CFEL SCIENCE

Colloquium

1st February 2012 - 14:00

Bldg. 28c, seminar room

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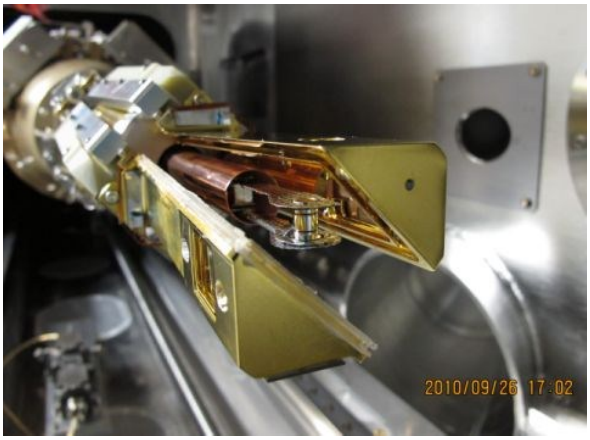
Mega-joule experiments on the National Ignition Facility - on the road to produce a microscopic star in the laboratory*



Picture of a cryogenic ignition target before enclosed by the shroud. The hohlraum contains a spherical 2.2-mm diameter capsule and the thermonuclear fuel layer.

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. The first inertial confinement fusion implosion experiments with cryogenic fuel layers have recently been fielded. These experiments use mega joule laser energies that compress fusion capsules in indirect dive hohlraums to test initial hot spot formation and thermonuclear fuel assembly.

We applied 0.17 mg of equimolar deuterium-tritium thermonuclear fuel with the potential for ignition and significant fusion yield conditions. Measurements of the implosion core, neutron yield, temperatures and fuel areal density show compression by a factor of 30 to a fuel density of over 500 g/cc and hot spot temperature of 3.5 keV resulting in stagnation pressures of more than 100 Gbar. This achievement is the result of the first hohlraum and capsule tuning experiments where the stagnation pressures have been systematically increased by more than a factor of 10 by fielding low-entropy implosions through the control of radiation symmetry, small hot electron production, and proper shock timing. These implosions demonstrate high Lawson confinement parameters of 10 atm s where the comparison with radiation-hydrodynamic simulations indicates that these implosions are within a factor of three required for reaching ignition and high yield. In this talk we will discuss recent findings indicating that further increases in pressure will be achieved in the near future.

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Host: Oliver D. Mücke, CFEL