

GeV mono-energetic proton beam generation in laser foil-plasma interactions

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Abstract:

We report on a self-organizing, quasi-stable regime of laser proton acceleration, producing 1 GeV nano-Coulomb proton bunches from laser foil interaction at an intensity of 7×10^{21} W/cm². The results are obtained from 2D-PIC simulations, using a circular polarized laser pulse with Gaussian transverse profile, normally incident on a planar, 500 nm thick hydrogen foil. While foil plasma driven in the wings of the driving pulse is dispersed, a stable central clump with 1 - 2 λ diameter is forming on the axis. The stabilisation is related to laser light having passed the transparent parts of the foil in the wing region and enfolding the central clump that is still opaque. Varying laser parameters, it is shown that the results are stable within certain margins and can be obtained both for protons and heavier ions such as He²⁺.

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