ON THE RECORD ACHIVEMENTS OF THE LIVERMORE LABORATORY IN THE FIELD OF LASER THERMONUCLEAR FUSION [[1]](#footnote-1)\*)

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There is discussed the obtaining a record yield of the deuterium-tritium reaction energy in recent experiment on irradiating a thermonuclear capsule with a laser-induced X-ray pulse, carried out at the Lawrence Livermore National Laboratory (USA) in August 2021. The results of this experiment were reported in the express information of the Livermore laboratory and in the report of this laboratory at the meeting in the frames of international conference IFSA (Inertial Fusion Scinces and Applications), which was held in a virtual format on September 22, 2021. The Livermore laboratory has been conducting the researches directed to thermonuclear ignition - the release of fusion energy exceeding the energy of acting laser pulse - for about ten years, during which the output of thermonuclear energy has been consistently increasing. The outstanding significance of the August experiment is that the achieved thermonuclear yield not only significantly exceeded the previous results, but also came close to the expended laser energy - the fusion energy was 1.35 MJ, i.e. 70% of the laser pulse energy, which in this experiment was equal to 1.93 MJ.

The experiments of the Livermore laboratory are carried out on the world's largest laser facility NIF [1], which generates a pulse of the 3rd harmonic of Nd-laser radiation (wavelength 351 nm) with an energy of about 1.8 MJ (in the standard mode) in 192 beams. The main direction of experiments is indirect irradiation of a thermonuclear capsule with a laser-induced X-ray pulse. A thermonuclear capsule in the form of spherical multilayer shell is placed in the geometric center of cylindrical converter of laser radiation into X-rays. Laser beams are introduced into the converter through the entrance holes at the converter’s side ends, pass through the gap separating the converter from the thermonuclear capsule, and are focused on the inner surface of converter. Indirect irradiation is more energy-consuming than direct irradiation of thermonuclear capsule with laser beams - the energy of the X-ray pulse, which ultimately affects the capsule, is only about 10% of laser pulse energy. This is primarily due to the limitation of the minimum dimensions of the converter and its entrance holes. However, indirect irradiation is able to provide more favorable conditions of capsule implosion due to reducing the negative influence of hydrodynamic instabilities. Under conditions of energy shortage, an increase in the laser pulse energy by 8-10% compared to the standard laser operation mode, as well as an increase in the fraction of X-ray radiation acting on thermonuclear capsule, due to the optimization of the converter parameters are, apparently, the main factors in achieving a record result.

References

1. E. Moses and C. R. Wuest, Fusion Sci. Technol. 47, 314 (2005).
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLIX/R/ru/JE-Gus%27kov.docx) [↑](#footnote-ref-1)