitude for both spherical implosion and cone guide implosion. In those experiments, it is found that the heating laser energy was not transfered into the core plasmas effectively in the case of without cone because of strong dumping of the intense laser pulse in coronal plasmas. Therefore, we concluded that the more efficient core heating occurs in the cone guide target and it will be better as an ignition target. In the peta watto laser experiments which is going in this Aprile, we will inject 500 J /1 ps pulse into cone targets to heat compressed CD plasmas with a density of 50–100 g/cc. In this experiment, it is expected that the plasma is heated to higher than 1 keV. The detail of the experiment will be reported in the conference.