Monoenergetic ion bunch generation by laser and double layer thin foil target interactions

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Abstract

We present a novel scheme to generate monoenergetic ion bunches based on high power laser facilities, such as Texas PetaWatt Laser Facility (TPW). We investigate high energy ion bunch generation from double layer thin foil target irradiated by intense linearly polarized (LP) laser pulse using two-dimensional (2D) particle-in-cell (PIC) simulations. With counting in the effect of pre-pulse, we make the target with two different kinds of materials, low Z in the front and high Z in the rear. The low-Z ions are accelerated by the laser-driven hot electrons and penetrate through the high-Z ion layer to generate a quasi-monoenergetic ion bunch, and this bunch will continue to be accelerated by the quasi-stable electrostatic sheath field, which is formed by the immobile high-Z ions and the hot electrons, with lower instability. With truncating the long pre-pulse, the high quality monoenergetic ion bunch is gained. This mechanism offers possibility to generate monoenergetic ion bunch without ultrahigh-contrast and ultrahigh gradient laser pulses in beam generation experiments, which is confirmed by our simulations.

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