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Present Status and First Experiments on the National Ignition Facility*

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The National Ignition Facility (NIF) has a prime goal of attempting ignition by indirect-drive in 2010 with 1 MJ of laser energy. The major demonstrated and future capabilities and status of NIF construction will be discussed in light of this goal. For example, NIF has recently exceeded the highest energy 1ω laser capability worldwide by firing 8 of its beams simultaneously. Meanwhile, a first set of laser-plasma interaction, hohlraum energetics and hydrodynamic experiments have been performed using the first 4 beams, in support of indirect drive Inertial Confinement Fusion (ICF) and High Energy Density Physics. The experiments have been undertaken with laser powers and energies of up to 8 TW and 17 kJ in flattop and shaped 1 – 9 ns pulses focused with various beam smoothing options. In parallel, a robust set of optical and x-ray spectrometers, calorimeters and imagers have been activated. In the area of laser-plasma interactions, the effects of laser beam smoothing by spectral dispersion (SSD) and polarization smoothing (PS) on the beam propagation in long scale gas-filled targets has been studied at plasma scales relevant to indirect drive low Z filled ignition hohlraum designs [1]. The latest long scale gas-filled target experiments have shown propagation over 7 mm of low Z plasma without filamentation and beam break up when using full laser smoothing. In the area of hohlraum energetics, we have first verified the hohlraum radiation temperature scaling with laser power and hohlraum size [2], [3] to make contact with hohlraum experiments performed at the NOVA and Omega laser facilities. The vacuum hohlraums yielded low laser backscattering and hot electron fractions, and the hohlraum radiation temperature measured with an 18 channel soft x-ray power diagnostic agreed well with radiation-hydrodynamics LASNEX calculations. From time-resolved hard x-ray imaging, time-integrated hard x-ray spectroscopy and coronal radiation measurements, we have also validated analytical models and LASNEX calculations of long pulse hohlraum plasma filling [3], [4]. In the area of hydrodynamics, we have extended the study of high-Mach number hydrodynamic jets of astrophysical and ICF interest to 3D geometries [5]. The resulting jet features and space resolved transverse areal densities were diagnosed by point projection radiography from multiple views. The comparison of all these results with detailed radiation-hydrodynamics and ray-tracing modelling will be presented.

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