Master's thesis abstract

«Collimated relativistic electron beam generation in the interaction of an intense ultrashort laser pulse with a dense plasma and their applications»

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In this thesis a comprehensive experimental study of electron acceleration processes in the interaction of laser radiation of relativistic intensity ($5 * 10^{18}$ W/cm^2) with a dense plasma created by a nanosecond prepulse on the surface of a solid-state target was carried out. It was shown that optimization of the preplasma profile allows one to obtain a collimated (~ 0.05 rad) electron beam with a charge of ~ 30 pC (for E> 1 MeV) and a temperature of ~ 2 MeV by utilizing the interaction of a high-power laser pulse with a solid target. The acceleration mechanism is direct laser acceleration (DLA) in a plasma channel created by a reflected pulse in a long tail of tenuous preplasma.

A source of secondary particles (neutrons) was created with a flux of 10^5-10^6 $s^{-1}J^{-1}$ using the Be (γ, n) reaction (E_{tr} = 1.7 MeV) and electrons accelerated as a result of laser-plasma interaction. A method is proposed for estimating the charge of an electron beam above a certain threshold based on measuring the neutron yield in the photonuclear reaction, the obtained charge value is Q ~ 10 pC, and is in agreement with the results of measurements by the Faraday cup.

The dependence of the electron beam generation efficiency on the spatial arrangement of the focus points of the main relativistic laser pulse and the controlled nanosecond prepulse was experimentally established, it is shown that there exists a single region in which the beam is generated efficiently. The efficiency of electron beam generation and neutron yield was measured as a function of the energy of the fundamental radiation. The results obtained require further experimental and theoretical studies.