Laboratory investigation of the filamentation instability in counter-streaming flows using optical diagnostics

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Weibel/Filamentation instability, as a promising candidate for generation strong magnetic fields to excite the astrophysical shock formation, has been widely investigated using high-energy laser facilities in laboratory, such as SG-II, OMEGA-EP/OMEGA, and NIF.Simulations show that the strength of self-generated magnetic fields reaching up to 300 T can mediate shock formation. However, obtaining such strong magnetic fields is anchallengeunder the current flows conditions(n_e~ 0.5-1×10^{19} cm^{-3}, υ~ 10^8 cm s^{-1}, T ~ 1 keV).Here we report the recent study of Weibel instability in modified counter-streaming flows at SG-II. Our experiments exploit the high-velocity (~3000 km s^{-1}) interpenetrating plasma flows by interaction of high-energy lasers with powders(DLi) instead of foils. The evolution of the Weibel instability, from linear phase to nonlinear phase, has been successfully observed by optical diagnostics. Faraday rotation method is utilized to measure the self-generated magnetic fields. The identified strength of the magnetic fields is about 100 T.Our results reveal that the strength of the B field mainly depends on the flow velocity (υ) and density (n_e), because the growth rate is proportional to$\upsilon$and the dissipation rate is inversely proportional to n_e.