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Collisionless shock generation by counter-streaming plasmas produced using a high-power laser

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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 (3rd harmonic of Nd:Glass laser), 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 microm (60 microm) and 60 micro m 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.

Keywords: Collisionless shock, high-power laser, counter-streaming plasmas