



Fast Neutron Detection with ^6Li -loaded Liquid Scintillator

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We report on the development of a fast neutron detector using a liquid scintillator doped with enriched ^6Li . The lithium was introduced in the form of an aqueous LiCl micro-emulsion with a di-isopropylnaphthalene-based liquid scintillator. A ^6Li concentration of 0.15 % by weight was obtained. A 125 mL glass cell was filled with the scintillator and irradiated with fission-source neutrons. Fast neutrons may produce recoil protons in the scintillator, and those neutrons that thermalize within the detector volume can be captured on the ^6Li . The energy of the neutron may be determined by the light output from recoiling protons, and the capture of the delayed thermal neutron reduces background events. In this paper, we discuss the development of this ^6Li -loaded liquid scintillator, demonstrate the operation of it in a detector, and compare its efficiency and capture lifetime with Monte Carlo simulations. Data from a boron-loaded plastic scintillator were acquired for comparison. We also present a pulse-shape discrimination method for differentiating between electronic and nuclear recoil events based on the Matusita distance between a normalized observed waveform and nuclear and electronic recoil template waveforms. The details of the measurements are discussed along with specifics of the data analysis and its comparison with the Monte Carlo simulation.

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