

Collisionless shock formation and particle acceleration in conditions relevant for NIF experiments.

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Collisionless shocks are ubiquitous in the Universe and play an important role in the slow down of plasma flows, magnetic field generation/amplification, and particle acceleration. Depending on the plasma conditions, different plasma processes are believed to mediate shock formation and particle injection, however, these are not yet fully understood. Kinetic plasma simulations and high-energy-density (HED) laser-plasma experiments can help probe different plasma conditions and identify the dominant processes at play. I will present recent large-scale particle-in-cell (PIC) simulations of counter-streaming plasma flows for conditions relevant to ongoing collisionless shock experiments at the National Ignition Facility (NIF). The simulations take into account the time-dependent density and velocity profiles of the flows, that are inferred from hydrodynamical simulations. This study demonstrates that inhomogeneous ablation plasma profiles increase coherent length of magnetic field structures and make shock formation more efficient. I will show the comparison of the simulation results with recent experimental measurements on NIF, which suggest the characterization of electromagnetic collisionless shock formation for the first time in the laboratory. Finally, I will discuss the expected signatures of particle acceleration and the role of collisional effects.