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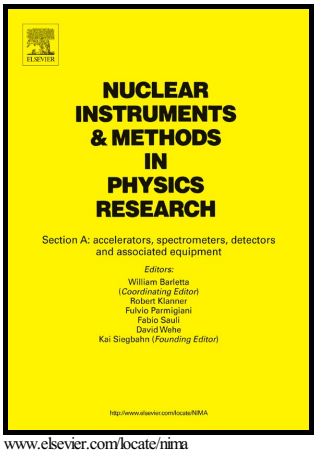

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Characterization of the scintillation anisotropy in crystalline stilbene scintillator detectors

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Abstract

This paper reports a series of measurements that characterize the directional dependence of the scintillation response of crystalline melt-grown and solution-grown *trans*-stilbene to incident DT and DD neutrons. These measurements give the amplitude and pulse shape dependence on the proton recoil direction over one hemisphere of the crystal, confirming and extending previous results in the literature for melt-grown stilbene and providing the first measurements for solution-grown stilbene. In similar measurements of liquid and plastic detectors, no directional dependence was observed, confirming the hypothesis that the anisotropy in stilbene and other organic crystal scintillators is a result of internal effects due to the molecular or crystal structure and not an external effect on the measurement system.

Keywords: stilbene, organic scintillator, neutron detection, scintillation anisotropy;

1. Introduction

For many decades, the *trans* isomer of the organic crystal scintillator stilbene has been used for radiation detection. Recently, a new solution-based growth method has been developed that produces large crystals with high light output and excellent neutron-gamma pulse shape discrimination (PSD) [1, 2, 3]. This solution-grown stilbene is receiving substantial interest over liquid and plastic alternatives as its performance is better than liquid and PSD-capable plastic scintillators [2, 4, 5], and its solid form is often easier to work with than liquid scintillators that are subject to thermal expansion and risk of leaks.

Crystal organic scintillators are known to have a directionally dependent scintillation response for heavy charged particle interactions. The directional dependence of anthracene has been widely characterized [6, 7, 8, 9], but only limited measurements have been reported for the directional dependence of stilbene. Previous measurements of proton recoil events in stilbene include the magnitude of change in light output at 3.7, 8, and 22 MeV [10, 8], and the light output vs. angle in two planes at 3.7 MeV [10] and in one plane at 14 MeV [7]. Thus far, no measurements of the

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