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Generation of quasi-monoenergetic ion beams from layered targets irradiated by an ultraintense laser pulse

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Irradiating an ultraintense laser pulse on a thin-foil can generate energetic ion beams. On the contrary to the surface sheath field [1], which drives acceleration of ions on the surface of thin foil leading to a thermal energy spectra, a bulk electrostatic field [2] can be utilized with a layered targets. Interesting nonthermal ion spectra have been observed from such targets with strong reduction of low energy ions.

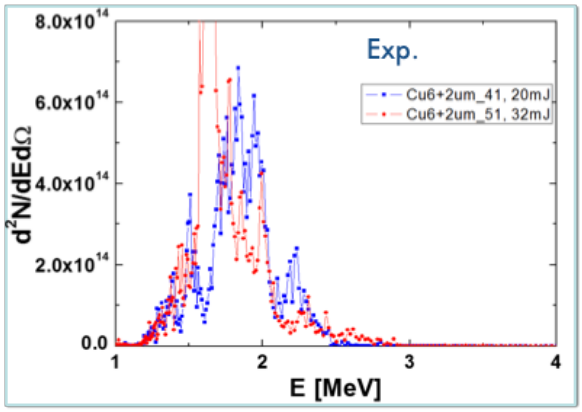

Figure 1. Proton energy spectra from an ILEF target with laser intensity of 10^{19} W/cm^2, which consists of two copper foils attached and a contamination layer in between.

An ILEF (Ion-Layer Embedded Foil) [3] target has been proposed with two-dimensional PIC (Particle-In-Cell) simulations, which predicted a monoenergetic proton beam. Fig. 1 shows a proton energy spectra from a ILEF target with a laser intensity of 10^{19} W/cm^2, which consists of two copper foils attached and a contamination layer as an ion layer. To suppress interactions between protons from every contamination layers, a cleaning laser was irradiated on the rear surface of the target to remove the rear-surface contamination layer. The results show quite interesting peaked spectra, which is far from a thermal-like spectrum.

Figure 2 shows proton spectrum from a double-layer target, a copper foil with a PMMA coating on the rear surface with thickness of 1 μm. The overall spectral shape resembles a thermal-like spectrum but one can find a peak at 4 MeV. It is suggested that the mismatch of the plasma resistivity between metal and polymer layers can build a strong electrostatic field at the interface thus leading to an additional acceleration. To understand the physical mechanism on such a target, an intense simulation is underway.

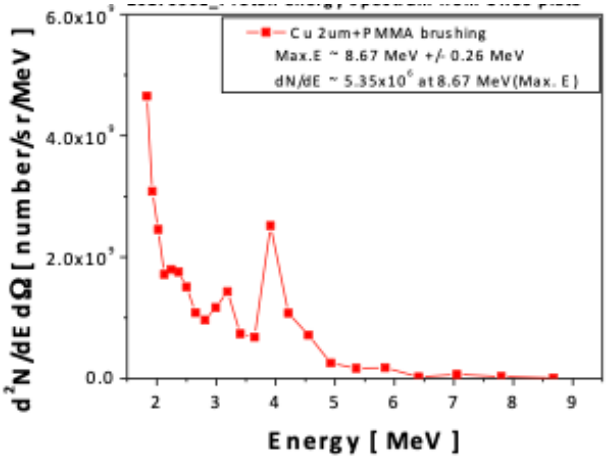

Figure 2. Proton energy spectrum from a double-layer target with a laser intensity of 10^{19} W/cm^2.

References

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