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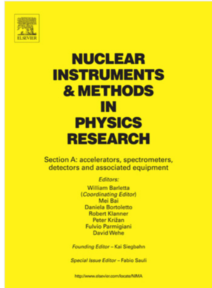

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Tests of a Solution-grown Stilbene Scintillator in Mono-energetic Neutron Beams of 565 keV and 5 MeV

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Abstract: The results of measurements performed with a solution-grown stilbene scintillator placed in reference mono-energetic neutron fields are presented. The ∅ 25 mm organic scintillator was positioned in 5 MeV and 565 keV neutron fields delivered by the AIFIRA facility at CENBG. The goal of the experiment was to assess the performance of the solution-grown stilbene crystal (*n*-γ discrimination, response, anisotropy, sensitivity) relative to that of a BC501A liquid scintillator of larger size. Neutron pulse height spectra after gamma discrimination are compared. The results show that the stilbene crystal not only has a better discrimination capability than the BC501A (35% higher FoM) at 5 MeV, but is also able to separate neutrons from gamma-rays at 565 keV and below, a range where the BC501A is inoperative. This study also confirms the anisotropy of the crystal response, as already observed by other groups at different energies.

Keywords: Organic Scintillators, Solution-grown Stilbene, Mono-energetic Neutrons, PSD, Scintillation Anisotropy

1. Introduction

The development of detectors capable of measuring the continuous-energy neutron spectrum in the intermediate-to-fast range (5 keV to 15 MeV) is of interest in numerous applications. Accurate neutron spectrum measurements in the intermediate range (5 keV to ~600 keV) in mixed neutron-gamma-rays are notoriously difficult. The present work is motivated by the development of a fast neutron spectrometer for the MASURCA critical facility [1,2], but it is also relevant to applications such as steady-state and pulsed neutron beam characterization, prompt and delayed fission neutrons in nuclear physics, fission and fusion reactors, in-core and out-of-core (neutron leakage) spectra in low-flux critical experiments, transmission and shielding benchmarks, neutron-induced material irradiations, detector calibration, neutron radiography, nuclear safeguards, etc. Among the aforementioned, measurements of the prompt fission neutron spectrum away from the 1 MeV peak have received considerable attention in recent years, since such data have major repercussion on fission models and applications [3,4,5,6,7].

The specific needs are for detectors having a reasonably good energy resolution (< 10%) so as to distinguish broad peaks and valleys in the spectra, a small size for good spatial resolution (less than 50 mm), sufficient sensitivity and high efficiency so as to operate in low flux levels, able to discriminate neutrons from gamma-rays, reliable without requiring frequent calibrations or complicated correction factors, easy to handle and operate. Such neutron detectors would nicely