Fast Neutron Detection in Super-intense γ Radiation

Hongjie Liu [1,2], Yuqiu Gu[1,2], Bo Cui[1], Leifeng Cao[1,2]

[1] *Research Center of Laser Fusion, CAEP, Mianyang, China*
[2] *Science and technology on plasma physics laboratory, Mianyang, China*

Scintillator detectors in inertial confinement fusion experiments are predominantly used to measure neutron yield and ion temperature of the primary fusion reactions. The detection of neutrons in fast-ignition experiments is very challenging since it requires the neutron detection system to recover within 100 ns from a high background orders of magnitude stronger than the signal of interest. Liquid scintillator with different compositions was investigated. We present several designs of liquid scintillator using the Geant4 Code and the X-Lab Code. Our liquid scintillator is based on PPO, dissolved in xylene and enriched with molecular O_2. The detector consists of a 2-3 liters volume of liquid scintillator coupled to a gated MCP. The gating performance under high-intensity γ rays was experimentally checked. The typical flight time spectrum of the neutrons from (p,n) reaction driven by a PW laser is shown in Fig.1. The neutron yield in the fast ignition experiments on Shenguang-II laser facility was successfully measured using this detector. Our neutron detection system could suppress the background signal and eliminate the afterglow present in conventional plastic scintillators.

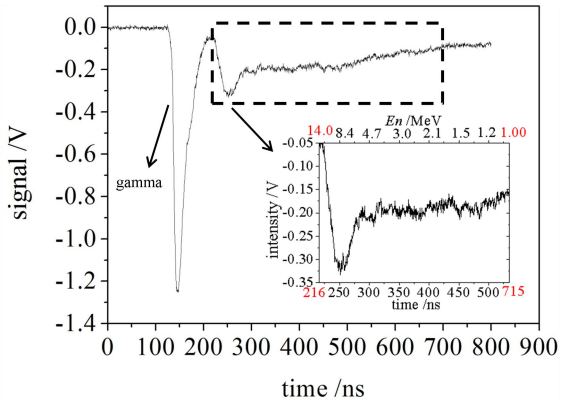

Fig. 1 Neutron flight time spectrum obtained in PW laser

References:

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