Fast neutron production from (p,n) and (d,n) reactions driven by laser-accelearated particles


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In recent years, there has been a growing interest in the laser-based neutron sources. These sources have some advantages: high brightness (due to sub mm size and short duration), ability to produce particles with energies greater than 14 MeV, radiation purity (if targets without tritium are used). Potential applications for such sources are neutron resonance spectroscopy [1], calibration of neutron diagnostics for fusion facilities [2], detection of special materials in cargo containers [3] etc.

At a picosecond laser facility [4] in RFNC-VNIITF, we have conducted experiments on neutron production from double targets: an intense beam of laser accelerated ions from pitcher target was directed into a catcher target. Different configurations of pitcher (catcher) targets were tested: H$_8$C$_{10}$O$_4$ (LiF), CD$_2$ (LiF), CD$_2$ (LiD). Neutrons were registered by scintillation detectors using methods of delayed registration [5] and time-of-flight. In addition, amount of $^7$Li(p,n)$^8$Be reactions inside catchers was recovered from measurement of their activity near 479 keV line.

In experiments, we have detected neutrons with energies in excess of 10 MeV. This is the evidence of $^7$Li(d,n)$^8$Be reaction. Neutron yield exceeded $5 \cdot 10^8$ neutrons per shot.

References