ADVANCES IN HYDRA AND ITS APPLICATIONS TO SIMULATIONS OF INERTIAL CONFIMENT FUSION TARGETS

Michael M. Marinak, Gary D. Kerbel, Joseph M. Koning,
Mehul V. Patel, Scott M. Sepke, Britton Chang, Pierre Michel, David Larson

Lawrence Livermore National Laboratory, Livermore, CA, USA

A new set of capabilities has been implemented in the HYDRA 2D/3D multiphysics inertial confinement fusion simulation code. We discuss how these enhance its ability to simulate various aspects of inertial confinement fusion targets.

A model for energy transfer[1] between crossed laser beams has been implemented. It enables integrated simulations of NIF ignition targets to calculate cross-beam energy transfer in a self-consistent manner. We show examples of how cross-beam transfer affects plasma conditions, including capsule implosion symmetry. Studies of fast ignition targets are now being carried out in HYDRA. These are performed by running the 2D/3D relativistic hybrid plasma simulation code Zuma in conjunction with HYDRA. Zuma simulates the transport of hot electrons from where they are produced by a petawatt laser to their deposition in the dense fuel. Results obtained for an indirect drive fast ignition implosion design considered for the National Ignition Facility will be presented. A novel polar S_N multigroup radiation transport package now operates on 2D meshes. It converges with second order accuracy without significant ray effects. We compare results for a capsule only simulation obtained by this method with those obtained by multigroup diffusion. We also discuss improvements to our NLTE opacity modeling through the use of the Detailed Configuration Accounting model (DCA). It is now being employed to model hohlraum wall opacities of with NLTE kinetics, treating many more levels than used previously. A recently added Monte Carlo particle transport library allows accurate simulations of nuclear diagnostic signatures from capsule implosions. It models transport of neutrons, gamma rays and light ions, as well as products they generate from nuclear and coulomb collisions. We also discuss improvements to HYDRA's 3D MHD package, which include a new set of methods for calculating MHD forces, new circuit models and an expanded set of terms in the equations for electrical and thermal conductivity.

1. P. Michel et. al, Phys. Plasmas **17,** 056305 (2010).