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Preplasma Expansion Measurements by Observing Prepulse-Induced Proton Energy Distribution in Ultrahigh-Intensity-Laser and Solid-Target Interactions TEH LIN, TAKESHI MATSUOKA, ANATOLY MAKSIMCHUK, DONALD UMSTADTER, University of Michigan — Different preplasma conditions in laser-plasma interactions affect the plasma density profile and change the plasma heating mechanism and efficiency. However, to measure its effect involves complicated experimental setups. We used a novel and easy-manipulated method to measure the preplasma, which is produced by the prepulse of the ultrahigh intensity laser and solid targets. By introducing prepulse delays (1.5ps∼600ps) and intensities (0∼10%), different maximum proton energies at target normal direction will be generated from the laser-plasma interactions. A peaked distribution of the maximum proton energy with respect to the prepulse delays is observed, and with different prepulse delays, different widths of the peaks suggest the preplasma expansion behavior. Furthermore, a clear correspondence of preplasma expansion scale and proton acceleration efficiency is derived to explore the optimal preplasma scale length to provide higher maximum proton energy. This experiment was conducted with the frequency doubled laser pulses from the T^3 laser system at the Center for Ultrafast Optical Science of the University Michigan. The pulse energy is up to 1 J, a pulse duration of 400 fs, the wavelength is 0.53 μm and the maximum intensity is 10^{19} W/cm^2. The prepulses are introduced by inserting a Michelson interferometer in the laser chain.

Teh Lin
University of Michigan

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