NEUTRON PRODUCTION FROM Li(d,xn) DRIVEN BY HIGH-INTENSITY LASER-TARGET INTERACTIONS*

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Plasma based neutron sources traditionally utilize *d-d* or *d-t* nuclear fusion reactions. These two reactions have been known for a long time and widely used for neutron production. But neutrons can also be produced in nuclear reactions of deuterium with other low-Z elements such as lithium, beryllium and carbon. The neutron yield and directionality can be improved significantly by bombarding thick targets (~1 mm) made of these elements with high energy (MeV) deuterons. The higher neutron yield compared to both *d-d* and *d-t* reactions is due to the very large cross section for neutron production (~1 barn) even at incident deuteron energies as high as 100 MeV. The most remarkable feature of the neutron generation process is that at deuteron energies above 10 MeV the neutrons are emitted in a very narrow cone, forming a pencil-like beam. In this work, we study the neutron production from deuterium-lithium nuclear fusion reactions driven by a high-intensity ultrashort pulse laser. A set of differential cross sections for the Li(d,xn) reaction for incident deuteron energies of up to 50 MeV is assembled and tested by comparing the angular distribution of emitted neutrons against experimental data. The neutron production from laser-target experiments has been studied theoretically as a function of laser energy with a 3D Monte Carlo ion beam-target deposition model. The neutron yield in the forward direction is estimated to be $\sim 10^8$ neutrons/ster per unit laser energy. The proposed scheme for neutron production from *d-Li* reactions is superior to that from *d-d* reactions, producing a collimated beam of neutrons with higher neutron yield.

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