HYDRA Simulations of Recent Collisionless Shock Experiments Performed on OMEGA

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Abstract

Many types of shocks which occur in astrophysical situations are said to be collisionless since the thickness of the shock is much smaller than the Coulomb collision mean free path. Self-generated magnetic fields that are present within these collisionless shocks are thought to play a role in several different astrophysical phenomena, such as particle acceleration, and the structuring of supernova remnants. The development and evolution of these self-generated magnetic fields is not entirely understood. To investigate the microphysics which plays a role in collisionless shock formation in the laboratory, experiments were performed on the Omega laser, whereby two opposing targets are each irradiated with 1016 W/cm2 to produce counter-streaming flows. In experiment, several different target materials were employed to investigate species effects, namely carbon, polyethylene, and beryllium. To model results obtained in experiment a hybrid PIC code will be employed to capture the effect of the ion kinetics, while treating the electrons with a fluid description. As an initial step to this task, as presented in this work, the behavior of a single flow of laser-produced plasma will be modeled using the Arbitrary Lagrange-Eulerian (ALE) radiation hydrodynamics code HYDRA (Marinak 2001), developed at LLNL. This work was performed under the auspices of the U.S.

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