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X-ray characterization of high energy density plasmas produced in mega-joule laser experiments on the National Ignition Facility[1]

SIEGFRIED GLENZER, Lawrence Livermore National Laboratory

With completion of the National Ignition Facility (NIF) at the Lawrence Livermore National Laboratory the quest for producing a burning fusion plasma has begun. The goal of these experiments is to compress matter to densities and temperatures higher than the interior of the sun to initiate nuclear fusion and burn of hydrogen isotopes. In the first indirect-drive hohlraum experiments on NIF, we have demonstrated symmetric capsule implosions at unprecedented conditions of mega-joule laser energies. 192 simultaneously fired laser beams heat ignition hohlraums to radiation temperatures of 3.3 million Kelvin compressing 2-millimeter capsules by the soft x rays produced inside the hohlraum. In these experiments, symmetry and velocity of the implosion are measured by imaging the 9 keV capsule x-ray emission on a temporally resolving 2-D detector. In addition, x-ray radiography and scattering techniques are being developed for measuring the density and temperature of the implosion. The experiments indicate conditions suitable for compressing deuterium-tritium filled capsules with the goal to produce burning fusion plasmas in the laboratory.

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