Generation of high-energy (>15 MeV) neutrons using short pulse lasers

JACK DAVIS, GEORGE PETROV, TZVETELINA PETROVA, Naval Research Laboratory, DREW HIGGINSON, FARHAT BEG, University of California-San Diego — The production of high-energy (>15 MeV) neutrons has been demonstrated experimentally for the first time using the Titan laser as a driver of high-energy ion beams. Neutrons with energy of up to 18 MeV have been generated from $^7\text{Li}(d,n)^8\text{Be}$ reactions driven by laser pulses with peak intensity $2\times10^{19}$ W/cm$^2$, pulse duration of 9 ps and energy of 360 J. Three nuclear reactions, d(d,n)$^3\text{He}$, $^7\text{Li}(d,n)^8\text{Be}$, and $^7\text{Li}(p,n)^7\text{Be}$ have been explored as potential candidates for high-energy neutron production using a 3D Monte Carlo simulation model. For each reaction the required driver ion beam energy and number have been determined. We found that for the $^7\text{Li}(p,n)^7\text{Be}$ reaction $10^{10}$ protons with energy >20 MeV are required to generate high-energy neutrons, while for the $^7\text{Li}(d,n)^8\text{Be}$ reaction a comparable amount of deuterons with energy >5 MeV are needed.

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