OPTICA APPLICATA online
A quarterly of the Institute of Physics, Wroclaw University of Technology
open access
Wroclaw University of Technology
INSTITUTE OF PHYSICS

Optica Applicata 2005(Vol.35), No.1, pp. 5-22

Fast ion generation by a picosecond high-power laser

Jan Badziak, Piotr Parys, Jerzy Wolowski, Heinrich Hora, Josef Krasa, Leos Laska, Karel Rohlena

Keywords

fast ion, plasma, picosecond laser

Abstract

Recent progress in ultrashort-pulse high-power laser technology has resulted in the production of extremely high light intensities approaching 10^{20} W/cm^2. The great non-linear forces generated by the laser pulse during its interaction with plasma can be used to accelerate electrons and ions to energies from hundreds of keV to hundreds of MeV over distances of only microns. This creates the prospect of construction of compact laser-based particle accelerators and their application in material science, medicine, nuclear physics, and inertial confinement fusion. In this paper, the results of our recent studies on fast ion generation in plasma produced by an intense 1-ps laser pulse, performed using the terawatt Nd:glass laser at Institute of Plasma Physics and Laser Microfusion (IPPLM) in Warsaw, are briefly reviewed. The properties of fast proton beams generated from thin foil targets of various structures as well as the heavy ion fluxes emitted from massive high-Z targets are discussed. The possibility of producing picosecond ion beams of ultrahigh ion current densities (> 10^{10} A/cm^2 close to the target) is considered. The most important features of fast ion generation in the plasmas produced by ultrashort (1 ps) and long (0.5 ns) laser pulses are also compared.