Physics Colloquium

Inertial Confinement Fusion (ICF) – One plausible approach to achieving ignition and energy gain in a laboratory

Johan A. Frenje
Plasma Science and Fusion Center, MIT

Abstract:

Demonstrating ignition and energy gain in a laboratory is a scientific grand challenge that requires creating extreme states of matter under precise, highly controlled conditions. One plausible approach to achieve this is hot-spot ignition in an Inertial Confinement Fusion (ICF) capsule implosion at the National Ignition Facility (NIF). Using this method it is necessary to maintain the deuterium-tritium (DT) fuel in the capsule at low entropy and to ensure that the capsule kinetic energy during the implosion is efficiently converted to hot-spot thermal energy upon stagnation. Analysis of NIF implosions performed to date indicates that the implosion performance has improved more than 100x since the first experiment in September, 2010, and that we are about a factor of 2-3 away from conditions required for ignition. In this presentation, I will introduce the concept of ICF; present the experiments at the NIF; discuss the ongoing and future efforts that will possibly address this gap to ignition conditions; and finally describe our work on understanding plasma stopping power that is relevant to alpha-particle transport and heating of the hot spot.

The work described here was supported in part by US DOE (Grant No. DE-FG03-03SF22691), LLNL (subcontract Grant No. B504974) and LLE (subcontract Grant No. 412160-001G).

Friday, April 3rd, 2015
4:00-5:00 pm
Goudsmit Conference Room, LP 208