SOURCE OF CHARGED PARTICLES AND NEUTRONS FROM 10 PW ULTRASHORT LASER PULSE INTERACTION WITH MICRO-CLUSTER TARGET [[1]](#footnote-1)\*)

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Due to their high energy, femtosecond lasers with record characteristics, including multi-PW power levels [1, 2], are capable of providing efficient heating of a large volume of the irradiated medium. Such a medium serves as a source of laser-accelerated charged particles, neutrons, and secondary electromagnetic and radioactive radiation. Currently, research is being actively carried out aimed at finding schemes suitable for efficient acceleration of charged particles using various types of targets that can provide almost complete absorption of high-power laser radiation, including various microstructured, as well as cluster and microdrop targets.

The purpose of this work is computational optimization to achieve the maximum number of laser-heated charged particles (deuterons) of moderate energies and thermonuclear neutrons in a large volume of a cluster medium. As such a target, as an example, a medium of heavy water droplets containing deuterium is considered. It is assumed that a high-energy 10 PW laser pulse, for example, from the XCELS (Exawatt Center for Extreme Light Studies) laser system [3], at a moderately relativistic intensity of ~1018 W/cm2, is focused into a sufficiently large volume of the microcluster medium (the spot diameter is approximately 500 μm) . Due to the specified feature of the problem, it is hardly possible to simulate the interaction of laser radiation in the entire extended microstructured medium. We propose a new scheme for dividing the interaction region into different zones depending on the depletion of the laser pulse. The optimization of a cluster target for 30 fs laser pulse with an energy of ~300 J, carried out using particle-in-cell simulation (PIC), predicts a yield of thermonuclear neutrons at a level of ~109 neutrons/sr. The expected brightness of the neutron burst reaches a value of over 1018 neutrons/(cm2 s). If it is possible to synchronize XCELS laser beams (12 beams of 12 PW each) with a nanosecond delay, then with multilateral heating the expected neutron yield can be increased by an order of magnitude, with the neutron yield reaching 1010 neutrons/sr.

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1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/It/ru/DD-Gozhev.docx) [↑](#footnote-ref-1)