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Abstract Title	Efficient proton and ion generation beyond 100MeV/nucleon by laser excitation of nanofoils
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Abstract	Here, we discuss new acceleration mechanisms experimentally only accessible with relativistic laser intensities beyond 10^20 W/cm^2. These mechanisms promise much higher proton and ion energies exceeding 100MeV/nucleon. However, they also have much more demanding requirements for the laser parameters, like ultrahigh contrast and flat top focusing.

Summary

In the past 10 years laser-driven acceleration of protons and ions has been of particular interest for fundamental as well as applied sciences. With intensities on the order of 10^18 to 10^19 W/cm^2, ion acceleration is typically achieved by laser light interacting with micrometer scaled solid matter targets in the TNSA regime, favoring acceleration of protons to energies of up to ~60MeV [1] and only generating ion beams (Z>1) below 10MeV/nucleon [2]. This mechanism seems to have stagnated in terms of particle energy as well as conversion efficiency and control of spectral shape, remaining too low for most advanced applications; for instance, ion fast ignition [3] or hadron cancer therapy [4] can have demands for energies well in excess of 100MeV/nucleon. Here, we want to discuss ways to overcome these limitations. With continuing progress on laser technologies ultra-high contrast and relativistic intensities (>10^20 W/cm^2) are more and more available allowing to experimentally access new acceleration mechanisms. Radiation pressure acceleration (RPA) [6, 7] and Break-Out Afterburner (BOA) [8] have been discovered in numerical experiments using PIC-codes on massively parallel supercomputers. These mechanisms efficiently transfer laser energy to all target ions, and promise much higher proton and ion energies making them a promising and competitive alternative to conventional accelerators. However, they also have much more demanding requirements for the laser parameters, like ultrahigh contrast laser pulses (RPA, BOA), flat top focusing (RPA) and high laser intensities (>5x10^19 for BOA, >1x10^22 for light sail RPA). In this regard we also present data from the Trident laser facility, where proton and ion energies exceeding 100MeV/nucleon have been demonstrated with the BOA mechanism.

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