Numerical simulations of ion acceleration by relativistic laser pulse interacting with multicomponent dense plasma

by Sidorov Igor Andreevich

Diploma thesis abstract

This work is dedicated to research of high-energy ion bunch generation via ultrarelativistic laser pulse and multilayered multicomponent plasma interaction. Computer program based on 1D2P Particle-in-cell method was developed for these means.

Maximum ion bunch energy and spectrum width dependencies on laser pulse properties (intensity and duration) and target parameters (layer number and thickness, atom sort, light ion concentration) are investigated. Optimal light ion layer thickness is calculated, for which accelerated ion energy is maximal (reaches $5 - 160$ MeV for intensities $5 \times 10^{18} - 5 \times 10^{20}$ W/cm^2). Additional calculations showed that optimal thickness rises from 75 to 600 nm with intensity increase from 5×10^{18} to 5×10^{20} W/cm^2 and doesn't depend on pulse duration.

Also optimal thickness for monoenergetical ion spectrum was calculated. Laser pulse properties dependency investigation showed that optical thickness is lower for high intensities (200 nm for 5×10^{18} W/cm^2 and 25 nm for 5×10^{20} W/cm^2).

Program was tested to produce correct results by comparing them to results from analogical analytic and experimental works.

Scientific advisor:
associate professor A.B. Savelev-Trofimov