laser triggered Proton acceleration from low-dense target and new radiation sources for medical application

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Laser triggered ion acceleration is attracted a lot of attention during last ten years du to possible application of collimated high energetic ion beams in inertial confinement fusion, nuclear physics, radiography and medicine for shot-live isotope production and hadrons therapy.

The laser pulse interacts with target electrons as ions are accelerated by collective plasma fields, mostly by electrostatic charge separation field. Increase in number and temperature of hot electrons often results in increasing of value of accelerated electrostatic fields and maximum ion energy. This work demonstrates that such increase may be achieved by using low-dense targets. Based on the 3D simulations it has been shown that reduction of target density results in increasing of proton energy.

A technique suggested for triggering nuclear reactions by laser-accelerating ions with a powerful ltrashort laser pulse in a plasma is widely adopted now to study the most effective ways for neutron generation and isotope production. Such a technique offers a unique opportunity for medical applications. We report here an interesting example for isotope and neutron production that makes use of protons and deuterons accelerated to multi-MeV energies by a powerful laser pulse. New laser technique permits production of radionuclides for SPECT (single-photon emission computed tomography) and PET (positron emission tomography), as well as for neutrons.