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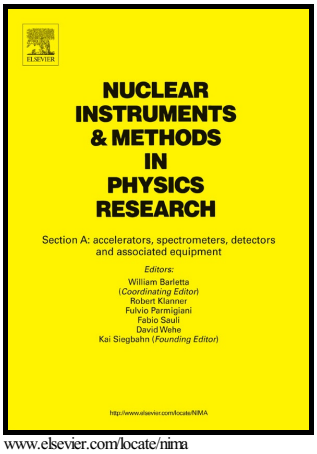

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Pulse-shape discrimination and energy quenching of alpha particles in $Cs_2LiLaBr_6:Ce^{3+}$

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Abstract

$Cs_2LiLaBr_6:Ce^{3+}$ (CLLB) is an elpasolite scintillator that offers excellent linearity and gamma-ray energy resolution and sensitivity to thermal neutrons with the ability to perform pulse-shape discrimination (PSD) to distinguish gammas and neutrons. Our investigation of CLLB has indicated the presence of intrinsic radioactive alpha background that we have determined to be from actinium contamination of the lanthanum component. We measured the pulse shapes for gamma, thermal neutron, and alpha events and determined that PSD can be performed to separate the alpha background with a moderate figure of merit of 0.98. We also measured the electron-equivalent-energy of the alpha particles in CLLB and simulated the intrinsic alpha background from ^{227}Ac to determine the quenching factor of the alphas. A linear quenching relationship $L_\alpha = E_\alpha \times q + L_0$ was found at alpha particle energies above 5 MeV, with a quenching factor $q = 0.71$ MeVee/MeV and an offset $L_0 = -1.19$ MeVee.

Keywords: Elpasolite; Scintillators; Pulse Shape Discrimination; Alpha Background; Actinium Contamination; Alpha Quenching

1. Introduction

Elpasolite scintillators are a promising new class of inorganic crystals that have the ability to detect and distinguish between gamma-ray and neutron radiation. This makes them an attractive option for applications that require excellent performance under constraints such as size and weight, for example handheld radiation detectors that support homeland security or space-based

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