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Neutron production by laser irradiating a spherical target

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We use two dimensional Particle-in-cell code to simulate an ultra-intense laser interacts with spherical target to obtain neutrons. More deuterium ions can be accelerated into the cavitycenter due to the confinement of Au shell. Up to 71% laser energy was absorbed. Heating the deuterium ions from tens of keV to several MeV, and raising the density at the center of the cavity up to tens of critical density in several picoseconds. Two different mechanisms account for the efficient yield of the neutrons in the cavity: (1) At the early stage, the neutrons are generated by the high energy deuterium ions based on the "beam-target" approach. (2) Later, the neutrons are generated by the thermalnuclear fusion when most of the deuterium ions reach equilibrium in the cavity.A large number of deuterium ions accelerated inward can pass through the target center and the outer Au layer and finally stopped in the CD2 layer. This also causes efficient yield of neutrons inside the CD2 layer due to "beam-target" approach. A postprocessor has been designed to evaluate the neutron yield and the neutron spectrum is obtained.

Reference:

Min-Qing He Hong-Bo Cai, Hua Zhang, Quan-Li Dong, Cang-Tao Zhou, Si-Zhong Wu, Zheng-Ming Sheng, Li-Hua Cao, Chun-Yang Zheng, Jun-Feng Wu, Mo Chen, Wen-Bing Pei, Shao-Ping Zhu, and X. T. He, Physics of Plasmas **22**, 123103 (2015).

Figure 1.

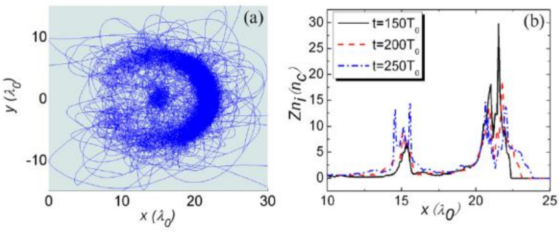

Fig.1 (a) Typical trajectories of the electrons during t=0-300 T_0, the electrons are sampled randomly in the deuterium layer and (b) ion density distribution at t =150T_0 (black solid line), t =200T_0 (red dash line), and t =250T_0 (blue dash and dot line).

Figure 2.

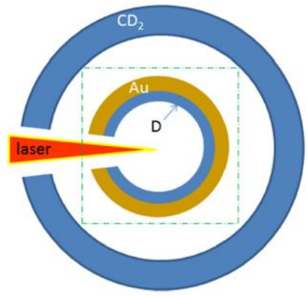

Fig.2 Schematic three-layer target for laser-driven neutron source. The PIC simulation region is marked with the green dash-dotted line. The outer CD_2 target serves as converter for additional neutron production as hit by fast deuterium ions.