August 31, 2015

Charter for the ICF/HED National Implosion Stagnation Physics Group

Implosion schemes convert the kinetic energy of ablator and fuel to thermal energy producing a hot stagnation phase when the central temperature reaches a maximum and the remaining kinetic energy (RKE) reaches a minimum. The efficiency of this process, which is dictated by ability to control 3D effects is a major factor determining whether ignition can be achieved in the near term or in setting the scale of the driver needed.

With this in mind, "The ICF/HED National Implosion Stagnation Physics Group will be led by two scientists from different institutions. The overarching goal of this effort is to substantially advance our understanding of the physics of the stagnation process and the state of the fuel and ablator near and at stagnation through improved analysis and simulation as well as new experiments and diagnostics. More specifically, this effort has the following objectives:

1. To compare and contrast the physics of ignition relevant stagnation processes for x-ray-driven, directly-driven and magnetically-driven implosions.
2. To scrutinize state of the art simulations and experimental measurements.
3. To increase the rate of scientific progress by applying peer review of on-going campaigns from the national ICF/HED community having a broad experimental and computational basis.
4. To meet for a continuing series of day-long workshops to disseminate widely the resulting minutes and action items.
5. To make periodic reports and recommendations to the ICF Executive Committee.

A core organization group consisting of a couple of representatives from each of the labs – LLNL, LLE, LANL, SNL, and NRL – in addition to a few academics will define a well-formulated agenda for this effort. Some of the activities of the group should include:

(1) Compare diagnostic techniques for measurements of the compressional temperature rise, RKE (which can be low mode and high mode), and the distribution of surrounding high-density shell, with the aim of better understanding the conversion of shell-kinetic energy to hot-spot thermal energy. Techniques for measuring the spatial and temporal profiles of the hot spots will be compared. Neutron and gamma emission spectra, and x-ray emission spectra will be compared for the three approaches using measured lines, edges and continua. Techniques for measuring the amount and distribution of the surrounding cold material, such as x-ray absorption/scattering, and neutron scattering should be compared and scrutinized. It is expected that new ideas and innovative concepts will guide future coordinated diagnostic activities across the facilities.

(2) Compare models for the stagnation phase. Calculated deviations from simulated one dimensional behavior should be highlighted. The degree of deviations from hydrodynamic behavior into the kinetic region for the three approaches should be compared. The importance of phenomena such as self-generated magnetic fields, conduction and radiative losses should be considered and compared for the three approaches. It is expected that new ideas and innovative concepts will guide future coordinated simulation activities across codes.

(3) Compare experimental results (1) and theories (2) for the three approaches, which will guide future campaigns of experiments with the goal of better understanding alpha particle heating.