Collisionless shock generation in high-power laser produced counter-streaming plasmas

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Laboratory experiments to study collisionless shock generation in counter-streaming plasmas have been investigated using Gekko XII HIPER laser system (352 nm (3ω), 500 ps, ~100 J / beam, one or four beams, $< 10^{15}$ W/cm^2) at Institute of Laser Engineering, Osaka University. Two types of double-plane targets, Jet and Ablation types were used. In the Jet (Ablation) type, 10 μm (60 μm) and 60 μm thick CH planes were placed with the separation of 4.5 mm; beams were irradiated on the 1st CH and a rear-side (an ablation) plasma is formed, and the plasma from the 2nd CH is created by radiation and/or plasmas from the 1st CH. The plasmas and shocks were diagnosed transverse to the main laser propagation direction; shadowgraphy and modified Nomarski interferometry using a probe laser with ICCD and streak cameras, and SOP and GOI using a visible (450 nm) self-emission. Counter-streaming plasmas were produced, and shock waves were observed. The width of the transition region is much shorter than ion-ion mean-free-path. A particle-in-cell simulation has predicted generation of an electrostatic shock.